OREGON STATE UNIVERSITY EXTENSION SERVICE

# Introduction to Pasture and Grazing Management in Western Oregon

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Photo: Melissa Fery, © Oregon State University
Figure 1. A herd of cows that has just been moved to an ungrazed pasture.

## Summary

This publication is for farmers and ranchers new to managing pastures in the Pacific Northwest. It is a complement to the online *Introduction to Pasture and Grazing Management* course available at https://workspace.oregonstate.edu/course/pasture-and-grazing-management. It provides the basics of establishing and maintaining a productive pasture for your livestock. The core principle is that as a livestock producer, you are actually a grass and legume farmer, using the forages that you grow as a feed source for your animals. Developing this perspective will help you better manage pastureland for sustainable forage-livestock systems.

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## Benefits of improving pasture management

Regardless of your farm's size, whether you have many acres and hundreds of animals or a few acres of pasture with a small flock of sheep, good pasture management brings numerous benefits.

**Animal health, growth and development**. A well-managed pasture provides nutritious forage for animals. High-quality forages are essential for efficient and productive livestock grazing systems. Good pasture management also provides a healthier environment for animals, reducing toxic plants and harmful insects and diseases. Higher productivity, fewer visits from the veterinarian, and lower mortality rates all contribute to the profitability and value of your farm or ranch.

**Reduced feed costs.** A well-managed pasture produces more forage for grazing, silage or hay than a poorly managed pasture. This increased forage production may

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Photo: Melissa Fery, © Oregon State University
Figure 2. An overgrazed pasture that is being invaded by weeds.

support more animals per acre or reduce the need for purchased feed, increasing profitability.

**Land stewardship.** Well-managed pastures are good for the environment. They capture carbon dioxide ($CO_2$) from the atmosphere, release oxygen ($O_2$) for us to breathe, protect soil losses from wind and water erosion, and enrich the soil with organic matter from their extensive root systems. These benefits lead to improved soil health and quality and effective nutrient recycling. Also, good pasture management reduces soil compaction, allowing more effective use of rainfall through improved infiltration and improved soil moisture storage. These additional benefits enhance soil microorganism communities because soils are seldom disturbed by tillage.

**Beautiful landscapes.** Well-managed pastures are aesthetically pleasing. Both rural and urban residents value pastoral landscapes. Improved pasture appearance could increase your property value and provide short- and medium-term benefits for you, your livestock and the environment.

## Common pasture management challenges

What are your greatest pasture management challenges right now? Do you currently have a pasture management plan to address these challenges? Compare your current situation with the following common pasture management problems.

**General neglect**. Although the grasses and legumes in a pasture may appear to grow well with little management, they require an adequate supply of nutrients. Harmful plants and other weeds need to be controlled. Without a plan for regular management, general neglect leads to unproductive pastures.

**Overgrazing.** Overgrazing occurs when animals are allowed to graze in a pasture for too long or the stocking rate is too high. In either case, plants do not have the time or opportunity to regrow after grazing. Overgrazing is one of the most serious mismanagement practices. It's the reason that pastures fail to produce at their potential and require frequent renovation or complete replanting.

**Bare ground.** Healthy, productive pastures are characterized by thick stands of grasses and legumes with little visible bare ground. Patches of bare ground result from overgrazing, trampling and pugging, which occurs when wet pasture is trampled by livestock into an almost completely muddy surface. Bare ground also results from low soil pH, inadequate levels of nutrients, pest damage, soil compaction, poor drainage and

Photo: Dana Martin, © Oregon State University

Figure 3. A rancher uses electric netting fencing to employ rotational grazing.

improper irrigation schedules or delivery methods. Bare ground results in less forage for your animals and leaves space for weeds to grow. Bare soil will also have higher temperatures during the summer growing season, which leads to reduced soil moisture.

When evaluating your pasture, ask yourself: Is my pasture suffering from any of these common problems? An honest assessment of your pasture's current state is an important first step in creating a better management strategy.

To help you evaluate your pasture, review the *NRCS Guide to Pasture Condition Scoring* (https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1044239.pdf). This guide includes a Pasture Condition Score Sheet (https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1044237.pdf) for rating your pasture.

## Get in the grass-growing business

Forages should be managed with careful consideration of soil conditions, fertility management, irrigation scheduling, harvest intervals and pest management. Pasture forage grasses and legumes are consumed directly by livestock, rather than being mechanically harvested like hay and silage. If you are raising ruminants for meat production, your animals convert pasture forages into animal protein and fat that you market to generate income for your farm or ranch. The same is true for animals raised for milk or fiber (wool/hair) production. The sustainability of your business is built on the foundation of healthy, productive, high-quality pastures.

### *How grasses grow*

Plants need sunlight, water, soil, minerals and enough leaves to capture the sun's energy. Grasses absorb soil minerals and water through root hairs, which are transported

to larger roots, up into the stems, and finally to the leaves. Stems and leaves contain chlorophyll, which captures energy from sunlight to use for plant growth. Through photosynthesis, leaves absorb $CO_2$ from the air and use it through an enzymatic process to make sugars, starches and structural fibers. In the process, they release $O_2$ required by humans and animals. Along with the mineral elements transported through the plant from the soil, the carbohydrates produced through photosynthesis are used to make proteins and fats, which are then used to build new plant tissues. The aboveground plant tissues become the forage for grazing, silage and hay production.

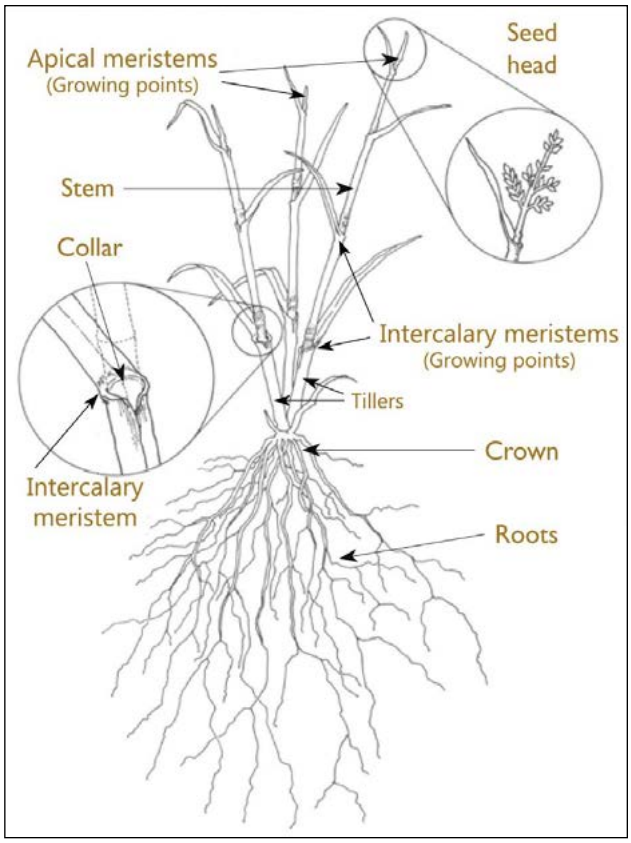



Figure 4. Two types of meristems are particularly important: apical meristems and intercalary meristems.

### *Growth and regrowth*

All plant growth initiates at growing points called meristems. These meristems are sites of active cell division and growth, and they give rise to new leaves, stems, roots, shoots, seedheads and seeds. From a pasture and grazing management perspective, two types of meristems are particularly important; apical meristems and intercalary meristems. **Apical meristems** (at the apex or endpoint) produce leaves, stems and floral structures. Roots, stolons and rhizomes also contain apical meristems at their endpoints. The shoot apical meristem is also called a shoot apex or growing point.

**Intercalary meristems** are those inserted between other plant parts. These meristems are located at the base of nodes and leaf blades (see Figure 4). The leaf blade intercalary meristem can be seen easily as a lighter-colored region at the junction of the leaf blade and the leaf sheath. This region is called the collar and is responsible for initial leaf blade growth and regrowth following grazing. During the vegetative growth stage, the apical meristem is located deep within the tiller. When the grass transitions from vegetative to reproductive stages in response to temperature and photoperiod, the apical meristem elevates within the tiller and produces a seedhead. Tillers are “daughter plants” that are attached to the “mother plant,” initiating from a bud near ground level. Tillering allows plants to increase in size and vigor. Figure 4 shows a generalized grass plant and provides a more detailed look at grass growing points and grass plant components.

To ensure rapid grass regrowth, shoot apical meristems (those that result in the seedhead) and intercalary meristems (those that result in internode and leaf blade growth) must be protected at key development times. If regrowth meristems are removed by ill-timed or overly severe grazing, plants will be unable to regrow, and tillers will die. The grass growth rate is also dependent on the stored energy reserves in the stem bases, crown and belowground “pseudostems” in some plant species. A common mismanagement practice allows animals to graze plants down to the crown, giving plants insufficient recovery time.

### *Grass growth stages*

Grasses go through three stages of growth and development: vegetative, transition and reproductive.

**Vegetative.** The vegetative stage is characterized by rapid growth of shoots and roots. During this development stage, the shoot apical meristem is near or below the soil surface. Thus, only leaves are being produced by plant tillers. Grasses are highly palatable and highly digestible during the vegetative stage. *The key management principle during this phase is to maintain enough leaf material to support photosynthesis. For cool-season grass-legume pasture mixtures, 3–4 inches of leaf material should remain after grazing.*

**Transition.** During the transition stage, the shoot apical meristem begins to elongate in response to temperature and photoperiod signals from the environment. This meristem develops into a seedhead. As stems elongate, the apical meristems elevate, making them more vulnerable to removal. Ill-timed removal will slow grass regrowth since new growth will originate from basal buds in the crown, which will develop into new tillers (daughter plants). These basal buds are not fully formed until the seedhead is about to emerge from the flag leaf (the uppermost leaf on a stem). During this stage, grazing removes these elevated apical meristems, delaying pasture regrowth and weakening the stand. *The key management principle during this phase is to observe the location of shoot apical meristems and the development of basal buds. Graze only lightly during this phase.*

**Reproductive.** The reproductive stage is identified with an observable seedhead within the flowering stem (culm). Reproductive subphases are referred to as boot, early head emergence, late head emergence, full head emergence, flowering, anthesis, and seed maturity. Stem tissue has a high percentage of fiber, and lignification occurs at later periods of the reproductive phase.

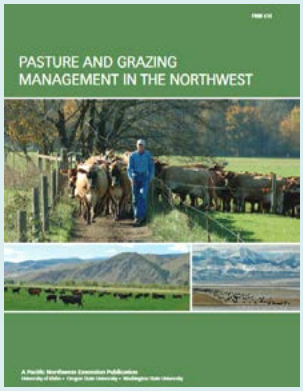
Thus, reproductive-phase forage is lower in palatability and digestibility. For the greatest per acre digestible dry matter, graze or mechanically harvest forages in the boot stage when the seedhead is within the top leaf, the "flag leaf." (See Figure 4). This will provide high-quality forage and permit basal buds to initiate growth by removing the apical dominance caused by reproductive seedheads (from the plant hormone auxin). *In this phase, the key management principle is to graze or mechanically clip pastures to remove reproductive heads and allow the next flush of growth to occur. This is especially important in late spring to ensure enough soil moisture to grow the next flush of pasture growth before summer drought.*

### *Growth belowground—roots*

Good root growth and development are vital to the vigor and quality of your pasture. Shoot growth and root growth are interdependent: shoot growth provides energy for the entire plant (including the roots) through photosynthesis, while roots absorb water and nutrients from the soil — essential for plant growth.

A portion of a grass plant's roots shed and die every year. The root system needs to regrow by at least that same amount each year to maintain a productive pasture. Ideally, a plant is not only maintaining but also increasing root size and density. In a pasture, the root systems of grasses and legumes are intermingled, preventing weeds from establishing. When grass plants are weakened by overgrazing, the root systems will be significantly reduced. This will result in less forage for grazing animals or silage and hay production and more open spaces in a pasture, leading to weed invasion.

To learn more about grass plants and how they grow and regrow, consult Grass Growth and Regrowth for Improved Management (https://forages.oregonstate.edu/regrowth/how-does-grass-grow) on the OSU Forage Information System website.




Pasture and Grazing Management in the Northwest

This book offers pasture managers information and tools to enable their pastures and livestock to reach their maximum production potentials. Seventeen chapters provide detailed information on estimating forage production, grazing management and pasture renovation. The book by editors Glenn E. Shewmaker and Mylen Bohle is available at https://catalog.extension.oregonstate.edu/pnw614

## Relationships among grazing, root health and grass growth

Rather than basing the length of grazing solely on the number of animals or acres of pasture, it is best to frequently monitor forage growth and use that information to determine an appropriate grazing period. Experienced managers estimate or measure (clip, weigh and dry forage) to determine the amount of dry matter available in each field. Producers may also base the grazing period on estimates of dry matter intake and nutritional requirements for specific livestock species. Pasture sticks or rulers designed to measure forage canopy height or rising plate meters (which measure compressed forage height) are specialized tools for estimating available dry matter. Both tools must be calibrated for the species and conditions of your pasture.

For simplicity, forage height can be used as an indicator for when to let animals into, and when to move them off, a pasture. The basic rule for the pasture species used in western Oregon is 8–12 inches to start grazing and 3–4 inches to stop grazing. This will protect plants from overgrazing, but does not provide specific information about available forage, which is required to determine stocking numbers and grazing duration.

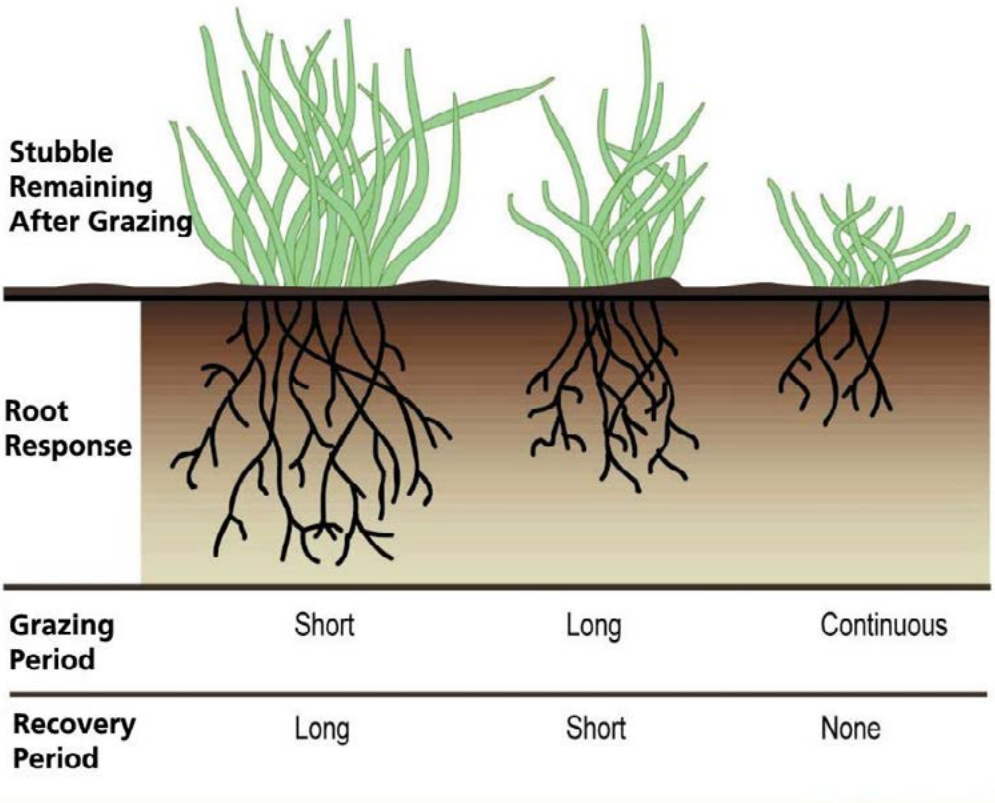



Figure 5. Relationship among stubble remaining after grazing, recovery period and root growth.

### *Effect of grazing and mowing on root growth*

Plant roots stay healthy when grazing severity is moderate and grazing periods are short with long rest periods. Root growth significantly decreases when grazing is continuous, and plants are given little time to recover.

### *Take half, leave half concept*

Many ranchers in rangeland conditions (semiarid climate areas without irrigation) manage their pastures according to the principle of "take half, leave half." This grazing philosophy has a scientific basis, assuming grazing is based on the appropriate starting point for plant height. As a general rule, removing up to 50% of leaf growth has minimal impact on root growth; however, once you remove more than 50% of shoots, root growth decreases significantly.

Photo: Melissa Fery, © Oregon State University

Figure 6. Some grass can be grazed when it reaches 8–10 inches, but it should be rested once it has been grazed to 3 inches.

Although the take half, leave half principle can work reasonably well, it must be adjusted for initial grazing height — the required residual height for the species used in improved pastures grown in humid climates or irrigated systems. It is also complicated in pastures with multiple species of grasses, legumes and other forbs — each with its own optimal grazing height based on growth habit. For example, perennial ryegrass can be grazed when it reaches 8–10 inches and should be rested once it has been grazed to 3 inches. Orchardgrass, however, requires a higher residual height; it may be grazed when it reaches 8 inches and should be rested at 4 inches. For sod-forming species, like creeping bentgrass or Kentucky bluegrass, the remaining stubble height can be 2 inches. Base your grazing timing on the most vulnerable and key desirable grass and legume species in your pasture. Irrigation scheduling and fertilization rates should also be based on your most important species.

Remember that stored carbohydrates in the plant provide the energy to initiate grass growth in the early spring and regrowth after defoliation by grazing or mechanical harvest. These energy resources are stored in grass stem bases. This is why overgrazing (below 3 or 4 inches) is so damaging to both shoot and root growth. Your job as a pasture manager is to ensure that grasses and legumes have healthy root systems. This will increase the productivity and longevity of your pastures.

### *Critical management periods*

Pastures are sensitive to overgrazing in the early spring and fall and pugging during wet winter conditions. Pasture plants rely on carbohydrates stored in their roots and in the stem bases and crown in the early spring. Other plant structures such as rhizomes (underground stems) and stolons (creeping stems located aboveground) may also be sources of energy. These nonstructural carbohydrates (sugars and starches) help drive initial spring growth so plants can produce their first leaves. These energy reserves fuel the initial regrowth after winter dormancy. After that, plants generate energy from photosynthesis. In cool-season grasses, the primary nonstructural carbohydrate

is fructan. It is stored in the lower 3–4 inches of grass tillers. This is why grazing more closely than 3–4 inches damages pasture plants.

Grasses are particularly sensitive to excessive leaf removal (overgrazing) during this early spring period. Regular removal of early leaf growth will weaken the plant and may result in tiller death. If your animals have had no fresh pasture all winter, you may be tempted to let them graze the first flush of green. However, consider the short-term gain versus long-term damage! Give your pastures enough time to reach at least 8 inches before turning animals in to graze and remove them when pastures are grazed to 3–4 inches. This may require feeding additional hay for a week or two and keeping your animals in a sacrifice area, allowing pastures to get the good start they need.

Autumn is another critical management period for cool-season grasses. Grass growth declines in the summer due to heat, lack of moisture and root shedding. Even in irrigated pastures, cool-season grass growth declines in hot temperatures. Cooler temperatures and first rains will bring plants out of this summer "dormancy," and you will see a flush of new grass growth. During this time, grass plants need energy to generate new roots and form new tillers, directly impacting the amount and timing of growth the following spring. Maintaining adequate stubble height in the fall will ensure better spring growth when grasses and other species come out of winter dormancy.

Allowing animals to overgraze during these critical periods will reduce pasture productivity and longevity and increase the opportunity for perennial and winter annual weeds to establish. To maintain a healthy pasture, avoid grazing plants below the minimum recommended residual levels of 3–4 inches. Pastures need vigorous roots, protected growing points and adequate leaf area. Pastures also need water, sunlight and nutrients to be productive year after year.

## Rotational grazing

Rotational grazing (also called rotational stocking) is a pasture utilization system involving periods of dense stocking followed by nongrazing periods of rest for plant recovery and regrowth. The pasture is divided into smaller areas (paddocks) and animals are moved from one paddock to the next, depending on the plants' condition in each paddock. This type of system gives the grazed plants time to regrow and restore their energy reserves. Management-intensive Grazing (MiG) is a goal-driven approach to grazing management with an emphasis on intensive management. MiG is characterized by balancing animal demand with forage supply throughout the grazing season and allocating forage based on animal requirements.

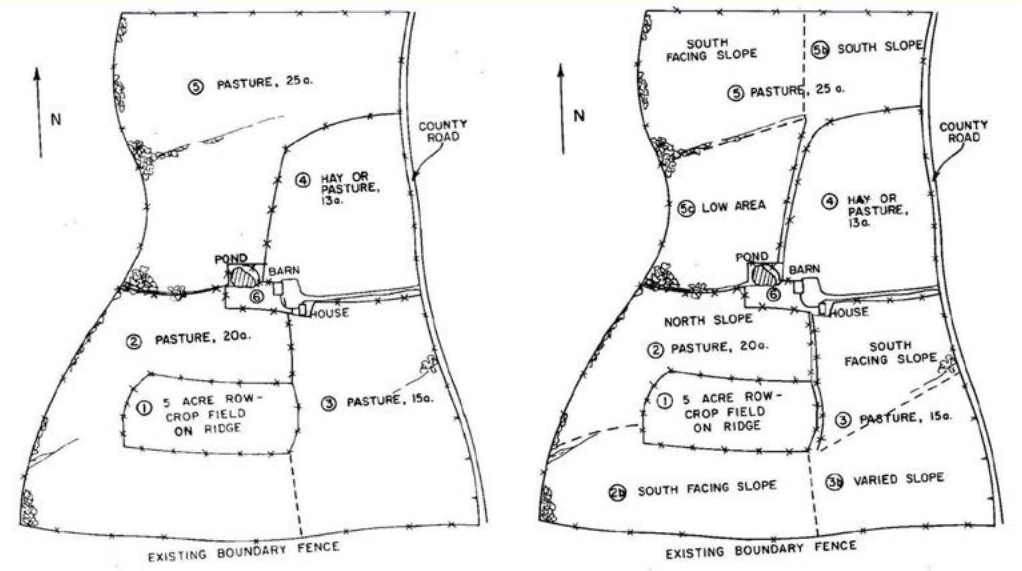
Photo: USDA-NRCS
Figure 7. A rancher uses temporary fencing to keep livestock out of a grazing area being rested for plant recovery and regrowth.

Benefits of Management-Intensive Grazing (http://livestocktrail.illinois.edu/pasturenet/paperDisplay.cfm?ContentID=6614) provides additional information about MiG.

In contrast to rotational grazing, animals in a continuous grazing (or continuous stocking) system have unrestricted access to the entire pasture throughout a large portion of the growing season. The advantage of continuous grazing — when done with appropriate stocking rate, high-quality forage mixtures and continuous seasonal grazing — is reduced labor and fence costs.

However, the problem with continuous grazing is that the livestock graze freely on whatever is most appealing to them, leaving the less-palatable plants ungrazed. As grazed plants begin to regrow, the animals return to those same plants to graze the palatable new growth again. Meanwhile, the less palatable grasses continue to grow and become even less appealing to your animals. Over time, this "selective grazing" alters the pasture; the poor quality forages and weeds increase, and the more desirable pasture forages decline. In rotational stocking systems, you allow grasses to regrow to an appropriate height before regrazing.

With rotational grazing, rotation (the decision of when to move animals among paddocks) is based on the quality of the forage and the condition of the pasture, considering growth stage and plant height. Typically, the more paddocks, the better, as plants will have longer to recover between grazing events. But even dividing a pasture into just two paddocks will provide some benefit to your pasture. With rotational grazing management, animals will eat plants they would otherwise avoid. The ability to rotate animals into smaller pastures and the practice of mowing plants when they reach their reproductive stage will help improve feed quality and seasonal distribution of forage for your grazing animals.




Plan 1: Create 4 paddocks using permanent (x—x—x) and temporary (— —) fencing.

Plan 2: Create 8 paddocks wtih a combination of permanent and temporary fencing.

Illustration: From *Planning Fencing Systems for Intensive Grazing Management* by L.W. Turner, C.W.Absher and J.K. Events, University of Kentucky Cooperative Extension
Figure 8. Examples of two different fencing plans for rotational grazing.

Rotational grazing requires time, labor, fencing and a source of water in each paddock. However, the increased productivity and longevity of the pasture often provide benefits to offset the increased costs. Figure 8 provides examples of two different plans for an 80-acre farm in rolling countryside. These sample plans have been adapted from the publication *Planning Fencing Systems for Intensive Grazing Management* (http://www2.ca.uky.edu/agcomm/pubs/id/id74/id74.pdf) from the University of Kentucky Cooperative Extension.

Photo: Melissa Fery, © Oregon State University

Figure 9. Multispecies grazing works best when livestock are complementary in their foraging and nutritional demands.

## Multispecies livestock grazing

If you have a diversified livestock farm, you can also consider multispecies rotational grazing — grazing two or more livestock species on the same land area. The different livestock types can be combined into one group and moved through your paddock system together, or livestock may be separated by species and follow each other in rotation. The key factor is that the livestock should be complementary in their foraging behaviors and nutritional demands.

Livestock have forage preferences. Some animals, such as goats and horses, are selective grazers that choose specific plants (and plant parts) based on their mouth type. Cattle are considered less selective grazers; they use their large, strong tongues to grab and rip off large portions of forage with each bite to fill their large rumen. Cattle also tend to trample forage more than smaller animals like sheep or goats.

For more information on forage preferences and how different animals graze, watch the video *Who's Coming to Dinner (https://media.oregonstate.edu/media/0_83xmv6tp)*.

Chickens can also be used to scatter manure piles and consume undigested grains and parasite larvae. Pigs disturb the soil surface as they forage so, while not effective grazers, they can be used in rotation on a small pasture area to prepare it for reseeding.

### *Benefits of multispecies grazing:*

- ***Increased pasture productivity.*** More plant types are eaten by the different animal species. The growth of more desirable plants reduces weed growth and brush establishment. Some studies have shown that this increased pasture productivity has the potential for increased animal gains.
- ***Reduced parasite load in fields.*** Sheep and goats are affected by different parasites than those that affect cattle. Thus, grazing a paddock with cattle, followed by sheep and goats together, and following with chickens, may result in breaking some parasite life cycles.
- ***Economic rewards.*** Adding an additional livestock species to your farm is an opportunity to diversify your income sources. Some animals will learn to protect each other, which may result in reduced predation.

Photo: Melissa Fery, © Oregon State University

Figure 10. Mixed-species grazing systems require that the animals get along and don't become stressed.

*Challenges of multispecies grazing systems:*

- ***Animal behavior problems***. Some lead animals may bully and stress other animals.
- ***Incompatibility in supplemental feeding***. For example, a mineral supplement intended for goats may have a copper content that would be toxic for another livestock species.
- ***Increased fencing costs***. A simple fencing plan that is adequate for cattle or horses may not be sufficient to keep goats in the proper place.
- ***Management concerns***. Learning about and managing several livestock species may be time-consuming and frustrating.

### Stocking rate

Stocking rate is defined as the relationship between the number of animals and area of land over a specified time period. Note that stocking rate is a function of both **space** and **time**: the pasture size and the number of days you are grazing. Determining an appropriate stocking rate is a matter of matching livestock requirements with the available forage. Key factors are your pasture condition, whether it is irrigated, animal species and physiological stage. Other factors include the types of animals you are grazing (as grazing habits and size differ within a species), how many paddocks you will be rotating among and how much you will be fertilizing.

## Sacrifice area

A sacrifice area is a small pasture, pen or corral where you keep animals when most of your pasture area is regrowing. Animals should be confined to the sacrifice area and fed hay (or haylage or silage) during the rainy season when the soil is prone to compaction or at any time when inadequate plant growth would result in overgrazing. Sacrifice areas can also be useful if you need to separate or confine animals, control the amount of pasture or feed consumed, or care for sick or injured animals.

Sacrifice areas function best if they are located on higher ground and are away from wetlands, surface water flows and wells. Manure accumulation in these areas can affect water quality, so plan to regularly remove manure and wasted feed to utilize as fertilizer and compost.

Photo: Melissa Fery, © Oregon State University
Figure 11. Some regions depend on irrigation for continued pasture growth throughout the season.

If you live in an area where the sacrifice areas get muddy or excess manure accumulates, causing unsafe conditions for your animals, consider laying a footing material such as wood chips, gravel or sand (each of which can be used with or without geotextile fabric).

For more information about constructing sacrifice areas and footing materials, review *Managing Small-Acreage Horse Farms in Western Oregon and Washington* (EC 1558) (https://catalog.extension.oregonstate.edu/ec1558).

If possible, locate your sacrifice area so it is surrounded by grassy strips, lawn, pasture or native grass plantings and away from streams or creeks. The vegetation in these buffer areas acts as a natural filtration system to reduce sediment and contaminants washed from the sacrifice area. Since animals will need supplemental feed while in the sacrifice area, consider locating it near your hay storage area.

## Irrigation, nutrient and weed management

In tandem with grazing decisions, pasture managers also need to manage irrigation, soil nutrients and weeds.

### Irrigation

In some regions, livestock producers depend on irrigation for continued pasture growth throughout the season. Without sufficient soil moisture, forage growth slows or ceases altogether. Proper irrigation is a vital tool to maintain growth or initiate grass regrowth, dissolve manure and inorganic fertilizer and reduce soil temperatures during the hotter summer months.

In Oregon, you are required to have a water right to access irrigation water. If you have a water right and plan to irrigate, there are multiple irrigation methods to consider: flood, hand line, wheel line, pod system, gated pipe, little and big gun, linear and pivot irrigation systems. In addition, some small farms use solid set systems for pasture. These systems are efficient but require precautions to protect the pipe from the livestock. The irrigation system should be based on available water resources, farm size and field layout, labor availability, available management time and financing.

Your irrigation management plan (when to irrigate and how much water to apply) should be based on soil type and the amount of moisture lost to evapotranspiration. A soil's infiltration rate and water holding capacity are based on its texture, organic matter

content and soil depth. Evapotranspiration is the average daily water loss from the soil plant system (evaporation from the soil plus transpiration from plant leaves).

During the growing season, keep the soil above 50% of its water holding capacity. When it reaches 50%, irrigate to full water holding capacity. If irrigation is available, start early (early May in western Oregon), since drought-induced dormancy is difficult to reverse. The time between irrigations depends on the evapotranspiration rate. Water losses are greater during the hot, dry, longer days of summer than at any other time of year. For example, in Central Oregon during spring, the frequency of irrigation could be every two to three weeks; in the summer it could be every five days, depending on the soil's water holding capacity.

Real-time data can be used to support your irrigation management plan. Daily evapotranspiration rates are provided by many agricultural weather stations, such as Agri-met (https://www.usbr.gov/pn/agrimet/). Monitoring soil moisture levels can also help you determine when to irrigate, whether irrigation periods are sufficiently spaced and whether the proper amount of water is applied during each irrigation.

Additional information about pasture irrigation and developing a specific water management plan is found in Chapter 6 of *Pasture and Grazing Management in the Northwest*.

## Nutrients

All plants require nutrients from the soil for growth and development. Soil nutrient levels in pastures are affected by soil type, plant species, the type of animals you are raising and the timing and intensity of grazing. To maintain adequate soil nutrient levels for good pasture growth and forage production, develop a nutrient management plan. Important components include soil sampling and testing; soil pH and nutrient levels; timing, type, and amount of fertilizers; and including legumes in pastures.

### *Soil testing*

An initial soil test establishes the base fertility of the soil. A regular soil testing program will allow you to determine changes in fertility based on fertilization and nutrient removal and reveal any nutrient deficiencies or imbalances. Following the initial soil test, soil testing every two to three years will allow you to evaluate your progress. If you plan to renovate a pasture, take soil samples a few months in advance so that you can incorporate the needed lime and fertilizer into the root zone before planting. After renovating, take soil samples every year or two until the pasture is well established and productive.

For established pastures, where soils are not tilled, use a split or stratified soil sampling strategy. Phosphorus and calcium are mostly immobile in the soil. Levels of these nutrients are often higher in the top 2 inches of the soil. A stratified sampling procedure, where you divide the soil core into a section representing 0–2 inches and another representing 2–6 inches, gives a more accurate picture of the nutrient content in your field and fertilization requirements.

A basic soil analysis for pastures includes pH, SMP buffer (to determine lime requirement), phosphorus, potassium, calcium, magnesium and boron if you are growing alfalfa or other legumes in a mixed grass-clover pasture. Testing for nitrogen is not recommended since the nitrogen in the soil sample is not stable. Organic nitrogen can mineralize, and plant-available nitrogen can volatilize. Nitrogen applications should be based on forage yield potential, soil moisture and temperature.

For more information on soil sampling, refer to *A Guide to Collecting Soil Samples for Farms and Gardens* (EC 628) (https://catalog.extension.oregonstate.edu/ec628).

*Fertilizing your pastures*

The primary macronutrients for pastures are nitrogen (N), phosphorus (P) and potassium (K). These soil nutrients can be added to the pastures by applying commercial fertilizer, manure or compost.

*Nutrient Management for Pastures: Western Oregon and Western Washington* (EM 9224) (https://catalog.extension.oregonstate.edu/em9224 ) is a comprehensive resource that provides details about nutrient management practices.

**Commercial fertilizers.** Commercial N-P-K fertilizers supply plant-available nutrients according to their nutrient content. They are available in many formulations to meet soil nutrient requirements for forage production. N fertilizer is typically selected according to the N cost per pound and the potential for volatilization losses.

**Manure.** Grazing animals return as much as 90% of nutrients through urine and manure, though the nutrients are not evenly distributed throughout the pasture. Whenever possible, utilize manure resources to replenish soil nutrients. However, manure's nutrient content varies by livestock type, collection and storage practices, bedding material and composting process.

P is often at adequate levels in pasture systems where manure is applied. Additional application may not be needed. A soil test will help you decide how much of these nutrients are needed. Livestock manure usually provides adequate amounts of K. However, additional K may be needed if your pasture is managed for silage or hay production. For the most accurate information for your farm, have the manure you will be using analyzed by a certified lab.

**Compost.** Composting manure and other organic materials may be more economical than purchasing commercially available fertilizers. Composting manure may also help reduce weed seeds and pathogens.

There are potential water quality concerns with manure accumulation or runoff. When storing and applying manure resources, ensure it does not end up in waterways, including streams, ditches or drainage ways.

### Splitting applications of N fertilizers

When using commercial N fertilizers on pastures, use split applications at key times throughout the year, not one application. For example, in late summer or early autumn, apply 40 lb N/ acre to stimulate regrowth before winter. In late winter, apply another 40 lb N/ acre, and in the spring, an additional 40–60 lb N/ acre. To address N deficiency, you can also consider adding legumes to your pasture mix.

## Forage conditions that cause livestock health problems

Serious livestock health concerns can be related to the amount, type and condition of forages consumed.

- **Nitrate poisoning** may occur when animals feed on plants that accumulate nitrate, when nitrogen fertility is high or when plants are stressed from insufficient irrigation or rainfall. For more information see *Nitrate Poisoning in Ruminants* (FS 139E, Washington State University) (http://pubs.cahnrs.wsu.edu/publications/pubs/fs139e).
- **Selenium deficiency** is a concern in western Oregon and other areas with low soil selenium. Learn how to supplement this trace mineral in *Selenium Supplementation Strategies for Livestock in Oregon* (EM 9094) (https://catalog.extension.oregonstate.edu/em9094).
- **Grass tetany** is related to magnesium (Mg) deficiency leading to low Mg levels in an animal's blood. It is most common in cows before calving into early lactation. Grass tetany can follow grazing of lush, rapidly growing cool-season grasses in the early spring when high in potassium (K) concentration and slow to uptake Mg from the soil. Read "Grass Tetany: fast growing grasses can mean problems" to learn more about how to prevent this disease (https://extension.oregonstate.edu/crop-production/pastures-forages/grass-tetany-fast-growing-grass-can-mean-problems).

When forage is mechanically harvested and removed and fed off-site, soil nutrients will be depleted more quickly. The nutrients in silage and hay are removed and not recycled as they are in pasture grazing systems. Manure and compost returned to the soil add valuable organic matter.

To learn more about manure and compost as fertilizers, refer to *Fertilizing with Manure and Other Organic Amendments* (PNW 533) (https://pubs.extension.wsu.edu/fertilizing-with-manure ).

Remember, if you have adequate forage for your animals, it may not be necessary to purchase additional nutrients to grow more grass.

### *Soil pH*

Soil solution pH measures soil acidity and alkalinity. Soil pH is affected by soil type, rainfall, temperature and types of fertilizers used. Soil pH greatly affects the availability of nutrients and populations of soil microorganisms. A near-neutral pH (6–7) is best for nutrient availability and plant growth.

A soil test will show your soil pH and help you understand which nutrients are needed to meet yield goals. If you need to increase the pH of your soil (make it less acid), the SMP buffer test will help you determine how much liming material is needed. Ground limestone (calcium carbonate) or dolomitic limestone (containing Mg) are applied to maintain an appropriate soil pH.

Applying and incorporating lime into the root zone before planting a new seeding is most effective. Topdressing lime on the soil's surface in established pastures primarily affects the top couple of inches of the soil profile, since it is not mobile in the soil profile. Note that legumes require a higher soil pH than grasses for optimal growth due to the requirements of the symbiotic relationship with *Rhizobium* bacteria that results in biological nitrogen fixation. Grass species can tolerate a slightly acidic soil (around pH 5.5), whereas many clovers such as white clover are more sensitive to acidic soil and will not grow well in soils with a pH below 5.8. Alfalfa is even more sensitive and requires a minimum soil pH of 6.2–6.5.

To learn more about liming your pastures, refer to *Applying Lime to Raise Soil pH for Crop Production (Western Oregon)* (EM 9057) (https://catalog.extension.oregonstate.edu/em9057).

### *Legumes*

Legumes can fix nitrogen ($N_2$) from the air through a symbiotic relationship between the legume and *Rhizobium* bacteria that form nodules on the root of the plant (Figure 12). Legumes managed as part of the pasture's plant community can provide most of

Photo: Julie Grossman, © University of Minnesota

Figure 12. Rhizobium bacteria form nodules on the root of the plant.

the N needed in a pasture grazing system, reducing the need to apply N-containing fertilizers.

When planting legumes, the seed should be inoculated with the proper species-specific strains of *Rhizobium* bacteria to ensure high nitrogen fixation rates. Most legume seed is available preinoculated. If the seed is not inoculated or the inoculum viability date has passed, it should be inoculated with a fresh culture before seeding. Legumes will develop root nodules when the process is working, and the nodules will have a dark red center from the leghemoglobin molecule if they are fixing $N_2$.

In addition to soil and nutrient benefits, legumes provide high-quality feed for grazing animals. Forage legumes are high in protein and are highly digestible. In climates where cool-season grasses are the predominant forage, and in the summer, when these grasses tend to be less productive, legumes can provide supplemental forage.

To learn more about pasture legumes, refer to the MatchClover Species Selection Tool at https://forages.oregonstate.edu/matchclover/species-selection-tool.

## Weed management

Weed management is another key aspect of maintaining pasture productivity and forage quality. Weeds compete with pasture grasses and legumes for soil moisture and nutrients, and reduce forage production. Also, some weeds are toxic to livestock.

A preventive approach is best. In a high-quality, established pasture that is properly grazed, weeds should not be a major problem. If your pasture has serious weed problems, review your grazing management practices. You will often find a weakened stand of grasses and legumes and compacted soil in areas that have been overgrazed. It is in these areas that weeds often dominate. By modifying grazing practices and improving soil fertility and water management, you can enhance forage production and reduce space for weeds to grow and establish.

The first step in developing a plan for weed management is to properly identify the problem plants and learn about their life cycle and biology. Is the weed an annual, biennial or perennial plant? How does it reproduce? Does the weed reproduce via seeds or vegetatively or both? For example, Canada thistle, a perennial weed, can reproduce from a tiny rhizome fragment or seeds. Hand pulling or hoeing this troublesome weed may only create a larger thistle patch.

With some basic information about your specific weeds, a year-round management plan can help determine what weed-control practices are most appropriate for your situation. An integrated approach that combines prevention, mechanical, biological, cultural or chemical controls is most effective. Your weed management plan should also identify the best timing for implementing control practices based on the most vulnerable part of the plant's life cycle. To be successful, you will need to plan ahead. Walking through your pastures and identifying weeds in an early growth stage will provide the greatest control opportunity. To learn more about managing weeds in your pastures refer to the *PNW Weed Management Handbook* at https://pnwhandbooks.org/weed.

### *Poisonous and injurious plants*

Poisonous weeds and those with damaging physical structures (spines, thorns, etc.) can injure animals, causing significant economic losses. *Direct* economic losses can include poor health and growth, birth defects and animal deaths. *Indirect* losses result from the extra costs of controlling the plants, fence construction, veterinarian bills or lost forage because it is not safe to harvest.

Livestock generally avoid eating poisonous plants found in pastures if enough quality forage is available. However, there are cases of rogue animals preferring specific toxic plants for unknown reasons. Goats, for example, may browse on poisonous plants.

Animals may also inadvertently consume poisonous plants in hay, silage or lush spring pastures.

With such a wide variety of poisonous plants, it's essential to learn about the most common problem plants in your area, what parts of the plant are poisonous, and in which stages of growth they are most toxic. Determine if the plant is toxic when dried (in hay, for example), and which livestock species are susceptible to the toxin. You should be able to identify the plants at various growth stages, including young plants as they emerge in the spring. These may be controlled with a shovel or spot treatment with herbicides. Plants killed by herbicide are often more palatable to livestock. Ensure that dead plants are removed or animals are excluded from these areas. In cases of widespread infestations, you may need to consider renovation options, starting with a plan to reduce weeds and weed seeds before replanting.

To learn more about poisonous and injurious plants in pastures, refer to "Poisonous Plants Commonly Found in Pastures" at https://extension.oregonstate.edu/collection/poisonous-plants-commonly-found-pastures.

## Pasture renovation

Pastures that have been damaged by overgrazing and compaction and are no longer dominated by desirable forages may require partial or complete pasture renovation. Renovation includes numerous steps aimed at improving pasture growth and productivity. It can be as simple as interseeding or overseeding improved forages into an existing stand, or it may involve more extensive operations involving liming, fertilization, tillage and reseeding. Weed populations can be minimized before forage seeding by using another crop for one or two years before pasture re-establishment. Combine your renovation activities with improved grazing management practices to efficiently use of your climate and soil.

Renovating a pasture for long-term success requires planning, appropriate timing, suitable equipment, sufficient financial resources and follow-up management. Before you initiate plans to renovate, decide if you are ready to implement management changes so that your newly planted pasture does not deteriorate in just a couple of years. Otherwise, the time and money spent will be largely wasted.

Once the newly renovated or re-established pasture is green and growing, you may be tempted to allow your livestock to start grazing. However, grazing should be deferred until seedlings are well established. Young seedlings are developing their root systems and building energy reserves for future growth. If the soil is moist and the root system is still weak, animals will pull the new plants out of the soil when grazing. One way to determine if the pasture is ready for grazing is to give individual plants a test by pulling on them swiftly upward from the plant base, just as an animal might when grazing. If you pull it out, do not let animals graze. If the plant stays rooted, you can consider letting your livestock graze for short periods. Maintain a stubble height of 3–4 inches. To encourage tillering, mow the grass to 4 inches until it passes the pull test.

See *Pasture and Hayland Renovation for Western Washington* (http://pubs.cahnrs.wsu.edu/publications/pubs/eb1870/) for more information about planning, preparing soil and seeding pastures.

## Managing pastures through the seasons

As pasture growth and conditions change from season to season, you must also adjust your management to maintain long-term pasture productivity.

**Winter:** From November to February, rainfall saturates many soils, which makes them vulnerable to compaction. Soil compaction can restrict root growth and reduce the uptake of water and nutrients required for plant growth. This can weaken grass plants and create bare patches that weeds will invade. Daylength decreases, and soil

## Endophyte toxicity

Endophytes are intercellular fungi found in perennial ryegrass and tall fescue. Although endophytes are beneficial to the grass plants when used for turf, improving heat tolerance and pest resistance causes livestock problems.

Compounds released by the fungi can result in lower weight gains for animals, overheating related to vasoconstriction, rough hair coat and hoof loss from the tall fescue endophyte. Toxins associated with this fungus can lower reproductive rates and cause abortion, lack of milk production and prolonged gestation.

Since turf-type cultivars are purposely infected with endophytes to improve their agronomic characteristics, livestock should not be grazed on turf-type cultivars or fed lawn clippings. The ryegrass endophyte results in ryegrass staggers evidenced by a stiff-legged gait when excited.

For more information on endophyte toxicity, see *Endophyte Toxins in Grass and Other Feed Sources: Risks to Livestock* (EM 9156) *(*https://catalog.extension.oregonstate.edu/em9156*)*. If you have concerns about your pasture's endophyte status, contact the Oregon State University Endophyte Service Lab (http://oregonstate.edu/endophyte-lab/) for more information about testing.

temperatures cool. This reduces or stops plant growth, creating a period of dormancy. During the winter season, adjust your management accordingly:

- Limit grazing, as most grasses are not actively growing.
- Keep animals off pastures when soil is saturated.
- Put animals in a sacrifice area to reduce pasture overgrazing and compacting.

**Spring:** As temperatures gradually warm and day length increases, pasture plant growth rates increase. By the end of February, plant roots will be growing and absorbing nutrients. If autumn and winter management have maintained sufficient residual dry matter (3–4 inches), grasses will regrow vigorously using the stem bases' stored energy. Legumes regrow from crowns and taproots. In the springtime, management activities include:

- Apply nitrogen. Use a split-application based on the T-Sum 200 method. Rather than a set calendar date, the T-Sum 200 method uses heat units accumulated from Jan. 1 to determine the best timing. To learn more, see Appendix 3: "Calculating T-Sum in Oregon from Weather Data" in *Nutrient Management for Pastures: Western Oregon and Western Washington* (EM 9224) (https://catalog.extension.oregonstate.edu/em9224).
- Rotate animals through pastures retaining 3–4 inches stubble height as a guide.
- Walk pastures to determine weed presence and manage as needed.
- Remove livestock from identified fields in early April if silage or hay production is part of your management plan. Fertilize according to soil test information.
- Consider mowing your pasture to remove reproductive stems and encourage vegetative regrowth. Set the mower blade to leave 3–4 inches stubble height.
- Begin planning now for fall planting if you determine a field needs renovation. Implement a weed management plan, test soil to determine if lime or other fertilizers will be needed, find equipment and determine forage species and cultivars and seeding rates.

**Summer:** The warm, dry summers in western Oregon often result in grass dormancy for nonirrigated pastures. Summer management practices include the following:

- Maintain adequate stubble height and rotate livestock to pastures with adequate forage growth.
- Provide alternative pasture areas or stored feed sources if pasture species are not actively growing.
- Consider initial cultivation, germinating weed seeds and subsequently incorporating new sprouts if planning fall pasture renovation.

**Fall:** As rains begin in September, you will see a flush of new grass growth. It is tempting to have animals graze high-quality forage, but this short-term gain may come at the expense of long-term damage. If adequate stubble height is retained, you will see good management results in the spring when plants regrow; pastures managed to maintain a residual 3–4 inch stubble height will regrow faster. This is because the stem bases and roots store energy needed for the initial spring regrowth. Autumn is also an important time for grasses to grow new roots and form new tillers. Large animals can easily trample grass plants and break off the potential new growth. Fall management activities:

- Take soil samples for nutrient analysis and apply lime and nutrients such as P and K.
- Walk your pastures and pay attention to weed management.

- Implement renovation plans, incorporate fertilizers, create a seedbed and plant desired forage species. Complete these steps by early October to have adequate time for new seedling growth before the first hard frost (26 degrees F).

To learn more about managing your pasture through the seasons, explore *Western Oregon and Western Washington Pasture Calendar* (PNW) *(*https://catalog.extension.oregonstate.edu/pnw699*)*.

## Summary

Regardless of your farm's size, good pasture management brings numerous benefits. Learning about pasture plant growth and development and best practices for managing your pasture will allow you to produce the optimum amount and quality of feed for your environment. This may improve the seasonal distribution of forage and reduce the amount of feed you have to purchase.

The following points summarize the concepts covered in this publication.

- **Take a soil test.** Use a stratified soil testing approach to determine your pasture's nutrient levels, pH, and macro- and micronutrient content.
- **Add legumes** to your pasture mix. Legumes fix atmospheric nitrogen into plant-available form and reduce the need for N fertilization, increase the quality of pastures and grow better in the summer than most cool-season grasses, thereby providing additional forage in hotter months.
- **Add lime** based on soil test information. Use the SMP buffer test to determine how much limestone is needed to increase your soil's pH to the level required by your pasture species.
- **Control weeds.** Weeds compete with your pasture for soil nutrients, water and sunlight. Additionally, some weeds are poisonous or injurious to livestock, are generally less productive than improved forage species and are less palatable to livestock.
- **Use supplemental feeds** when pasture growth is not adequate for grazing. Bring in hay or silage for your livestock rather than putting them on a pasture at times when the pasture plants are dormant or when they need time to regrow after grazing.
- **Use sacrifice areas.** When pasture growth is restricted due to wet soils, dry soils, summer heat, inadequate soil fertility, etc., moving animals to a sacrifice area with supplemental feed will prevent overgrazing.
- **Consider grass height.** Put animals out on pasture based on the optimal grazing height for your grass species and use that information to manage when animals are let in and taken out of a pasture.
- **Rotate pastures.** Use rotational grazing to maintain pasture productivity and quality through avoiding overgrazing,
- **Overseed or renovate your pasture** if desired forage plants are missing. While renovating a pasture can be time-intensive and expensive, in some cases, it is needed and will save money in the long-term by reducing supplemental feed costs. However, changes in management plus interseeding are viable options before choosing to completely renovate.

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