

# Managing Dairy Grazing for More Milk and Profit

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**W**ell-managed grazing is the foundation of a successful and profitable pasture-based system. To improve your farm's profitability, you must emphasize reducing costs and/or improving efficiency. Increased reliance on grazed forages offers considerable opportunity to reduce costs: The estimated cost of pasture is about one-half the cost of ensiled legume or grass forages on a dry matter basis. The dairy cow's intake and the efficiency with which pasture is utilized are the most important factors determining profitability.

To maximize the intake of high-quality forage, pastures must be managed to ensure their rapid growth and regrowth. This involves an understanding of plant growth and development and the factors that influence animal intake.

## Ensuring rapid growth and regrowth of pasture plants

Rapid growth and regrowth of forage grasses and legumes depend on several factors:

- Maintaining adequate leaf area and optimizing net accumulation of CO<sub>2</sub> and growth
- Protecting meristems responsible for regrowth
- Providing adequate levels of nutrients and soil moisture

The following sections describe the important aspects of each of these factors for **existing pastures** that have the desired species composition. To establish a new pasture or renovate an existing one, see "Pasture renovation and establishment," page 8.



Photo by Lynn Ketchum, © Oregon State University

## Maintain adequate leaf area to optimize photosynthesis and growth rates

A forage grass or legume's potential for growth is due to its ability to trap and store energy from sunlight. Photosynthesis occurs in the chloroplasts of green plant leaves. Plants make simple sugars or carbohydrates (CH<sub>2</sub>O) and release oxygen (O<sub>2</sub>) using light energy from the sun, carbon dioxide (CO<sub>2</sub>) from the air, and water (H<sub>2</sub>O) from the soil. This reaction supports all life on earth.

Light interception depends on the amount of leaf in the pasture canopy. This is expressed as Leaf Area Index (LAI: the surface area of leaf blades per unit area of ground). Due to differing canopy architecture, plants with leaves oriented horizontally, like white and red clovers, have a critical LAI (when 95 percent of all the light is intercepted) of 3–5; alfalfa, with tall stems and smaller leaflets, has a critical LAI of 5–6; and grasses with vertically

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oriented leaf blades, like orchardgrass and perennial ryegrass, have a critical LAI of 7–10.

This difference in canopy structure affecting optimal LAI is shown in Figure 1, with perennial ryegrass intercepting 100 percent of the incident radiation with an LAI of 10 compared to white clover intercepting 100 percent at an LAI of 7.

### Manage to optimize growth rates

Forage plant growth and regrowth follow an S-shaped curve (a logistic function), with initial growth being slow (Phase 1: Lag Phase), intermediate growth being rapid (Phase 2: Log or Linear Growth Phase), and later growth again being slow (Phase 3: Stationary or Maturity Phase) (Figure 2). The implications of this for grazing are to begin grazing at the top of Phase 2 (the rapid growth phase) and end grazing at the bottom of Phase 2. Doing this will ensure that there is sufficient leaf area to capture a large percentage of the incident solar radiation and convert it to the energy required for growth.

For perennial ryegrass–white clover pastures, optimal growth, regrowth, and forage quality occur when Phase 2 begins at 3 to 4 inches and ends at 10 to 12 inches. This represents 3,000 to 3,600 pounds DM/acre “on offer” at the beginning of grazing, and 900 to 1,200 pounds DM/acre (“residual dry matter”) at the end of grazing. Extending grazing into Phase 1 (below 3 inches) will reduce leaf area below the optimum for photosynthesis, remove storage carbohydrates in stem bases, and reduce root growth, resulting in reduced vigor, long-term productivity, and longevity of the stand.

### Protect meristems

In addition to maintaining adequate leaf area for photosynthesis, you must protect the plant’s regrowth potential. Growing points, also known as **meristems**, are critically important because they are the source of all plant growth. Meristems are the sites of cell division and growth and give rise to new leaves, stems, roots, and inflorescences, as well as to more meristems and new shoots. There are three meristematic sources of tissue growth in

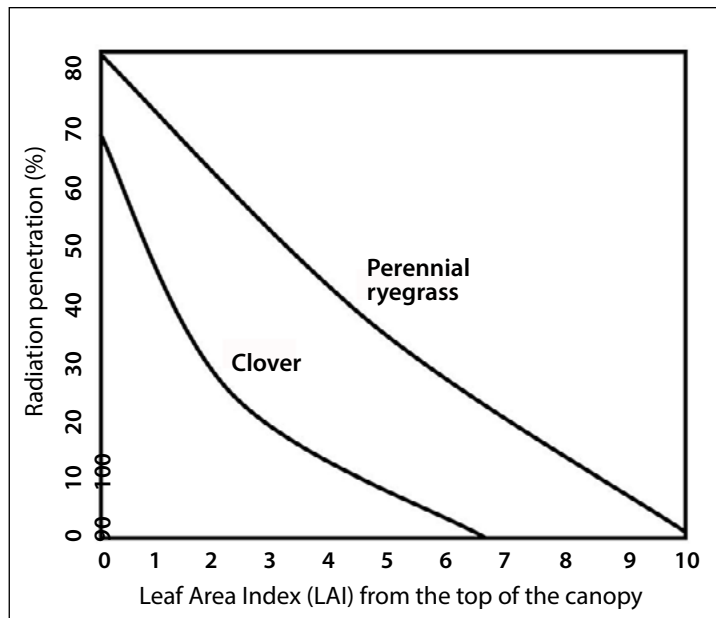


Figure 1. Light penetration as a function of leaf area index (LAI) for perennial ryegrass and clover.

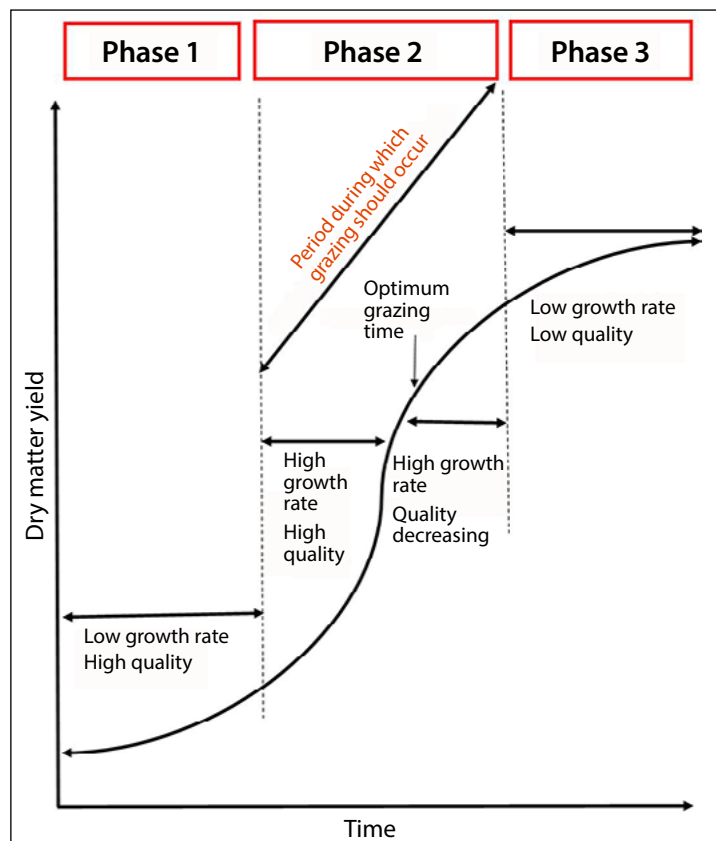


Figure 2. S-shaped growth curve.

grasses and legumes: apical, intercalary, and axillary meristems.

The apical meristem (also known as the shoot or root apex) is located at the growing end of each stem and root. This shoot meristem remains near ground level if internodes that form the culm (stem) have not elongated. Grasses that require and receive vernalization (a winter chilling period) for flowering transition to reproductive shoots after receiving springtime temperature and photoperiod signals from the environment.

Although this transition to the reproductive stage can be delayed by defoliation, it's incorrect to say that grazing can keep plants in the vegetative stage. All grasses will elevate the apical meristem during the initial growth cycle due to internode elongation. There is, however, a difference among species in the regrowth cycles.

### **Jointed and non-jointed grass species**

There is another important difference among grass species: their classification as jointed or non-jointed. Jointed types are also called culmed vegetative regrowth types or “long-shooted.” These grasses elevate their apical meristem in each regrowth cycle.

This is an important distinction with respect to grazing management, because these grasses are more susceptible to ill-timed grazing (or mechanical) defoliation. Prairiegrass and timothy are jointed species, making them difficult to manage in grazing systems. Perennial ryegrass and orchardgrass are non-jointed species with culmless regrowth habit, making them easier to manage and less vulnerable to stand depletion as long as a 4-inch residual is maintained for carbohydrate reserves needed for regrowth.

### **Provide adequate levels of nutrients and soil moisture**

Ensuring adequate LAI for photosynthesis and protecting regrowth mechanisms are the foundations of proper grazing management. Optimizing yield requires two other components: meeting plants' nutritional needs and providing adequate soil moisture.

Periodic soil testing followed by liming and fertilization to soil-test recommendations is critically

important to ensure high levels of forage production and long-lived forage stands. Take soil samples annually if your pasture has nutrient deficiencies, or every 3 to 4 years if soil fertility is within recommended levels. Sample soil on about the same date each year, since nutrient levels fluctuate seasonally. Consult *A Guide to Collecting Soil Samples for Farms and Gardens* (EC 628) for more information on soil sampling. (See “For more information,” page 11.)

With good management, perennial, mixed grass–legume pastures need only limited fertilizer, since nutrients are exported only in the body composition of grazing animals gaining weight or in animal products (such as milk). Where pastures are composed mostly of grasses, some nutrients, especially nitrogen, need to be replenished. Fertilization planning is most effective when fertilization rates and soil test results are tracked in a spreadsheet for several years.

### **Soil reaction (pH)**

Soil reaction or soil solution pH is a measure of soil acidity or alkalinity. Soil pH is measured between 0 and 14, with acidic soils having a pH less than 7 and alkaline soils having a pH above 7.

Soil pH is a product of parent material and the environment. Rainfall and temperature largely control processes that determine soil pH. The mountainous and coastal regions of the western U.S. have high rainfall and therefore acidic soils. Fertilizer sources can also affect soil pH.

Grass pastures are moderately tolerant of soil acidity. Apply lime if the soil pH is below 5.4 or the calcium soil test is below 5 meq Ca/100 g soil. Select a soil-testing laboratory that uses the SMP buffer test to estimate the amount of agricultural lime needed. This buffer test is best suited for western Oregon soils, since they have large lime requirements and significant reserves of exchangeable aluminum (Al).

Legumes are more sensitive to low soil pH than grasses. Beneficial bacteria present in nodules on roots of forage legumes convert atmospheric nitrogen (N<sub>2</sub>) to a form plants can use. Strongly acidic conditions limit this biological nitrogen fixation. Thus, legumes are more responsive to liming than grasses. Surface applications of 1 to 2 tons per acre are recommended when soil pH is below 5.8.

## Nutrients

### NITROGEN (N)

Grass pastures respond well to N fertilizer application. Nitrogen-limited grass pastures were shown to increase dry matter production by 2.5 tons/acre (2.8 MT DM/ha) for the initial 89 pounds/acre (100 kg N/ha), and 2.8 tons/acre (3.1 MT DM/ha) for the second 89 pounds (100 kg) N applied (Figure 3). Even higher responses have been reported in various studies. N can also increase the quality of the grass by increasing crude protein and digestibility.

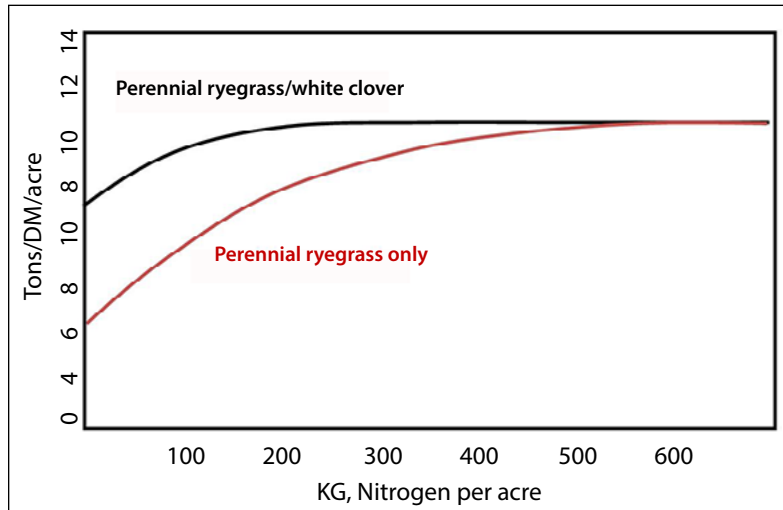


Figure 3. Nitrogen fertilizer production response curves for perennial ryegrass and perennial ryegrass–white clover mixtures.

Legumes are included in pasture mixes because they fix  $N_2$  from the air and are high-quality forages. As the amount of legume increases in a grass–legume mixture, the need for N fertilizer decreases. In Figure 3, with no N applied, the perennial ryegrass–white clover mixture produced 5.2 tons/acre (5.8 MT DM/ha) *more* than the grass-only treatment. That represents a replacement value of 179 pounds N/acre (200 kg N/ha). Similarly, the differential between treatments with 89 pounds N/acre (100 kg N/ha) applied was 4.5 tons/acre (5 MT DM/ha), also a replacement value of 178 pounds/acre (200 kg N/ha).

When legumes make up more than 60 percent of the mixture, yield responses to N fertilizer are minimal. N applications usually reduce the proportion of legume in a grass–legume stand. Excessive N encourages grasses as the dominant species.

Soil temperature is also important. Biological nitrogen fixation begins when soil temperatures are above 52°F. Lower soil temperatures greatly reduce the bacteria's ability to fix  $N_2$  or to mineralize organic matter to provide N for pasture growth.

Thus, optimal fertilizer efficiency has been observed when the first spring-time N application is made based on a method called T-sum 200. T-sum 200 calculates growing degree days (GDD) beginning on January 1:  $GDD = (T_{max} + T_{min}) \div 2 - T_b$ , where  $T_{max}$  is the day's maximum temperature,  $T_{min}$  is the minimum temperature, and  $T_b$  is the base temperature for cool-season grass species (0°C or 32°F). For more information on using the T-sum method, see *Early Spring Forage Production for Western Oregon* (EM 8852-E).

### General N fertilization recommendations for Western Oregon grass–clover dairy pastures

- For the initial spring N fertilizer application, apply 30 to 50 lb N/acre to all pasture types.
- Subsequently, for **pastures without legumes**, apply 30 lb N/acre per month during the growing season to support continuous production. Apply N in August or September, with adequate soil moisture, to correct late-summer shortages and promote fall grass growth.
- For **pastures with a significant clover percentage**, reduce the subsequent N applications:
  - For pastures with > 50% clover, consider no N applications following early spring.
  - For pastures with 35–50% clover, reduce applications to 15 lb N/acre per month.
- Monitor the grass in all pastures for symptoms of N deficiency (such as slow growth and/or yellowish color). If you observe deficiencies, apply 30 lb N/acre.
- New seedlings or pastures cut for green-chop, silage, or hay may require additional N to optimize productivity, either as animal manure or commercial fertilizer.
- Analyze manure for nutrient concentration before application. Typical N content is around 6 lb N/1,000 gal liquid manure from a tank and 4 lb N/1,000 gal liquid manure from a storage pond. In this example, you could apply 5,000 gal/acre of tank manure or 7,500 gal/acre of pond manure to provide 30 lb N/acre.

### **PHOSPHORUS (P)**

Adequate P fertilization is particularly important for legumes. Estimate the need for P fertilization with a soil test. Apply P on established pastures in the fall or spring before growth begins. When using ammonium phosphate materials, do not over-apply N to supply adequate P. Moderate rates of N and P (40 to 60 pounds/acre) applied together sometimes have a synergistic effect on plant growth. Fall applications of N and P from ammonium phosphate materials on south coastal Oregon pastures produced more forage than individual applications of either N or P.

### **POTASSIUM (K)**

An adequate level of available K is essential for optimal growth of grass-clover pastures. Potassium is particularly important for clover growth. Due to extensive fibrous roots, grasses compete vigorously with clovers for soil K. High-producing pastures can rapidly deplete soil K. Test soil every 2 years to determine available K levels.

Potassium deficiency is indicated by light-colored spots around the margins of clover leaves and yellow to brown coloring of grass leaf tips. Reduced growth due to insufficient K fertilizer often occurs before deficiency symptoms are seen.

Split K fertilizer applications for established, high-yielding irrigated pastures, with the first application in late spring (to avoid grass tetany) and the second application in midsummer. For other pasture types, apply K in the fall or spring.

### **SULFUR (S)**

Plants absorb S as sulfate ( $\text{SO}_4^{-2}$ ). Most fertilizer materials supply S as sulfate. Soil sulfate increases in the fall. It is decreased by leaching in November and December and by microorganisms in the spring. Make S applications in late winter or spring, unless there are severe deficiency symptoms, in which case additional fall or spring applications may be needed.

Apply 20 to 30 pounds S/acre annually as sulfate or 30 to 40 pounds S/acre every other year.

### **BORON AND OTHER MICRONUTRIENTS**

Boron (B) deficiencies are sometimes observed in legumes growing on coarse-texture soils. Clovers have a higher B requirement than grasses. However,

too much B can be highly toxic to plants; therefore, do not exceed recommended rates. Distribute B evenly over the field. Never band B-containing fertilizer materials.

If the soil test value for B is below 0.25 ppm (hot water extractable method), apply 1 to 3 pounds B/acre. Mix thoroughly when applying B with other fertilizers. Spring applications are preferred.

Deficiencies of other micronutrients such as zinc (Zn), copper (Cu), manganese (Mn), and iron (Fe) have not been observed on irrigated pastures in the western U.S. Soil test for these micronutrients before applying. If you choose to apply a micronutrient, do so on a trial basis to ensure that a deficiency exists and that the response is economical.

### ***Plant tissue testing***

If you suspect a nutrient deficiency, plant tissue analysis can be helpful in identifying the deficient nutrient. Sample grasses and legumes separately. Collect samples just before turning animals in to graze (at the top of Phase 2; 10 to 12 inches high or just prior to heading).

Randomly select 25 plants across the pasture. Cut plants at a height of 3 inches, and ensure that there is no soil contamination. Air-dry samples prior to shipping to the laboratory.

### ***Irrigation***

There are a number of irrigation methods used in Oregon, including flood, hand line, wheel line, gated pipe, little and big gun, linear, and pivot. The method of choice depends on the system that came with the farm; the size of the farm; and the amount of labor, time, and money available. Some small farms use solid-set systems for pasture. These systems are efficient but require care to protect the pipe from the livestock.

Determining when to irrigate and how much water to apply are specialized tasks. Though many techniques exist, monitoring soil moisture may be the easiest irrigation scheduling technique. This technique can help you determine when to irrigate, whether irrigation periods are sufficiently spaced, and whether the proper amount of water is applied during each irrigation period.

During the growing season, the soil should dry out to about 50 percent of the soil water-holding capacity before it is irrigated again to its capacity. Water-holding capacity is determined by soil texture, organic matter content, and soil depth. The time between irrigation varies from less than 1 week to several weeks, depending on the time of year and the water-holding capacity of the soil.

Moisture evaporates from the soil and plants transpire; that is, they lose moisture through the stomates in their leaves. Considered together, these two processes are referred to as **evapotranspiration**.

Evapotranspiration or average daily water loss from the soil–plant system varies by season; water losses are greater during the hot, dry, longer days of summer than at any other time of year.

Follow an irrigation management plan based on the infiltration rate, water-holding capacity of the soil, and amount of moisture lost to evapotranspiration. Use weather and soil information to ensure adequate but not excessive irrigation. Agrimet has information for a variety of areas of Oregon: [http://www.usbr.gov/pn/agrimet/or\\_charts.html](http://www.usbr.gov/pn/agrimet/or_charts.html). Ask an irrigation specialist at your local OSU Extension office or the USDA Natural Resources Conservation Service office to help you develop a water management plan.

## Estimating forage production

### Seasonal pasture species

Pasture production is distinctly seasonal in nature. Except for corn grown for silage, most of the forages used in the PNW are cool-season species. Oregon’s dairy pastures depend primarily on perennial ryegrass, orchardgrass, and white clover that are characterized by high growth rates in April, May, and June and much slower growth rates in July and August, even when irrigated. Incorporating warm season species (for example, corn, sorghum, and sudangrass) that have high growth rates in June, July, and August can be helpful in providing better seasonal distribution of forage availability (Figure 4).

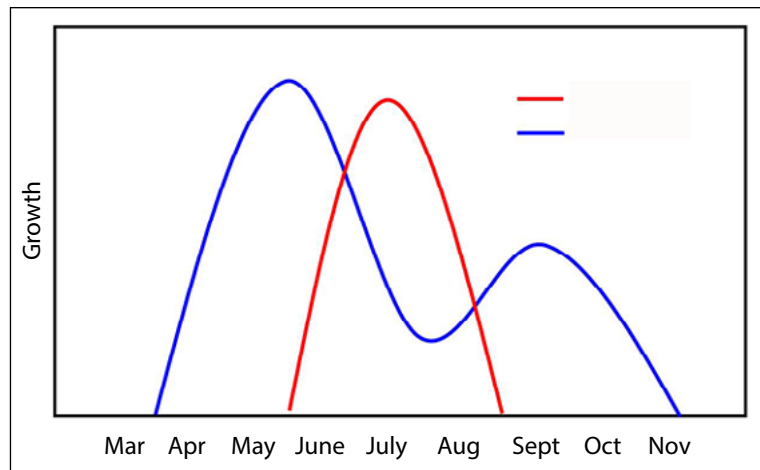


Figure 4. Stylized seasonal growth distribution curve for cool- and warm-season forage species.

### Feed budgeting using a “feed wedge”

Seasonal growth patterns provide some information about the general nature of forage availability. However, the challenge is to estimate the current and future inventories of available forage to make grazing management decisions easier, more accurate, and less stressful. One approach is to use a “feed wedge” (also called a pasture wedge or grazing wedge). The feed wedge creates a picture of the current pasture situation in table form by ranking paddocks based on their average pasture cover.

The grazing wedge shown in Figure 5 (page 7) depicts a 24-paddock rotational pasture system. This system provides fresh pasture each day and allows plenty of time for healthy plant regrowth before grazing again.

The columns, depicting individual paddocks, show that on any given day the paddocks will have different amounts of forage, mainly because each has had a different amount of time for regrowth. The paddocks with the smallest supply, on the far left, were grazed down to a residual level. As you move right across the graph, the columns get larger, indicating that the estimated DM increases until we ideally reach our preferred grazing height.

Creating a pasture feed wedge requires a farm walk to collect individual paddock DM estimates. Pastures can be assessed in several ways. Some of the common methods are calibrated eye assessment; measuring average height and multiplying by 300 pounds DM/acre/inch; and using a rising plate

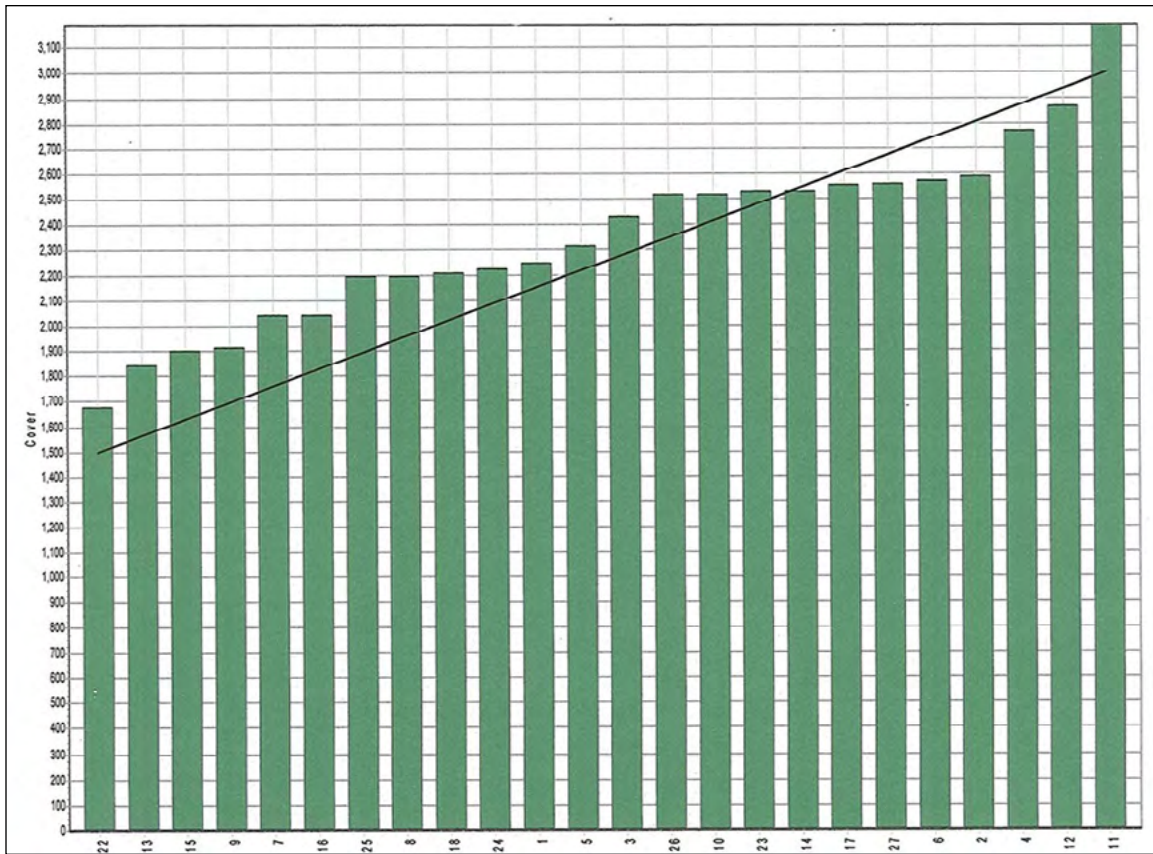


Figure 5. A grazing wedge showing estimated dry matter (DM) in each of the 24 grazing paddocks in the grazing system.

meter, a falling plate meter, a capacitance probe, or a C-Dax pasture meter.

### Factors affecting animal intake

It can be a challenge to assure that high-producing dairy cows early in lactation consume enough forage to meet their nutritional needs. All of the feed they consume must be of the highest quality to maintain production levels. Both quality and quantity of available pasture forage are important.

Pasture intake is directly influenced by the amount of feed allocated in the pasture. This is affected by the height of the pasture presented to the animals, the size of the pasture, and the percentage of the forage in the pasture that they consume.

Livestock's forage intake is limited by bite size and rate. The ease with which cows can tear off and consume pasture plants greatly influences forage intake. Thus, maturity and quality affect intake.

Coarse, mature grasses, for example, may reduce feed intake. Forage intake is also reduced if cows are required to walk considerable distances while grazing.

Cattle on pasture graze 8 to 10 hours per day and spend another 3 to 4 hours ruminating the feed they've consumed while grazing. Cows take approximately 36,000 bites and consume about 28 pounds DM/day under ideal conditions.

Pasture allowances need to be generous if high-producing dairy cows are to consume the required 20 or more pounds DM/day. Providing an allowance of 3,000 pounds DM/acre (approximately 10 inches; the top of Phase 2) at the beginning of each grazing period will ensure high rates of intake.

Table 1 (page 8) shows how to calculate the area of pasture needed to supply the daily feed allowance for dairy cows.

**Table 1. Sample pasture budget, based on Oregon growing conditions.**

Forage on offer at top of Phase 2 (10 inches)	3,000 lb DM/acre
(subtract) Residual dry matter at bottom of Phase 2 (4 inches)	– 1,200 lb DM/acre
Pasture allowance	= 1,800 lb DM/acre
Daily feed allowance for 100 cows @ 36 lb DM/day*	3,600 lb DM/acre
Pasture area required for 1 day = 3,600 lb ÷ 1,800 lb/acre	2 acres
Days required before re-grazing (with 50 lb DM/acre/day)	30 days
Area needed for a 30-day rotation = 2 x 30	60 acres

\*Assumes a 1,200-pound cow consuming 3% body weight.

## Pasture renovation and establishment

When deciding whether to renovate existing pastures or to completely re-establish them, base your decision on a site inventory of:

- Environmental conditions
- Water availability
- Forage utilization
- Economics
- Management ability and style
- Existing desirable plants
- Extent of weed invasion

Keeping the existing vegetation and improving management practices may be the most economical approach. It may take 3 or more years of good management to restore a pasture to the desired condition. Replanting will require more investment in time and money.

### Renovating an existing pasture

The least-cost method of pasture improvement is to change the composition of an established pasture through fertilizer management and improved irrigation and grazing practices. In mixed pastures, N application favors grasses. Application of P without N favors legumes. Continuous stocking reduces the number of highly palatable plants and increases undesirable plants, while rotational grazing allows desirable plants to persist.

Pasture renovation often is motivated by the desire to control weeds or undesirable grass species. However, not all weedy plants are detrimental to pastures. In fact, some weedy plants provide

nutritional value to grazing animals. Thus, consider carefully before initiating expensive weed control methods. Integrated weed management—including scouting, prevention, and mechanical, cultural, biological, and chemical methods—is often the most successful approach to achieving the desired composition of pastures.

Interseeding a legume into grass pastures can result in improved forage quality and reduced N fertilization requirements. However, interseeding legumes into grass-dominated stands is difficult and often fails. For interseeding to succeed, competition from established plants must be reduced either chemically or culturally. This can be done with a non-selective herbicide or close grazing followed by the use of a no-till drill to plant desirable legumes and grasses directly into the sod.

### Establishing a new planting

#### Seedbed preparation

If you decide to establish a new pasture, growing an annual crop such as oats or annual ryegrass will help provide a general cleanup of the pasture before reseeding. If you do not use a rotation crop, then kill existing vegetation with herbicides and/or tillage before planting. A firm, fine, moist, weed-free seedbed is required for the small seeds of forage grasses and legumes to establish successfully.

1. Apply recommended fertilizer, lime, and other soil amendments before you till so they can be incorporated during tillage.
2. Use a moldboard plow, offset disk, chisel plow, or rototiller to bury surface residues and weed seed. This is a must. If necessary, use a



ripper or subsoiler to break up compacted soil layers.

3. Finally, use a harrow, roller, roller harrow, cultipacker, ground hog, or land plane to firm the seedbed. Walk across the site to test the firmness. Footprints should be ¼ to ½ inch deep. If they are deeper, additional firming is needed before planting.

The final seedbed should be firm but not hard, fine but not powdery, moist but not muddy, and free of competitive weeds, especially perennials. A properly prepared seedbed holds moisture, helps control planting depth, and provides good seed-to-soil contact.

### Planting methods

There are various planting methods, including conventional drills, minimum/no-till drills, and broadcast seedings. Regardless of the planting method, it is critical that you set the equipment for the proper seeding rate, depth, and distribution.

#### DRILLING

When using a drilling method, don't drill seed in wide rows, since this results in large, open areas (6 to 8 inches between rows) for weed establishment. Drill lighter rates in two directions to fill open areas.

Most forage species have small seeds, making planting depth especially important. In medium to heavy soils, most species should be planted approximately ¼ inch deep. In sandy soils, plant no more than ¾ inch deep. For seed mixtures, plant at the depth that favors the smallest seed.

#### BROADCASTING

To ensure a good stand when broadcasting, increase the seeding rate by 30 to 100 percent. The higher rate will compensate for poorly placed seed. Ideally, broadcast half the seed over the field in one direction and the other half perpendicular or at an angle to the first pass. Following broadcasting, immediately incorporate the seed into the soil with a roller, cultipacker, or light harrow.

### Species and variety selection

Newer varieties of perennial ryegrass or orchardgrass combined with white or red clover can produce over 12,000 pounds DM/acre annually. Newer varieties of white clover and perennial ryegrass, such as some developed in New Zealand, are well adapted to western Oregon.

### Mixtures and seeding rates

The majority of western Oregon and Washington dairy pastures are composed of perennial ryegrass, orchardgrass, and white clover. A small amount of annual ryegrass is sometimes included at initial planting, since it is quick to establish. It is highly competitive with perennial ryegrass and orchardgrass, however, so keep the amount to a minimum.

Recommended seeding rates have changed dramatically over the past 30 years, primarily due to less care being taken with seedbed preparation. Historically, 10 to 12 pounds of perennial ryegrass and 2 to 3 pounds of white clover were recommended per acre. Current recommendations are 30 pounds of perennial ryegrass or 20 pounds of orchardgrass sown with 2 to 3 pounds of white clover.

Orchardgrass requires better drainage conditions than perennial ryegrass. They can be used together in well-drained or moderately well-drained soils. In more poorly drained soils, perennial ryegrass will perform better.

Table 2 lists species and seeding rates for two recommended dairy pasture mixes.

**Table 2. Two pasture seeding recommendations for well-drained soils in western Oregon**

	Mixture 1	Mixture 2
	----- lb seed/acre -----	
Perennial ryegrass	—	30
Orchard grass	20	—
Annual ryegrass	5*	5*
White clover	2	2

\*Use only if early growth is important and pastures will be dry enough to graze early.

## Key points

- ▶ High-quality pasture grasses and legumes provide the least-cost source of nutrition for dairy cows.
- ▶ Rapid growth and subsequent regrowth after grazing require maintaining optimal leaf area index (LAI) and protecting regrowth meristems.
- ▶ Maximizing the intake of high-quality forage requires allocating a sufficient quantity of forage to ensure large bite size and rate.
- ▶ Start each grazing event at the top of Phase 2 (pastures 10 to 12 inches high) to ensure adequate forage allowance for high intake.
- ▶ Remove animals from pastures when forage is at the bottom of Phase 2 (3 to 4 inches high) to ensure rapid regrowth rates.
- ▶ Allowing pastures to enter Phase 3 (taller than 12 inches; greater than 3,600 pounds DM/acre) will result in lower growth rates and lower forage quality.
- ▶ Grazing below 3 inches (entering Phase 1; less than 900 pounds DM/acre residual dry matter) greatly reduces growth rates and removes stored energy from stem bases.
- ▶ It is important to protect meristems to ensure rapid regrowth. Grasses that elevate the apical meristem in each regrowth cycle (“jointed” or “culmed vegetative regrowth” species) are especially vulnerable. Perennial ryegrass and orchardgrass are non-jointed species with culmless regrowth habit, so they are less vulnerable to stand depletion if a 4-inch residual is maintained.
- ▶ Periodic soil testing followed by liming and fertilization to soil-test recommendations is important to ensure high levels of forage production and long-lived forage stands.
- ▶ Nitrogen is the most limiting nutrient for pasture production. For optimal pasture production, calculate T-sum 200 or apply N 6 weeks before initial spring grazing, periodically throughout the grazing season, and prior to fall growth.
- ▶ Follow an irrigation management plan to ensure adequate but not excessive water during the grazing season. Information is available through Agrimet ([http://www.usbr.gov/pn/agrimet/or\\_charts.html](http://www.usbr.gov/pn/agrimet/or_charts.html)).
- ▶ Develop a grazing or pasture wedge (feed wedge) to aid in estimating current and future forage availability. Assessment methods include measuring pasture height using rising or falling plate meters or capacitance probes. Perennial ryegrass–white clover pastures typically have 300 pounds DM/acre/inch.
- ▶ Pasture intake and subsequent milk production are directly affected by the amount of forage allocated for grazing. Grazing that begins at 10 inches and finishes at 4 inches provides 1,800 pounds DM/acre and ensures high rates of intake.
- ▶ The least-cost method of pasture improvement is to change the composition of an established pasture through fertilizer management and improved irrigation and grazing practices.
- ▶ If you decide to establish a new pasture, growing an annual crop will help prepare the land before reseeded. Soil testing followed by incorporation of needed fertilizer, lime, and other soil amendments and then final seedbed preparation should result in a firm, moist seedbed.
- ▶ Seed of most species should be planted approximately ¼ inch deep. If broadcast seeding, follow the planting with rolling, cultipacking, or light harrowing.
- ▶ Common mixtures for dairy pastures use either perennial ryegrass (30 pounds/acre) and white clover (2 pounds/acre) or orchardgrass (20 pounds/acre) and white clover (2 pounds/acre).
- ▶ Leave about 4 inches of growth (1,200 pounds DM/acre) at the end of the grazing season for stronger pastures the following year.

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## For more information

### **Oregon State University Extension Service**

You can find these and many other publications in the OSU Extension Catalog at <http://extension.oregonstate.edu/catalog/>

*A Guide to Collecting Soil Samples for Farms and Gardens* (EC 628)

*Calculating Dairy Manure Nutrient Application Rates* (EM 8768)

*Early Spring Forage Production for Western Oregon Pastures* (EM 8852-E)

*Keeping Track of Manure Nutrients in Dairy Pastures* (PNW 549)

*Nutrient Management for Dairy Production: Manure Application Rates for Forage Production* (EM 8585-E)

*Pastures—Western Oregon and Western Washington* (FG 63)

### **Other resources**

Agrimet.

[http://www.usbr.gov/pn/agrimet/or\\_charts.html](http://www.usbr.gov/pn/agrimet/or_charts.html)

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