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Perennial Ryegrass

(*Lolium perenne* L.)

D. Hannaway, S. Fransen, J. Cropper, M. Teel, M. Chaney, T. Griggs, R. Halse, J. Hart, P. Cheeke, D. Hansen, R. Klinger, and W. Lane

Perennial ryegrass (*Lolium perenne* L.), also called English ryegrass, is a cool-season perennial bunchgrass native to Europe, temperate Asia, and North Africa. It is widely distributed throughout the world, including North and South America, Europe, New Zealand, and Australia.

Perennial ryegrass is important in forage/livestock systems. High palatability and digestibility make this species highly valued for dairy and sheep forage systems. As a result, it often is the preferred forage grass in temperate regions of the world.

Characteristics include:

- High yield potential
- Fast establishment
- Suitability for reduced-tillage renovation
- Use on heavy and waterlogged soils

In the United States, perennial ryegrass is used for forage predominately in the coastal Northwest, irrigated intermountain valleys of the West, the Midwest, and Northeast.

Perennial ryegrass can behave as an annual, short-lived perennial, or perennial, depending on environmental conditions. It resembles annual ryegrass (*Lolium multiflorum* Lam.), although perennial ryegrass has more leaves in lower parts of the plant canopy, its collar and blade are more narrow, and lemmas are awnless.

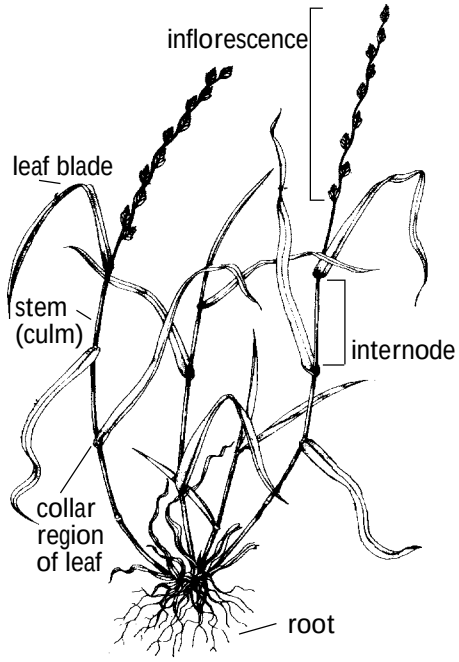

Figure 1.—Perennial ryegrass plant.

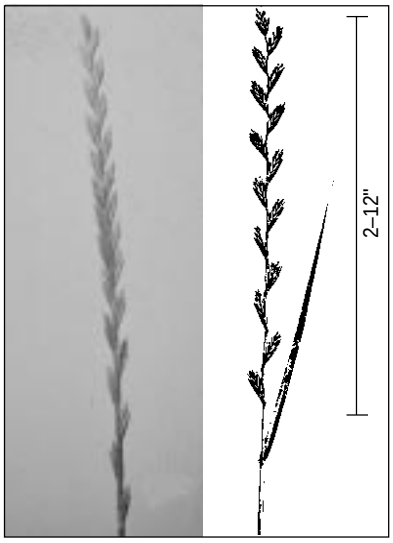

Figure 2.—Inflorescence.

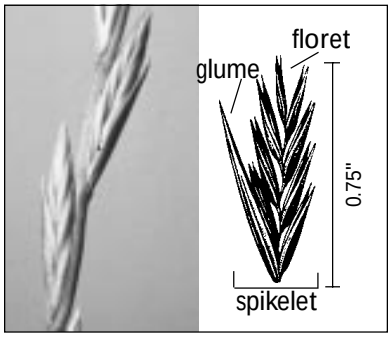

Figure 3.—Spikelets and florets.

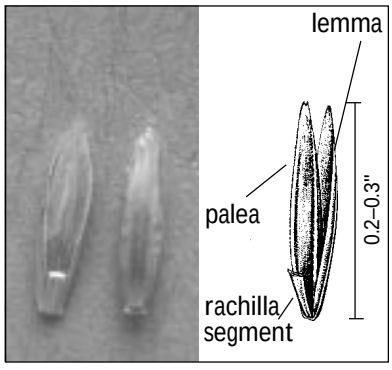

Figure 4.—Seed.

Identification

Perennial ryegrass, like other grasses, may be identified by floral parts (inflorescence, spikelet, and seed) or vegetative parts (leaf, stem, collar, and root). See Figures 1–7.

Inflorescence (seed head)

The *inflorescence* is a spike 2 to 12 inches (5 to 30 cm) long. It has 5 to 40 alternately arranged *spikelets* attached edgewise directly to the central axis (rachis). Lemmas are awnless, in contrast to annual ryegrass. See Figures 2 and 3.

- *Inflorescence*—Flowerhead terminating the stem
- *Peduncle*—Uppermost culm (flowering stem) segment
- *Spikelet*—Unit of the grass flowerhead

Spikelet

Spikelets contain 3 to 10 *florets.* The terminal (end) spikelet has two *glumes*, but the inner glume is absent in the other spikelets. See Figure 3.

- *Floret*—Lemma and palea with the enclosed flower
- *Glume*—Two usually empty bracts at the base of the spikelet

Seed

Lemmas of perennial ryegrass are awnless. In contrast, annual ryegrass is awned.

Seeds per pound average 237,000 (521,000 per kg), with a range of 200,000 to 265,000 per pound (440,000 to 583,000 per kg). Perennial ryegrass seeds are 0.2 to 0.3 inches long (5 to 8 mm), and width at the midpoint is 0.04 to 0.06 inches (1 to 1.5 mm). See Figure 4.

- *Lemma*—The lower of two bracts enclosing the flower
- *Palea*—The upper of two bracts enclosing the flower
- *Rachilla*—Main axis of the spikelet
- *Seed*—A ripened ovule containing an embryo with a seed coat, often with additional storage tissues

Stem

Flowering stems (*culms*) are comprised of nodes and internodes, each node bearing a leaf. Culms are 12 to 40 inches in height (30 to 100 cm) depending on variety, moisture, and site conditions. The uppermost culm segment is called the peduncle, the structure that supports the flowering parts. The stem base commonly is reddish.

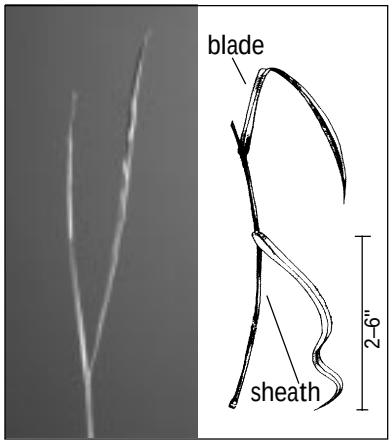

Figure 5.—Leaves and stems.

Leaf

Leaves of perennial ryegrass are folded in the bud (in contrast to those of annual ryegrass, which are rolled). See Figure 5.

Leaf blades are 0.08 to 0.25 inches wide (2 to 6 mm) and 2 to 6 inches long (5 to 15 cm). They are sharply taper-pointed and *keeled.*

Blades are bright green. They are prominently ridged on the upper surface. Lower surfaces are smooth, glossy, and hairless. Leaf margins are slightly rough to the touch.

Blades increase in size from the first to the seventh leaf on a tiller, although tillers rarely have more than three live leaves at one time.

Leaf *sheaths* usually are not keeled. They are compressed but sometimes almost cylindrical. Sheaths are hairless, pale green, and reddish at the base. They may be closed or split.

- *Leaf*—The main lateral appendage of a stem, usually flattened, serving as the main organ for photosynthesis
- *Keel*—Central ridge on the back or outer surface of a folded leaf or seed
- *Sheath*—Lower part of the leaf that encloses the stem internode
- *Lamina* (blade)—Part of the leaf above the collar

Collar

The *collar,* a narrow band of *meristematic* tissue at the junction of the blade and the stem, accounts for increasing blade length. Once the blade has achieved its maximum length, cells in the collar cease dividing. The perennial ryegrass collar region is narrow, hairless, and yellowish- to whitish-green. *Auricles* are small, soft, and claw-like. The 0.01- to 0.1-inch (0.25 to 2.5 mm) *ligule* is thin-membranous and rounded or toothed at the tip. See Figure 6.

- *Auricle*—Small claw- or ear-like outgrowths at the junction of the sheath and blade of some grasses
- *Ligule*—Outgrowth at the inner junction of the leaf sheath and blade, often membranous, sometimes a fringe of hairs
- *Meristem*—Group of actively dividing cells from which roots, shoots, leaves, and flowers are derived

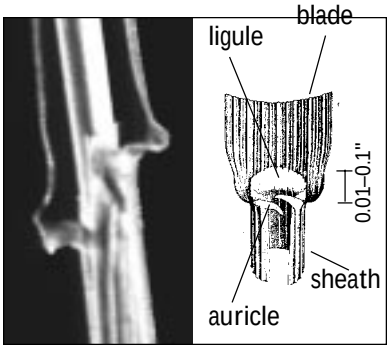

Figure 6.—Collar region.

Root

The shallow root system is highly branched and produces *adventitious* roots from the basal nodes of tillers. See Figure 7. Perennial ryegrass has no *rhizomes*, though *stolons* have been reported.

- *Adventitious*—Second root system that develops from the lower nodes of each tiller
- *Seed (seminal)*—First roots to develop but short lived
- *Rhizome*—Underground stem bearing scalelike leaves, rooting at the nodes
- *Stolon*—Prostrate or creeping stem, rooting at the nodes

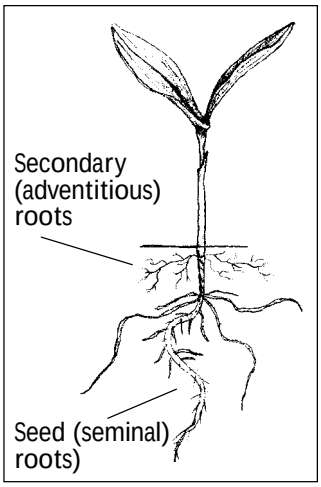

Figure 7.—Roots.

Area of adaptation

Perennial ryegrass is best adapted to cool, moist climates where winter kill is not a problem. Its primary use for forage in the United States is in the Pacific Northwest. There also is considerable use in irrigated intermountain valleys, the Midwest, and the Northeast. See Figure 8.

Perennial ryegrass grows best on fertile, well-drained soils but has a wide range of soil adaptability. It is suited for use in soil drainage classes ranging from well drained to poorly drained. It will tolerate long periods of flooding (15 to 25 days) when temperatures are below 80°F (27°C). A minimum precipitation range is 18 to 25 inches (457 to 635 mm). Perennial ryegrass tolerates both acidic and alkaline soils, with a pH range of 5.1 to 8.4. Best growth occurs when soil pH is maintained between 5.5 and 7.5.

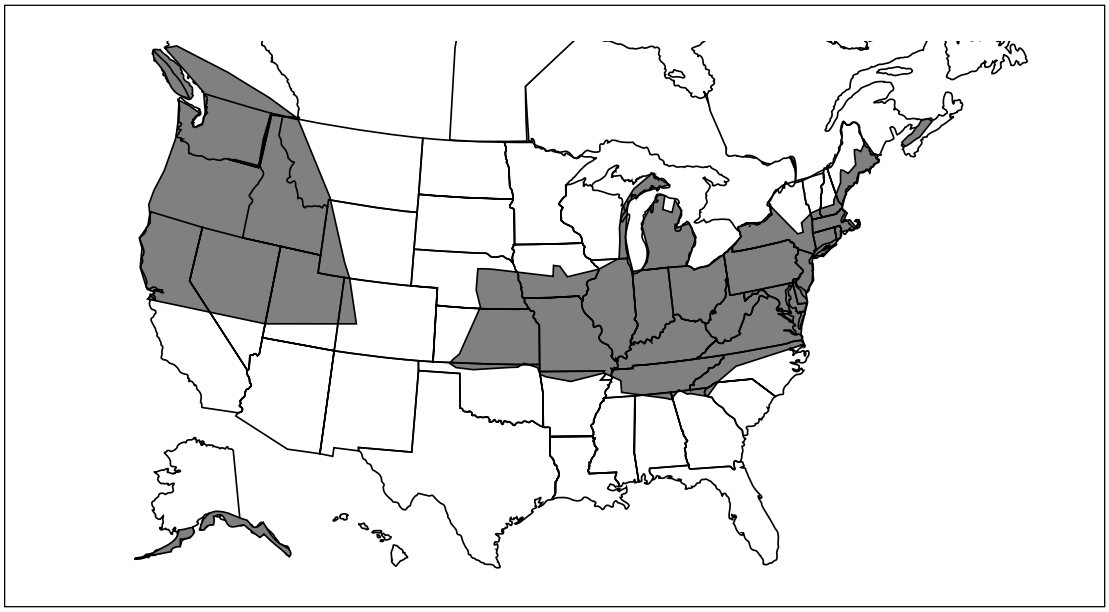

Figure 8.—Areas of adaptation of perennial ryegrass in North America.

Spring and fall are the seasons of best growth; during the hot summer months, perennial ryegrass becomes dormant. Maximum growth occurs between 68 and 77°F (20 to 25°C). Perennial ryegrass is adapted to shade in the warmer portions of a cool, humid climate.

Perennial ryegrass is more sensitive to temperature extremes and drought than is annual ryegrass. Even with irrigation or abundant rainfall, production suffers when daytime temperatures exceed 87°F (31°C) and nighttime temperatures exceed 77°F (25°C).

Perennial ryegrass is less winter-hardy than orchardgrass and tall fescue and less drought-tolerant than smooth bromegrass. Studies in Wisconsin, however, suggest that perennial ryegrass is able to overwinter in colder climates, even where snow cover is unreliable. In the Pacific Northwest, perennial ryegrass will survive most winter weather conditions. However, during very harsh winters, it may winter kill. Thus, it should be considered a short-lived perennial.

Uses

Perennial ryegrass is grown primarily for pasture and silage. It can be grown for hay in the Pacific Northwest, but typically will provide only one hay cutting and little regrowth. It also is used for reducing soil erosion, recycling nutrients from manure and biosolids, wildlife feed, and turf.

Pasture

Perennial ryegrass is considered the premier-quality pasture grass throughout the world, having higher digestibility than other temperate, perennial grass species. Tetraploid varieties (those having four sets of chromosomes) have slightly higher digestibility than diploid varieties (with two sets of chromosomes).

Because of its high quality, perennial forage-type ryegrass is used primarily for lactating dairy cows on pasture. However, it is suitable for all classes of livestock, especially those with high nutrient requirements such as young, growing animals. Currently, lack of persistence and sensitivity to high temperature and drought are the main limitations to expanded use for pasture in the United States.

Silage and hay

Perennial ryegrass often is harvested for silage. It makes up a considerable portion of dairy-quality grass silage in coastal regions of the Pacific Northwest.

As with all forage species, silage quality is influenced greatly by maturity stage. For the optimal compromise between quality and quantity, cut perennial ryegrass in the boot stage. (See “Cutting and grazing management” section.)

Harvesting perennial ryegrass for hay is not recommended in high rainfall/humidity areas such as the coastal Pacific Northwest. Good hay curing weather typically occurs too late in this region for producing high-quality ryegrass hay.

Manure and biosolids application

High growth rates under high fertility and an extensive root system make perennial ryegrass valued for use in nutrient recycling systems. For example, if a forage is 3 percent N (18.75 percent crude protein), 5 tons contain 300 lb of N (136 kg N). Thus, highly productive grasses such as perennial ryegrass can utilize 300 to 400 lb of nitrogen (N) per acre (336 to 448 kg N/ha) per year from livestock manure or biosolids. This ability to use large quantities of nitrogen results in high-quality forage and protects groundwater from contamination through leaching of unused nitrate.

Soil conservation

Perennial ryegrass is well suited to soil conservation uses. Its extensive, shallow, fibrous root system makes it effective for reducing soil erosion. It is recommended for use alone or as a fast-starting component in mixtures, where it provides rapid cover and allows longer-lived or more winter-hardy species to become established.

Wildlife

Perennial ryegrass also is useful as wildlife feed. Geese, coots, widgeons and other ducks, wild turkeys, rabbits, deer, and elk graze this forage. Quail and songbirds such as the white-crowned sparrow, golden-crowned sparrow, Savannah sparrow, and brown towhee feed on seeds, as does the pocket mouse.

Turf

Use of perennial ryegrass for turf has increased in recent years with selection of more dense-growing and persistent turf types. It is one of the most versatile turfgrass species.

For turf, perennial ryegrass is used alone or in combination with other grasses. Disease problems and limited cold and heat tolerance, however, limit its persistence and zone of adaptation. Recent improvements in turf

varieties include improved disease resistance, heat tolerance, darker green color, and better mowing characteristics.

Be aware, however, that a fungal endophyte often is added to "turf-type" varieties of perennial ryegrass for increased pest resistance. The endophytic fungus produces toxins that can cause serious health problems for livestock. Use endophyte-infected varieties with caution, if at all, for livestock feed. (See "Animal health/forage antiquality issues.")

Varieties

There are many important perennial ryegrass varieties. All are reproduced by seed.

Many types of ryegrass exist, because most varieties do not self-pollinate but easily cross with other *Lolium* and *Festuca* species. Persistence of perennial x annual hybrids falls between that of annual and perennial varieties. As a result, these crosses are called intermediate, or short-rotation ryegrasses.

There are both diploid and tetraploid forage-type varieties. Tetraploids have fewer, but larger tillers with wider leaves, resulting in more open sods. Both the seed and seedlings of tetraploids are larger, but growth rate is greater for diploids. Tetraploids are less winter-hardy and less persistent than diploids.

Including both forage and turf types, many varieties are listed in *Grass Varieties of the United States*. Information on varieties also is available from the Oregon Ryegrass Growers Seed Commission and through the Germplasm Resources Information Network. (See "For more information.")

Perennial ryegrass varieties are grouped into three maturity categories: early, intermediate, and late. These groupings are somewhat helpful, but there is substantial overlap among them.

Recommendations

Field trials are conducted at various research and extension centers. These trials evaluate varieties for yield and/or quality based on local conditions.

Consult your county extension office for specific recommendations of varieties that have performed well in your area. Always use certified seed to assure a high germination percentage and freedom from noxious weeds. Request endophyte-free varieties for forage use.

Establishment

Perennial ryegrass can be seeded in spring or late summer. In addition, it may be fall-seeded in areas with mild winters. Seeding depth should be between 0.25 and 0.5 inch (0.6 to 1.25 cm). When seeding with legumes, 0.25 inch (0.6 cm) is preferred.

Recommended seeding rates and suggested companion species are shown in Table 1. When broadcasting, increase seeding rates by 50 percent or more, depending on seedbed condition. Reduce seeding rates by

Table 1.—Recommended mixtures and seeding rates.[a]

Use	Precipitation (inches)	Perennial ryegrass seeding rate (lb/a)	Companion species	Companion species seeding rate (lb/a)
Pasture	20–30 and shallow soils	15–20	Subclover (in mild-winter, droughty areas) and/or white clover	7–10 2–3
	30–60 or irrigated	15–20	White clover (and red clover)[b] and/or orchardgrass or tall fescue[c]	2–3 (5) 5–8
	>60	15–20	Birdsfoot trefoil or white clover and/or tall fescue[c]	6 2–3 3–5
Hay or Silage	30–60 or irrigated	15–20 8–10	None (perennial ryegrass alone) Hay-type white clover (and red clover)[b] and/or orchardgrass or tall fescue[c]	— 2–3 (5) 5–8
		12–15	Oats or barley[d]	20–50
		6–8	Alfalfa	10–12

[a]Increase rates by 50 percent or more if seeding into a poorly prepared seedbed. Reduce rates 30 percent for irrigated production areas of the intermountain west.
[b]Red clover may be added for a 2–3 year contribution.
[c]Orchardgrass or tall fescue may be added for additional summer growth. Lower palatability of tall fescue, however, may cause selective grazing of mixtures.
[d]Oats or smooth-awned barley may be used as a nurse/companion crop with perennial ryegrass or ryegrass-legume seedings. Harvest the cereals for green chop, silage, or hay; and harvest the perennial ryegrass the following year. Harvesting cereals at the milk stage minimizes competition. The higher range cereal seeding rates are more competitive with perennial ryegrass but give more first-year yield.

30 percent for well-prepared seedbeds for irrigated production in the intermountain West (east of the Cascades). When renovating, mow or graze the existing sod short to reduce competition.

Mixtures

Perennial ryegrass often is mixed with orchardgrass in 50:50 to 30:70 (ryegrass/orchardgrass) ratios. Mixing ryegrass with orchardgrass improves swathing and drying, thus reducing the mechanical harvesting problems often encountered with pure stands of either species.

However, orchardgrass is extremely sensitive to ryegrass competition in the establishment year. Only 5 lb/a (6 kg/ha) of short-rotation ryegrass results in greater than 50 percent suppression of orchardgrass the first year.

Perennial ryegrass also may be mixed with tall fescue. In this case, it must be either harvested at the boot stage for silage or intensively grazed to prevent selective grazing caused by lower palatability of tall fescue.

For pasture and silage production, perennial ryegrass routinely is used in combination with white clover. On nonirrigated hill pastures in New Zealand, western Oregon, and northern California, perennial ryegrass frequently is seeded with subterranean clover.

You also can mix late-maturing perennial ryegrass varieties with alfalfa. Recommended seeding rates are 10 to 12 lb/a (11 to 13 kg/ha) alfalfa and 6 to 8 lb/a (7 to 9 kg/ha) perennial ryegrass.

In the Northeast and Midwest, perennial ryegrass is planted with alfalfa, oversown into older stands, or seeded into poorly established stands. Interestingly, Amish farmers prefer perennial ryegrass because its small root system allows it to be plowed under by horse-drawn plows.

Fertility and pH requirements

Perennial ryegrass requires high fertility levels for good production. Fertilization should be based on a soil test. Obtain specific recommendations from extension nutrient management guides.

Perennial ryegrass tolerates both acidic and alkaline soils, with a pH range of 5.1 to 8.4. Best growth occurs when soil pH is maintained between 5.5 and 7.5. Consult your county extension office for specific fertilization and liming rates.

Perennial ryegrass is very responsive to nitrogen (N) fertilization. For each pound of N added (up to 250 to 400 lb/a/yr or 280 to 448 kg/ha/yr), per-acre yields of dry matter increase by 20 to 30 lb (22 to 34 kg/ha). At higher rates, the yield increase from each pound of additional fertilizer N declines. Typically, the maximum economic level of annual N fertilizer is approximately 160 lb N/a/yr (180 kg N/ha/yr).

Applications of total yearly N should be split as evenly as possible to meet the continuing need for nitrogen throughout the growing season. Make the first application at the beginning of the season and the others after each harvest except the last. This pattern produces greater annual yield and better quality forage than does a single, early spring application.

Meeting but not exceeding soil, plant, and animal needs is a continual adjustment process. Fertility requirements and harvest/grazing management practices must be balanced to accommodate the sometimes competing objectives of:

- High yields
- High-quality forage
- Optimum N_2 fixation by forage legumes
- Maximum recycling of animal manures and municipal biosolids

Manure and biosolids

Most dairies can supply all the nitrogen, phosphorus, potassium, and other nutrients needed for forage production by applying manure to forage crops. In fact, the annual value of nutrients in manure from 100 lactating cows exceeds $10,000.

Applying too much manure, however, results in excess plant uptake of nutrients, such as potassium, and can lead to animal health problems—especially in dry cows. Excess manure application also contributes to nutrients and microorganisms in runoff water and potential nutrient leaching to groundwater.

Thus, analyzing the nutrient value of manure and applying the correct amount is essential for efficient use, optimum plant growth, and proper stewardship of natural resources. See EM 8585, *Manure Application Rates for Forage Production*, for an example of how to calculate the proper amount of manure to apply on perennial ryegrass.

Legume nitrogen fixation

The amount of atmospheric nitrogen (N_2) fixed by legumes growing in combination with grasses depends on the legume species and the environment in which they are growing. If inorganic (plant-available) soil N is present, legumes fix less N_2. Available inorganic N also increases competition from the grass, which in turn reduces the amount of N_2 fixed per unit area. Thus, to maximize the nitrogen-fixing contribution of legumes, apply only moderate amounts of fertilizer N or manure.

Boron (B) and molybdenum (Mo) are important nutrients for nitrogen fixing legumes. Monitor legumes for deficiency symptoms, particularly west of the Cascades in the Pacific Northwest. Deficiency symptoms include discoloration, streaking, or shriveling.

If you suspect micronutrient deficiencies, submit leaf samples to a certified laboratory for analysis. Your local extension agent can assist with sampling and interpretation.

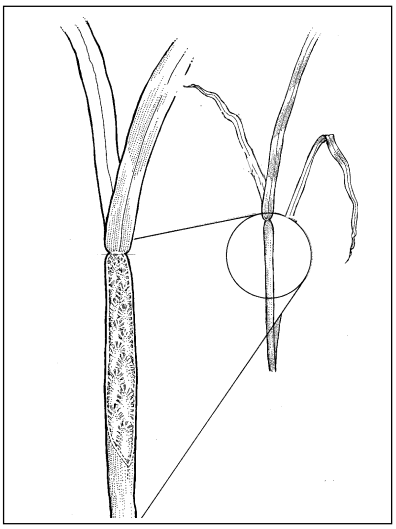

Figure 9.—Boot stage. The inflorescence is contained in the sheath of the flag (uppermost) leaf.

Cutting and grazing management

Cutting and grazing management greatly influences forage quality, productivity, and persistence. Quality is most affected by maturity stage at harvest. To obtain high-quality preserved forage (silage or hay), harvest perennial ryegrass at the early boot stage. See Figure 9. For silage, let plants wilt prior to ensiling. Lower water content will reduce effluent losses from silos.

In the Pacific Northwest, four to six harvests are possible. With a five-cutting system, typical percentage yield distribution is 40, 18, 15, 12, and 15. Later maturing varieties may delay harvest by 10 to 14 days, but seldom enough to avoid poor haying weather. Alternatively, the first harvest may be grazed, green chopped, or ensiled. To stimulate growth, fertilize immediately following the initial harvest.

Perennial ryegrass can withstand close, frequent grazing and thus is ideally suited for intensive sheep and cattle grazing systems. The diploid varieties in particular tolerate treading well.

New seedlings

Make sure new stands are well established and approximately 10 to 12 inches tall (25 to 30 cm) before grazing or harvesting. Plants are established when they have three or four leaves and are not easily pulled out of the ground. Test by pulling on newly established plants. If they resist your pulling, livestock won't be able to remove plants by grazing.

Allow plants to attain a height of 4 to 10 inches (10 to 25 cm) before grazing. Do not graze shorter than 1 inch (2.5 cm). For mechanical harvest, increase the cutting height to 2.5 inches (6 cm).

If you practice intensive rotational grazing management, rest pastures at least 2 weeks following grazing. In slower growing seasons, provide longer recovery periods to allow regrowth to 4 to 10 inches (10 to 25 cm).

You also may use leaf numbers to time defoliation. When tillers have three fully expanded leaves, plants are ready to be grazed or cut. At this time, stored energy reserves in stem bases and roots allow rapid regrowth.

Established stands

Grazing and cutting management should ensure large quantities of high-quality forage, rapid regrowth, and long-lived stands. These objectives can be achieved by understanding grass regrowth mechanisms and applying these important principles.

Wise management in early spring, while the grass is in the vegetative stage, ensures rapid regrowth. When in the vegetative stage, grass shoots show no sign of seed head development in the basal zone.

For pastures, good management at this stage involves allowing plants to grow to 6 to 8 inches (15 to 20 cm), grazing to 2 to 4 inches (5 to 10 cm), and providing a regrowth period. For hay or silage, allow plants to reach the boot stage before mechanical harvest.

In the transition stage, the apical meristem is converted from a vegetative bud to a floral bud. Progress toward seed head development is easily monitored by splitting a shoot lengthwise with a sharp blade. Plants are in the early transition stage when internodes at the base of the shoot have elongated and have raised the meristematic growing point (the potential seed head) to a vulnerable height. See Figure 10.

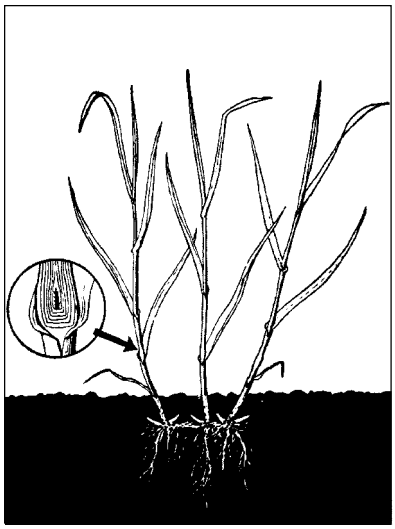

Figure 10.—Elevated apical meristem in the early transition phase.

Following each grazing or mechanical harvest cycle, fertilize with nitrogen at 50 lb/a (56 kg/ha).

Perennial ryegrass pasture regrowth can be utilized in as few as 10 days following grazing or may require as many as 30 days depending on the duration of grazing and the growing season.

Allow regrowth to 4 to 8 inches (10 to 20 cm). For most rapid regrowth and greatest animal intake, graze no closer than 2 inches (5 cm).

Stand development and persistence

Stands of perennial ryegrass are more dense than those of annual ryegrass, tall fescue, or orchardgrass. Perennial ryegrass has a canopy that grows closer to the soil surface, permitting more light to penetrate and resulting in a denser stand.

Some varieties develop a fully dense stand in less than a year, with planting rows indistinguishable by the fourth cutting. Other varieties may take 2 years before best stands are obtained.

Stand decline is accelerated by stress from inadequate fertility or water or improper harvest management. Repeated harvesting without allowing replenishment of stored carbohydrates reduces stand persistence and regrowth. Typically, stands decline after the fifth year of production.

The presence of the fungal endophyte imparts insect and disease resistance, which improves persistence in some areas. Toxins produced by the plant and endophyte, however, cause animal health problems. (See “Animal health/forage antiquality issues.”)

Frosted forage

Perennial ryegrass is susceptible to temporary, and perhaps permanent, damage if utilized in freezing weather or when frosted. Avoid livestock and human traffic on frosted or frozen plants.

Composition/nutritional characteristics

Perennial ryegrass is noted for high levels of quality, palatability, digestible energy, protein, and minerals. Ryegrasses accumulate high levels of total usable carbohydrates in spring and fall.

Composition, however, depends largely on maturity stage at harvest and on fertility. Thus, in order to balance rations, analyze forage samples for protein, energy (fiber), calcium, and phosphorus. “Book values” are available for perennial ryegrass from the “Nutrient Requirements of Domestic Animals” series of publications from the National Research Council. (See Table 2.)

Table 2.—Nutritional composition of perennial ryegrass.*

Feed description	TDN (%)	DE (Mcal/kg)	ME (Mcal/kg)	NEm (Mcal/kg)	NEg (Mcal/kg)	CP (%)	Ca (%)	P (%)
Fresh, early vegetative	80	3.50	2.87	—	—	19.0	0.65	0.40
Fresh, late vegetative	72	3.15	2.58	—	—	16.0	—	—
Fresh, heading	60	3.00	2.46	1.57	0.97	10.4	0.55	0.27
Hay, sun-cured, early vegetative	64	2.82	2.40	1.41	0.78	8.6	0.65	0.32

* All values expressed on a dry matter basis. TDN=Total Digestible Nutrients; DE=Digestible Energy; ME=Metabolizable Energy; NEm=Net Energy for Maintenance; NEg=Net Energy for Gain; CP=Crude Protein; Ca=Calcium; P=Phosphorus.

TDN values are listed for ruminants. Values for horses generally are lower.

Adapted from:

National Research Council. *United States-Canadian Tables of Feed Composition*, 3rd revision (National Academy Press, Washington, DC, 1982).

Morrison, F.D. *Feeds and Feeding*, abridged, 9th edition (Morrison Publishing Company, Claremont, Ont., 1961).

Thompson, K.F., and D.P. Poppi. Livestock Production from Pasture. In *Pastures*, R.H.M. Langer, ed. (Oxford University Press, Melbourne, 1990).

Animal health/forage antiquality issues

Fungal endophyte/ryegrass staggers

Ryegrass staggers is an important disorder associated with perennial ryegrass. It is caused by a fungal endophyte (*Neotyphodium lolii* Latch, previously known as *Acremonium lolii* Latch). This is a different endophyte from the one associated with tall fescue.

This fungus does not harm the grass plant and is transmitted only by seed. In fact, the endophyte benefits the plant by producing toxins that impart resistance to several kinds of insects and diseases. Unfortunately, the same toxins cause adverse health effects in animals.

In the early stages, affected animals have difficulty flexing their legs and thus have an unusual gait. In severe cases, animals have difficulty walking and may fall repeatedly. Convulsions and death may occur. There is no treatment for ryegrass staggers except to reduce consumption of infected plants.

The symptoms of ryegrass staggers are worsened by excitement. If animals show symptoms, allow all the animals in that paddock to move to a safe paddock. Open the gate, move the salt, and allow the animals to move quietly on their own to the uninfected paddock. Don't drive them. Animals showing convulsions or inability to walk on their own should be quietly carried to a dark corner of the barn to eliminate noise and other stimuli. Give them uninfected forage and water to allow toxins to clear from their system.

The endophytic fungus is present only in seed head tillers and not in basal leaves. Thus, monitoring crop development can help avoid problems.

The long-term solution to this problem may be the introduction of "novel endophytes" that produce specific chemical compounds that impart insect resistance without causing animal disorders. See Cheeke's book, *Natural Toxicants in Feeds, Forages, and Poisonous Plants* for more information.

Facial eczema

Facial eczema is a condition of severe dermatitis in cattle, sheep, and goats. Newly shorn sheep are especially vulnerable. It is caused by a toxin in spores of the saprophytic fungus *Pithomyces chartarum* (Berk. And Cart.) M.B. Ellis. In reality, the skin lesions are the secondary result of liver damage, rather than the direct result of the plant toxin.

The *P. chartarum* fungus grows in the moist, protected dead material at the base of forage plants, especially perennial ryegrass. Fungal growth is favored by warm, wet, humid weather, heavy dew, or irrigation. Intensive grazing practices increase the risk of facial eczema.

Animals suffering from facial eczema become restless and seek shade (photophobia). Growth and milk production are reduced dramatically. Typical symptoms of facial eczema include severely ulcerated skin in non-pigmented areas of the body. Other symptoms may include itching and rubbing of affected areas, scabs, loss of appetite, droopy and swollen ears, and swollen lips and eyelids.

Remove animals suffering from facial eczema from the contaminated pasture and provide them with shade, cool water, and a good diet. Feeding hay and/or grain reduces toxin consumption and maintains the animals until the skin lesions heal, and new, healthy liver tissue grows. See *Natural Toxicants in Feeds, Forages, and Poisonous Plants* for more information.

Pest control

Weeds

Prevention of weed invasion is one of the most effective weed control methods. Preventive measures include use of certified seed (to minimize introduction of weed seeds at planting) and pregermination of weed seeds prior to final seedbed preparation.

Proper harvest and fertility management encourages vigorous growth of forage species and minimizes weed invasion. Early detection and removal of invasive weeds with a shovel or spot spraying with an appropriate herbicide further reduces costs and helps maintain a weed-free forage stand.

Tansy ragwort, a common pasture weed.

Monitoring stands on a yearly basis is helpful in early detection of weed problems. Monitoring is best done after stands have been grazed or mechanically harvested because excessive forage growth prevents adequate monitoring. To assist in identifying weeds, color photos of many common weeds are found in the book *Weeds of the West.*

Diseases

In humid climates, perennial ryegrass is susceptible to ergot, which is toxic to livestock, and to stripe smut, which can cause grass to be unpalatable. Many varieties are susceptible to leaf spots, fusarium, brown blight, and other fungus diseases in hot, humid climates. Most varieties also are susceptible to snow molds, and many are susceptible to mildews of various sorts including powdery mildew.

In the northeastern and northwestern sections of the United States, crown rust, stem rust, and bacterial wilt can be problems depending on weather conditions and variety susceptibility. Stem rust often is a problem in late spring and early summer, especially if forage is allowed to accumulate. Stem and crown rust occur in late summer and early fall.

Although rust is not toxic to livestock, it can affect quality and palatability. For horses especially, the spores from rusts can cause significant respiratory problems. Maintaining high fertility and harvesting the accumulated forage reduce rust problems.

For turf and grass seed production, chemical control measures are available. Most, however, are not registered for forage use.

Insects

The grass grub is an important pest of ryegrass. Grub larvae eat ryegrass roots, rendering the plant more susceptible to drought. In New Zealand, the

Argentine stem weevil is a major perennial ryegrass problem. Perennial ryegrass is resistant to this weevil (and other pests) if the grass is infected by the fungal endophyte. Presence of the endophyte, however, can cause a neurological disorder in livestock known as ryegrass staggers. See "Animal health/forage antiquality issues."

The European cranefly (*Tipula paludosa* Meigen) is important in some parts of the Pacific Northwest. Chemical control measures are available, but seldom economical. Typically, pastures are renovated and reseeded when stands are lost to the European cranefly.

For more information

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Germplasm Resources Information Network:

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Oregon Ryegrass Growers Seed Commission:

http://ryegrass.com/

Authors: *Forage Specialists*: David Hannaway, Extension forage specialist, Oregon State University; Steve Fransen, Extension forage agronomist, Washington State University; Jim Cropper, forage management specialist, Natural Resources Conservation Service; Merle Teel, professor emeritus, University of Delaware; Marty Chaney, pasture specialist, Natural Resources Conservation Service; Tom Griggs, forage physiologist, University of Idaho. *Botany specialist:* Richard Halse, herbarium curator, Oregon State University. *Soil science specialist:* John Hart, Extension soil scientist, Oregon State University. *Livestock specialists:* Peter Cheeke, animal scientist; Donald Hansen, Extension veterinarian; Robert G. Klinger, forage technician and sheep producer (all of Oregon State University); and Woody Lane, Lane Livestock Services, Roseburg, Oregon.

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