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Orchardgrass (*Dactylis glomerata* L.)

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Orchardgrass (*Dactylis glomerata* L.) is native to western and central Europe, but has been grown in North America for more than 200 years. In the 1830s, settlers in western Virginia recognized the forage value of shade-tolerant *D. glomerata* plants growing in an orchard.

Since then, orchardgrass has spread throughout much of the United States. It has been recognized as an excellent hay, pasture, and silage crop in the Pacific Northwest since the early 1900s.

Orchardgrass is an upright, perennial, cool-season bunchgrass that produces an open sod. It reproduces sexually by seed production and asexually by tiller formation.

Orchardgrass is known as “cocksfoot” in Europe, New Zealand, and Australia. This name was derived from the shape of its seed head (inflorescence). The genus name (*Dactylis*) also was derived from the shape of the seed head; from the Greek word *dactulos*, meaning a finger, referring to the stiff branches of the seed head.

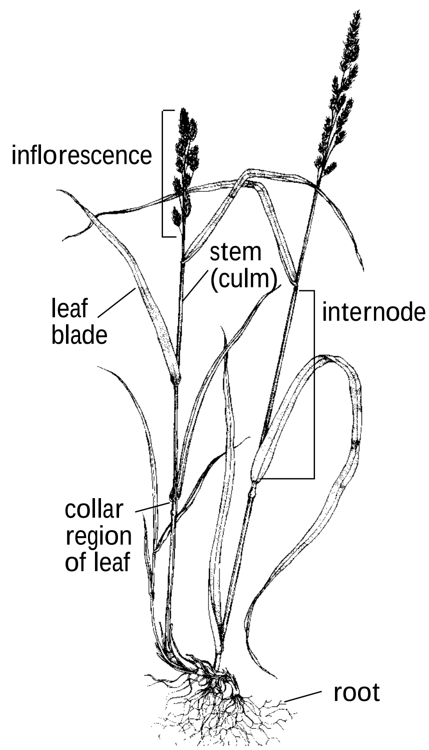


Figure 1.—Orchardgrass plant.

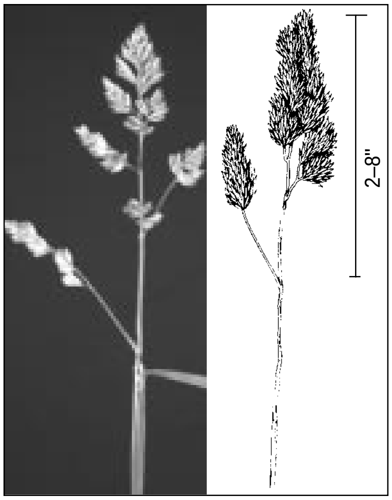


Figure 2.—Inflorescence.

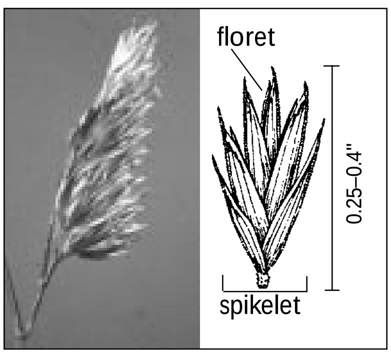


Figure 3.—Spikelets and florets.

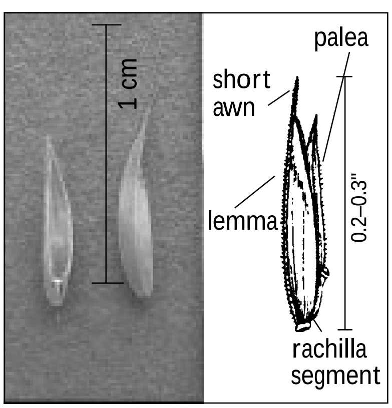


Figure 4.—Seeds.

Identification

Orchardgrass, like other grasses, may be identified by floral parts (inflorescence, spikelet, and seed) or vegetative parts (leaf, stem, collar, and root). See Figures 1–6.

Inflorescence (seed head)

The branched orchardgrass inflorescence is a compact or partly spreading *panicle*. It is 2 to 8 inches long (5 to 20 cm). See Figure 2.

- *Inflorescence*—Seed head terminating the stem
- *Panicle*—Branched flowerhead, with main axis, divided branches, and stalked spikelets

Spikelet

Seed heads are composed of *spikelets* that bear two to eight *florets*. Spikelets are attached to panicle branches by *pedicels*. Flowers are borne in one-sided clusters on stiff branches. See Figure 3.

- *Floret*—Lemma and palea with the enclosed flower
- *Pedicel*—Stalk of the spikelet
- *Spikelet*—Unit of the grass flowerhead, generally composed of two glumes and one or more flowers, each borne between a lemma and a palea

Seed

Individual florets are smaller than those of tall fescue or ryegrass and are slightly curved. *Lemmas* are abruptly pointed or short-awned. See Figure 4. Seeds per pound average 460,000 (1,012,000 per kg), with a range of 330,000 to 562,000 per pound (726,000 to 1,236,000 per kg).

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

Stem

Stems are erect, ranging from 1 to 4 feet in height (30 to 120 cm). Vegetative shoots are compressed, giving a flat appearance that is distinctive for vegetative identification. See Figure 5.

- *Culm (stem)*—The main axis of a grass plant, comprised of nodes and internodes, each node bearing a leaf
- *Peduncle*—Uppermost culm segment

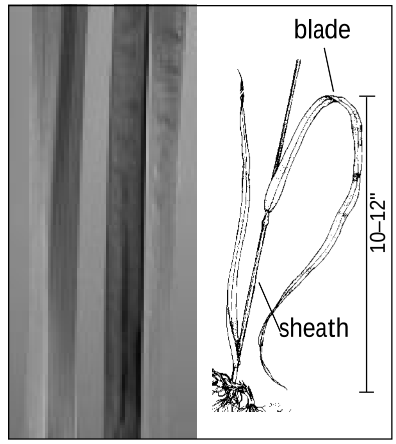


Figure 5.—Leaves and stems.

Leaf

Orchardgrass leaves are 0.1 to 0.5 inches wide (2 to 12 mm) and may reach a length of 3 feet (1 m). They are folded when they emerge from the whorl of preceding leaves, resulting in a distinctly flat appearance and a V-shape in cross section. See Figure 5.

Leaves vary in color from green to bluish-green, depending on variety and nutrient concentration. The lower surface is not shiny and has a distinct keel (center ridge). Leaf margins and leaf sheaths usually are somewhat rough to the touch when mature, although some soft-leaved varieties have been developed.

- *Keel*—Sharp fold or ridge at the back of a compressed leaf sheath or blade
- *Lamina* (blade)—Part of the leaf above the sheath
- *Leaf*—The main lateral appendage of a stem, usually flattened, serving as the main organ for photosynthesis
- *Sheath*—Lower part of the leaf that encloses the stem

Collar

The *collar* is a narrow band of *meristematic* tissue accounting for increasing blade length. Once the blade has achieved its maximum length, cells in the collar cease dividing. The orchardgrass collar region is broad and divided with no *auricles*. See Figure 6. The *ligule* is membranous, approximately 0.1 to 0.4 inches long (3 to 10 mm), rounded, and often split and ragged on top. The leaf *sheath* is united below the collar region, forming a closed tube for most of its length.

- *Auricle*—Small claw- or ear-like outgrowths at the junction of the sheath and blade of some grasses
- *Collar*—Zone of meristematic tissue at the junction of the blade and sheath
- *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

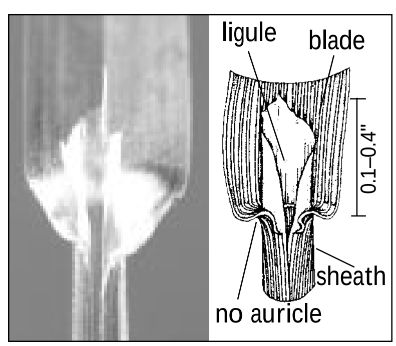


Figure 6.—Collar region.

Root

Orchardgrass produces an extensive fibrous root system. It has no stolons and only rarely has short rhizomes.

- *Rhizome*—Underground stem bearing scalelike leaves, rooting at the nodes
- *Root*—A cylindrical plant organ without nodes or internodes and with branches originating from the inside; usually serving as the main organ of attachment and absorption.
- *Stolon*—Prostrate or creeping stem, rooting at the nodes

Area of adaptation

In North America, orchardgrass is grown throughout much of the northeastern and north central United States. It is well adapted to snow-covered valleys in mountainous states, and to the high rainfall and irrigated regions of the intermountain West, the Pacific Northwest, British Columbia, and southern Alberta. See Figure 7. It can be grown with irrigation or on dryland areas having at least 25 inches (600 mm) of precipitation annually.

Orchardgrass is suited to moderately well-drained to excessively drained soils. It will not tolerate wet soils or survive prolonged flooding. In dormant periods, however, orchardgrass will tolerate flooding periods of about 2 weeks if temperatures are below 50°F (10°C).

Orchardgrass is tolerant of shade; its ability to grow under trees undoubtedly led to its common name. It is more tolerant of heat and drought than perennial ryegrass, timothy, or Kentucky bluegrass, but less so than tall fescue. Drought tolerance of orchardgrass is related to its

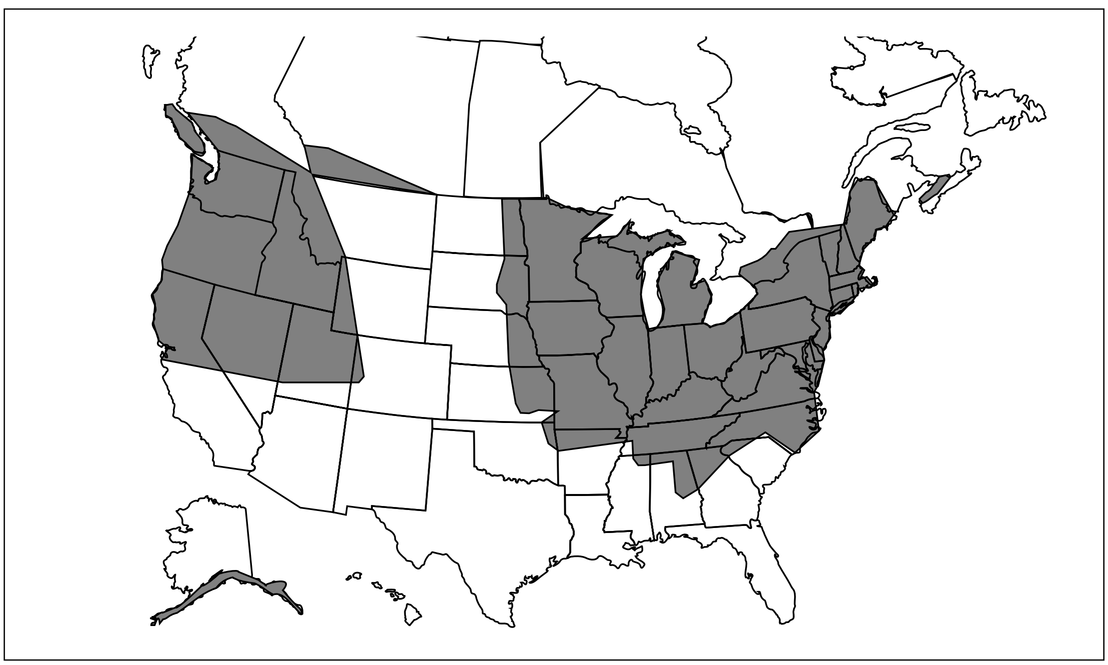


Figure 7.—Areas of adaptation of orchardgrass in North America.

extensive root system. Smooth bromegrass (*Bromus inermis* Leyss.) and mountain brome (*Bromus marginatus* Nees.) are better adapted to low rainfall, high summer temperatures, and severe winters.

In mild winter areas where winter forage growth occurs, orchardgrass varieties developed for winter growth can be chosen. Winter production of these varieties, however, is less than that of perennial ryegrass.

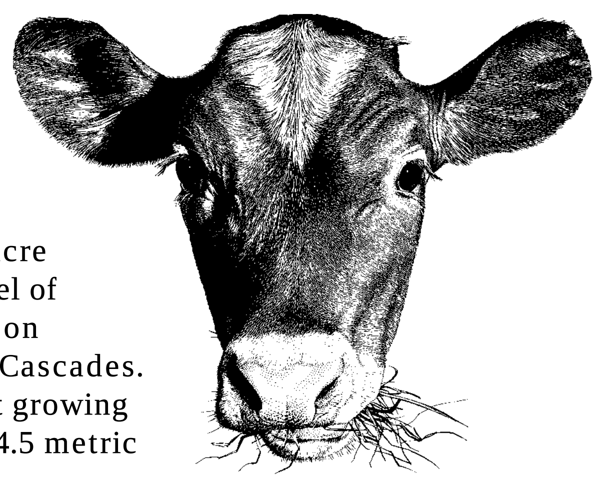
This lack of winter growth activity increases winter-hardiness compared to perennial ryegrass. Overfertilization with nitrogen (N), however, results in continued late fall growth and decreased winter hardiness. For harsh winter areas, orchardgrass varieties with excellent winter hardiness are available.

Uses

Orchardgrass is grown for hay, green chop, silage, and pasture. It is compatible with many legumes (alfalfa, birdsfoot trefoil, and various clovers) and other grasses (perennial ryegrass, tall fescue, etc.). Pure stands or simple mixtures (one grass and one legume), however, are easiest to manage due to differing regrowth characteristics.

With high levels of N fertilizer application, orchardgrass is among the most productive cool-season grasses. It also produces good midsummer yields when maintained under high nutrient supply and adequate moisture levels.

Hay, silage, and green chop



High yields of high-quality forage are obtained through the use of timely mechanical harvest techniques and nutrient management. Yields of 6 to 7 tons (5.5 to 6.3 metric tons) of dry matter per acre (dm/a) are possible with a high level of management and with irrigation or on subirrigated deep soils west of the Cascades. Higher elevation areas have a short growing season, and yields of 5 tons dm/a (4.5 metric tons) are typical.

Pasture

Growth characteristics of orchardgrass make it well suited to early spring pastures except when soils are very wet. Its tall growth form and regrowth habit make it better suited to rotational grazing than to continuous grazing. Frequency and intensity of grazing greatly affect pasture growth, but with sufficient recovery periods through rotational grazing systems, yields approaching those of mechanical harvesting are possible.

Various legumes can be combined with orchardgrass for pasture. If grown in mixtures with other less palatable grasses (e.g., tall fescue), selective grazing may result in depletion of the orchardgrass portion of the pasture.

Manure and biosolids application

High growth rates under high fertility and an extensive root system make orchardgrass valuable 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). Thus, highly productive grasses such as orchardgrass can use high rates of N, in excess of 300 lb N/a/yr (312 kg/ha/yr) when grown on deep soils with adequate water supplies. Thus, orchardgrass is valued in manure and biosolids application systems for its ability to simultaneously produce high-quality forage while utilizing large amounts of N, thus protecting groundwater from nitrate contamination.

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 soil environment. If nitrate nitrogen is present, legumes fix less N_2. Nitrates also increase grass growth. The resulting competition will suppress legume N_2 fixation. Thus, to maximize the nitrogen-fixing contribution of legumes, apply only moderate amounts of fertilizer N or manure (no greater than 50 lb N/a/yr; 56 kg N/ha/yr) during cool season growth.

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.

Other uses

Orchardgrass also may be used for soil erosion control on cut-over forest land. Due to its shade tolerance, dwarf types are used in orchards and other understory cover crop applications. Orchardgrass also is suited for use as wildlife habitat in areas where tame or introduced forage species are acceptable. Orchardgrass stands will decline under continuous, season-long grazing practices or frequent winter grazing west of the Cascades.

Varieties

Orchardgrass breeders have developed varieties that are later maturing, more productive, more resistant to disease, and more widely adapted than common orchardgrass. In first cutting, the development of late-maturing orchardgrass varieties coincides better with alfalfa than do early-maturing types.

Four orchardgrass growth habit types have been developed:

- Tall, stemmy, early
- Tall, leafy, late
- Medium tall, leafy, medium late
- Dwarf, leafy, medium late

The tall types are best suited to mechanical harvest. However, they also work well for grazing if proper management is used. The medium and dwarf types commonly are listed as “pasture types” and are recommended only for grazing systems. Varieties differ widely in resistance to leaf diseases, viruses, and winter cold.

Select varieties based on research, extension demonstration trials, or local grower experience. Current varietal information is provided in other extension and research publications, and in the Oregon Orchardgrass Commission publication, “Directory of Oregon Orchardgrass Seed Varieties.”

Inform your seed dealers about your specific forage and livestock goals so they can best match varieties to your needs. Use certified seed to assure a high germination percentage and freedom from noxious weeds.

Establishment

Orchardgrass establishes more slowly than perennial ryegrass but faster than tall fescue. Slower establishment into a mature sod is due to development of a more extensive root system. Full establishment into a “sod” may require 12 to 18 months, but orchardgrass can be harvested much sooner.

Delay grazing until seedlings are anchored sufficiently to prevent uprooting by livestock. In mild climates, such as west of the Cascades in the Pacific Northwest, two to three harvests may be taken in the seeding year.

Establish orchardgrass in early spring or late summer, depending primarily on soil type. Fine-textured soils may be too wet to cultivate and seed in early spring, while coarse-textured soils may be planted in spring or fall if irrigation is available. Slow establishment in cool fall temperatures makes spring planting preferred for many areas, especially where winter injury is a threat.

The seedbed should be loose on the surface but firm below the surface to assure proper planting depth. Use as narrow drill spacings as possible. Plant seed 0.25 to 0.5 inch deep (0.5 to 1 cm). If a legume is mixed with orchardgrass, a planting depth of 0.25 inch (0.5 cm) is better.

When planting orchardgrass in a dry seedbed, use a presswheel, cultipacker, or other soil-firming device to improve establishment. “Cereal-type” double disc drills with depth bands work well on prepared seedbeds.

Improve broadcast seeding success by dragging and/or rolling. Shallow harrowing often is used following broadcasting to provide better seed/soil contact, but it is difficult to harrow lightly enough to avoid planting more deeply than 0.25 to 0.5 inch (0.5 to 1 cm).

Seeding rates for conventional and no-till establishment methods, and suggested combination species, are shown in Table 1 (page 9). When broadcast seeding, increase rates by 50 percent or more, depending on seedbed condition. Seeding rates may be reduced by 30 percent for well-prepared seedbeds for irrigated production in the intermountain West (east of the Cascade Mountains).

Fertility and pH requirements

Obtain a soil test prior to preparing the seedbed for planting. Seedling growth may be retarded by inadequate soil pH. Orchardgrass is tolerant of soils with a pH range of 5.6 to 8.4. Orchardgrass seedlings may not flourish in soils with pH values below 5.6, primarily because of aluminum toxicity. Best growth occurs when soil pH is maintained between 6.0 and 7.5. Adjust soil pH 6 months to 1 year prior to planting. Broadcast phosphorus (P) prior to seeding or band at seeding.

Monitoring of soil nutrient levels is important for sustained high production and stand density. Orchardgrass is very responsive to N fertilization.

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

Use	Precipitation (inches)	Orchardgrass 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)	7–10
			and/or white clover	2–3
	30–60 or irrigated	15–20	white clover	2–3
			(and red clover)[b]	(5)
			and/or perennial ryegrass[c]	3–5
	>60	15–20	Birdsfoot trefoil	6
			or white clover	2–3
			and/or perennial ryegrass[c]	3–5
Hay or Silage	30–60 or irrigated	10–12	None (orchardgrass alone)	—
		8–10	Alsike clover or	3–4
			Ladino clover	2–3
			(and red clover)[b]	(5)
			and/or perennial ryegrass[c]	3–5
		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 seeding rates by 30 percent for irrigated production areas of the intermountain West.
[b]Red clover may be added for a 2–3 year contribution.
[c]Perennial ryegrass may be added for additional winter growth in mild winter areas. Use of more than 5 lb/a may result in undesirable competition.
[d]Oats or smooth-awned barley may be used as a spring-seeded nurse/companion crop with orchardgrass or orchardgrass-legume seedings. Harvest the cereals for green chop, silage, or hay; harvest the orchardgrass the following year. Harvesting cereals at the milk stage will minimize competition. The higher range cereal seeding rates are more competitive with orchardgrass but will give more first-year yield.

Split applications of nitrogen (N) fertilizer give a better distribution of growth throughout the year than a single application. If N fertilizer need is indicated by a soil test, apply 50 to 75 lb N/a (56 to 84 kg N/ha) in early spring and after the first cutting; 50 lb N/a (56 kg N/ha) after each cutting thereafter.

Another strategy for N application rates is to match application rates with crop removal in terms of lb N per ton of forage (kg N per metric ton). For example, apply 50 to 60 lb N/ton (25 to 30 kg/metric ton) of forage dry matter removed (2.5 to 3 percent of the dry matter). One ton of 100 percent dry matter is equal to approximately 1.15 tons of 15-percent moisture hay or 4 tons of 75-percent moisture freshly harvested grass.

For pastures or confined dairy or chicken operations where manure is spread, reduce the fertilizer amount 40 to 50 percent due to nutrient recycling of the manure. In situations where pastures are intensively managed and livestock manure is well distributed throughout the pasture, manure will supply about half of the needed nutrients. In these conditions, three applications of 30 to 40 lb N/a (34 to 45 kg/ha) have worked well.

Adequate levels of phosphorus, potassium, and sulfur without N favor legumes in a grass-legume mixture. Application of high rates of N, such as 200 to 400 lb N/a/yr (224 to 448 kg/ha/yr), coupled with long duration between grazing, in contrast, favors the grass and may result in disappearance of legumes from the mixture. This is due to the shading of the legumes by extensive grass growth and reduction of legume nitrogen fixation caused by high levels of soil nitrogen.

Detailed recommendations for fertilizer application based on soil test and crop performance information are found in extension fertilizer guides and in Natural Resources Conservation Service and Conservation District publications.

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 (hay or silage), harvest orchardgrass at early boot stage. See Figure 8. Delaying harvest until head emergence or early bloom increases yield but reduces quality and regrowth.

Later-maturing varieties may delay harvest by 10 to 14 days, but seldom enough to avoid poor haying weather in the Pacific Northwest and other spring rainfall areas. Alternatively, the first harvest may be grazed, green chopped, or ensiled. To stimulate growth, fertilizer immediately following the initial harvest.

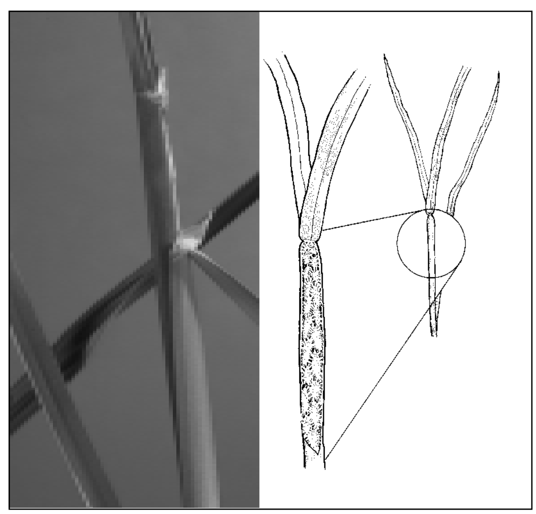


Figure 8.—Boot stage. The inflorescence is contained in the sheath of the flag (uppermost) leaf.

New seedlings

Because orchardgrass germinates and establishes more slowly than some other cool-season grasses, new stands can be seriously damaged by overgrazing or grazing too soon. 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.

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 8 to 10 inches, grazing to 2 to 4 inches, and providing a regrowth period. For hay or silage, allow plants to reach the pre-boot stage before mechanical harvest.

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 9.

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

A recovery period after cutting or grazing that allows regrowth of 8 to 10 inches (20 to 25 cm) is a reasonable rule of thumb for orchardgrass. In pastures, orchardgrass regrowth can be utilized as frequently as 14 to 21 days or may require more than 40 days, depending on grazing period, temperature, and moisture.

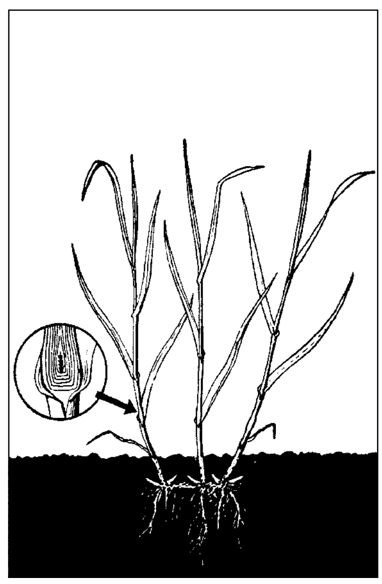


Figure 9.—Elevated meristem (growing point) in the early transition phase.

Under silage and green chop management systems, four to six harvests per year are common. With hay production, three harvests are obtained in addition to early spring and late fall pasturing.

In orchardgrass-legume mixtures, the legume can be reestablished, if necessary, by no-till seeding, or by overseeding during the spring, fall, or winter following close grazing or herbicide application. Some chemicals injure seedlings, so be sure to read labels and use chemicals correctly.

Persistence

Orchardgrass stands become thin and clumpy when first growth is consistently cut late, but stand longevity is not adversely affected. Stand decline is caused by the following:

- Overgrazing (grazing duration too long or removal of regrowth meristems)
- Treading damage, particularly on wet soils during winter or spring
- Mechanical damage from heavy equipment
- Continual late harvest
- Improper or inadequate distribution of manure, causing smothering
- Burning to remove stubble

In areas that produce subterranean clover/grass pastures (such as southwestern Oregon hill pastures), the practice of removing excess forage by fall burning assists subclover seedlings in reestablishment. Burning, however, often results in orchardgrass stand decline. You can avoid orchardgrass injury and aid subterranean clover establishment by grazing instead of burning, providing adequate nutrient levels, and allowing sufficient regrowth by late fall.

Composition/nutritional characteristics

Properly fertilized, well-managed stands of orchardgrass are capable of producing high-quality forage, with high levels of palatability, digestible energy, protein, and minerals. Orchardgrass accumulates high levels of usable carbohydrate 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 from the “Nutrient Requirements of Domestic Animals” series of publications from the National Research Council. See Table 2.

Table 2.—Nutritional composition of orchardgrass.*								
Feed description	**TDN (%)**	**DE (Mcal/kg)**	**ME (Mcal/kg)**	**NEm (Mcal/kg)**	**NEg (Mcal/kg)**	**CP (%)**	**Ca (%)**	**P (%)**
Fresh, early veg	72	3.17	2.76	1.64	1.03	18.4	0.58	0.54
Fresh, early bloom	68	3.00	2.46	1.57	0.97	12.8	0.25	0.39
Fresh, midbloom	57	2.51	2.06	1.21	0.64	10.1	0.23	0.17
Fresh, milk stage	53	2.34	1.91	1.14	0.40	8.4	—	—
Hay, early bloom	65	2.87	2.35	1.47	0.88	12.8	0.27	0.34
Hay, late bloom	54	2.38	1.95	1.11	0.55	8.4	0.26	0.30

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).

National Research Council. *Nutrient Requirements of Beef Cattle*, 7th revised edition (National Academy Press, Washington, DC, 1996).

Pest control

Good cultural management techniques minimize weed, disease, and insect problems. Practices include:

- Selecting adapted varieties
- Proper seeding techniques
- Maintaining adequate soil fertility
- Using appropriate cutting or grazing management

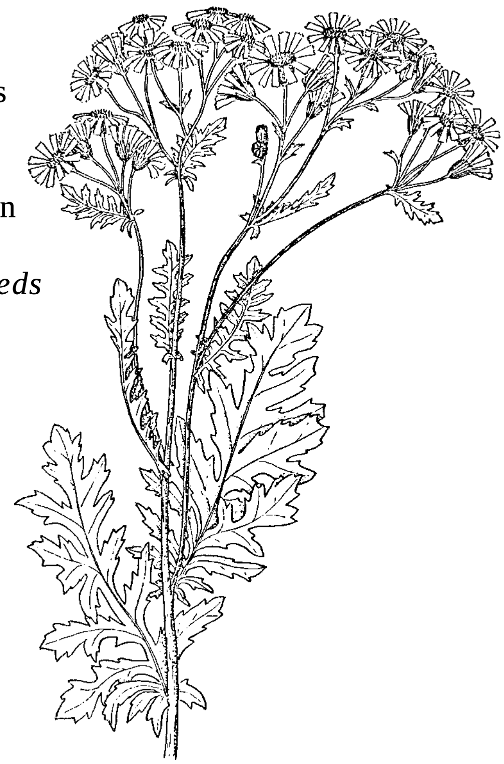
Control measures for individual weeds, diseases, and insects are provided in the Pacific Northwest pest control handbooks. See "For more information."

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.

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*.



Tansy ragwort, a common pasture weed.

Diseases

Selecting resistant varieties is the most economic means of disease control, since few fungicides are labeled for use on pastures, hay, or silage. In the case of leaf diseases, adequate fertility and water enable the plant to outpace the disease. Early harvest minimizes quality loss due to leaf diseases and reduces the number of spores available to infect regrowth.

Three orchardgrass diseases having major economic impact have been identified in the Pacific Northwest:

- Stripe rust (*Puccinia striiformis* Westend)
- Leaf scald (*Rynchosporium orthosporum* Caldwell)
- Orchardgrass mottle virus (CfMV)

These plant diseases cause reduced forage yield and quality but are not harmful to livestock except for respiratory sensitivity in horses.

Stripe rust (yellow rust) is a fungus-caused disease initiated by germinating spores dispersed by wind, water, animals, and machinery. Fruiting structures (uredia) are lemon-yellow to orange and become more numerous toward the leaf tips.

Stripe rust affects orchardgrass in late summer and fall. It can reduce forage quality by increasing acid detergent fiber by 6 to 8 percentage units.

Leaf scald appears as dark, bluish-gray, water-soaked blotches, which become light gray with darker brown margins. The lesions may be up to 1.25 inches long (30 mm) and constrict and wither the leaf areas beyond the lesions. The centers of the lesions are gray and become covered with spores. Forage quality is reduced by resulting leaf decomposition.

Spores develop during cool, moist spring weather and are readily spread by wind and rain. Leaf scald infects orchardgrass all year, with greatest infection in spring and fall.

Orchardgrass mottle virus causes a severe mottling and "dying out" of orchardgrass. It is transmitted by adults and larvae of a Chrysomelid beetle (*Oulema melanopus* L.). The virus is not seed-borne, but may be spread in the field by mowing equipment and grazing animals.

This disease probably reduces longevity of orchardgrass stands. It is a serious problem in the United Kingdom and is the most serious disease of orchardgrass in Japan. Some resistance has been found in locally adapted varieties in the Pacific Northwest.

Insects

More than 30 insects have been identified in orchardgrass stands. Although insect damage sometimes results in losses of yield, quality, and stand longevity, little is known about the economic losses incurred.

Promoting plant health through maintaining soil fertility and using appropriate harvest management practices reduces disease and insect damage. In addition, insect parasites, climate, and crop rotations are important factors in controlling orchardgrass pests.

Slugs

Slugs (*Agriolimax reticulatus* Müll.) are common on poorly drained soils. Young plants may be destroyed due to underground or soil-surface damage, which occurs mainly at night in the spring or autumn. Slugs are prevalent in new sowings after peas, cereals, or brassicas, particularly when large amounts of crop residue remain. Problems also are common when orchardgrass is seeded into heavily thatched sods.

Plowing and cultivation kill some of these pests, and more will die if the interval between plowing and sowing can be extended to 4 weeks or more. When seeding into existing sod, take advantage of the fact that tightly grazed sods do not seem to have the slug populations that thatched sods do. Thus, a good cultural method of slug damage control is to heavily graze sods before planting. Another approach is to lightly disk sods to tear up thatch and expose some mineral soil.

For more information

OSU Extension publications

Pacific Northwest Insect Control Handbook (Oregon State University, Corvallis, revised annually). $25.00

Pacific Northwest Plant Disease Control Handbook (Oregon State University, Corvallis, revised annually). $25.00. Also available as "An On-line Guide" at http://www.orst.edu/dept/botany/epp/guide/index.html

Pacific Northwest Weed Control Handbook (Oregon State University, Corvallis, revised annually). $25.00

Hart, J., et al. *Manure Application Rates for Forage Production*, EM 8585 (Oregon State University, Corvallis, reprinted 1997). $1.50

Hart, J., et al. *Pastures Fertilizer Guide for Western Oregon and Western Washington*, FG 63 (Oregon State University, Corvallis, revised 1996). No charge.

The Western Society of Weed Science. *Weeds of the West.* T.D. Whitson, editor (University of Wyoming, Laramie, 1991).

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Other print publications

Christie, B.R., and A.R. McElroy. Orchardgrass. In *Forages: An Introduction to Grassland Agriculture*, Vol. 1, 5th edition, pp. 325–333. R.F Barnes, D.A. Miller, and C.J. Nelson, editors (Iowa State University Press, Ames, 1995).

Cropper, J.B. Forage Suitability Groups. Chapter 3, section 2 in *National Range and Pasture Handbook* (Natural Resources Conservation Service Grazing Lands Technology Institute, Ft. Worth, TX, 1997).

Directory of Oregon Orchardgrass Seed Varieties (Oregon Orchardgrass Seed Producers Commission, Salem, OR).

Fransen, S., and M. Chaney. *Pasture and Hayland Renovation for Western Washington and Oregon*, Technical Bulletin (Washington State University, Pullman, in press).

Kvasnicka, B., and L.J. Krysl. *Grass Tetany in Beef Cattle*, CL 627. In *Cow-Calf Management Guide and Cattle Producer's Library*, 2nd edition (University of Idaho, Moscow, 1994).

Latteur, J.P. *Animal Disturbances on Fertilized Pastures*. Potassium Symposium, Brussels, Belgium (American Potash Institute, Atlanta, 1960).

Mahler, R.L. *Northern Idaho Fertilizer Guide: Grass Pastures*, CIS 853 (University of Idaho, Moscow, revised 1993).

Mahler, R.L. *Northern Idaho Fertilizer Guide: Legume and Legume-Grass Pastures*, CIS 851 (University of Idaho, Moscow, revised 1993).

*Oregon Orchardgrass: Top Quality Forage Seed from Oregon (*Oregon Orchardgrass Seed Producers Commission, Salem, OR).

Painter, C.G., J.P. Jones, and H.R. Guenthner. *Southern Idaho Fertilizer Guide: Irrigated Pastures*, CIS 392 (University of Idaho, Moscow, 1977).

Rogers, J. *The Effect of Top-dressed Lime upon Pasture Production and Quality* (M.S. Thesis, Oregon State University, Corvallis, 1996).

Van Santen, E., and D.A. Sleper. Orchardgrass. In *Cool-Season Forage Grasses*, pp. 503–534. L.E. Moser, D.R. Buxton, and M.D. Casler, editors (ASA, Madison, 1996).

World Wide Web

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Oregon Orchardgrass Seed Producers Commission:

http://www.forages.css.orst.edu/Organizations/Seed/Oregon_Orchardgrass_Seed_Producers_Commission.html

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