



PASTURE AND HAYLAND RENOVATION FOR WESTERN WASHINGTON AND OREGON

Farming West of the Cascades

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PASTURE AND HAYLAND RENOVATION FOR WESTERN WASHINGTON AND OREGON

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Abstract

This publication is designed to help you achieve a successful forage seeding whether you're a beginning or experienced forage producer. It's divided into sections so you can focus on the information you need. It contains recommendations for seed mixes and seeding techniques on pasture and hayland based on soils, climate, and intended use of the area.

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Pasture and Hayland Renovation for Western Washington and Oregon

This publication is designed to help you achieve a successful forage seeding whether you're a beginning or experienced forage producer. It's divided into sections so you can focus on the information you need, whether this is basic species facts and seeding methods, or just a list of the latest recommended cultivars. It contains recommendations for seed mixes and seeding techniques on pasture and hayland based on soils, climate, and intended use of the area. For additional assistance, contact your local Cooperative Extension office, Natural Resources Conservation Service, or Conservation District office.

Before you begin, here are some general observations that apply to all sites.

- First, evaluate the current management of the site. If you're ready to reseed, then you must not like what is growing on the site. However, what is growing there now is what is best adapted to how the site is currently being managed. If the area is reseeded, but the management is not changed, then soon the site will return to its present condition. Management changes might include more cross-fencing to allow more intensive rotational management, moving current fences so that different soil types are not fenced together into one unit, or creating a winter confinement area to protect pastures when soils are saturated and the grass isn't growing very fast. For more details on these techniques, refer to WSU Extension Bulletin 1713, Protecting Groundwater: Managing Livestock on Small Acreage, by Schmidt and Wolfley (1997).
- Generally, don't renovate more than 20% of the fields or acres in one year. Pasture or hayland forage will still be needed before the new seedings are ready to be used. Summer drought or winter flooding weather may damage or kill the new seeding before the plants have become established.
- Evaluate the current soil status with a soil test. Contact your local Cooperative Extension, Natural Resources Conservation Service, or Conservation District office for information on how to take a soil test and where to have it analyzed. Does the soil need lime? Prior to forage renovation is an excellent time to apply lime or other elements. Oregon State University Extension Bulletin FG 63 gives fertilizer and liming recommendations for western Washington and Oregon forage fields. Because magnesium is often at low levels in these soils, you may wish to use dolomitic lime rather than agricultural lime.

- Seed at the recommended time of year for the appropriate soil type. Seedlings are very easily damaged or killed by droughty topsoil, high soil temperatures, saturated soil, or frost heaving.
- If the new seeding is on land recently converted from forest, a soil test is especially important, because many nutrients and minerals will be out of balance for good grass and legume growth. If no test is available, fertilize with a N:P:K:S fertilizer with a ratio 3:1:2:1 and a rate of no more than 75 units of nitrogen per acre per application. Apply lime at a rate of at least 5 tons per acre.
- Species selection is critical to the long-term success of the planting. If the species are not adapted to the intended use or the site, the best seedbed preparation in the world won't make the seeding successful. Use Table 1 in this publication to select species that are adapted to the soils in the field and the intended use. Soils are categorized by winter and summer drainage. If the slope is greater than 15%, the soil will tend to act like the soils in the next drier category in the table.
- Multiple-species mixtures versus two-species mixtures: While at least one species in a multiple-species mixture will always grow no matter what the conditions, these mixtures are hard to manage for grazing or haying because the species often differ in palatability, maturity, adaptation to different soils, yield potential, and growing season conditions. Selective grazing, whereby we see patchy grazing, occurs when some species are avoided and other species are overgrazed in mixed stands.
- Multiple-species mixtures can be managed successfully under intensive grazing management systems. For less intensive grazing systems and for hay, a simple mixture with only a single grass and a single legume species is recommended.
- Seed tags will list minimum germination and purity. Germination is the percentage of seed in the bag that will germinate and grow. Purity is the actual amount of the species of seed you want to buy. Other materials may include chaff, dirt, and weed seeds. While the tag may say that no noxious weed seeds are present, many obnoxious weed seeds may be present. These are common weeds such as dandelion, dock, lambsquarters, or thistles. Buy the purest seed you can find. Don't scrimp on pennies per pound; it will save dollars in aggravation later.

- Kill the existing vegetation before reseeding. Plants with roots and leaves will always win the competition with seeds, so to favor the seeds, kill the undesirable plants. The existing vegetation can be killed either chemically or mechanically. If the field was in grass and is being reseeded directly back to grass, try to allow at least 4 weeks between initial plowing or discing and reseeding to allow breakdown of green vegetation.
- Compacted soil layers should be broken up before reseeding. Almost all fields west of the Cascades that have deteriorated enough to need reseeding also have soil compaction problems in the crop rooting zone. Fields that have been grazed in the winter are the most likely to have a compaction problem. Compacted soil restricts root growth, access to soil nutrients, and summer moisture. Compaction also restricts water penetration through the soil, resulting in soggy, ponded fields during the winter and spring and prematurely droughty fields in the summer. Tools such as subsoilers or aerators work well for this purpose. Take care when using subsoilers in fields that contain drain tile as the tools may damage the tile.
- Seeding depth is critical. Grass and legume seeds are extremely small; if buried too deep in the soil, they will run out of energy before they reach the surface (think of lettuce seed and how deep it's planted in the garden). Never seed deeper than 1/4 inch. It's better to seed too shallow than too deep, even if it means broadcasting seed directly on the soil surface. While a cultipacker seeder will do the best job of seeding, broadcasting seed followed by a light harrowing on a firm seedbed will usually give acceptable results.
- A firm seedbed is essential. If the soil is too "fluffy," it will dry out quickly and any small seedling perched on top of the soil clod will dry out and die. Packing the soil with a roller is best, but repeated harrowing or dragging before seeding (with a light harrowing afterwards) will also give acceptable results. Evidence of a firm seedbed is found when you can walk over the prepared seedbed and leave footprints no deeper than 1/4 inch. Firm seedbeds produce more even seedling emergence that covers the open soil more quickly.
- Weed control (including undesirable grasses) at and after seeding is critical to the success of a new seeding. Ignoring this step will return you to pre-seeding condition, or worse. Control of problem perennial weeds, such as Canada thistle, before seeding is most quickly accomplished with a herbicide currently recommended for control. However, Canada thistle can be controlled by persistent clipping prior to flowering. Repeated tilling or mowing of the area throughout the growing season prior to seeding will reduce (but not necessarily eliminate) weed infestations.
- The best method of weed control after seedling emergence is by clipping. Forage seedlings are too small and would be damaged if grazed at this time. Annual weeds generally grow faster than seedling grasses and legumes so they are taller. Clipping above the growing forage plants and removing the weed growing points stunts or kills the weedy plant. As the forage plants develop deeper and stronger root systems they soon can compete with the weeds. Young grasses and legumes may be susceptible to herbicide damage. In a new stand without legumes seeded, a wide range of herbicides can be used for broadleaf weeds. After these weeds are controlled, the legume can be overseeded. However, keep in mind that overseeding is not always successful, as the new legume seedlings are now competing with established plants. If grassy weeds are the problem, then these weeds should be controlled prior to seedbed preparation.
- Before letting livestock out on your beautiful new pasture, use the "Pull Test" to determine readiness. Grab a single plant and give a sharp tug. If you can pull the plant out of the soil, so can livestock. Don't let livestock graze new seedlings until they pass the Pull Test. After a new seeding has passed the Pull Test, for the next 90 days allow livestock to graze only lightly in a pasture rotation system to ensure healthy root development. In the meantime, it's fine to mow the field for hay or green feed to a 4" stubble height.

Selecting Your Species

Table 1 will help you select the adapted species for both your soil type and the intended use of the field. The most common uses include:

- Grazing or grazing/haying. This field will be used primarily for grazing, but may also be used for one or more cuttings of hay during the summer.
- Hay only. This field will not be used for grazing, only for haying of perennial species. (See WSU Extension Bulletin 1897).
- Exercise or confinement area. This is a small field that will receive heavy use from livestock. This field is used primarily for livestock exercise or as a holding area, not for forage production. These are perennial species that will help reduce the amount of annual weeds common in these areas.
- Temporary cover. This is any field with bare soil exposed which needs a temporary cover to protect it from erosion or to help suppress annual weeds. This cover can often be used as forage. Suggested species for this use can be found in Cogger, et al. (1997).

On steeper slopes (greater than 15%), soils will often behave like the "next drier" soil type (one step higher in Table 1), because moisture will drain from them more quickly.

Table 1. Forage species adaptation by use and soil type.

Soil Type	Use: Grazing only or Grazing & Hay	Use: Exclusively for Hay	Use: Exercise or Confinement Area	Use: Temporary Cover ³
Excessively drained, very dry in summer. Recommended seed-ing season: Fall.	Tall Fescue Orchardgrass Alfalfa Red Clover White Clover Birdsfoot Trefoil Subclover ⁵	Tall Fescue Orchardgrass Alfalfa Red Clover White Clover	Bentgrass Fine Fescue Tall Fescue White Clover	Annual Ryegrass Barley Cereal Rye Spring Wheat Winter Wheat Triticale Austrian Winter Peas ⁴ Subclover ⁵
Well-drained all year or shallow soil. Recommended seed-ing season: Spring or Fall.	Tall Fescue Orchardgrass Annual Ryegrass Perennial Ryegrass Alfalfa Red Clover White Clover Birdsfoot Trefoil Subclover ⁵	Tall Fescue Orchardgrass Alfalfa Red Clover White Clover	Bentgrass Fine Fescue Tall Fescue White Clover	Annual Ryegrass Perennial Ryegrass Barley Oats Cereal Rye Spring Wheat Winter Wheat Triticale Austrian Winter Peas ⁴ Subclover ⁵
Somewhat poorly drained in winter and early spring. Recommended seed-ing season: Spring or Fall.	Tall Fescue Annual Ryegrass Perennial Ryegrass Alsike Clover White Clover Big Trefoil Birdsfoot Trefoil	Tall Fescue Timothy Alsike Clover White Clover Big Trefoil Birdsfoot Trefoil	Bentgrass Fine Fescue Tall Fescue White Clover	Annual Ryegrass Perennial Ryegrass Barley Oats Cereal Rye Spring Wheat Winter Wheat Triticale Austrian Winter Peas ⁴
Saturated in late fall, winter and spring. Recommended seed-ing season: Fall.	Reed Canarygrass ¹ Meadow Foxtail ¹ Tall Fescue Alsike Clover White Clover Big Trefoil Birdsfoot Trefoil	Reed Canarygrass ¹ Meadow Foxtail ¹ Tall Fescue Timothy Alsike Clover White Clover Big Trefoil Birdsfoot Trefoil	Reed Canarygrass ¹ Meadow Foxtail ¹ Bentgrass Fine Fescue Tall Fescue White Clover	Oats Cereal Rye
Mixed drainage: dry uplands and wet swales. Recommended seed-ing season: Fall.	Tall Fescue Annual Ryegrass Perennial Ryegrass Alsike Clover White Clover Big Trefoil Birdsfoot Trefoil Meadow Foxtail ¹	Tall Fescue Orchardgrass ² Timothy Alsike Clover Red Clover White Clover Big Trefoil Birdsfoot Trefoil Meadow Foxtail ¹	Bentgrass Fine Fescue Tall Fescue White Clover	Annual Ryegrass Perennial Ryegrass Barley Oats Cereal Rye Spring Wheat Winter What Triticale Austrian Winter Peas ⁴

¹ Seeding not recommended. For management and rejuvenation of existing stands, see species information.² Use only in a mix with other species.³ Clip or graze all grains before the seedheads appear, or awns may cause mouth and eye irritation in livestock. Winter Wheat and Austrian Winter Peas should be used for fall seedings only.⁴ See species information for specific feeding recommendations.⁵ This species is most adopted south of the Lewis River on the westside.

Table 2. Seeding Rate Calculator

SPECIES <i>Place an "x" in the box under seedbed selected:</i>	Rate for each species seeded by itself (lb/acre)*		Calculate the pounds of seed needed per acre by multiplying selected rate (well-prepared or rough seedbed) by percentage		
	Well-prepared, tilled seedbed	Roughly prepared seedbed, little or no tillage	Fill in the percentage of each species desired in the seeding**	Multiply selected rate times desired percentage	Selected variety
Rates for permanent grass and legume seedings:					
<i>Grasses:</i>					
1. Bentgrass (Agrostis spp.)	5	8	%		
2. Bluegrass, Kentucky (Poa pratensis)	10	15	%		
4. Fescue, Fine (Festuca rubra)	20	30	%		
5. Fescue, Tall (Festuca arundinacea)	30	50	%		
7. Orchardgrass (Dactylis glomerata)	20	30	%		
8. Ryegrass, Annual or Italian (Lolium multiflorum)	30	50	%		
9. Ryegrass, Perennial** (Lolium perenne)	30	50	%		
10. Timothy (Phleum pratense)	10	15	%		
<i>Legumes:</i>					
	Rate for supplementation to grass seeding)				
11. Alfalfa (Medicago sativa)	10	15	%		
12. Clover, Alsike (Trifolium hybridum)	3	5	%		
13. Clover, Red (Trifolium pratense)	8	12	%		
14. Clover, White (Trifolium repens)	3	5	%		
15. Trefoil, Big (Lotus uliginosus)	3	5	%		
16. Trefoil, Birdsfoot (Lotus corniculatus)	5	8	%		
TOTAL: (sum of each column)			%		lb/acre
Rates for temporary cover or clean-up crop:					
<i>Annual Cereal Grains:</i>					
17. Barley (Hordeum vulgare)	150	250	%		
18. Oats (Avena sativa)	100	250	%		
19. Rye, Cereal (Secale cereale)	150	250	%		
20. Wheat (Triticum vulgare)	150	250	%		
21. Triticale (Triticosecale spp.)	150	250	%		
<i>Annual Legumes:</i>					
22. Austrian Winter Peas (Pisum sativum arvense)	150	250	%		
23. Subterranean (Sub-) clover (Trifolium subterraneum)	6	8	%		
TOTAL: (sum of each column)			%		lb/acre

*These rates assume 90% seed germination. If germination is less than 90%, either increase seeding rate by difference, or use different seed lot with 90% germination.

**This seed size is for tetraploid ryegrass. Diploid ryegrasses have approximately twice as many seeds per pound.

***Limit the number of species in a mix to minimize selective grazing and uneven production due to differing palatabilities, plant size, and maturity dates.

Grass, Legume, and Grass Descriptions

For use by wildlife species, consult a wildlife habitat guide for the species of interest.

General note: Yield estimates are based on an average to high level of fertility. Low-fertility sites will have low yields for all species.

Perennial Grasses

1. Bentgrass (*Agrostis spp.*)

Characteristics—non-native perennial (most species), vigorous sod-former, with growing points occurring above the soil level.

- Longevity—10+ years
- Palatability for livestock—moderate
- Yield—moderate
- Fertility needs—low to moderate
- Site adaptation—droughty to wet soils
- Shade tolerance—moderate
- Toxicities—none known
- Uses—forage production (pasture); confinement areas
- Seedling establishment—relatively rapid
- Seedling vigor—good
- Average number of seeds per pound—4,990,000
- Other—does well on acid soils

2. Kentucky bluegrass (*Poa pratensis*)

- Characteristics—non-native perennial, sod-former, with growing point occurring at the soil level.
- Longevity—10+ years
- Palatability for livestock—high
- Yield—moderate
- Fertility needs—moderate to high
- Site adaptation—well drained to moist soils
- Shade tolerance—moderate
- Toxicities—none known
- Uses—forage production (pasture); confinement areas
- Seedling establishment—slow
- Seedling vigor—good
- Average number of seeds per pound—2,150,000
- Other—this species is not well-adapted to western Washington and Oregon because it is susceptible to rust and powdery mildew which reduces forage quality. It also requires a soil pH around 6.5 and a high level of fertility to remain competitive.



Colonial bentgrass (top)
Creeping bentgrass (*Agrostis spp.*)

3. Reed canarygrass (*Phalaris arundinacea*)



Kentucky bluegrass (*Poa pratensis*) - Top
Reed canarygrass (*Phalaris arundinacea*)

- Characteristics—non-native perennial, sod-former, with growing points occurring above the soil level.
- Longevity—10+ years
- Palatability for livestock—low to moderate
- Yield—high
- Fertility needs—high
- Site adaptation—moist to saturated soils
- Shade tolerance—low
- Toxicities—plant indole alkaloids are related to low animal acceptance
- Uses—forage production (pasture, hay, and silage)
- Seedling establishment—slow
- Seedling vigor—slow
- Average number of seeds per pound—506,000
- Other—because of low seedling vigor, it is most successfully established with rhizome pieces. Vigorously discing and harrowing the field will rejuvenate sod-bound stands. *Because reed canarygrass is so invasive, do not introduce it into fields where it is not already present.* Palatability decreases rapidly after maturity, so it is best to maintain it between 4 and 12 inches in height.

4. Fine fescue (*Festuca* spp) such as Red fescue (*Festuca rubra*)

- Characteristics—non-native perennial, bunchgrass to strong sod-former, with growing points occurring at the soil level, or slightly below.
- Longevity—10+ years
- Palatability for livestock—low to moderate
- Yield—low
- Fertility needs—low to moderate
- Site adaptation—droughty to wet soils
- Shade tolerance—moderate to high
- Toxicities—endophyte fungus may be present in some turf varieties
- Uses—confinement areas
- Seedling establishment—moderate
- Seedling vigor—moderate
- Average number of seeds per pound—615,000
- Other—rust (particularly in the autumn) and powdery mildew

5. **Tall fescue (*Festuca arundinacea*)**

- Characteristics—non-native perennial, bunchgrass, with growing points occurring at the soil level
- Longevity—10+ years
- Palatability for livestock—moderate throughout the grazing season
- Yield—high
- Fertility needs—low to high
- Site adaptation—droughty to wet soils
- Shade tolerance—moderate to high
- Toxicities—internal fungus (endophyte) produces toxic products which are related to lower livestock gains and reproduction problems in horses. Toxin is concentrated in seedhead tillers and basal leaf sheaths. Endophyte-free varieties are available.
- Uses—forage production (pasture, hay and silage), confinement areas
- Seedling establishment—moderate
- Seedling vigor—moderate
- Average number of seeds per pound—225,000
- Other—susceptible to crown and stem rust which may affect yield. Crown rust resistant varieties are available.



6. **Foxtail, Meadow (*Alopecurus pratensis*)**

- Characteristics—non-native perennial, bunchgrass with short rhizomes
- Longevity—10+ years
- Palatability for livestock—high when very young, low most of the year
- Yield—moderate
- Fertility needs—moderate to high
- Site adaptation—moist to moderate
- Shade tolerance—low
- Toxicities—none known
- Uses—forage production (pasture)
- Seedling establishment—slow
- Seedling vigor—low to moderate
- Average number of seeds per pound—500,000
- Other—very cold tolerant



7. **Orchardgrass (*Dactylis glomerata*)**

Red fescue (*Festuca rubra*)- Top Tall fescue(*Festuca arundinacea*) - Bottom

- Characteristics—non-native perennial, bunchgrass, with growing points occurring at the soil level
- Longevity—10+ years
- Palatability for livestock—high throughout the grazing season



Foxtail, Meadow (*Alopecurus pratensis*) – Top right
Orchardgrass (*Dactylis glomerata*) – Bottom Right

- Yield—high
- Fertility needs—moderate to high
- Site adaptation—droughty to moist soils
- Shade tolerance—high
- Toxicities—none known
- Uses—forage production (pasture, hay and silage)
- Seedling establishment—moderately rapid
- Seedling vigor—good
- Average number of seeds per pound—540,000
- Other—susceptible to stripe rust which reduces forage quality while not affecting yield

8. Annual/Italian ryegrass (*Lolium multiflorum*)

- Characteristics—non-native perennial, bunchgrass, with growing points occurring above the soil level
- Longevity—1 to 4 years depending on the harshness of the winter
- Palatability for livestock—high throughout the grazing season
- Yield—high, declines after first year if fertility and management decline
- Fertility needs—high
- Site adaptation—moist to wet soils
- Shade tolerance—moderate
- Toxicities—internal fungus (endophyte) produces toxic products that are related to lower livestock gains and re-production problems in horses. Toxin is concentrated in seedhead tillers and basal leaf sheaths. Endophyte-free varieties are available.
- Uses—forage production (pasture and silage), confinement areas and corrals for temporary cover
- Seedling establishment—rapid
- Seedling vigor—rapid
- Average number of seeds per pound—190,000

Other—susceptible to stem rust which may affect yield. Forage production declines more than most species during dry summer growth period, but resumes with fall rains and extends into winter.

9. Perennial ryegrass (*Lolium perenne*)

- Characteristic—non-native perennial, bunchgrass, with growing points occurring at the soil level (diploid variet-ies) or slightly above the surface (tetraploid varieties)
- Longevity—5 to 8 years
- Palatability for livestock—high throughout the grazing season

- Yield—high, may decline after 3 to 5 years if fertility and management are reduced
- Fertility needs—high
- Shade tolerance—moderate
- Toxicities—internal fungus (endophyte) produces toxic products that are related to lower livestock gains and re-production problems in horses. Toxin is concentrated in seed head tillers and basal leaf sheaths. Endophyte-free varieties are available.
- Uses—forage production (pasture and silage), confinement areas and corrals
- Seedling establishment—rapid
- Seedling vigor—rapid
- Average number of seeds per pound—225,000
- Other—susceptible to stem rust which may affect yield. Forage production declines more than other species during dry summer growth period, but resumes with fall rains and extends into winter.

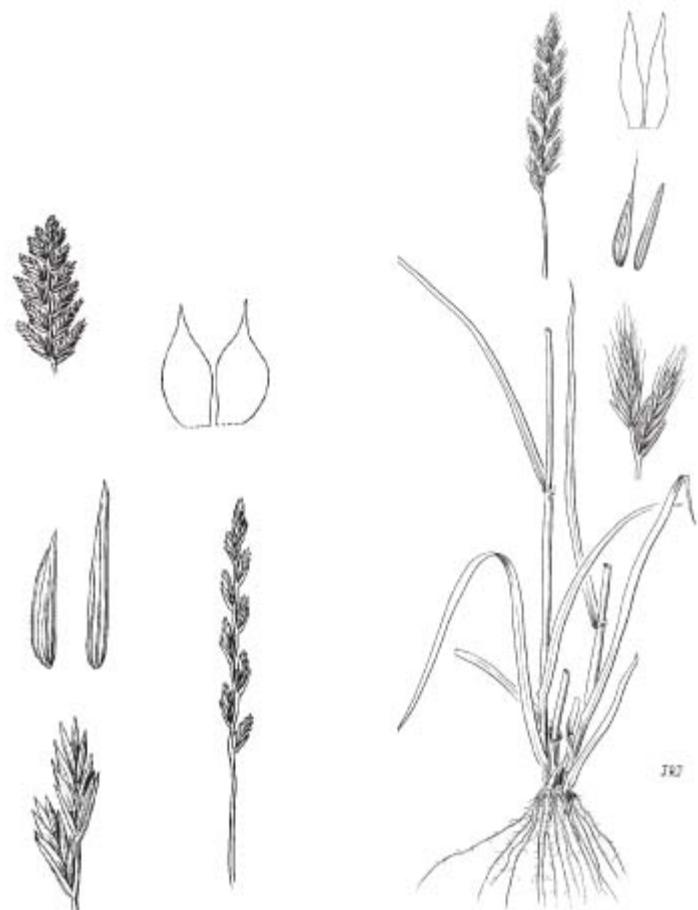
10. *Timothy (Phleum pratense)*

- Characteristics—non-native perennial, bunchgrass, with growing points occurring above the soil level
- Longevity—2+ years in pasture and 10+ years with hay and silage
- Palatability for livestock—moderate to high
- Yield—moderate
- Fertility needs—moderate
- Site adaptation—moist to saturated soils
- Shade tolerance—low
- Toxicities—none known
- Uses—forage production (hay and silage)
- Seedling establishment—moderate
- Seedling vigor—rapid
- Average number of seeds per pound—1,300,000
- Other—forage production declines more than most species during dry summer growth period

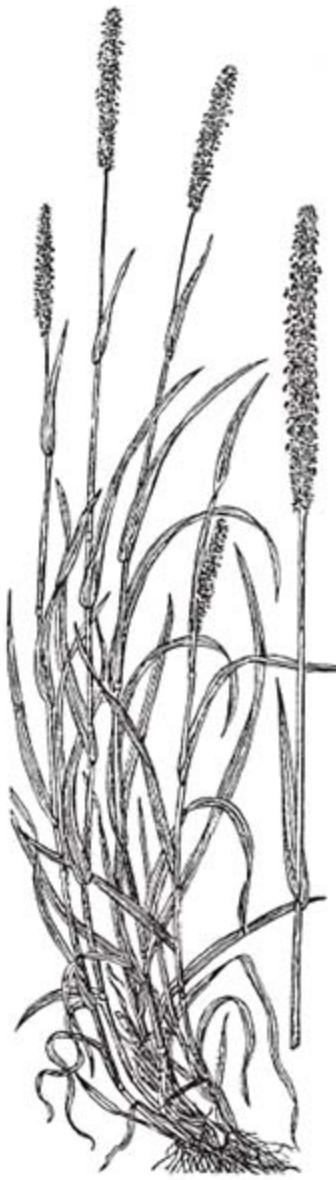
Perennial Legumes

11. *Alfalfa (Medicago sativa)*

- Characteristics—non-native erect perennial
- Longevity—3+ years in pasture and longer with hay and silage
- Palatability for livestock—high
- Yield—high
- Fertility needs—moderate to high
- Site adaptation—dry to well-drained soils—not suited to soils with high water tables



Perennial Ryegrass (*Lolium perenne*) – Top
Annual/Italian Ryegrass (*Lolium multiflorum*) – Bottom



Timothy (Phleum pratense) – Top
Alfalfa (Medicago sativa) – Bottom



- Shade tolerance—low
- Toxicities—bloat
- Uses—forage production (pasture, hay and silage)
- Seedling establishment—moderately fast
- Seedling vigor—good
- Average number of seeds per pound—225,000
- Other—cultivars susceptible to verticillium wilt, bacterial wilt, fusarium root rot, spring black stem, sclerotinia crown and stem rot, and Ascochyta are more likely to suffer greater stand losses. To maintain productive stands keep soil pH around 6.5.

12. *Alsike clover (Trifolium hybridum)*

Characteristics—non-native semi-erect perennial

- Longevity—2+ years in pasture and longer with hay and silage
- Palatability for livestock—high
- Yield—moderate to high
- Fertility needs—moderate
- Site adaptation—well-drained to saturated soils
- Shade tolerance—low
- Toxicities—bloat, photosensitivity and liver damage in horses
- Uses—forage production (pasture, hay and silage)
- Seedling establishment—rapid
- Seedling vigor—good
- Average number of seeds per pound—682,000
- Other—susceptible to bacterial wilt, fusarium root rot, rhizoctonia, powdery mildew, and sclerotinia crown and stem rot

13. *Red clover (Trifolium pratense)*

- Characteristics—non-native semi-erect perennial
- Longevity—2+ years in pasture and longer with hay and silage
- Palatability for livestock—high
- Yield—moderate to high
- Fertility needs—low to moderate
- Site adaptation—dry to moist soils
- Shade tolerance—low
- Toxicities—bloat, estrogen levels may cause conception problems in sheep
- Uses—forage production (pasture, hay and silage)
- Seedling establishment—rapid
- Seedling vigor—good
- Average number of seeds per pound—281,000
- Other—susceptible to bacterial wilt, fusarium root rot, rhizoctonia, powdery mildew, and sclerotinia crown and stem rot

14. **White clover (*Trifolium repens*)**

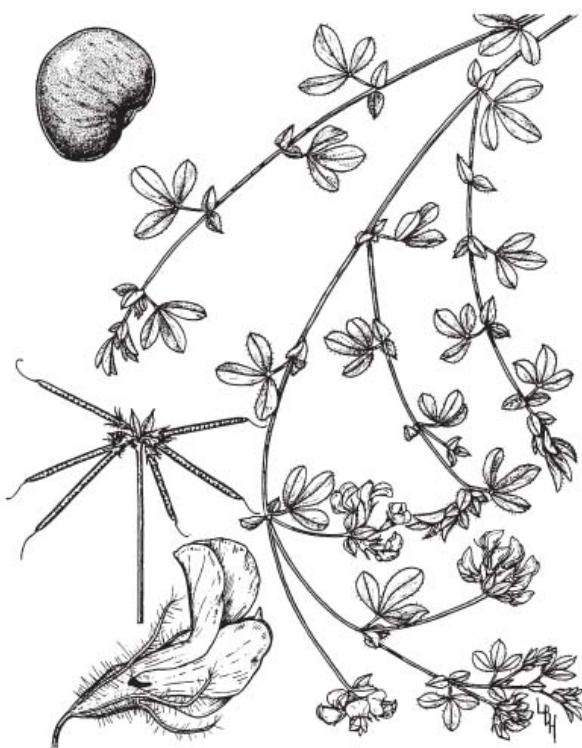
- Characteristics—non-native prostrate perennial
- Longevity—10+ years
- Palatability for livestock—high
- Yield—moderate
- Fertility needs—low to moderate
- Site adaptation—well-drained to wet soils
- Shade tolerance—low to moderate
- Toxicities—bloat
- Uses—forage production (pasture, hay and silage), con-finement areas
- Seedling establishment—rapid
 - Seedling vigor—good
- Average number of seeds per pound—800,000
- Other—susceptible to sclerotinia, crown and stem rot, rhizoctonia, fusarium root rot

15. **Big trefoil (*Lotus uliginosus*, *Lotus major*)**

- Characteristics—non-native prostrate perennial
- Longevity—10+ years
- Palatability for livestock—high
- Yield—moderate
- Fertility needs—low to moderate
- Site adaptation—moist to saturated soils
- Shade tolerance—low to moderate
- Toxicities—none known
- Uses—forage production (pasture, hay and silage)
- Seedling establishment—slow
- Seedling vigor—moderate
- Average number of seeds per pound—1,000,000



Alsike Clover (*Trifolium hybridum*) -Top
Red Clover (*Trifolium pratense*) – Bottom



Big Trefoil (*Lotus uliginosus*, *Lotus major*)- Top
Birdsfoot Trefoil (*Lotus corniculatus*) – Bottom

- Other—susceptible to sclerotinia, crown and stem rot, rhizoctonia, fusarium root rot, and verticillium. Better adapted to grazing than birdsfoot trefoil. Difficult to find seed.

16. ***Birdsfoot trefoil (Lotus corniculatus)***

- Characteristics—non-native prostrate perennial
- Longevity—10+ years
- Palatability for livestock—high
- Yield—moderate
- Fertility needs—low to moderate
- Site adaptation—well-drained to saturated soils
- Shade tolerance—low to moderate
- Toxicities—none known
- Uses—forage production (pasture, hay and silage)
- Seedling establishment—slow
- Seedling vigor—moderate
- Average number of seeds per pound—470,000
- Other—susceptible to sclerotinia, crown and stem rot, rhizoctonia, fusarium root rot, and verticillium

Annual Cereals

17. ***Barley (Hordeum vulgare)***

- Characteristics—non-native
- Longevity—1 year
- Palatability for livestock—high
- Yield—moderate
- Fertility needs—moderate
- Site adaptation—well-drained to moist soils
- Shade tolerance—moderate
- Toxicities—none known
- Uses—forage production (pasture, hay and silage)
- Seedling establishment—rapid
- Seedling vigor—good
- Average number of seeds per pound—13,600
- Other—generally winter-hardy in this region, similar to spring wheat, but less so than winter wheat

18. ***Oats (Avena sativa)***

- Characteristics—non-native
- Longevity—1 year
- Palatability for livestock—high
- Yield—moderate
- Fertility needs—moderate
- Site adaptation—well-drained to saturated soils
- Shade tolerance—moderate

- Toxicities—none known
- Seedling establishment—rapid
- Seedling vigor—good
- Average number of seeds per pound—16,000
- Other—will tolerate standing water for short periods of time. Least winter-hardy of cereals grown in the region.

19. **Cereal Rye (*Secale cereale*)**

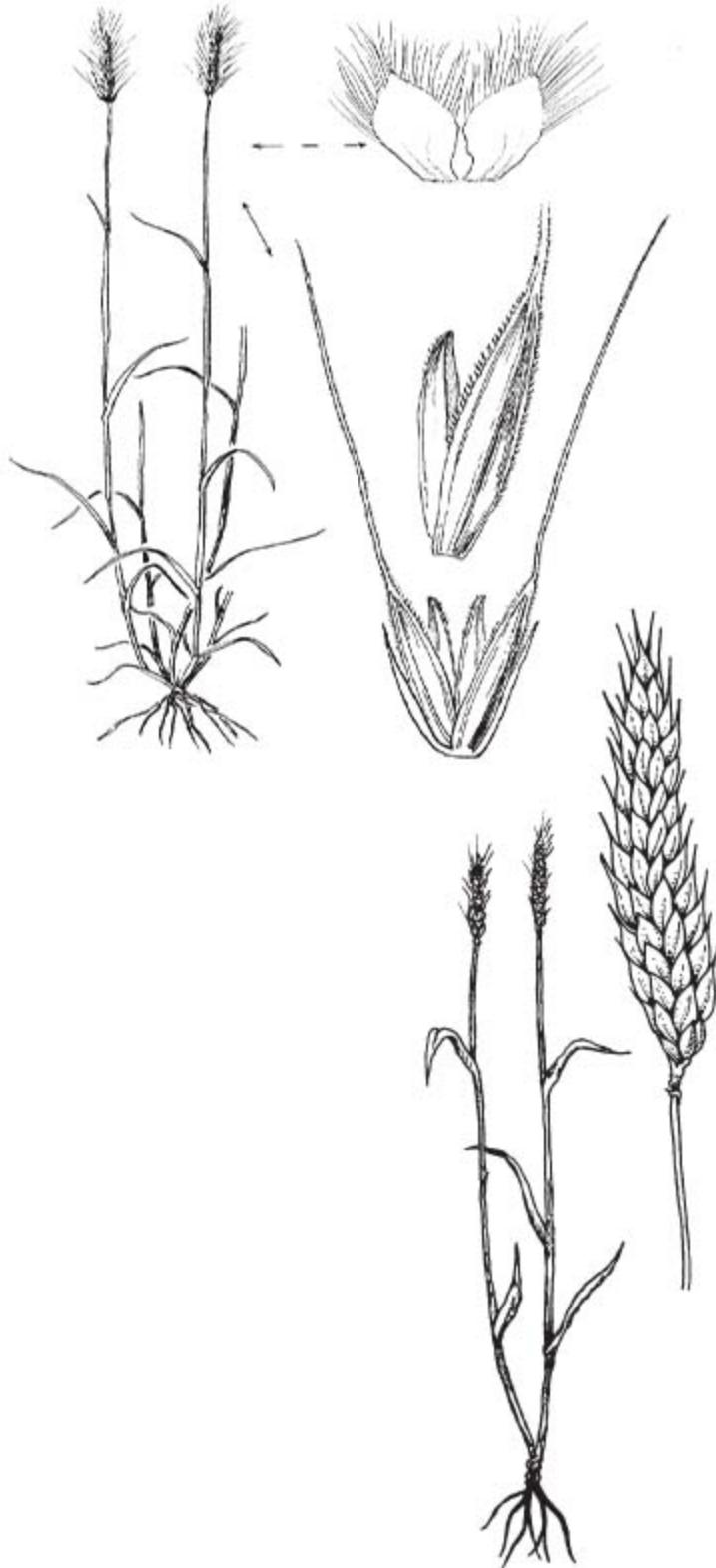
- Characteristics—non-native
- Longevity—1 year
- Palatability for livestock—high; may taint the flavor of milk in lactating cows
- Yield—moderate to high
- Fertility needs—moderate
- Site adaptation—well-drained to saturated soils
- Shade tolerance—moderate
- Toxicities—discourages the growth of other plants (allelopathy). *Do not plant a permanent seedling directly following plowing, discing, or chemical control of cereal rye.*
- Uses—forage production (pasture, hay and silage)
- Seedling establishment—rapid
- Seedling vigor—good
- Average number of seeds per pound—18,200
- Other—most winter-hardy of cereals grown. Generally, this is the tallest cereal grain for forage in the region



Cereal rye (*Secale cereale*)



Barley (*Hordeum vulgare*) – Top left
Oats (*Avena sativa*) – Bottom right



Wheat (*Triticum vulgare*) – Top left
Triticale (*Triticosecale spp.*) – Bottom right

20. *Wheat (Triticum vulgare)*

- Characteristics—non-native
- Longevity—1 year
- Palatability for livestock—high
- Yield—moderate to high
- Fertility needs—moderate
- Site adaptation—well-drained to moist soils
- Shade tolerance—moderate
- Toxicities—none known
- Uses—forage production (pasture, hay and silage)
- Seedling establishment—rapid
- Seedling vigor—good
- Average number of seeds per pound—11,400
- Other—spring wheats are only moderately winter-hardy

21. *Triticale (Triticosecale spp.)*

- Characteristics—non-native
- Longevity—1 year
- Palatability for livestock—high
- Yield—moderate to high
- Fertility needs—moderate
- Site adaptation—well-drained to moist soils
- Shade tolerance—moderate
- Toxicities—none known
- Uses—forage production (pasture, hay and silage)
- Seedling establishment—rapid
- Seedling vigor—good
- Average number of seeds per pound—12,300
- Other—spring triticales are more winter-hardy than spring wheats. Triticales are leafier than cereal rye and taller than spring wheat.

Annual Legumes

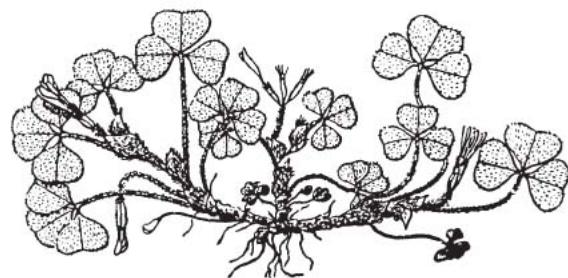
22. *Austrian Winter Peas (*Pisum sativum arvense*)*

- Characteristics—non-native
- Longevity—1 year
- Palatability for livestock—high
- Yield—low to moderate
- Fertility needs—moderate

- Site adaptation—well-drained to moist soils
- Shade tolerance—low
- Toxicities—none known
- Uses—forage production (pasture, hay, and silage)
- Seedling establishment—rapid
- Seedling vigor—good
- Average number of seeds per pound—18,000
- Other—if the soil is too cool and wet, germination is significantly reduced. This species should be planted together with a cereal for best results. Reduce seeding rate to 50 lb/acre when seeding with a companion cereal.

23. **Subterranean clover (*Trifolium subterraneum*)**

- Characteristics—non-native prostrate, winter annual
- Longevity—vigorous, self-reseeding annual
- Palatability for livestock—high
- Fertility needs—low to moderate
- Site adaptation—dry shallow to well drained and south of Lewis River in Washington State.
- Shade tolerance—low
- Toxicities—lower risk of bloat and estrogens in mixed grass stands
- Uses—forage production (pasture, increases soil fertility through good nitrogen fixation)
- Seedling establishment—rapid
- Seedling vigor—good
- Average number of seeds per pound—60,000
- Other—susceptible to slug and pill bug damage in the fall. More successful use of subclover in Oregon compared with Washington due to slightly warmer winter temperatures. Intensive grazing after seed is matured enhances establishment.



Austrian Winter Peas
(*Pisum sativum arvense*) – Top
Subterranean Clover
(*Trifolium subterraneum*) – Bottom

Seeding Methods

(plowing steep slopes will increase erosion hazard)

Spring Seeding Methods

1. ***Renovation using minimal herbicide—for fields with few weed problem***

- a. Control problem perennial weeds the year before reseeding.
- b. The fall prior to seeding, apply lime as indicated by a soil test. If no test is available, apply 2 to 5 tons per acre, depending on the previous history of the field.
- c. Graze the field in early spring to remove early growth vegetation.
- d. Plow or disc old sod as early in the spring as possible.
- e. Harrow to prepare a smooth, firm seedbed.
- f. Fertilize as indicated by a soil test. If no test is available, fertilize with a N:P:K:S fertilizer with a ratio 3:1:2:1 and at a rate of no more than 75 units of nitrogen.
- g. Plant to desired pasture species as early as possible, but usually no later than May 1.

2. ***Renovation using minimal herbicides—for fields with severe weed problems***

- a. The year before reseeding, control problem perennial weeds that will not be killed by tillage.
- b. The fall previous to seeding, apply lime as indicated by a soil test. If no test is available, apply 2 to 5 tons per acre, depending on the previous history of the field.
- c. Graze the field in early spring to remove early growth vegetation.
- d. Plow or disc old sod as early in the spring as possible.
- e. Plant a cleanup crop such as wheat, oats or annual ryegrass. This crop can be harvested for hay or grazed. If the plant has seedhead awns, harvest or graze before they appear. Fertilize as indicated by a soil test. If no test is available, fertilize with a N:P:K fertilizer with a ratio of 1:1:1 and at a rate of 50 units of nitrogen. Another option is to summer-fallow the field, working the soil repeatedly to kill the weeds.
- f. Plow or disc and harrow ground in early September and plant an overwinter cover crop to protect the soil and help control weeds.

- g. Graze or harvest the cover crop early in the spring to remove excess vegetation. Follow this by plowing or discing.
- h. Harrow to prepare a smooth, firm seedbed.
- i. Fertilize as indicated by a soil test. If no test is available, fertilize with a N:P:K:S fertilizer with a ratio 3:1:2:1 and at a rate of no more than 50 units of nitrogen.
- j. Plant to desired pasture species as early as possible, but no later than May 1.

3. ***Renovation using herbicides or herbicides/tillage—for all fields***

- a. The year before seeding, control problem perennial weeds that will not be killed by broad-spectrum herbicides.
- b. The fall prior to seeding, apply lime as indicated by a soil test. If no test is available, apply 2 to 5 tons per acre, depending on the previous history of the field.
- c. Use a broad-spectrum non-residual herbicide (such as Roundup*) in the early spring to kill the current species. The plants should have 4–6 inches of growth. If the field has been grazed, allow it to regrow to this height. Experience has shown that if tillage is delayed until the sod changes color to orange or brown, weed control will be better.
- d. Plow or disc ground, or use a no-till drill. If weed infestation is severe, allow the seeds in the soil to germinate and then apply the herbicide again, and allow it to work.
- e. If ground has been worked, harrow to prepare a smooth, firm seedbed.
- f. Fertilize as indicated by a soil test. If no test is available, fertilize with a N:P:K:S fertilizer with a ratio 3:1:2:1 and at a rate of no more than 75 units of nitrogen.
- g. Plant to desired pasture species as early as possible, but no later than May 1.

4. ***Renovation with minimal equipment or herbicides***

- a. Control problem perennial weeds such as Canada thistle the year before reseeding. Read the most current PNW Weed Control Handbook for specific weed control recommendations.
- b. The fall prior to seeding, apply lime as indicated by a soil test. If no test is available, apply 2 to 5 tons per acre, depending on the previous history of the field.
- c. Harrow vigorously or graze closely to expose bare soil. Do not do this when soil is saturated.

- d. Fertilize as indicated by a soil test. If no test is available, fertilize with a N:P:K:S fertilizer with a ratio 3:1:2:1 and at a rate of no more than 75 units of nitrogen.
- e. Plant at the “rough seedbed” seeding rate. Har-row lightly to settle seed firmly into contact with the soil surface. Keep the harrow tines out of the soil by adjusting them to the horizontal position or by turning over the harrow. Seed as early as possible for greatest success.
- f. Clip weeds as necessary after seeding. Grazing can be used to control weeds, but it needs to be very short duration and closely monitored or the seeding will be damaged or destroyed.

Fall Seeding Methods

- 1. **Renovation using conventional tillage and minimal herbicides—for fields which have droughty to well-drained soils**
 - a. Control problem perennial weeds such as Canada thistle the year before reseeding. Read the most current PNW Weed Control Handbook for specific weed control recommendations.
 - b. The fall prior to seeding, apply lime as indicated by a soil test. If no test is available, apply 2 to 5 tons per acre, depending on the previous history of the field.
 - c. Plow or disc the old sod as early in the spring as possible.
 - d. Plant a cleanup crop such as wheat, oats, or annual ryegrass. This crop can be harvested for hay or grazed. If the plant has seedhead awns, harvest or graze before they appear. Another option is to summer-fallow the field, working the soil repeatedly to kill the weeds.
 - e. Plow or disc and harrow ground in early September to prepare a smooth, firm seedbed.
 - f. Fertilize as indicated by a soil test. If no test is available, fertilize with a N:P:K:S fertilizer with a ratio 3:1:2:1 and at a rate of no more than 30 units of nitrogen.
 - g. Plant to desired pasture species as early in September as possible, but no later than October 1.
 - h. Clip weeds as necessary after seeding.

1. Renovation using herbicides or herbicides/tillage—for all fields

- a. The year before seeding, control problem perennial weeds that will not be killed by broad-spectrum herbicides.
- b. The fall prior to seeding, apply lime as indicated by a soil test. If no test is available, apply 2 to 5 tons per acre, depending on the previous history of the field.
- c. Graze until about June 1 (or take a crop of hay). Let field regrow to 4–6 inches stubble height.
- d. Use a broad-spectrum non-residual herbicide approximately June 15 to kill the sod. Experience has shown that if you delay any tillage until the sod changes color to orange or brown, weed control will be better.
- e. Either:
 - Plow or disc ground about once a month, to control weeds and undesirable grasses and aerate the soil, or
 - Apply herbicides as needed to control seedling weeds
- f. If perennial weed infestation is severe, apply the broad-spectrum non-residual herbicide again and wait until undesirable vegetation has changed color.

Herbicide application period:

- For droughty or well-drained soils: September 1–15
- For wet or sub-irrigated soils: August 1–15
- g. If ground has been worked, harrow to prepare a smooth, firm seedbed.
- h. Fertilize as indicated by a soil test. If no test is available, fertilize with a N:P:K:S fertilizer with a ratio 3:1:2:1 and at a rate of no more than 30 units of nitrogen.
- i. Plant to desired pasture species as early in September as possible, but no later than:
 - for well-drained or droughty soils—October 1
 - for wet or sub-irrigated soils—September 1
- j. Clip weeds as necessary after seeding.

3. Renovation with minimal equipment or herbicides

- a. Control problem perennial weeds.
- b. Graze pasture until early July, or harvest hay.
- c. In July, apply lime as indicated by a soil test. If no test is available, apply 2 to 5 tons per acre, depending on the previous history of the field.
- d. Harrow vigorously to expose bare soil. If weed seedlings germinate, harrow again.
- e. Fertilize as indicated by a soil test. If no test is available, fertilize with a N:P:K:S fertilizer with a ratio 3:1:2:1 and at a rate of no more than 50 units of nitrogen.
- f. Plant at the “rough seedbed” seeding rate. Har-row lightly to settle seed firmly into contact with the soil surface. Keep the harrow tines out of the soil by adjusting them to the horizontal position or by turning over the harrow. Seed by September 1.
- g. Clip weeds as necessary after seeding.

Cultivars

Current cultivar performance under trial at Washington State University and Oregon State University can be found on the Internet at <http://www.fis.orst.edu>

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