Idaho Roadside Revegetation Handbook

Prepared for:

The Idaho Transportation Department

July 2014

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The Idaho Transportation Department

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Introduction

Surface erosion, sedimentation, and shallow-seated slope failures in Idaho present a significant challenge to roadway construction and maintenance. Soil losses from such slopes deplete an important natural resource, induce excessive maintenance such as ditch and culvert clean-outs, and may adversely effect the quality of surface water in the state. Road construction and maintenance activities throughout the state are requiring greater attention to erosion and sediment control concerns due to environmental and economic pressures. Vegetation can be planted to reduce soil loss by holding soil particles in place, filtering soil particles out of run-off, intercepting raindrops, slowing overland flows, and maintaining infiltration. In Idaho, vegetation patterns and community distributions are quite complex due to precipitation extremes, topographic relief, climatic variations, and cultural practices. Precipitation zones can be used to identify species suitable for revegetation that are indigenous to specific construction sites.

This guidebook will summarize the characteristics and preferred environments of commonly used grass, grass-like, forb, legume, shrub, and tree species for roadside reclamation in Idaho. Native, introduced, and other species adapted to Idaho will be included. A potential species list was determined from numerous published and unpublished works to include field guides, seed catalogs, soil surveys, roadside plant establishment evaluations and input from the Idaho Transportation Department's roadside manager, district vegetation foreman and design manual. Plant materials included n the potential plant list have root and shoot growth habits that are resistant to the forces of erosion and have the ability to colonize disturbed sites. The format was created to include a title page, brief introduction, table of contents, page for each species, quick reference tables, a reference list, and appropriate enclosures in an appendix. The species page features a line drawing of the plant, a vegetation distribution map, and a species description

which includes life span, growth habit, origin, vegetation characteristics, habitat requirements, and soil stabilization properties.

The data represented in this guidebook are a summary of observations of revegetation specialists, information from research publications, and field surveys. Compiling available vegetation data into one comprehensive guidebook serves as an extremely useful tool for roadside managers locally and regionally. The revegetation guidebook can also serve as a reference to other reclamation, restoration, horticulture, and landscape projects throughout Idaho.

Acknowledgement of Revision

This manual was revised for content and accuracy of content in July 2014 by Cathy Ford and Jennifer Catanese. Among the revisions is the inclusion of 9 new plant pages featuring Woods' Rose, Sulphur-flower buckwheat, Black hawthorne, Silvery lupine, Silky lupine, Prairie coneflower, Low larkspur, Hardstem bulrush, and Green needlegrass.

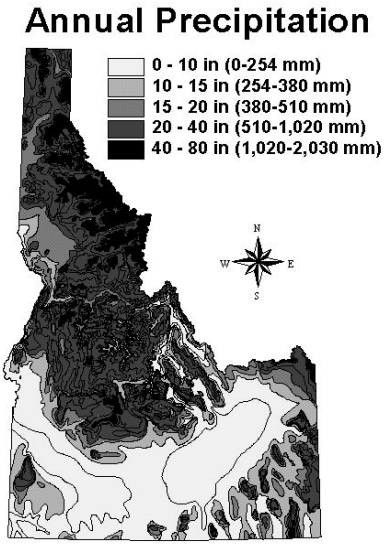
Revegetation summary tables and diagrams have been updated to reflect the most accurate and recent information and the "Topsoil Application for Revegetation of Roadsides" essay includes more in-depth scientific basis and additional supporting evidence.

Crested Wheatgrass

Agropyron cristatum

Richard W. Scott (1995)

Dave Powell USDA



LIFE SPAN: Perennial, long-lived.

GROWTH HABIT: Bunchgrass.

ORIGIN: Introduced.

VEGETATIVE CHARACTERISTICS:
Cool-season. Leaves are flat. Spiklets are flat. Rhizomatous at precipitation zones above 14 in, and roots reach a minimum depth of 8 in. Grows 24-39 in tall.

SITE REQUIREMENTS:

Precipitation zone.
Ranges from 0-18 in.

Elevation zone.
Below 7,000 ft.

Habitat & Climate requirements.
Adapted to the climatic conditions in the arid regions of the Intermountain West that have frost-free periods greater than 120 days.

Soil type.
Well-drained, moderately coarse, or medium-textured soils with a minimum depth of 10 in. Intolerant of silty soils.

APPLICATIONS:

Roadside suitability.
Little maintenance is required. Adapted to grazing, traffic, and disturbed sites. Used on mine spoils and roadsides. Tolerates drought, cold, and fire.

Establishment.
Germinates and establishes readily, seedlings develop slowly, good seed producer.

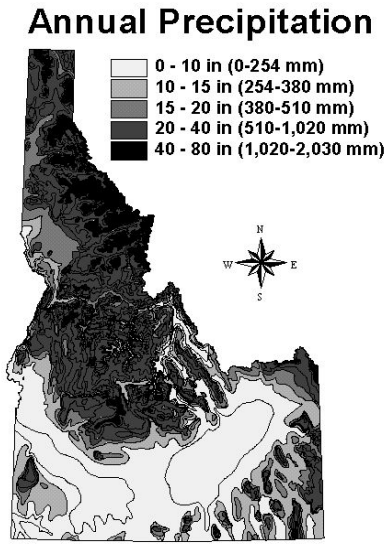
SEEDING RECOMMENDATIONS:
Plant in fall or early spring at a depth of 0.25-0.5 in. Seed 3-7 PLS lb per acre. There are 265,250 seeds per lb.

Thickspike Wheatgrass

Agropyron dasystachyum

Richard W. Scott (1995)

Rob Routledge, Sault College



LIFESPAN: Perennial, long-lived

GROWTH HABIT: Sod-former

ORIGIN: Native

VEGETATIVE CHARACTERISTICS:
Cool-season and creeping. Leaves are green to blue-green, narrow, smooth with slightly curled margins. Roots are fibrous to 10 in deep with rhizomes. Grows 16-32 in tall.

SITE REQUIREMENTS:

Precipitation zone.
Ranges from 8-20 in.

Elevation zone.
Ranges from 3800 to 10,000 ft.

Habitat & Climate requirements.
Adapted to a wide range of climatic conditions throughout the northern Intermountain region.

Soil type.
Well-drained, shallow to deep, course- to fine-textured, sandy soils.

APPLICATIONS:

Roadside suitability.
Forms a thick mat of roots in the upper 8-15 in of soil. Used for soil stabilization and to suppress weeds. Tolerates drought, fire, and weakly acidic to moderately alkaline soils.

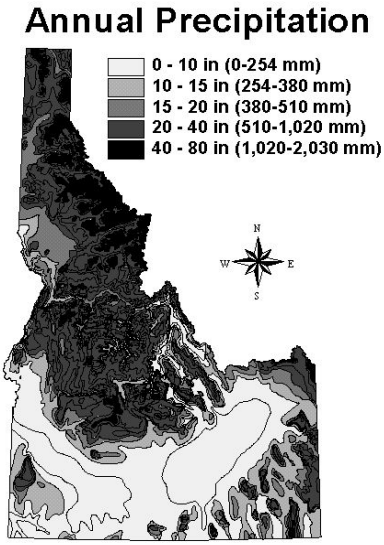
Establishment.
Germinates readily and has good seedling vigor. Not recommended to seed with strongly competitve plants.

SEEDING RECOMMENDATIONS:
Plant in early spring to late fall at a depth of 0.25-0.5 in. Seed 6-8 PLS lb per acre. There are 154,000 seeds per lb.

Intermediate Wheatgrass

Agropyron intermedium

James Stubbendieck et al. (1997)



LIFE SPAN: Perennial, long-lived.

GROWTH HABIT: Sod-former

ORIGIN: Introduced

VEGETATIVE CHARACTERISTICS:
Cool-season. Leaves are tapering, strongly veined, and green. Roots can reach a minimum depth of 20 in. Grows 2-4 ft tall.

SITE REQUIREMENTS:

Precipitation zone.
Minimum of 14 in.

Elevation zone.
Ranges from 3,500-9,000.

Habitat & Climate requirements.
Adapted to semi-humid conditions.

Soil type.
Well-drained, medium- to fine-textured soils.

APPLICATIONS:

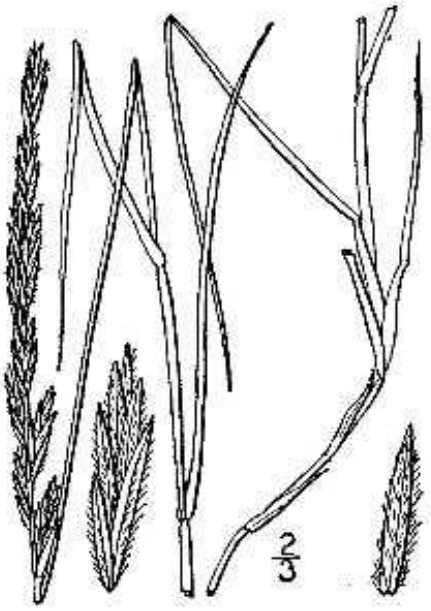
Roadside suitability.
Robust. Commonly used for roadside revegetation and restoration of disturbed sites. Tolerates moderate drought.

Establishment.
Reproduces from seeds, tillers, and rhizomes. Excellent seedling vigor and stand establishment.

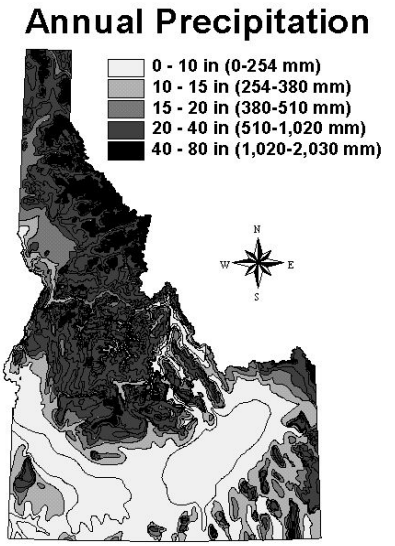
SEEDING RECOMMENDATIONS:
Plant in the fall or early spring at a depth of 0.5-1 in. Seed 8-10 PLS lb per acre. There are 88,000 seeds per lb.

Streambank Wheatgrass

Agropyron riparium



Britton, N.L. and A. Brown (1913)



LIFE SPAN: Perennial, long-lived.

GROWTH HABIT: Sod-former

ORIGIN: Native

VEGETATIVE CHARACTERISTICS:
Cool-season and creeping. Leaves are short, narrow, smooth, and somewhat curled at the margins. Rhizomatous roots that can reach a minimum depth of 18 in. Grows 16-32 in tall.

SITE REQUIREMENTS:

Precipitation zone.
Ranges from 10-25 in.

Elevation zone.
Ranges from 3,800-10,000 ft.

Habitat & Climate requirements.
Adapted to the climatic conditions of the Northern Great Plains and the Intermountain West.

Soil type.
Fine- to medium-textured, well-drained soils.

APPLICATIONS:

Roadside suitability.
Requires minimal maintenance. Used to suppress weeds and stabilize banks, roadsides, and eroded areas.

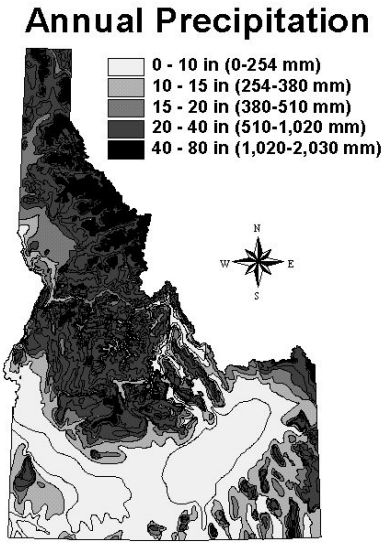
Establishment.
Germinates quickly and has excellent seedling vigor. Not recommended to seed with strongly competitive introduced species.

SEEDING RECOMMENDATIONS:
Plant early spring or late fall at a depth of 0.25-0.5 in. Seed 6-8 PLS lb per acre. There are 156,000 seeds per lb.

Siberian Wheatgrass

Agropyron sibiricum

A.L. Haferrichter et al. (1979)



LIFE SPAN: Perennial, long-lived.

GROWTH HABIT: Bunchgrass.

ORIGIN: Introduced.

VEGETATIVE CHARACTERISTICS:
Fine-leaved, cool-season grass. Roots are extensive with weak rhizomes when annual precipitation exceeds 14 in, and reach a minimum depth of 10 in. Grows 24-35 in tall.

SITE REQUIREMENTS:

Precipitation zone.
Ranges from 6-12 in.

Elevation zone.
Below 7,000 ft.

Habitat & Climate requirements.
Adapted to areas with a frost-free period less than 120 days.

Soil type.
Well-drained, shallow to deep, moderately course to fine-textured loamy or sandy soil.

APPLICATIONS:

Roadside suitability.
Weed barrier and competitive with introduced grasses. Tolerates drought and fire. Also tolerates weakly acidic to moderately alkaline soil, as well as saline soils.

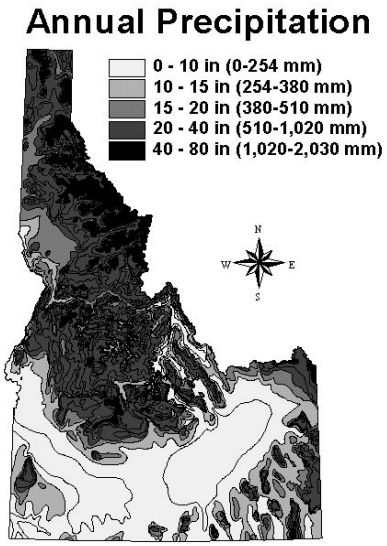
Establishment.
Poor seedling vigor but is easy to germinate.

SEEDING RECOMMENDATIONS:
Plant in fall or early spring at a rate of 3-7 PLS lb per acre. There are 170,000 seeds per lb.

Western Wheatgrass

Agropyron smithii

James Stubbendieck et al. (1997)



LIFE SPAN: Perennial, long-lived.

GROWTH HABIT: Sod-former

ORIGIN: Native

VEGETATIVE CHARACTERISTICS:
Cool-season. Leaves are blue-green and coarse with prominent veins. Inflourescence is a spike with hairy sheaths. Roots are fibrous with strong and spreading rhizomes and can reach a minimum depth of 20 in. Grows 12-36 in tall.

SITE REQUIREMENTS:

Precipitation zone.
Ranges from 10-14 in.

Elevation zone.
Ranges from 1,000-9,000 ft.

Habitat & Climate requirements.
Adapted to a wide range of climatic conditions.

Soil type.
Well-drained, heavy and fine to very fine soils.

APPLICATIONS:

Roadside suitability.
Aggressive, resistant to environmental stress, and is used for erosion control. Tolerates cold, moderately saline, and weakly acidic soils.

Establishment.
Poor germination rates, low seedling vigor, aggressive once established, and very persistent.

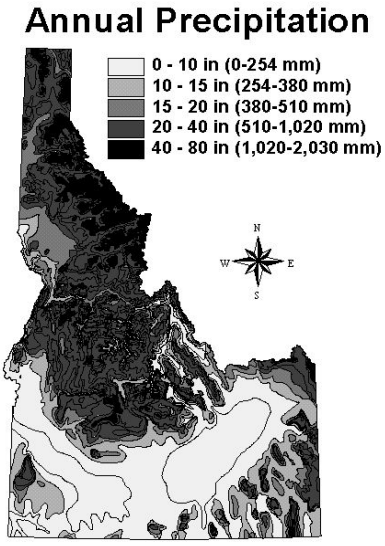
SEEDING RECOMMENDATIONS:
Plant in fall or spring. Seed 6-8 PLS lb per acre. There are 110,000 seeds per lb.

Bluebunch Wheatgrass

Agropyron spicatum

Richard W. Scott (1995)

Howard Scwartz CSU



LIFE SPAN: Perennial, long-lived.

GROWTH HABIT: Bunchgrass

ORIGIN: Native

VEGETATIVE CHARACTERISTICS:
Cool-season. Leaves are green to blue, lax, and flat to inrolled. Roots are extensive with strong tillers and rhizomes in high rainfall areas and can reach a minimum depth of 10 in. Grows 1-2 ft tall.

SITE REQUIREMENTS:

Precipitation zone.
Ranges from 10-40 in.

Elevation zone.
Ranges from 500-10,000 ft. Low plant vigor on poor sites above 6,500 ft.

Habitat & Climate requirements.
Adapted to a wide range of climatic conditions throughout sagebrush, ponderosa pine, mountain brush, and juniper lands.

Soil type.
Well-drained, medium- to course-textured soils over 10 in deep including very sandy soils or thin, rocky sites and on very steep slopes.

APPLICATIONS:

Roadside suitability.
Not compatable with aggressive introduced grasses. Tolerates cold, shade, drought, and fire. Intolerant of high water tables and poor drainage.

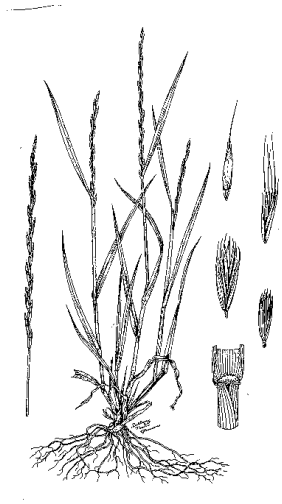
Establishment.
Several years are required to gain full productivity.

SEEDING RECOMMENDATIONS:
Plant in fall. Seed 8-14 PLS lb per acre. There are 140,000 seeds per lb.

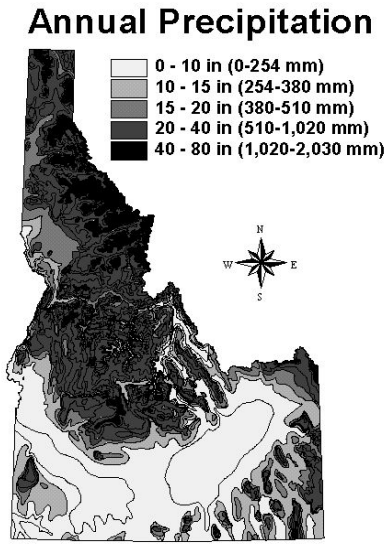
Slender Wheatgrass

Agropyron trachycaulum

Dave Powell USDA



James Stubbendieck et al. (1997)



LIFE SPAN: Perennial, long-lived.

GROWTH HABIT: Bunchgrass

ORIGIN: Native

VEGETATIVE CHARACTERISTICS:
Cool-season, erect and tufted. Seed stalks and stems have a reddish to purple base. Roots are fibrous extending 20 in with tillers and very short rhizomes. Grows 24-30 in tall.

SITE REQUIREMENTS:

Precipitation zone.
Ranges from 12-30 in.

Elevation zone.
Ranges from 4,500-12,000 ft.

Habitat & Climate requirements.
Adapted to a wide range of soil moisture conditions of the Intermountain Northwest and Northern Great Plains. Withstands temperatures to -40 F.

Soil type.
Well-drained, clay loam, loam, and sandy loam soils with a pH of 6.0-9.0.

APPLICATIONS:

Roadside suitability.
Commonly used for reclamation. Tolerates saline.

Establishment.
Good seedling vigor, germination rate, genetic variability, and establishment.

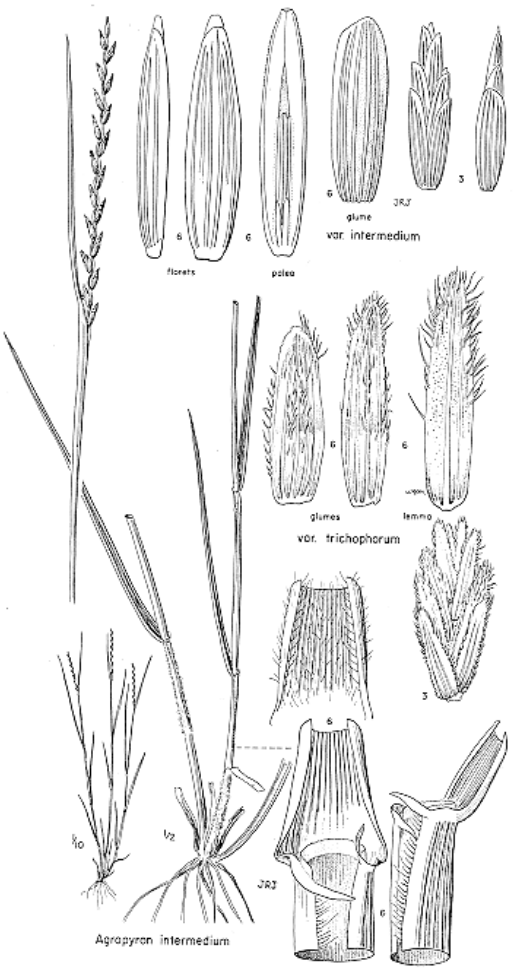
SEEDING RECOMMENDATIONS:

Plant in early fall at a depth of 0.25-0.75 in. Seed 6-8 PLS lb per acre. There are 159,000 seeds per lb .

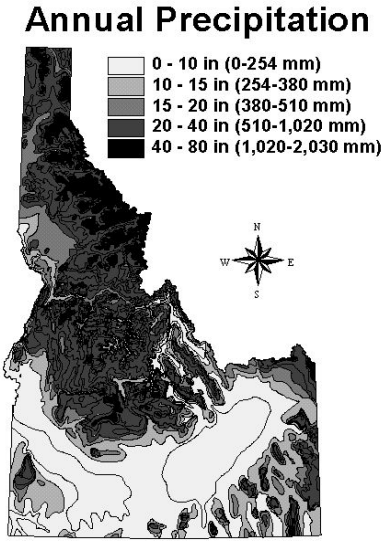
GRASSES

Pubescent Wheatgrass

Agropyron trichophorum



R.H. Mohlenbrock (1972)



LIFE SPAN: Perennial, long-lived.

GROWTH HABIT: Sod-former

ORIGIN: Introduced

VEGETATIVE CHARACTERISTICS:
Cool-season, robust, and strongly rhizomatous. Roots can reach a minimum depth of 20 in. Grows 13-14 in tall.

SITE REQUIREMENTS:

Precipitation Zone.
Ranges from 11-16 in, 12 in below 3,500 ft in elevation and 10 in above 3,500 ft.

Elevation zone.
Wide range.

Habitat & Climate requirements.
Adapted to a wide range of climatic conditions along foothills within semi-humid to semi-arid environments.

Soil type.
Well-drained, loamy, clay soils.

APPLICATIONS:

Roadside suitability.
Aggressive and remains green in the summer. Used primarily for perminent seedings and erosion control. Tolerates drought and slightly acidic, neutral, or mildly alkaline soils.

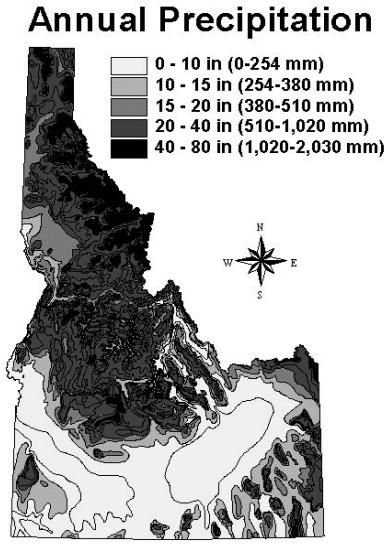
Establishment.
Easy germination. Low fertility requirement.

SEEDING RECOMMENDATIONS:
Plant in fall or early spring at a depth of 0.5-1 in. Seed 6-8 PLS lb per acre. There are 100,000 seeds per lb.

Mountain Brome

Bromus carinatus

Howard Schwartz CSU



LIFE SPAN: Perennial, short-lived.

GROWTH HABIT: Bunchgrass

ORIGIN: Native

VEGETATIVE CHARACTERISTICS:
Cool-season, grass with course culms and broad leaves. Roots can reach a minimum depth of 12 in. Grows 15-30 in tall.

SITE REQUIREMENTS:

Precipitation zone.
Ranges from 12-16 in.

Elevation zone.
Ranges from 500-10,000 ft.

Habitat & Climate requirements.
Adapted to a wide range of semi-arid conditions across the Intermountain area. Withstands temperatures to -40 F.

Soil type.
Clay to sandy loam soils with a pH of 5.5-7.5.

APPLICATIONS:

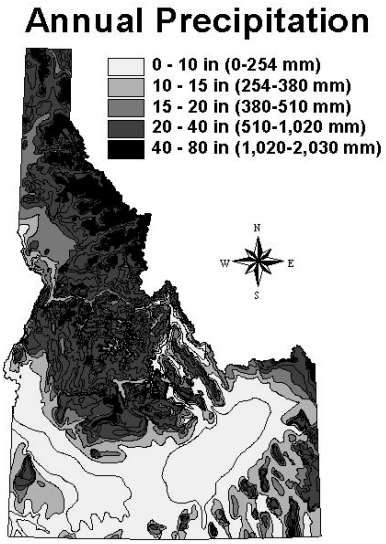
Roadside suitability.
Reaches full productivity in 1-3 years. Used for conservation work. Winter-hardy and moderately sensitive to saline. Tolerates shade and drought. Intolerant of high water tables.

Establishment.
Establishes quickly and has a low fertility requirement. Reseeds itself readily.

SEEDING RECOMMENDATIONS:
Plant in fall or early spring. Seed 6-8 PLS lb per acre. There are 64,000 seeds per lb.

Smooth Brome
Bromus inermis

James Stubbenieck et al. (1997)



LIFE SPAN: Perennial, long-lived.

GROWTH HABIT: Sod-former.

ORIGIN: Introduced.

VEGETATIVE CHARACTERISTICS:
Cool-season and strongly rhizomatous. Leaf blades are smooth and broad 0.2-0.5 in. Roots can reach a minimum depth of 12 in. Grows 13-25 in all.

SITE REQUIREMENTS:

Precipitation zone.
Ranges from 12-18 in.

Elevation zone.
Above 4,000 ft.

Habitat & Climate requirements.
Adapted to a wide range of climatic conditions throughout the Intermountain West. Withstands temperature to -40 F.

Soil type.
Well-drained, deep, fertile, clay loam to sandy loam with neutral pH.

APPLICATIONS:

Roadside suitability.
Aggressive, low-growing, and vigorous. Used for erosion control and weed supression. Tolerates shade.

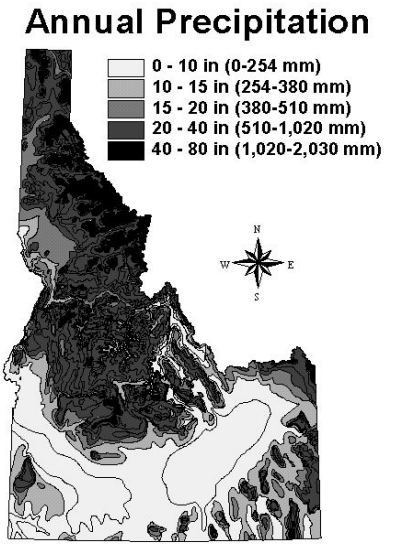
Establishment.
Germinates readily and seedlings grow rapidly. Moderate to high fertility requirement.

SEEDING RECOMMENDATIONS:
Plant in fall or spring at a depth of 0.25-0.5 in. Seed 4-5 PLS lb per acre. There are 125,000 seeds per lb.

Columbia Brome

Bromus vulgaris

Patricia A. Patterson et al. (1985)
Clinton H. Wasser (1982)



LIFE SPAN: Perennial.

GROWTH HABIT: Bunchgrass

ORIGIN: Native.

VEGETATIVE CHARACTERISTICS:
Cool season. Plants are tall, pubescent, and robust. Leaves are broad. Inflorescence is a narrow drooping panicle. Thick, fibrous roots that reach a minumum depth of 8 in. Grows 18-47 in tall.

SITE REQUIREMENTS:

Precipitation zone
Ranges from 11-20 in.

Elevation zone.
Ranges from 2,500-5,500 ft.

Habitat & Climate requirements. Adapted to cool, wet winters and warm dry summers. Requires a minimum 100 frost-free days and can withstand temperatures to -23 F.

Soil type.
Volcanic ash, sandy loam, and deep, well-drained loess.

APPLICATIONS:

Roadside suitability.
Used for erosion control and weed suppression where shade is a factor.

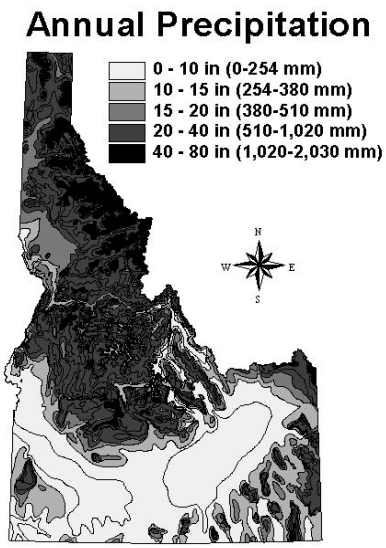
Establishment.
Resistant to fire and has 43-86% germination in the first year. Seedling vigor is high with a moderate spread rate.

SEEDING RECOMMENDATIONS: Plant in the fall or early spring at a depth of 0.25 in. There are 79,600-119,500 seeds per lb .

Pinegrass

Calamagrostis rubescens

James Stubbendieck et al. (1997)



LIFE SPAN: Perennial, long-lived.

GROWTH HABIT: Sod-former.

ORIGIN: Native.

VEGETATIVE CHARACTERISTICS:
Cool-season. Leaf blades are scabrous, flat, or somewhat rolled. Infloresence is a dense, long, cylindrical, purplish panicle. Roots are strong and well developed with creeping rhizomes, and can reach a minimum depth of 7 in. Grows 24-40 in tall.

SITE REQUIREMENTS:

Precipitation zone.
Ranges from 18-40 in.

Elevation zone.
Ranges from 0-10,000 ft.

Habitat & Climate requirements.
Adapted to a wide range of climatic conditions in the Northwest. Requires a minimum 100 frost-free days, and can tolerate temperatures to -28 F.

Soil type.
Well-drained, fine and medium-textured soils.

APPLICATIONS:

Roadside suitability.
Used for soil cover. Tolerates drought and fire.

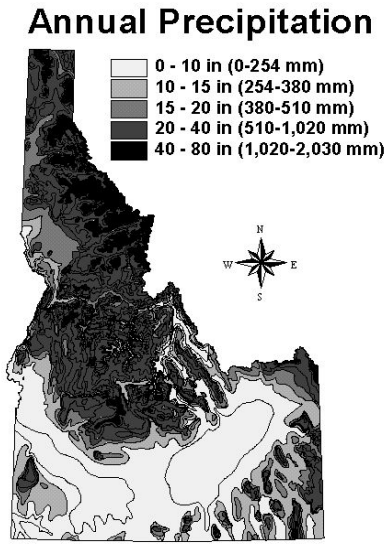
Establishment.
Difficult to germinate. Not very aggressive.

SEEDING RECOMMENDATIONS:
Plant in the fall or early spring. Seed 1-2 lb PLS per acre where topsoil is present. There are 2,646,000 seeds per lb.

Orchardgrass
Dactylis glomerata

A.S.Hitchcock (1971)

Steve Dewey USU



LIFE SPAN: Perennial, long-lived.

GROWTH HABIT: Bunchgrass.

ORIGIN: Introduced.

VEGETATIVE CHARACTERISTICS:
Cool-season. Leaves are basal and abundant. Stems are leafy and upright. Roots are medium-sized, fibrous, and can reach a minimum depth of 12 in. Grows 24-47 in tall.

SITE REQUIREMENTS:

Precipitation zone.
Ranges from 11-20 in.

Elevation zone.
Ranges from 6,500-9,000 ft.

Habitat & Climate requirements.
Adapted to subhumid climatic conditions. Requires 145 frost-free days and tolerates temperatures to -43 F.

Soil type.
Well-drained alluvial soils that are medium to moderately fine-textured.

APPLICATIONS:

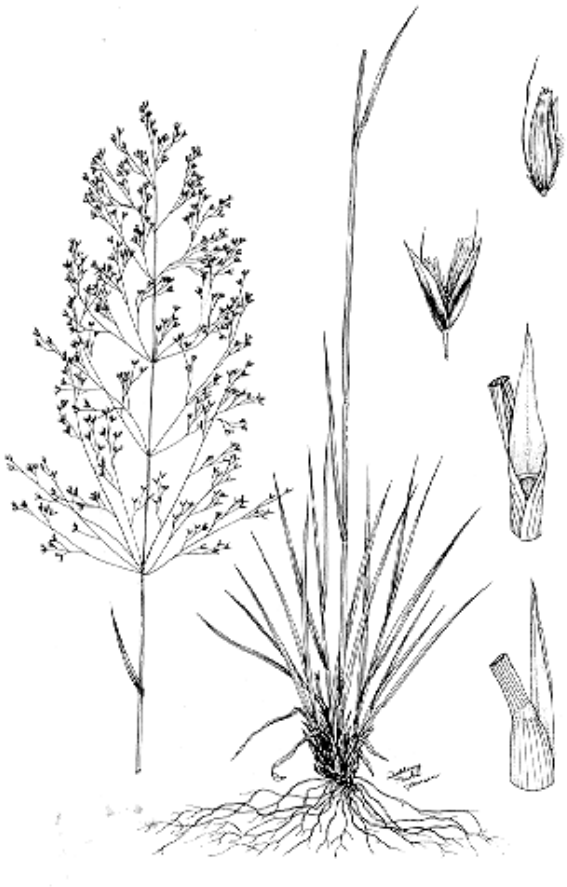
Roadside suitability.
Persistent. Used for erosion control. Tolerates shade, drought, and fire. As well as moderately acidic to mildly alkaline soils. Intolerant of saline soils.

Establishment.
Medium germination rate. Slow seed spread rate, but high seedling vigor.

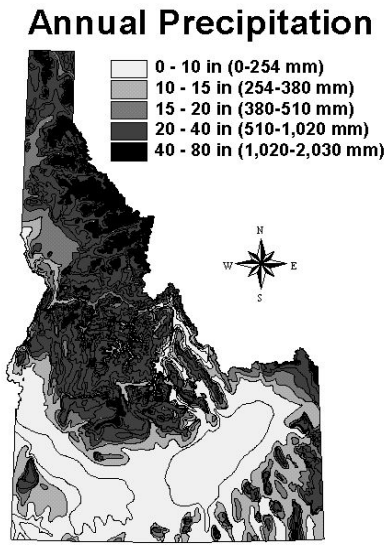
SEEDING RECOMMENDATIONS:
Plant in early spring or fall at a depth of 0.25-0.5 in. Seed 2-3 PLS lb per acre. There are 654,000 seeds per lb.

Tufted Hairgrass

Deschampsia cespitosa



James Stubbendiek et al. (1997)



LIFE SPAN: Perennial, long-lived.

GROWTH HABIT: Bunchgrass.

ORIGIN: Native.

VEGETATIVE CHARACTERISTICS:
Cool-season and densely tufted. Leaves are abundant and vary in texture from fine to very coarse. Inflorescence is a diffuse panicle. Roots can reach a minimum depth of 14 in. Grows 18-24 in tall.

SITE REQUIREMENTS:

Precipitation zone.
Ranges from 20-40 in.

Elevation zone.
Ranges from 5,000 -13,000 ft.

Habitat & Climate requirements.
Adapted to a wide range of cool conditions in open mountain areas of most western states. Withstands temperatures to -40 F.

Soil type.
Wet or hydric clay to sandy loam soils with acidic to basic pH levels.

APPLICATIONS:

Roadside suitability.
Pioneer species on disturbed sites. Used for shoreline stabilization, wetland enhancement, restoration, and filter strips.

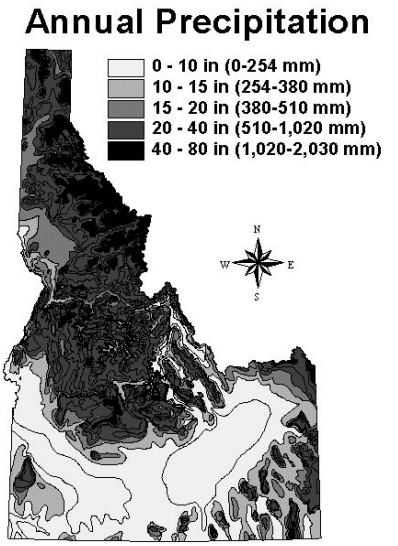
Establishment
Slow to establish, low seed production and moderate seedling growth. Low to moderate fertility requirement.

SEEDING RECOMMENDATIONS:
Plant in fall. Seed 2-4 PLS lb per acre. There are 1,500,000 seeds per lb.

Basin Wildrye

Elymus cinereus

James Stubbendiek et al. (1997)



LIFE SPAN: Perennial, long-lived.

GROWTH HABIT: Bunchgrass.

ORIGIN: Native.

VEGETATIVE CHARACTERISTICS:
Cool-season, erect, robust, and slightly spreading. Leaves are flat. Roots can reach a minimum depth of 16 in. Grows 2-8 ft tall.

SITE REQUIREMENTS:

Precipitation zone.
Ranges from 5-20 in.

Elevation zone.
Ranges from 0-9,000 ft.

Habitat & Climate requirements.
Adapted to areas with wet winters and dry summers. Often associated with juniper, mountain brush, and aspen communities.

Soil type.
Clay to loamy soils with moderately course- to moderately-fine-texture. Also withstands sandy areas.

APPLICATIONS:

Roadside suitability.
Poor competitor. Plant seperately from other species. Tall, spreads by short, thick rhizomes. Tolerates drought, salty, and alkaline soils.

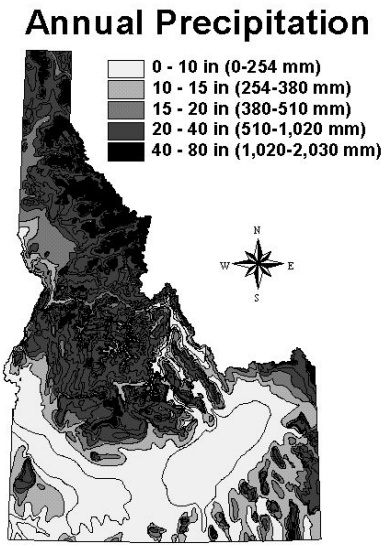
Establishment.
Slow to establish, fair seedling vigor, and good germination. Low fertility requirement.

SEEDING RECOMMENDATIONS:
Plant in fall or early spring at a depth of 0.5-0.75 in. Seed 6-10 PLS lb. There are 130,000 seeds per lb.

Blue Wildrye

Elymus glaucus

Richard W. Scott (1995)



LIFE SPAN: Perennial, short-lived.

GROWTH HABIT: Bunchgrass.

ORIGIN: Native.

VEGETATIVE CHARACTERISTICS:
Cool-season. Broad leaved, robust with dense, fibrous roots that can reach a minimum depth of 12 in. Grows 24-47 in tall.

SITE REQUIREMENTS:

Precipitation zone.
Ranges from 12-40 in.

Elevation zone.
Ranges from 0-6,000 ft.

Habitat & Climate requirements. Adapted to the climatic conditions of semi-shaded areas from the coast to the mid-montane. Withstands temperatures to -30 F.

Soil type.
Deep, clay loam to sandy loam soils with a pH of 5.5-7.5.

APPLICATIONS:

Roadside suitability.
Compatible with woody plants, provides quick effective ground cover, and is used for erosion control. Tolerates shade and moderate salinity.

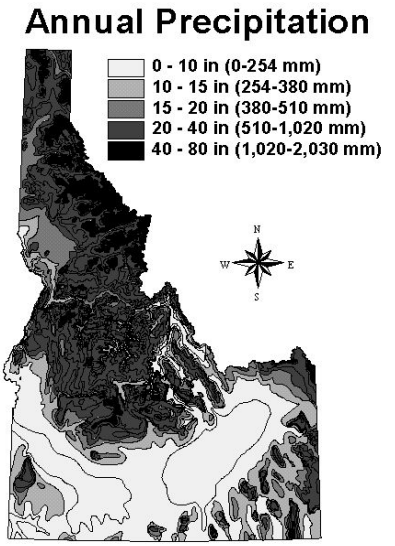
Establishment.
Rapid seedling growth and 90% germination in the first year. Low fertility requirement.

SEEDING RECOMMENDATIONS:
Plant in fall at a depth of 0.25-0.5 in. Seed 9 PLS lb per acre. There are 124,000-155,000 seeds per lb.

Tall Fescue

Festuca arundinacea

R.H. Mohlenbrock (1972)



LIFE SPAN: Perennial, long-lived.

GROWTH HABIT: Bunchgrass.

ORIGIN: Introduced.

VEGETATIVE CHARACTERISTICS:
Cool-season and robust. Leaves are broad. Roots are course, tough, and abundant and can reach a minimum depth of 12 in. Culms stand 20-80 in all.

SITE REQUIREMENTS:

Precipitation zone.
Ranges from 15-40 in.

Elevation zone.
Ranges from 500-10,000 ft.

Habitat & Climate requirements.
Adapted to subhumid areas.

Soil type.
Deep, loamy, clay, poorly-drained soils with pH 5.5-7.0.

APPLICATIONS:

Roadside suitability.
Winter-hardy, invasive, and remains green in dry summers. Used to stabilize cuts, fills, dikes, and deep waterways.

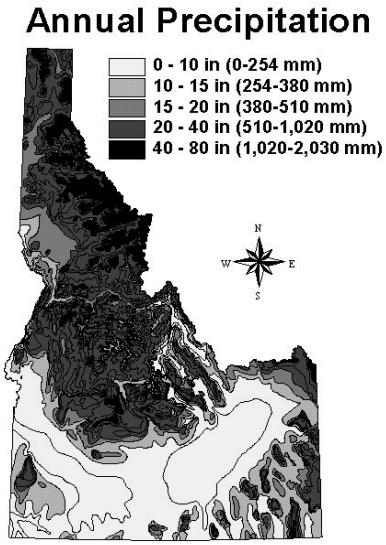
Establishment.
Easy to establish, rapid germination rate, and good seedling vigor. Low fertility requirement.

SEEDING RECOMMENDATIONS:
Plant in fall or early spring at a depth of 0.25-0.5 in. Seed 3-6 PLS lb per acre. There are 227,000 seeds per lb.

Idaho fescue

Festuca idahoensis

James Stubbendieck et al. (1997)



LIFE SPAN: Perennial, long-lived.

GROWTH HABIT: Bunchgrass.

ORIGIN: Native.

VEGETATIVE CHARACTERISTICS:
Leaves are basal, bluish green, and fine. Stems grow primarily from the base. Roots can reach a minimum depth of 14 in. Grows 12-39 in tall.

SITE REQUIREMENTS:

Precipitation zone.
Ranges from 10-40 in.

Elevation zone.
Ranges from 800-12,000 ft.

Habitat & Climate requirements.
Adapted to a wide range of climatic conditions.

Soil type.
Medium-textured, fairly dry, well-drained, moderately deep, sandy, or gravelly loams. Coarser soils on steep north slopes.

APPLICATIONS:

Roadside suitability.
Low-growing and is used to compete against cheatgrass. Tolerates slightly saline and alkaline soils.

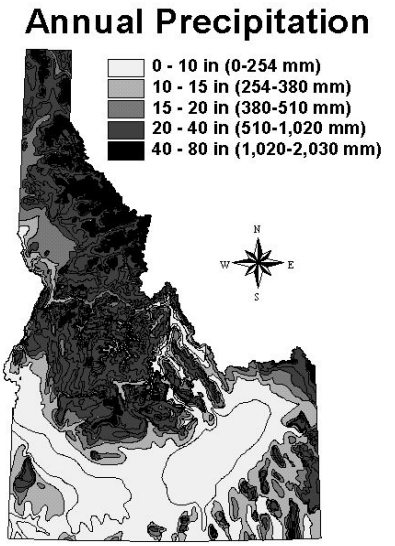
Establishment.
Good germination, low seedling vigor, and slow to establish.

SEEDING RECOMMENDATIONS:
Plant in fall or early spring. Seed 3-6 PLS lb per acre. There are 450,000 seeds per lb.

Hard Fescue

estuca longifolia

C.E. Hubbard (1954)



LIFE SPAN: Perennial, long-lived.

GROWTH HABIT: Bunchgrass.

ORIGIN: Introduced.

VEGETATIVE CHARACTERISTICS:
Leaves are very fine and abundant. Roots are densely fibrous and can reach minimum depths of 10 in. Grows 12-14 in tall.

SITE REQUIREMENTS:

Precipitation zone.
Ranges from 12-40 in.

Elevation zone.
Ranges from 500-12,000 ft.

Habitat & Climate requirements.
Adapted to a wide range of climatic conditions.

Soil type.
Shallow, well-drained, clay-to-sandy soils with a pH of 5.5-7.5.

APPLICATIONS:

Roadside suitability.
Low-growing, persistent, and competitive. Good soil binder. Used for soil protection on roadsides, ditchbanks, airport runways, and skid trails. Tolerates drought and medium-acidic to mildly alkaline soils.

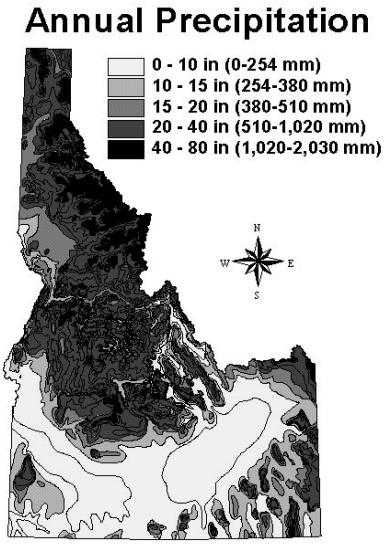
Establishment.
Good seed production and germination, slow seedling growth with a moderate fertility requirement.

SEEDING RECOMMENDATIONS:
Plant in spring or early fall at a depth of 0.25-0.5 in. . Seed 3-6 PLS lb per acre. There are 565,000 seeds per lb .

Sheep Fescue

Festuca ovina

L. Brown (1979)



LIFE SPAN: Perennial, long-lived.

GROWTH H

ORIGIN: Introduced.

VEGETATIVE CHARACTERISTICS:
Cool-season with low top production. Leaves are blue-green, fine, and short. Roots can reach a minimum depth of 10 in. Grows 8-16 in tall.

SITE REQUIREMENTS:

Precipitation zone.
Ranges from 9-24 in.

Elevation zone.
Ranges from 3,500-11,000 ft.

Habitat & Climate requirements.
Adapted to the climatic conditions of open woods and stony slopes. Withstands temperatures to -40 F.

Soil type.
Shallow, clay, sandy loam, sandy, gravelly soils with a pH of 5.5-7.5.

APPLICATIONS:

Roadside suitability.
Competes aggressively with weeds, provides ground cover, and has excellent root growth. Used for bank stabilization. Tolerates drought and moderate salinity.

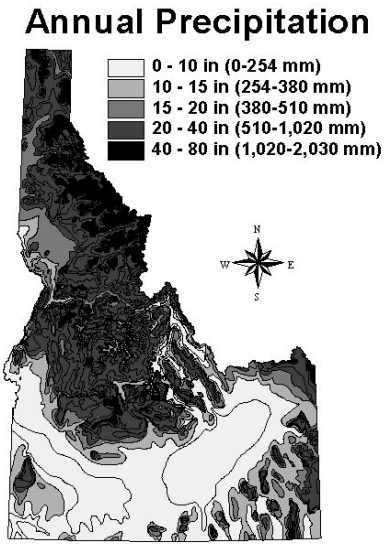
Establishment.
Good germination rate, good seed production, and slow to establish but persistent. Low fertility requirement.

SEEDING RECOMMENDATIONS:
Plant in fall or spring. Seed 3-6 PLS lb per acre. There are 680,000 seeds per lb.

Red Fescue

Festuca rubra

A.S. Hitchcock (1971)



LIFE SPAN: Perennial, long-lived.

GROWTH HABIT: Bunchgrass.

ORIGIN: Native to eastern US, but not to Idaho.

VEGETATIVE CHARACTERISTICS:
Leaves are fine. Roots are weakly rhizomatous and can reach a minimum depth of 12 in. Grows 16-39 in tall.

SITE REQUIREMENTS:

Precipitation zone.
Ranges from 18-40 in.

Elevation zone.
Ranges from 3,700-8,000 ft.

Habitat & Climate requirements.
Adapted to cool, moist, climatic conditions.

Soil type.
Well-drained, sandy, or gravelly soils with a pH of 5.5-6.5.

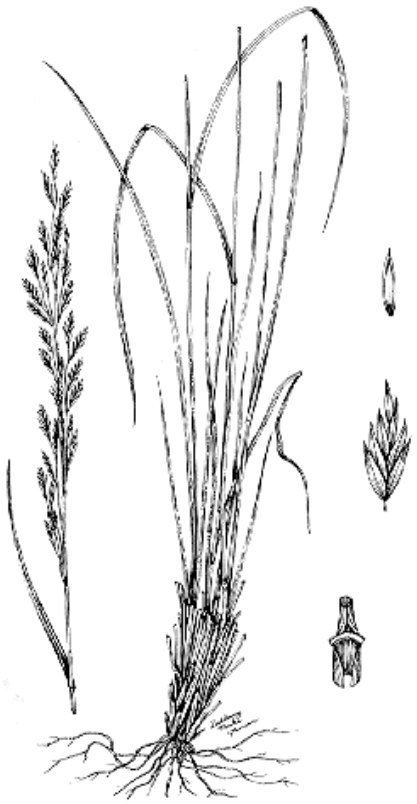
APPLICATIONS:

Roadside suitability.
Low growing, hardy, and competitive. Used for stabilizing roadsides, waterways, slopes, banks, cuts, and fills. Tolerates shade and salt.

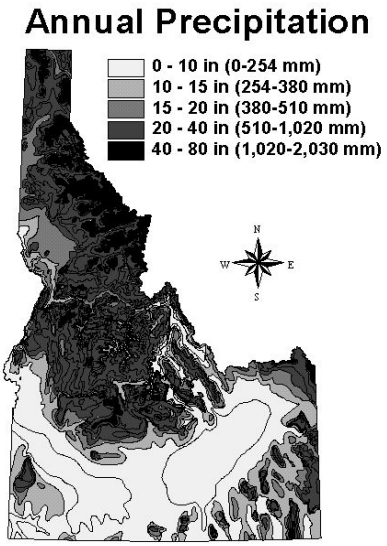
Establishment.
Developes slowly. Low fertility requirement.

SEEDING RECOMMENDATIONS:
Plant in fall or early spring. Turf application, 3-6 PLS lb per acre. There are 615,000 seeds per lb.

Rough Fescue
Festuca scabrella



James Stubbendieck et al. (1997)



LIFE SPAN: Perennial.

GROWTH HABIT: Bunchgrass.

ORIGIN: Native.

VEGETATIVE CHARACTERISTICS:
Erect and tufted. Leaves are prominently ridged and mostly basal. Roots can reach a minimum depth of 14 in. Grows 12-48 in tall.

SITE REQUIREMENTS:

Precipitation zone.
Ranges from 20-40 in.

Elevation zone.
Up to 10,000 ft.

Habitat & Climate requirements.
Adapted to a wide range of climatic conditions. Requires 90 frost-free days and tolerates temperatures to -38 F.

Soil type.
Deep, dry, medium- and coarse-textured soils.

APPLICATIONS:

Roadside suitability.
Forms an extensive fibrous root system.

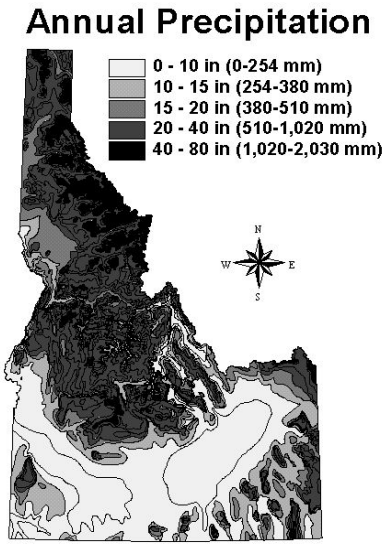
Establishment.
Easily established. Stands take 3-4 years to fully develop.

SEEDING RECOMMENDATIONS:
Plant at a shallow depth. Seed 3-6 PLS lb per acre. There are 200,000 seeds per lb.

Barley

Hordeum vulgare

A.S. Hitchcock (1971)



LIFE SPAN: Annual.

GROWTH HABIT: Bunchgrass.

ORIGIN: Introduced.

VEGETATIVE CHARACTERISTICS:
Cool-season. Blades are flat, with an erect spike inflorescence. Roots can reach a minimum depth of 12 in. Grows 23-47 in tall.

SITE REQUIREMENTS:

Precipitation zone.
Minimum of 12 in.

Elevation zone.
Up to 7,000 ft.

Habitat & Climate requirements.
Adapted to a wide range of climatic conditions.

Soil type.
Medium- to fine-textured with neutral pH.

APPLICATIONS:

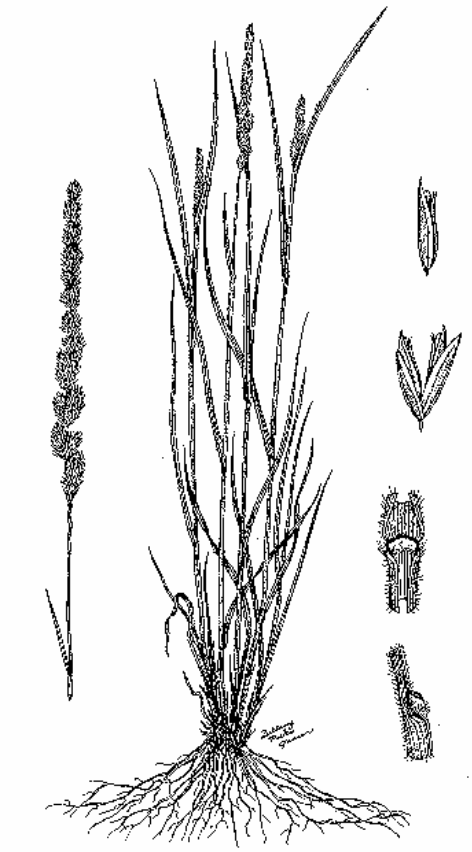
Roadside suitability.
Used as a cover or nurse crop. Perennials will out-compete. Moderately tolerates drought and alkaline or saline soils.

Establishment.
Excellent initial germination.

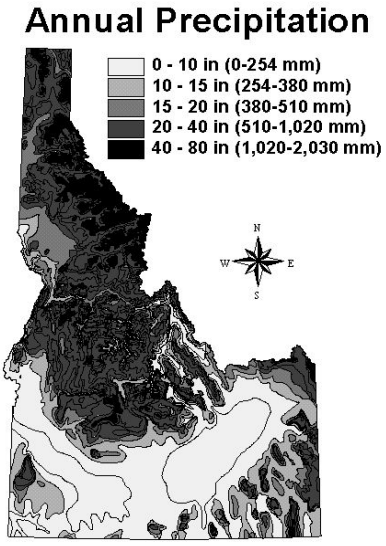
SEEDING RECOMMENDATIONS:
Plant in fall or early spring. For crops, seed 3-6 PLS lb per acre. There are 12,500 seeds per lb.

Prairie Junegrass

Koeleria cristata



James Stubbendieck et al. (1997)



LIFESPAN: Perennial, long-lived

GROWTH HABIT: Bunchgrass

ORIGIN: Native

VEGETATIVE CHARACTERISTICS:
Cool-season, erect and tufted. Leaves are basla, short, and dense. Roots can reach a maximum depth of 20 in. Grows 12-24 in tall.

SITE REQUIREMENTS

Precipitation zone.
Ranges from 12-20 in.

Elevation zone.
Up tp 7,500 ft.

Habitat and Climate requirements.
Temperate zones. Requires a minimum 150 frost-free days and minimum winter temperatures to -40 F.

Soil type.
Well-drained, shallow, deep to very deep clay loam, silty-to-sandy soils with a pH pf 6.5-8.0

APPLICATIONS

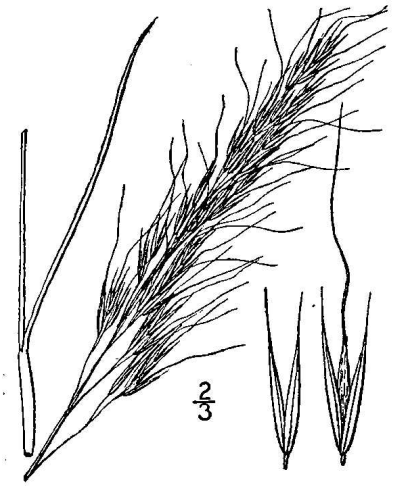
Roadside suitability.
Fairly tolerant of drought, fire, shade, and saline conditions.

Establishment.
Good germination rate and slow to moderate seedling growth with a low-to-moderate fertility requirement.

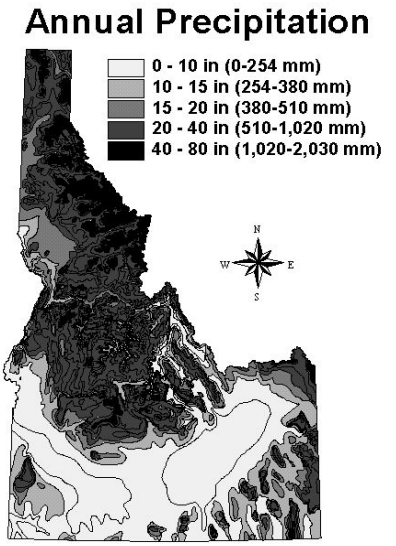
SEEDING RECOMMENDATIONS:
Plant in fall or early spring. Seed 2-5 PLS lb per acre. There are 700,000-2,315,400 seeds per lb.

Green Needlegrass

Nassella Viridula



Britton, N.L., and A. Brown. 1913



LIFE SPAN: Perennial

GROWTH HABIT: Bunchgrass

ORIGIN: Native

VEGETATIVE CHARACTERISTICS:
Cool-season. The seed head is a compacted panicle, varying from 4 to 10 inches in length.This species has rather deep, fibrous roots which in favorable situations may extend to a depth of 10 feet or more. It grows to a height of 18 to 36 inches.

SITE REQUIREMENTS:

Precipitation zone.
12-18 in annual precipitation

Elevation zone.
All elevations up to about 5,000 ft.

Habitat and Climate requirements.
Thrives in in both the True Prairie and Mixed Prairie, and is adapted to bottomlands, flat benches and overflow area along streams.

Soil type.
Green needlegrass grows on medium to fine-textured soils, but prefers clayey soils.

APPLICATIONS:

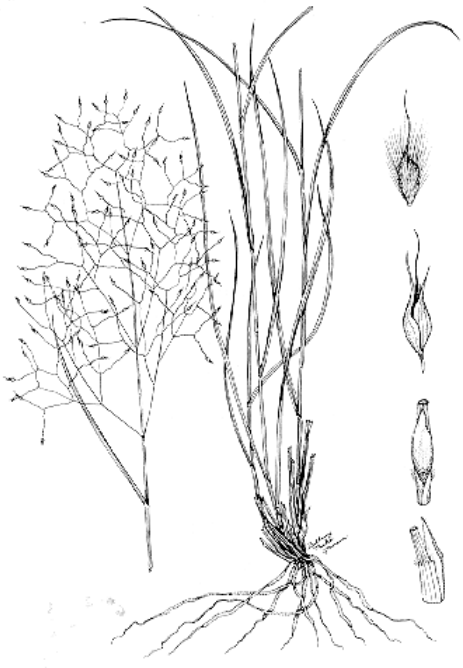
Roadside suitability.
Tolerates drought and provides good soil stability.

Establishment.
Recommended for seeding mixes in the 12 to 18 inch precipitation zone. High dormancy is a characteristic of the seed of this species.

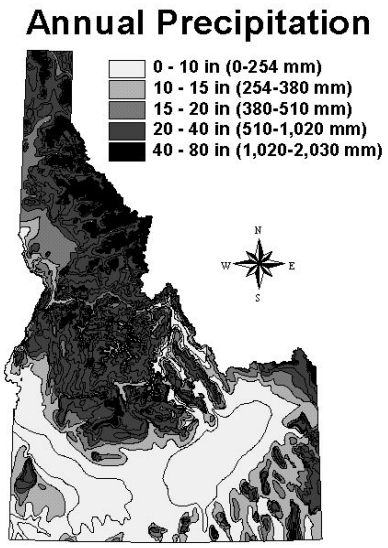
SEEDING RECOMMENDATIONS:
Plant in spring at 8 PLS lbs per acre. There are approximately 181,000 seeds per pound.

Indian Ricegrass

Oryzopsis hymenoides



James Stubbendieck et al. (1997)



LIFE SPAN: Perennial.

GROWTH HABIT: Bunchgrass.

ORIGIN: Native.

VEGETATIVE CHARACTERISTICS:
Warm- or cool-season and densely tufted. Leaf blades are slender and involute. Inflorescence is a diffuse panicle. Roots are fibrous, deep, and well developed, and can reach a minimum depth of 18 in . Grows 4-24 in tall.

SITE REQUIREMENTS:

Precipitation zone.
Ranges from 0-15 in.

Elevation zone.
Ranges from 0-8,200 ft.

Habitat & Climate requirements.
Arid and semi-arid climates throughout the Intermountain West.

Soil type.
Well-drained, course-textured, sandy loams.

APPLICATIONS:

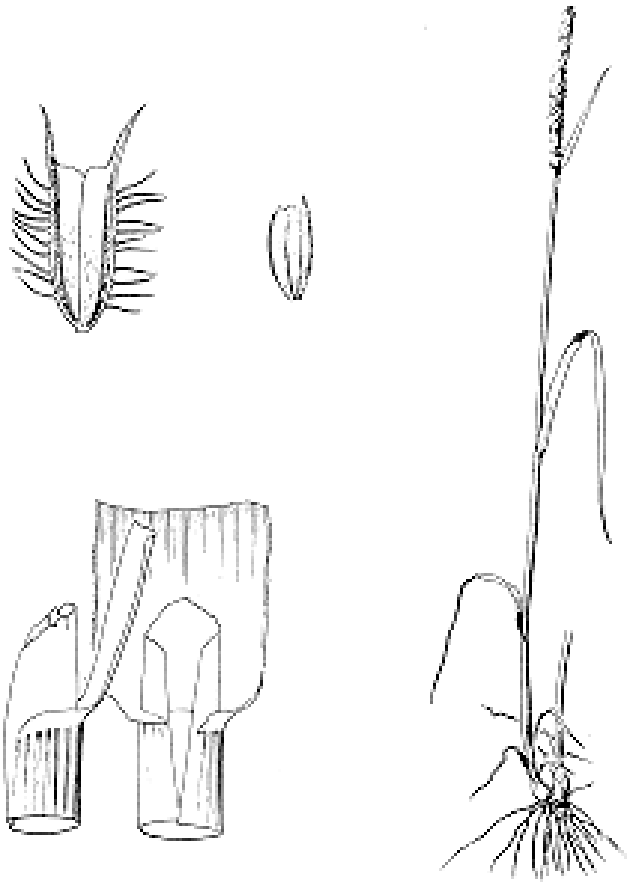
Roadside suitability.
Hardy and reduces wind erosion on sandy soils. Used for land reclamation. Tolerates drought, fire, and weak salinity. Intolerant of shade.

Establishment.
Difficult to germinate and slow to establish.

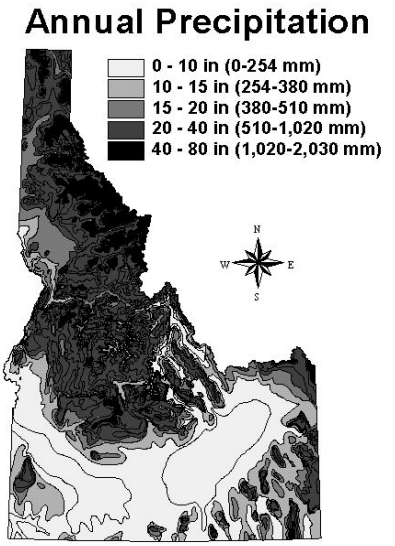
SEEDING RECOMMENDATIONS:
Plant in fall at a depth of 3 in. Seed 6-12 PLS lbs per acre. There are 141,000 seeds per lb.

Timothy

Phleum pratense



Patricia A. Patterson et al. (1985)



LIFE SPAN: Perennial.

GROWTH HABIT: Bunchgrass.

ORIGIN: Introduced.

VEGETATIVE CHARACTERISTICS:
Cool-season. Clums 19-39 in tall, from a swollen or bulblike base, forming large clumps. Blades are elongate, with a crowded spikelet inflorescence. Roots will reach a minimum depth of 10 in.

SITE REQUIREMENTS:

Precipitation zone.
Minimum of 16 in.

Elevation zone.
Up to 8,400 ft.

Habitat & Climate requirements.
Adapted to cool humid areas in the temperate zone of the west. Withstands temperatures to -40 F.

Soil type.
Poorly-drained, alluvial, clay-to-sandy loam soils with pH of 5.0-7.5.

APPLICATIONS:

Roadside suitability.
Used for hay and erosion control. Tolerates shade and moderate levels of salinity.

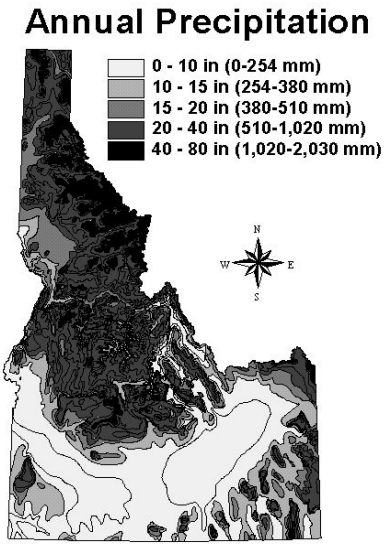
Establishment.
Good germination rate, moderate seedling growth, establishes cover quickly with a moderate fertility requirement. Tolerates shade and moderate levels of saline.

SEEDING RECOMMENDATIONS:
Plant in fall or spring at a depth of 0.25-0.5 in. Seed 1-3 PLS lb per acre. There are 1,300,000 seeds per lb.

Canby Bluegrass

Poa canbyi

J. Looman (1983)



LIFE SPAN: Perennial, long-lived.

GROWTH HABIT: Bunchgrass.

ORIGIN: Native.

VEGETATIVE CHARACTERISTICS:
Cool-season. Leaves are basal and abundant. Roots are shallow and fibrous, reaching a minimum depth of 10 in. Grows 13-24 in.

SITE REQUIREMENTS:

Precipitation zone.
Ranges from 9-20 in.

Elevation zone.
Up to 5,000 ft.

Habitat & Climate requirements.
Adapted to a wide range of climatic conditions throughout the Intermountain area.

Soil type.
Well-drained, dry, rocky, and sandy soils of medium-texture with neutral pH.

APPLICATIONS:

Roadside suitability.
Low-growing, vigorous, and a good competitor for cheatgrass. Tolerates drought.

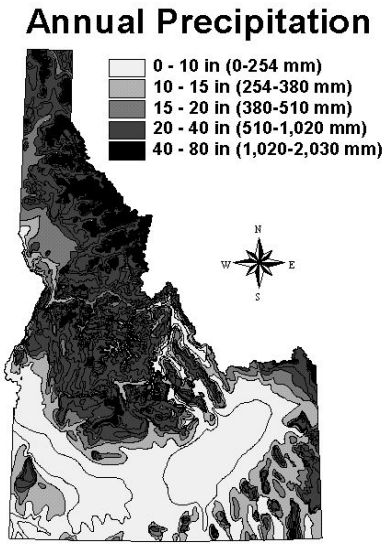
Establishment.
Difficult to establish and slow-to-moderate seedling growth.

SEEDING RECOMMENDATIONS: Plant in late fall at a depth of 0.25 in. Seed 2-4 PLS lb per acre. There are 926,000 seeds per lb.

Canada Bluegrass

Poa compressa

R.H. Mohlenbrock (1972)



LIFE SPAN: Perennial, short-lived.

GROWTH HABIT: Sod-former.

ORIGIN: Introduced.

VEGETATIVE CHARACTERISTICS:
Cool-season. Leaves are short. Inflorescence is a panicle. Stems are flat. Roots are fibrous with short rhizomes and stolons and a minimum rotting depth of 1 in. Grows 6-20 in tall.

SITE REQUIREMENTS:

Precipitation zone.
Ranges from 15-40 in.

Elevation zone.
Adapted to a wide range.

Habitat & Climate requirements.
Adapted to the climatic conditions of dry sites. Withstands temperatures to -40 F.

Soil type.
Shallow, poor, dry, clay-to-sandy loam soils with a pH of 5.0-7.5.

APPLICATIONS:

Roadside suitability.
Short, hardy, and requires little maintainence. Considered a weed on fertile, moist pastures designed for high productivity. Used for erosion control on roadsides, ditch banks, and borrow pits. Tolerates shade and moderate salinity.

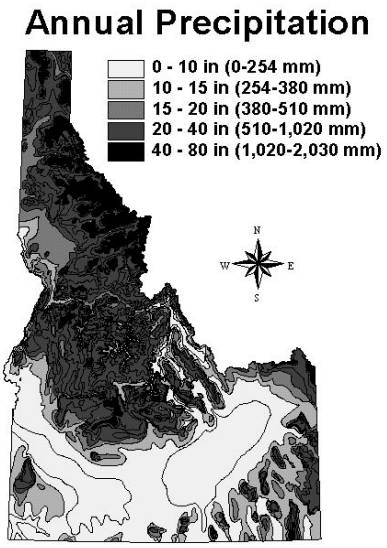
Establishment.
Slow to establish. Rapid seedling growth and medium germination rate. Low fertility requirement.

SEEDING RECOMMENDATIONS:
Plant in fall or early spring at a depth of 0.25-0.5 in. Seed 1-4 PLS lb per acre. There are 2,500,000 seeds per lb.

Nevada Bluegrass

Poa nevadaensis

R.H. Mohlenbrock (1972)



LIFE SPAN: Perennial, long-lived.

GROWTH HABIT: Bunchgrass.

ORIGIN: Native.

VEGETATIVE CHARACTERISTICS:
Cool season. Erect and tufted. Branches are loose. Inflorescence is a narrow panicle. Roots can reach a minimum depth of 10 in. Grows 20-40 in tall.

SITE REQUIREMENTS:

Precipitation zone.
Ranges from 10-15 in.

Elevation zone.
Wide range.

Habitat & Climate requirements.
Adapted to moist sagebrush and ponderosa pine areas throughout the Intermountain West.

Soil type.
Well-drained, sandy, or loamy soils.

APPLICATIONS:

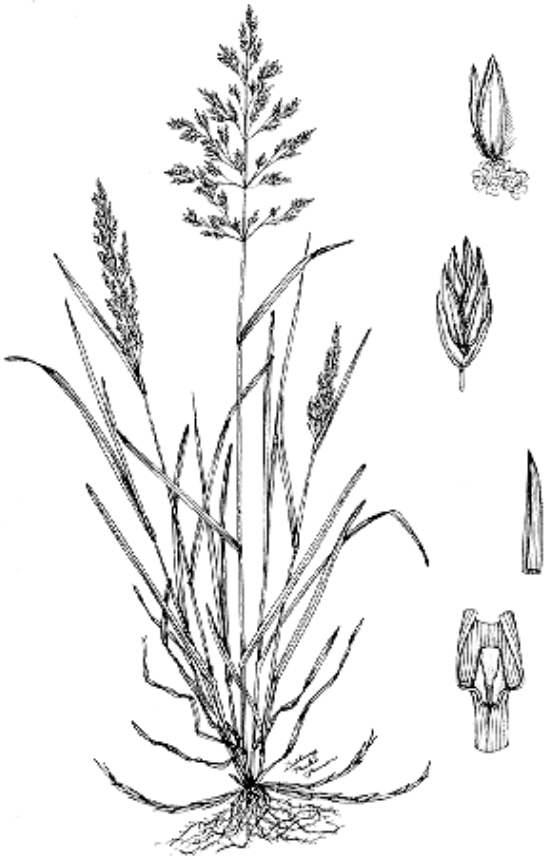
Roadside suitability.
Tolerates medium-acidic to alkaline soils.

Establishment.
Moderate to difficult to establish with slow to moderate seedling development. Excellent competition when established.

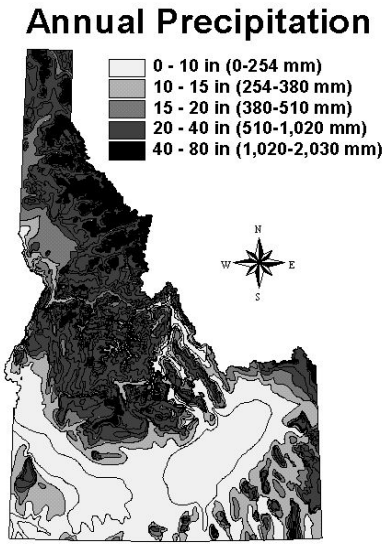
SEEDING RECOMMENDATIONS:
Plant in fall or early spring. There are 1,082,000 seeds per lb.

Kentucky Bluegrass

Poa pratensis



James Stubbendieck et al. (1997)



LIFE SPAN: Perennial, long-lived.

GROWTH HABIT: Sod-former.

ORIGIN: Introduced.

VEGETATIVE CHARACTERISTICS:
Cool-season and tufted. Culms are hollow. Base is bulb-like. Roots are shallow and fibrous reaching a minimum depth of 10 in. Grows up to 40 in tall.

SITE REQUIREMENTS:

Precipitation zone.
Ranges from 18 in or more.

Elevation zone.
Up to 10,000 ft.

Habitat & Climate requirements.
Adapted to cool, moist, growing conditions. Withstands temperatures to -40 F.

Soil type.
Shallow, well-drained, clay loam-to-sandy loam alluvial soils of limestone origin with neutral pH. Shallow, nonplowable, rocky areas.

APPLICATIONS:

Roadside suitability.
Aggressive competitor. Used for lawns, parks, cemetaries, turf, golf courses, and land reclamation. Considered a weedy species in agriculture. Moderately sensitive to saline conditions. Tolerates long summer dry periods and moderate shade.

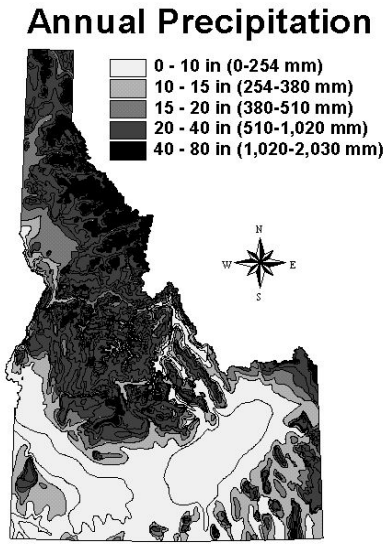
Establishment.
Seeds remain viable for 5 years, easy to germinate, slow to moderate seedling growth. Moderate fertility requirement.

SEEDING RECOMMENDATIONS: Plant in fall or spring at a depth of 0.25 in or less. Seed 2-3 PLS lb per acre. There are 2,177,000 seeds per lb.

Sandberg Bluegrass

Poa sandbergii

Richard W. Scott (1995)



LIFE SPAN: Perennial, long-lived.

GROWTH HABIT: Bunchgrass.

ORIGIN: Native.

VEGETATIVE CHARACTERISTICS:
Cool-season. Leaves are mostly basal, narrow, and curly at maturity. Infloresence are narrow and compact. Roots are fibrous and reach a minimum depth of 10 in. Grows 1-12 in tall.

SITE REQUIREMENTS:

Precipitation zone.
Minimum of 8 in.

Elevation zone.
Ranges from 1,000-12,000 ft.

Habitat & Climate requirements.
Adapted to the climatic conditions of semi-desert areas. Plains, dry woods and rocky slopes.

Soil type.
Moderately course- to moderately fine-textured clay loam soils with a neutral pH.

APPLICATIONS:

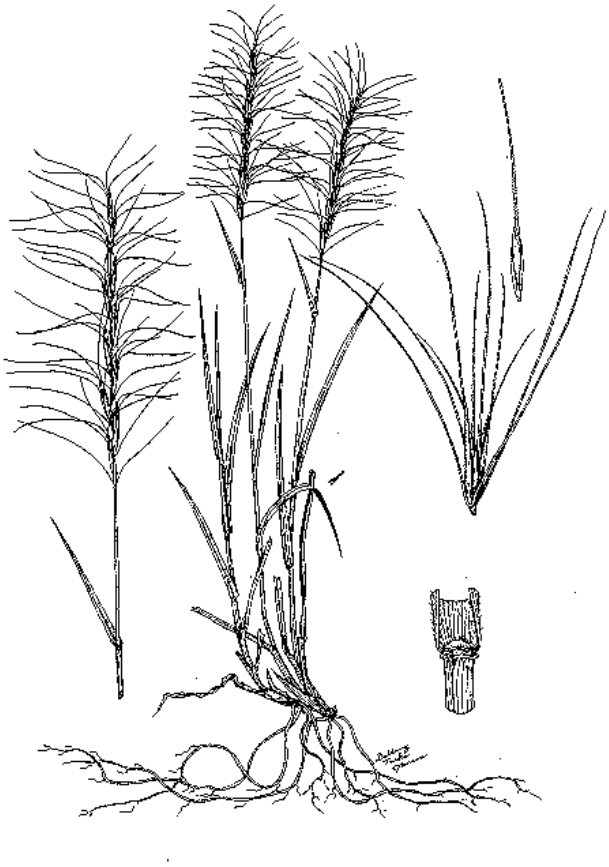
Roadside suitability.
Low growing. Starts growth early in the spring with adequete moisture and stays green late into the summer. Tolerates drought.

Establishment.
Low seed viability.

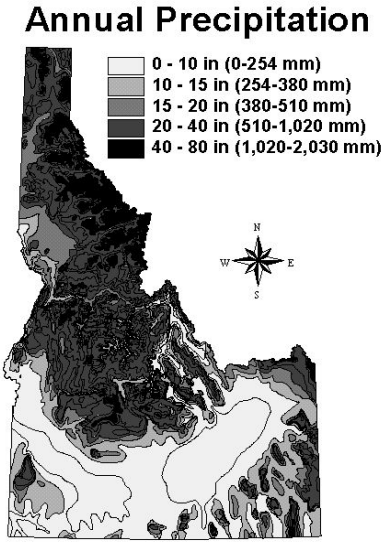
SEEDING RECOMMENDATIONS:
Plant in fall or early spring at a depth less than 1 in. Seed 2-4 PLS lb per area. There are 925,000 seeds per lb.

Bottlebrush Squirreltail

Sitanion hystrix



James Stubbendieck et al. (1997)



LIFE SPAN: Perennial.

GROWTH HABIT: Bunchgrass.

ORIGIN: Native.

VEGETATIVE CHARACTERISTICS:
Cool-season, tufted, with bristly inflorescence. Leaves are glabrous to densely white pubescent. Grows 4-20 in tall.

SITE REQUIREMENTS:

Precipitation zone.
Ranges from 6-16 in.

Elevation zone.
Middle to high elevations.

Habitat & Climate requirements.
Adapted to the climatic conditions of dry hills, plains, open woods, and rocky slopes.

Soil type.
Dry, gravelly, shallow to deep soils.

APPLICATIONS:

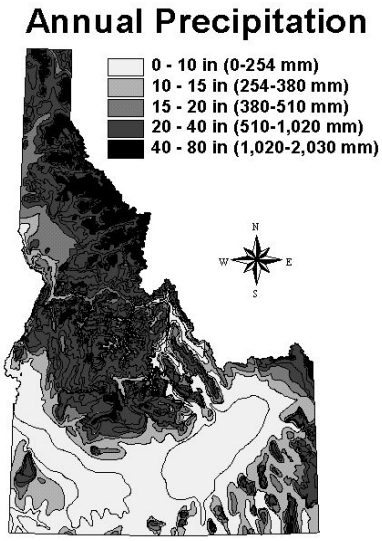
Roadside suitability.
Seed availability is limited. Short to medium sized, used for revegetation of disturbed lands. Tolerates drought and alkaline conditions.

Establishment.
40-60 % germination in the first year.

SEEDING RECOMMENDATIONS:
Plant in fall. Seed 5-12 PLS lb acre. There are 192,000 seeds per lb.

Hardstem bulrush

Schoenoplectus acutus



LIFE SPAN: Perennial

GROWTH HABIT: Graminoid

ORIGIN: Native

VEGETATIVE CHARACTERISTICS:
Form dense stands. The stiff stems are dark green and 3-12 ft tall. The leaves wrap around the stem and have a tapered tip standing above the see head. Roots are extensive, black, and wiry.

SITE REQUIREMENTS:

Precipitation zone. 10-12 inches

Elevation zone.
low to mid elevations, generally below 2,300 m (7,500 ft)

Habitat & Climate requirements. Found in inundated to periodically wet areas of marshes, swamps, and meadows and along lake, reservoir, and pond shorelines

Soil Type.
Hardstem bulrush will grow on soils that range from peat to coarse substrates. It will grow and spread on alkaline, saline, and brackish sites and will re-sprout after fire.

APPLICATIONS:

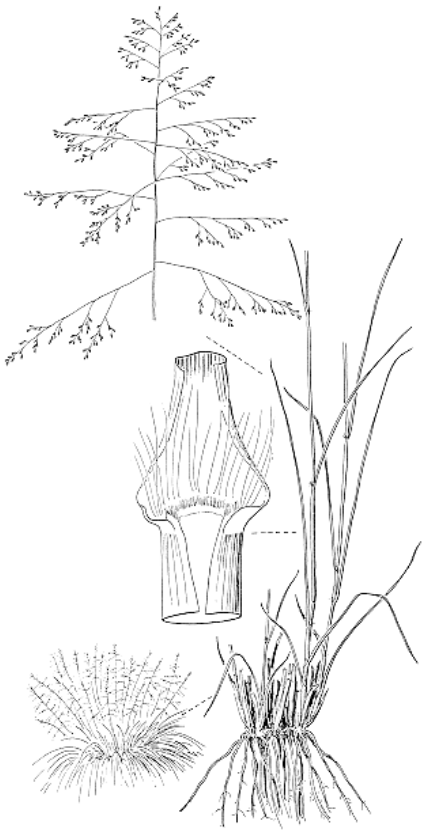
Roadside Suitability.
Hardstem bulrush's dense root mass makes this species an excellent choice for soil stabilization.

Establishment.
Hardstem bulrush reproduces from seed and rhizomes. Wild plants can be collected and transplanted directly into the desired site.

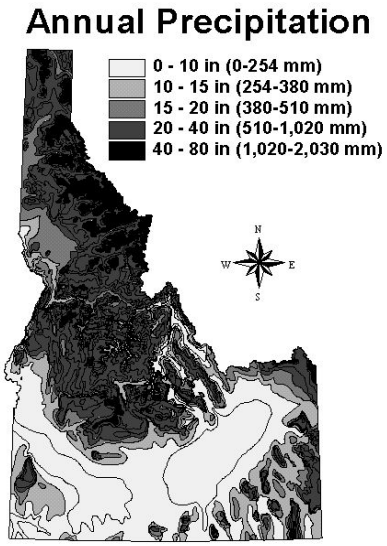
SEEDING RECOMMENDATIONS:
Seed 5 PLS lb per acre.

Alkali Sacaton

Sporobolus airoides



R.H. Mohlenbrock (1972)



LIFE SPAN: Perennial.

GROWTH HABIT: Bunchgrass.

ORIGIN: Native.

VEGETATIVE CHARACTERISTICS:
Warm-season, erect to spreading, robust, and densely tufted. Leaves are elongated and flat. Roots are fibrous with short rhizomes and can reach a minimum depth of 16 in. Grows 20-40 in tall.

SITE REQUIREMENTS:

Precipitation zone.
Ranges from 6-10 in.

Elevation zone.
Ranges from 3,500-8,000 ft.

Habitat & Climate requirements.
Adapted to a wide range of climatic conditions in low, slightly moist, alkaline flats, desert drainages, semi-desert areas, open plains, valleys, and bottom lands.

Soil type.
Poorly-drained, fine-textured clayey soils that are alkali or saline-alkali.

APPLICATIONS:

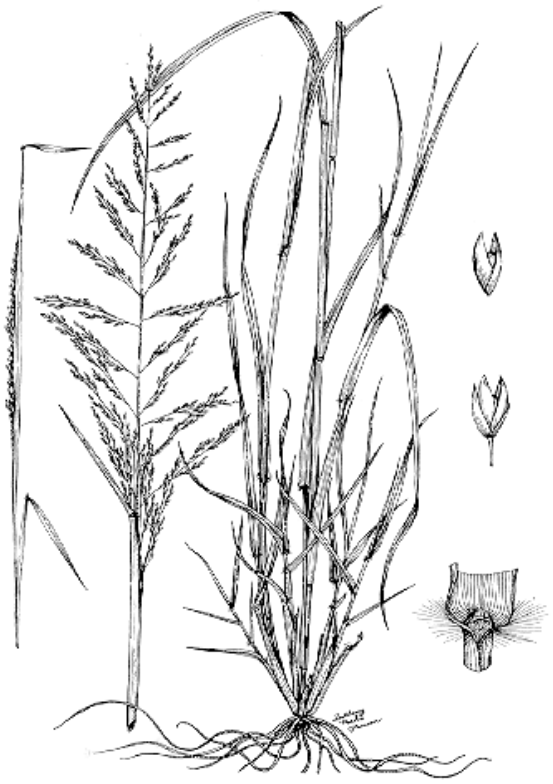
Roadside suitability.
Minimal maintenance required. Used to reseed lowlands and reduce erosion. Tolerates drought, cold, alkaline, and saline conditions.

Establishment.
Seeds must undergo an afterripening period of several months for good germination results.

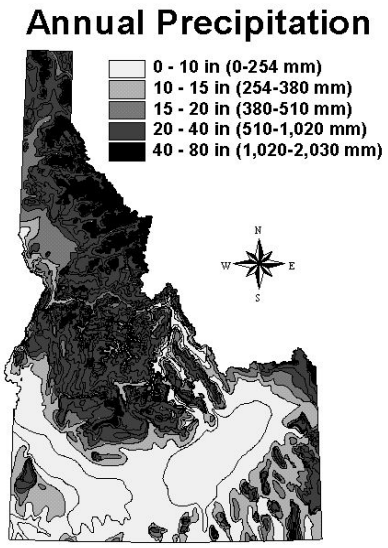
SEEDING RECOMMENDATIONS:
Plant in early spring or fall. Seed 2-3 lb PLS per acre. There are 1,750,000 seeds per lb.

Sand Dropseed

Sporobolus cryptandrus



James Stubbendieck et al. (1997)



LIFE SPAN: Perennial.

GROWTH HABIT: Bunchgrass.

ORIGIN: Native.

VEGETATIVE CHARACTERISTICS:
Warm-season and tufted. Leaves are involute. Stems are leafy and spreading. Roots are fibrous and reach a minimum depth of 18 in. Grows 12-40 in tall.

SITE REQUIREMENTS:

Precipitation zone.
Ranges from 10-40 in.

Elevation zone.
Up to 8,000 ft.

Habitat & Climate requirements.
Adapted to a wide range of climatic conditions, especially suited to open areas and disturbed sites.

Soil type.
Dry, coarse, shallow, sandy, and calcareous sites.

APPLICATIONS:

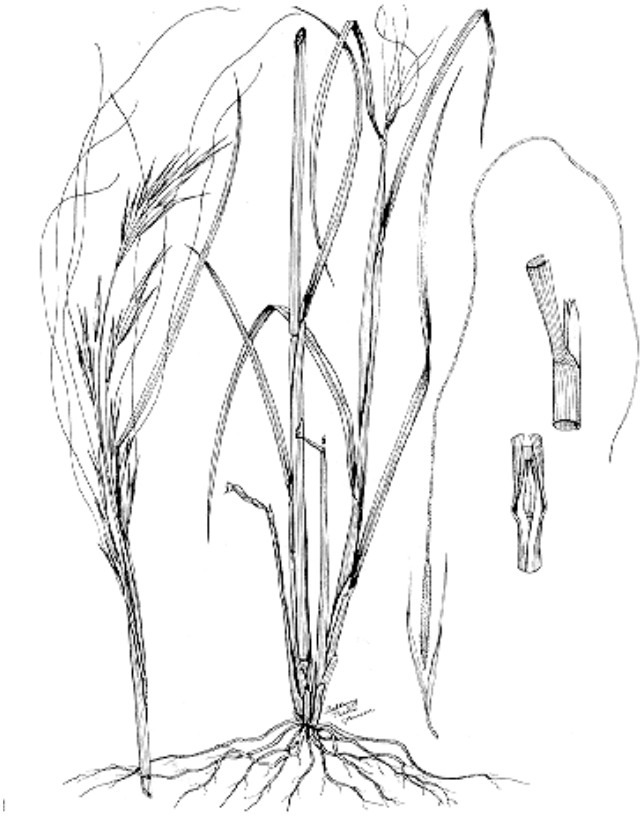
Roadside suitability.
Used for erosion control. Tolerates alkaline conditions and drought. Intolerant of shade.

Establishment.
Medium germination rate, prolific seeder, established easily, and seeds are long-lived.

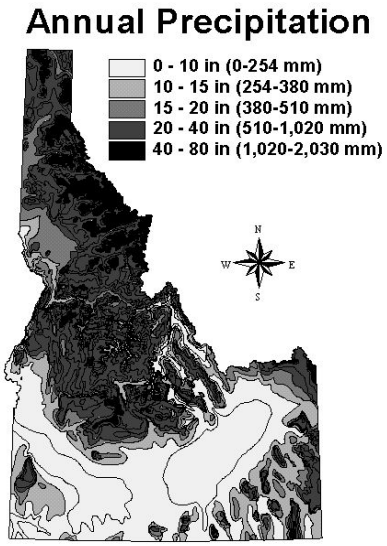
SEEDING RECOMMENDATIONS:
Plant in spring at a depth of 0.25-0.5 in. Seed 1-2 PLS lb per acre. There are 5,298,000 seeds per lb.

Needle and Thread

Stipa comata



James Stubbendieck et al. (1997)



LIFE SPAN: Perennial.

GROWTH HABIT: Bunchgrass.

ORIGIN: Native.

VEGETATIVE CHARACTERISTICS:
Cool-season, erect, densely tufted, and very leafy. Inflorescence is a narrow panicle. Awns are long, twisted, and tapering. Roots are fibrous and extend 3-5 ft. Grows 12-24 in tall.

SITE REQUIREMENTS:

Precipitation zone.
9 in or less

Elevation zone.
Ranges from 300-5,000 ft.

Habitat & Climate requirements.
Adapted to the dry climatic conditions of the Intermountain Pacific Northwest.

Soil type.
Shallow, calcareous, well-drained, sandy and gravely soils with a neutral pH.

APPLICATIONS:

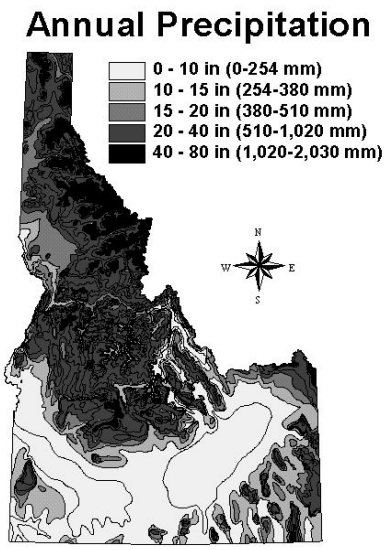
Roadside suitability.
Long awns cause problems with seed collection and application. Tolerates drought.

Establishment.
Medium germination rate. Low fertility requirement.

SEEDING RECOMMENDATIONS:
Plant in fall. Seed 6-8 PLS lb per acre. There are 115,000 seeds per lb.

Western Needlegrass
Stipa occidentalis

Richard W. Scott (1995)



LIFE SPAN: Perennial.

GROWTH HABIT: Bunchgrass.

ORIGIN: Native.

VEGETATIVE CHARACTERISTICS:
Cool-season. Stems are slender. Leaf blades are 4-12 in long, usually involute and ascending. Roots are spreading, deep, and penetrating and reach a minimum depth of 16 in. Grows 12-30 in tall.

SITE REQUIREMENTS:

Precipitation zone.
Ranges from 10-20 in.

Elevation zone.
Ranges from 4,500-10,000 ft.

Habitat & Climate requirements.
Adapted to the climatic conditions of plains, ridges, and open timber extending from upper foothills into higher mountains.

Soil type.
Dry, well-drained soils.

APPLICATIONS:

Roadside suitability.
Soil stabilizer, tolerates drought. Well suited to disturbed areas.

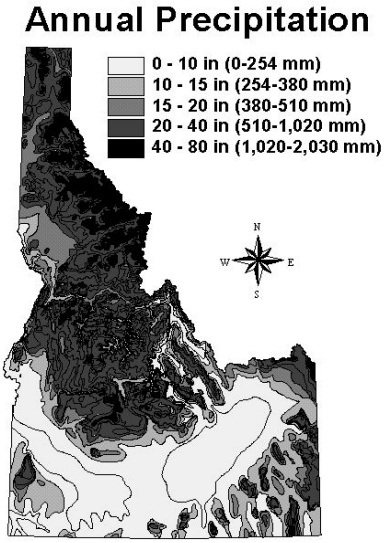
Establishment.
Seeds are large with awns that must be removed before planting. Starts growth early, but establishes and matures slowly.

SEEDING RECOMMENDATIONS:
Plant in fall or early spring. Seed 3-5 PLS lbs if planted alone. In a mixture seed 1 lb. There are 311,000 seeds per lb.

Thurber's Needlegrass

Stipa thurberiana

R.H. Mohlenbrock (1972)



LIFE SPAN: Perennial.

GROWTH HABIT: Bunchgrass.

ORIGIN: Native.

VEGETATIVE CHARACTERISTICS:
Cool-season. Leaves are very fine with ascending branches. Inflorescence is a long and narrow panicle. Roots can reach a minimum depth of 10 in. Grows 12-20 in tall.

SITE REQUIREMENTS:

Precipitation zone.
Ranges from 8-15 in.

Elevation zone.
Ranges from 6,500-9,000 ft.

Habitat & Climate requirements.
Adapted to a wide range of climatic conditions.

Soil type.
Rocky, shallow soils.

APPLICATIONS:

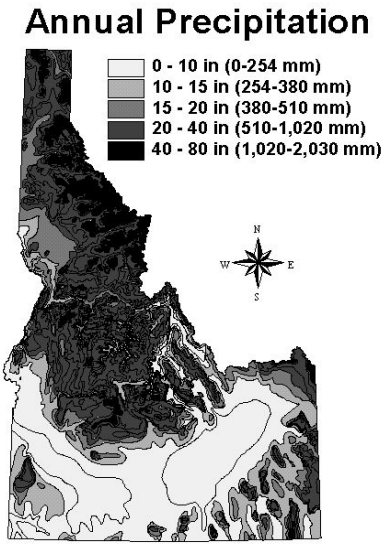
Roadside suitability.
Good soil stabilize and medium statured. Tolerates drought.

Establishment.
Low seedling vigor and germination rates. Awns may interfer with seeding.

SEEDING RECOMMENDATIONS:
Plant in the fall. Seed 6-8 PLS lbs per acre. There are 150,000 seeds per lb.

Spring Wheat
Triticum aestivum

A.S. Hitchcock (1971)



LIFE SPAN: Annual.

GROWTH HABIT: Bunchgrass.

ORIGIN: Introduced.

VEGETATIVE CHARACTERISTICS:
Cool-season, erect, and tufted. Roots can reach a minimum depth of 18 in. Grows 13-25 in tall.

SITE REQUIREMENTS:

Precipitation zone.
Minimum of 12 in.

Elevation zone.
Ranges from 0-10,000 ft.

Habitat & Climate requirements.
Temperate zones.

Soil type.
Medium-textured soil with a neutral pH.

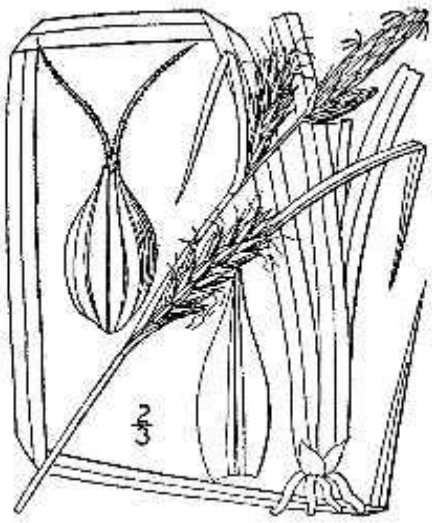
APPLICATIONS:

Roadside suitability.
Used as a cover, nurse, or temporary erosion control crop. May compete with establishing perennials. Tolerates drought.

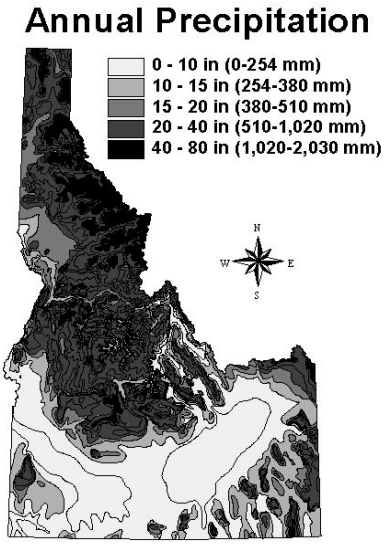
Establishment.
Slow seed spread rate, but seedling vigor is high.

SEEDING RECOMMENDATIONS:
Plant in fall or early spring. Seed 3-6 PLS lb per acre. There are 11,000 seeds per lb.

Nebraska Sedge
Carex nebrascensis



Britton, N.L. and A. Brown (1913)



LIFE SPAN: Perennial.

GROWTH HABIT: Sedge, sod-former.

ORIGIN: Native.

VEGETATIVE CHARACTERISTICS:
Cool-season. Leaves are light green. Stems are triangular. Base is reddish. Roots are rhizomatous and can reach a minimum depth of 10 in. Grows 8-47 in tall.

SITE REQUIREMENTS:

Precipitation zone.
Not a limiting factor for reproduction.

Elevation zone.
Up to 9,000 ft.

Habitat & Climate requirements.
Wet meadows, swamps, streams, marshes, edges of lakes or ponds, and ditches.

Soil type.
Wet, alkaline, moderatelyfine-textured, loamy soils.

APPLICATIONS:

Roadside suitability.
Excellent soil stabilizer. Used for riparian area reclamation.

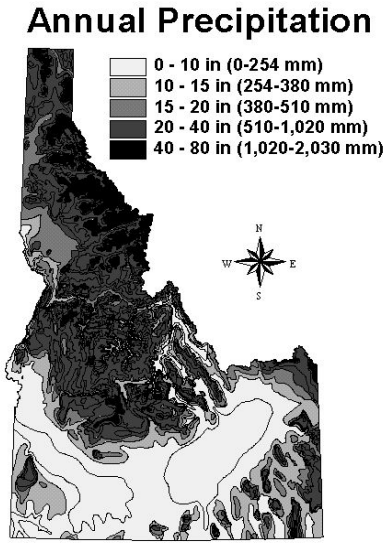
Establishment.
Establishes on dry sites if the roots stay wet.

SEEDING RECOMMENDATIONS: Plant in fall or early spring. Seed 5 PLS lb per acre. There are 534,100 seeds per lb.

Baltic Rush

Juncus balticus

James Stubbendieck et al. (1997)



LIFE SPAN: Perennial.

GROWTH HABIT: Sod-forming rush.

ORIGIN: Native.

VEGETATIVE CHARACTERISTICS:
Cool-season. Erect. Leaves are wiry and round. Roots are deep and rhizomatous and can reach a minimum depth of 20 in. Grows up to 43 in tall.

SITE REQUIREMENTS:

Precipitation zone.
Requires persistent wet conditions.

Elevation zone.
Up to 10,000 ft.

Habitat & Climate requirements.
Adapted to the climatic conditions of wetlands and riparian areas.

Soil type.
Sometimes associated with alkaline sites. Persists in moist or wet, deep, organic soils or in shallow, gravelly soils if the moisture is ample.

APPLICATIONS:

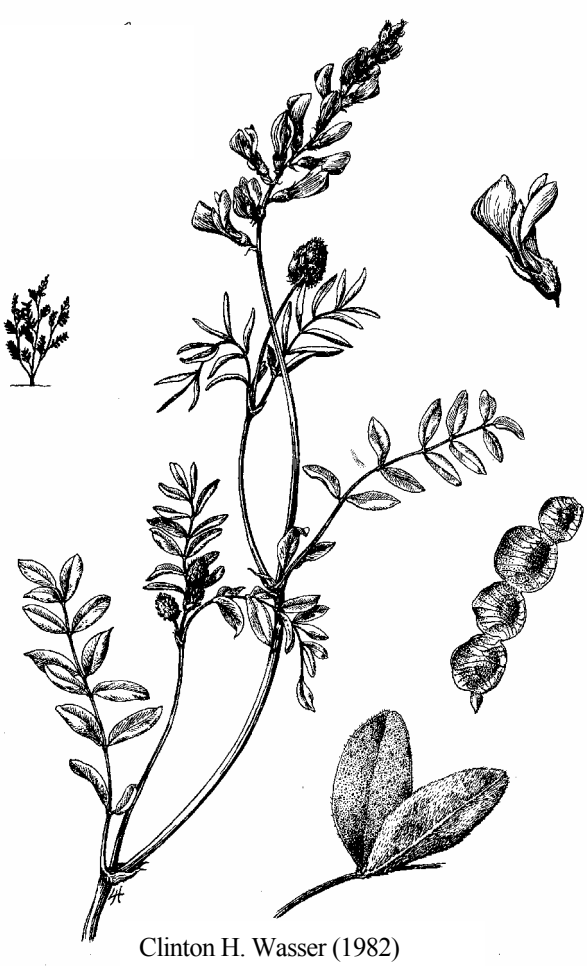
Roadside suitability.
Excellent for rehabilitating wetland and riparian areas.

Establishment.
Medium germination rate with slow seedling development.

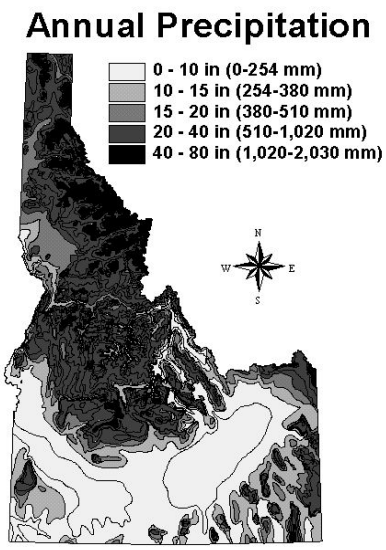
SEEDING RECOMMENDATIONS:
Plant in the fall or spring. Seed 1-2 PLS lb per acre. There are 109,301,000 seeds per lb.

Northern Sweetvetch

Hedysarum boreale



Clinton H. Wasser (1982)



LIFE SPAN: Perennial.

GROWTH HABIT: Herbaceous legume.

ORIGIN: Native.

VEGETATIVE CHARACTERISTICS:
Flowers are pink-purple, pea-type, and in spike-like clusters. Leaves are oblong and pinnately compound. Stems are square and reddish. Roots can reach a minimum depth of 18 in. Grows 10-24 in tall.

SITE REQUIREMENTS:

Precipitation zone. Greater than 10 in.

Elevation zone.
Approximately 8,500 ft.

Habitat & Climate requirements.
Adapted to open, exposed, rocky hillsides, and canyons.

Soil type.
Well-drained, medium-textured, sandy or clay soils.

APPLICATIONS:

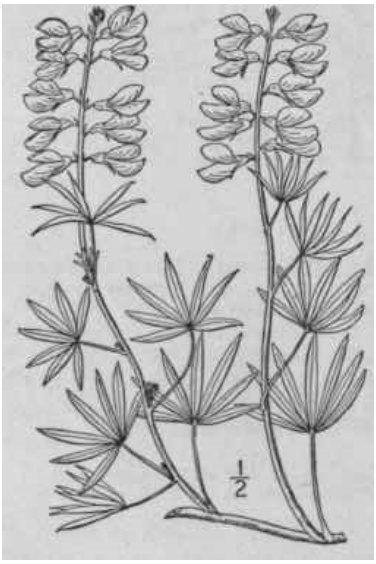
Roadside suitability.
Provides good soil stability. Tolerates drought.

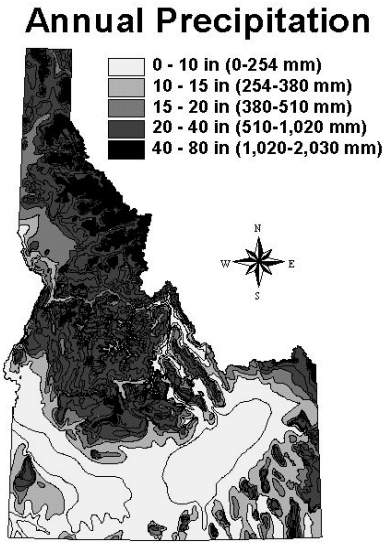
Establishment.
Good to excellent seedling vigor. Establishes well by the second year. Fair compatibility with other species. Moderately competitive to a native species.

SEEDING RECOMMENDATIONS:
Plant in the spring. Seed 8-10 PLS lb per acre. There are 33,600 seeds per lb.

Silvery Lupine

Lupinus argenteus





LIFE SPAN: Perennial

GROWTH HABIT: Forb/herb Subshrub

ORIGIN: Native

VEGETATIVE CHARACTERISTICS:
Bears from one to several, occasionally branched stems, each 1-2 ft. tall and covered with hairs. Stalked, palmately-compound, silvery-green leaves line the stems. Grows to a height of 18-24 in.

SITE REQUIREMENTS:

Precipitation zone.
8-35 inches

Elevation zone.
Ranges from 1000-3000 ft.

Habitat & Climate requirements: Requires 180 frost-free days minimum. Only occurs at a minimum of -43° F. Has a medium drought tolerace.

Soil type.
Adapted to coarse, fine, and medium textured soils. Grows along the coast and in dry and open meadows, prairies and forest clearings.

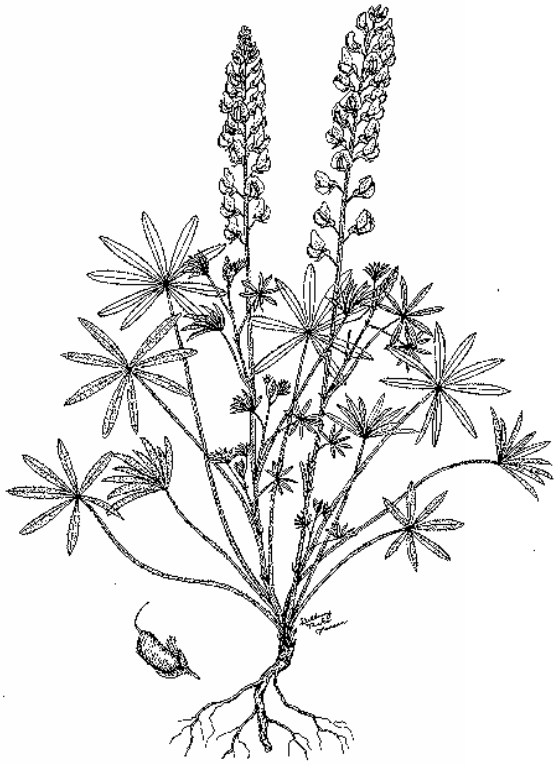
APPLICATIONS:

Roadside suitability.
A long-lived, showy perennial with soil nitrogen-fixing capacity and substantial taproot. Excellent for soil stabilization.

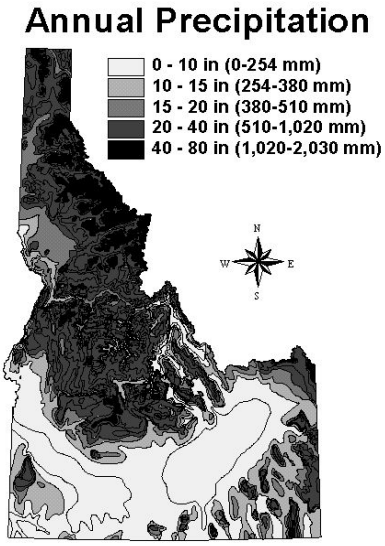
Establishment
Establishes best with direct seeding. Reproduces by seeds.

SEEDING RECOMMENDATIONS:
Sow seed in late fall at 4-7 PLS lb per acre to utilize natural cold stratification during winter.

Tailcup Lupine
Lupinus caudatus



James Stubbendeck et al. (1997)



LIFE SPAN: Perennial.

GROWTH HABIT: Herbaceous legume.

ORIGIN: Native.

VEGETATIVE CHARACTERISTICS:
Cool-season. Flowers are in dense racemes, attractive, and blue. Taprooted with some fibrous roots that can reach a minimum depth of 6 in. Grows 12-24 in tall.

SITE REQUIREMENTS:

Precipitation zone.
Wide range.

Elevation zone.
Up to 10,500 ft.

Habitat & Climate requirements.
Adapted to a wide range of conditions on open sites.

Soil type.
Course or fine well-drained, dry-to-moist, calcareous soils.

APPLICATIONS:

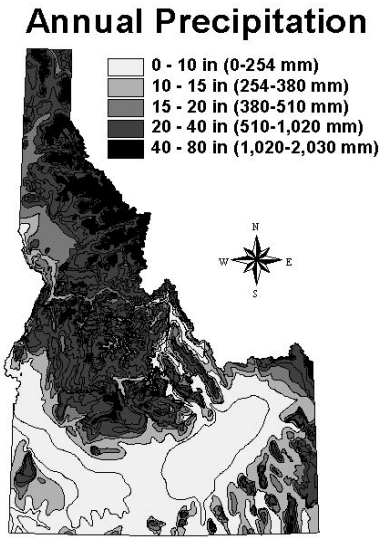
Roadside suitability.
Well suited to disturbed sites. Susceptable to fire. Partially tolerates shade and alkaline conditions.

Establishment.
Propigate by plant divisions, shoot cuttings, or seeds. Fairly easy to establish.

SEEDING RECOMMENDATIONS:
Plant in the spring. Seed 4-7 PLS lb per acre. There are 21,000-135,000 seeds per lb.

Silky Lupine

Lupinus sericeus



LIFE SPAN: Perennial

GROWTH HABIT: Forb, Subshrub

ORIGIN: Native

VEGETATIVE CHARACTERISTICS:

Cool-season. Leaves are hairy, alternate and divided palmately to resemble the fingers of a hand, growing smaller up the stem. Showy flowers grow in clustered stalks 3-5 in at stem tips. Grows to a height of 26-56 in.

SITE REQUIREMENTS:

Precipitation zone.
Grows best in 10-20 in. of annual precipitation.

Elevation zone.
Ranges from 1,500-10,000 ft.

Habitat & Climate requirements.
Dry, rocky, and varied slopes.

Soil type.
Variety of well-drained soils.

APPLICATIONS:

Roadside suitability.
A long-lived, showy perennial with soil nitrogen-fixing capacity and substantial taproot. Excellent for soil stabilization.

Establishment.
Establishes best with direct seeding. Reproduces by seeds.

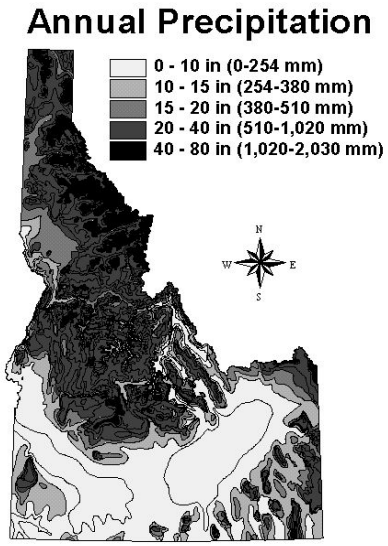
SEEDING RECOMMENDATIONS:

Sow seed in late fall at 4-7 PLS lb per acre to utilize natural cold stratification during winter.

Alfalfa

Medicago sativa

James Stubbendieck et al. (1997)



LIFE SPAN: Perennial, long-lived.

GROWTH HABIT: Herbaceous legume.

ORIGIN: Introduced.

VEGETATIVE CHARACTERISTICS:
Leaves are alternate and pinnately trifoliate. Stems are erect and grow from a woody crown. Flowers are violet-blue. Taproot that can reach minimum depths of 24 in. Grows less than 24 in tall.

SITE REQUIREMENTS:

Precipitation zone.
Ranges from 12-18 in.

Elevation zone.
Below 7,500 ft.

Habitat & Climate requirements.
Adapted to semi-arid climatic conditions.

Soil type.
Deep, well-drained soils of all textures with a pH of 6.5 or above.

APPLICATIONS:

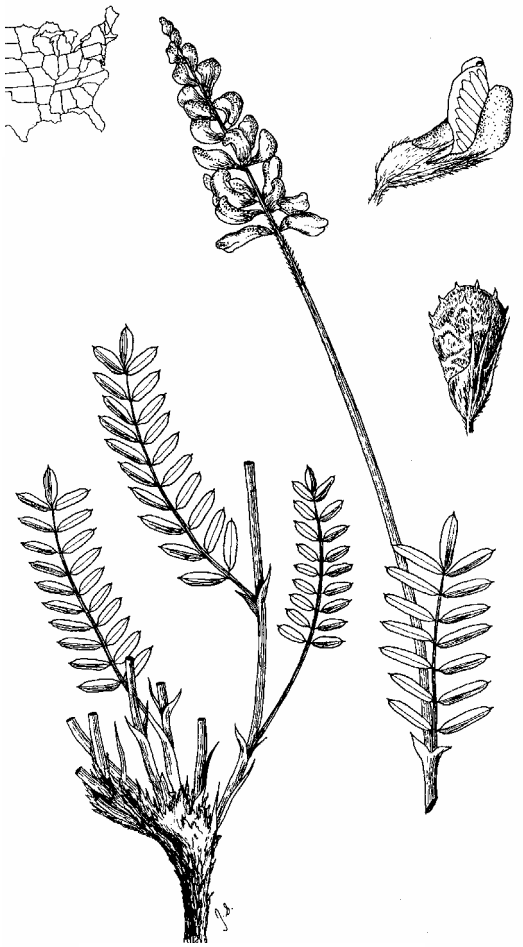
Roadside suitability.
Used for windbreaks and cover crops. Winter-hardy. Tolerates drought and full sunlight.

Establishment.
Easily established and persistant on disturbed sites or areas of construction.

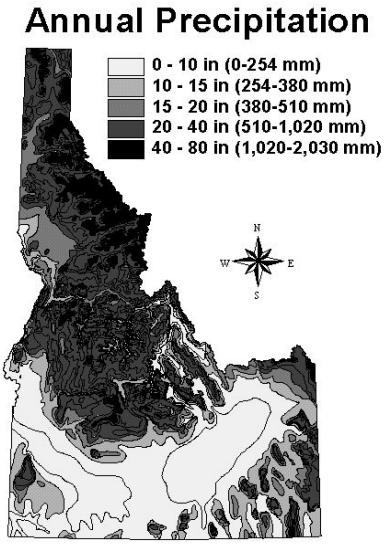
SEEDING RECOMMENDATIONS:
Plant in early spring or fall at a depth of 0.25 in. Seed 1-2 lb PLS per acre. There are 210,000 seeds per lb.

Sanfoin

Onobrychis viciaefolia



Clinton H. Wasser (1982)



LIFE SPAN: Perennial, long-lived.

GROWTH HABIT: Herbaceous legume.

ORIGIN: Introduced.

VEGETATIVE CHARACTERISTICS:
Cool-season. Upright and leafy. Flowers are pink. Roots can reach a minimum depth of 14 in. Grows 25 in or taller.

SITE REQUIREMENTS:

Precipitation zone.
Ranges from 15-18 in.

Elevation zone.
Above 4,000 ft.

Habitat & Climate requirements.
Adapted to the Northern Great Plains and Intermountain regions.

Soil type.
Well-drained, medium-textured, sandy-to-loamy soils.

APPLICATIONS:

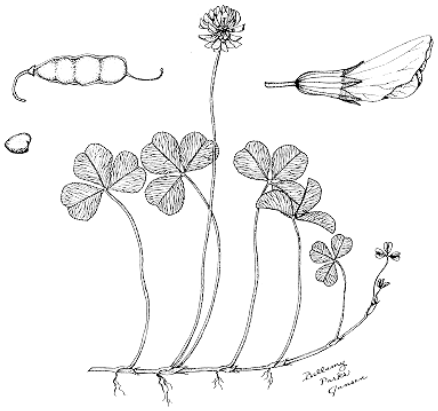
Roadside suitability.
Moderately tall in stature. Tolerates drought, frost and alkaline conditions. Deep tap root.

Establishment.
Easy to establish, a good seed producer, and long-lived once established.

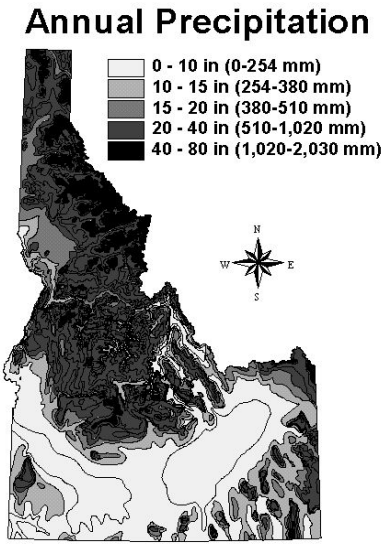
SEEDING RECOMMENDATIONS:
Plant in spring at a depth of 0.25-0.75 in. Seed 2-4 PLS lb per acre .

White Dutch Clover

Trifolium repens



James Stubbendieck et al. (1997)



LIFE SPAN: Perennial, long-lived.

GROWTH HABIT: Herbaceous legume.

ORIGIN: Introduced.

VEGETATIVE CHARACTERISTICS:
Branches are creeping. Flowers are white to pink born on long stalks. Roots are up to 24 in deep. Grows less than 12 in tall.

SITE REQUIREMENTS:

Precipitation zone.
Over 20 in.

Elevation zone.
Ranges from 0-14,000 ft.

Habitat & Climate requirements.
Adapted to a cool, moist, humid climatic conditions.

Soil type.
Clay and silt loams of medium-to-high fertility or shallow, sandy soils with a high water table.

APPLICATIONS:

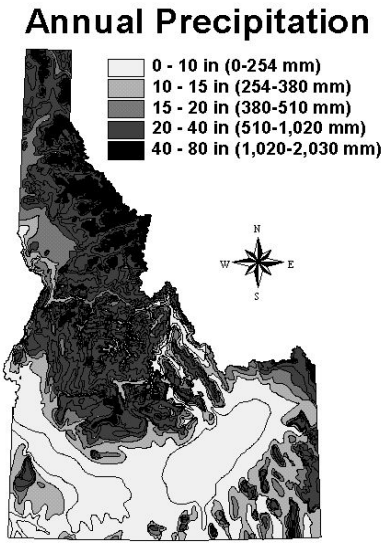
Roadside suitability.
Short and creeping. Used for erosion control on streambanks and roadsides. Cold-hardy. Tolerates poor drainage and shade. Intolerant of strongly acidic or alkaline conditions. Also a weak sod-former.

Establishment.
Easy to establish, good seed producer, and long-lived once established.

SEEDING RECOMMENDATIONS:
Plant in spring or fall. Seed 2-4 PLS lb per acre. There are 850,000 seeds per lb.

Western Yarrow
Achillea millefolium

James Stubbendieck et al. (1997).



LIFE SPAN: Perennial.

GROWTH HABIT: Forb.

ORIGIN: Native.

VEGETATIVE CHARACTERISTICS:
Cool-season. Leaves are basal and fern-like with dense silky hairs. Flowers are white, rounded, and clustered in a terminal corymb. Roots are fibrous with well-developed rhizomes that can reach a minimum depth of 8 in. Grows 12-36 in tall.

SITE REQUIREMENTS:

Precipitation zone. Greater than 20 in.

Elevation zone.
Ranges from 200-9,000 ft.

Habitat & Climate requirements.
Adapted to a wide range of climatic conditions. Requires 120 frost-free days and can withstand temperatures as low as -38 F.

Soil type.
Commonly found on sandy and gravelly loams that are weakly basic to weakly acidic.

APPLICATIONS:

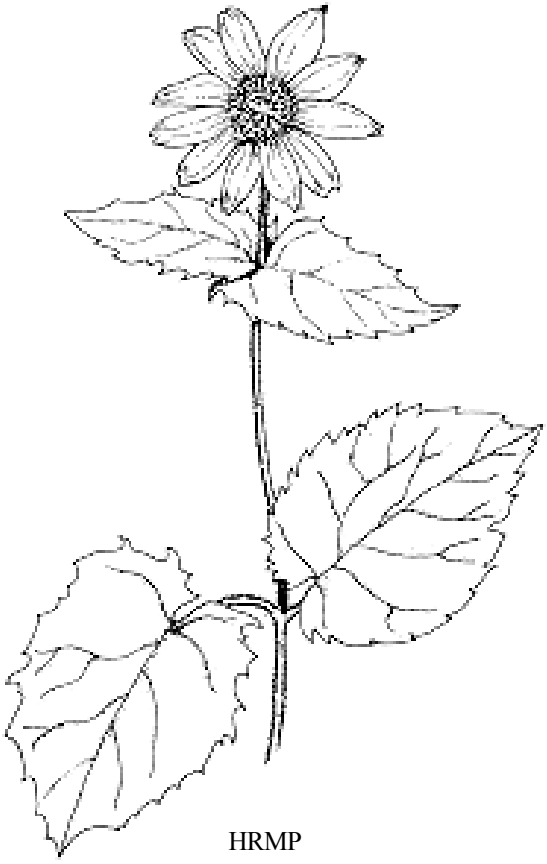
Roadside suitability.
Turf-forming. Good stabilization value. Found on disturbed sites and roadsides. Resistant to drought and fire.

Establishment.
Reproduces by seeds and root stalks and is easily established.

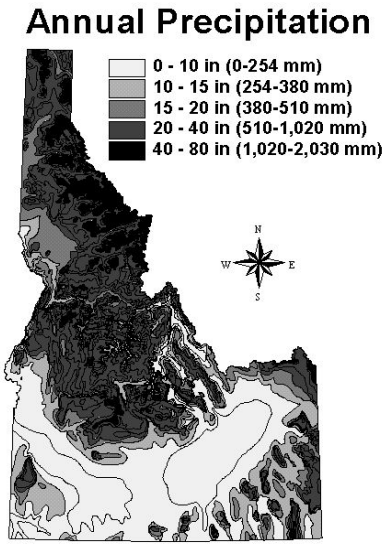
SEEDING RECOMMENDATIONS:
Drill or broadcast in fall or early spring. Seed 0.5-2 PLS lb per acre . There are 2,770,000 seeds per lb.

Heartleaf Arnica

Arnica cordifilia



HRMP



LIFE SPAN: Perennial.

GROWTH HABIT: Forb.

ORIGIN: Native.

VEGETATIVE CHARACTERISTICS:
Leaves are basal and heart-shaped. Flowers are large, yellow, and born in a loose cyme. Roots are fibrous with rhizomes and reach a minimum depth of 6 in. Grows 6-24 in tall.

SITE REQUIREMENTS:

Precipitation zone.
Ranges from 10-35 in.

Elevation zone.
Ranges from 1,000-11,000 ft.

Habitat & Climate requirements.
Warm, moist forests at mid-elevations in the Pacific Northwest. Requires 130 frost-free days and can withstand temperatures as low as -28 F.

Soil type.
Fine-, medium-, and coarse-textured soils, with high moisture content.

APPLICATIONS:

Roadside suitability.
Moderate soil stabilization limited to open forest understory. Attractive low growing plant that provides good cover for soil protection. Shade and fire tolerant.

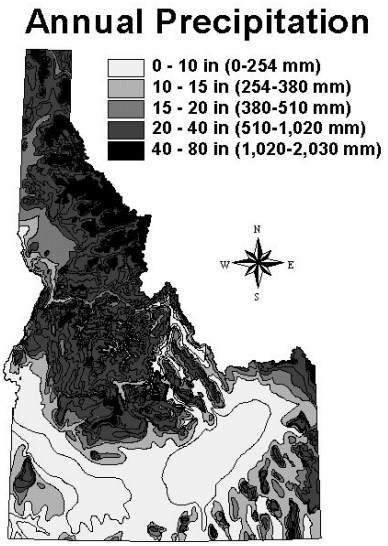
Establishment.
Seedling vigor is high and seed and vegetative spread rates are rapid, but cold stratification is required. Can also be propagated by corms, cuttings, and sprigs.

SEEDING RECOMMENDATIONS:
Plant in early spring. Plant between 4-7 PLS lb per acre. There are 220,000 seeds per lb.

Gray Aster

Aster glaucodes

Richard W. Scott (1995)



LIFE SPAN: Perennial.

GROWTH HABIT: Forb.

ORIGIN: Native.

VEGETATIVE CHARACTERISTICS:
Flowers are white-lavendar. Roots are fibrous with rhizomes and reach a minimum depth of 10 in. Grows 24-60 in tall.

SITE REQUIREMENTS:

Precipitation zone.
Ranges from 14-30 in.

Elevation zone.
Ranges from 4,000-10,000 ft.

Habitat & Climate requirements.
Adapted to the western United States on dry, exposed, disturbed, and depleted lands. Requires 130 frost-free days and can withstand temps to -43 F.

Soil type.
Medium- to moderately-coarse-textured soils.

APPLICATIONS:

Roadside suitability.
High stabilization value. Useful plant in erosive areas. Tolerates drought and fire.

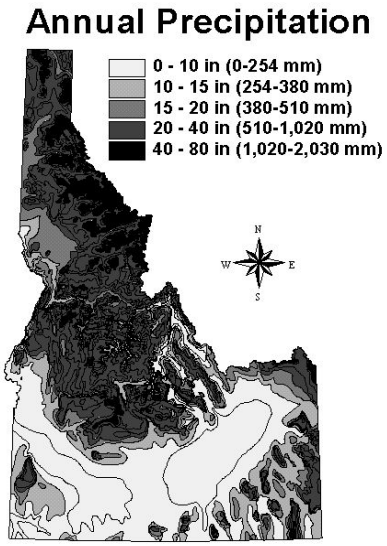
Establishment.
Moderate moisture requirement.

SEEDING RECOMMENDATIONS:
Direct seed or transplant in the fall at a depth of 0.5 in. Seed 5 lb PLS per acre. There are 540,000 seeds per lb.

Arrowleaf Balsamroot

Balsamorhiza sagittata

Patricia A. Patterson et al. (1985)



LIFE SPAN: Perennial.

GROWTH HABIT: Forb.

ORIGIN: Native.

VEGETATIVE CHARACTERISTICS:
Tufted. Leaves are broad and arrowhead-shaped. Flowers are showy and yellow. Taproots are deep, reaching a minimum depth of 14 in, thick, and woody. Grows 16-30 in tall.

SITE REQUIREMENTS:

Precipitation zone.
Ranges from 8-14 in.

Elevation zone.
Ranges from 4,300-8,300 ft.

Habitat & Climate requirements.
Adapted to a wide range of climatic conditions throughout the Great Basin, Rocky Mountains, and along the foothills up to the aspen zone.

Soil type.
Well-drained, deep, sandy, silty, loamy to extremely stony soils. Occasionally found on acidic soils with duripans or hardpans.

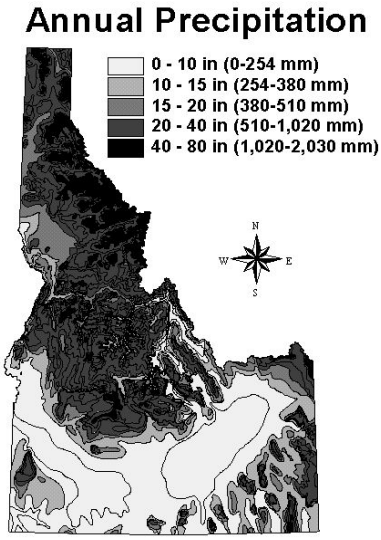
APPLICATIONS:

Roadside suitability.
Highly productive. Winter-hardy and persists in full sunlight. Tolerates drought.

Establishment.
Establishment is slow and seedling vigor is low.

SEEDING RECOMMENDATIONS:
Seed in the spring. Broadcast or drill at a depth of 0.33 in. Plant 10-12 PLS lb per acre. There are 27,000 seeds per lb.

Low larkspur
Delphinium bicolor



LIFE SPAN: Perennial

GROWTH HABIT: Forb

ORIGIN: Native

VEGETATIVE CHARACTERISTICS:
Leaves are generally round in shape and divided into deep lobes that radiate from the center.

SITE REQUIREMENTS:

Precipitation zone. Areas with 8-12 in of precipitation

Elevation zone.
Ranges from 3,000-10,000 ft.

Habitat & Climate requirements.
Moist areas and varying slopes.

Soil Type.
Occurs on well-drained, loamy soils.

APPLICATIONS:

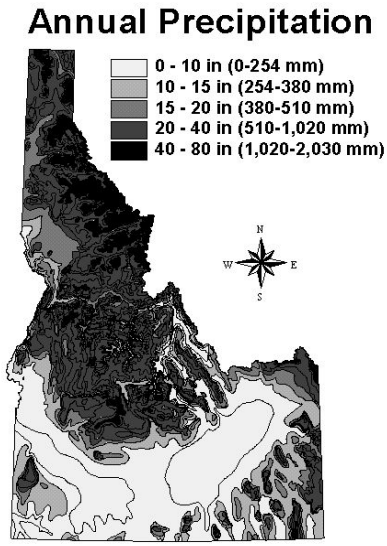
Roadside Suitability.
Fibrous roots help stabilize soil, and readily colonizes disturbed areas such as roadsides.

Establishment.
Difficult species to transplant. Low larkspur mainly reproduces by seed . It is pollinated by bees,and probably self-pollinates as well. Low larkspur may reproduce vegetatively.

SEEDING RECOMMENDATIONS:
Direct seeding in Fall at 3 PLS lb/acre incoporates natural cold stratification.

Yellow Buckwheat
Eriogonum flavum

Charles Grier Johnson (1993)



LIFE SPAN: Perennial.

GROWTH HABIT: Forb/small shrub.

ORIGIN: Native

VEGETATIVE CHARACTERISTICS:
Leaves in dense clusters that are green above and gray and hairy beneath. Stems are tangled and have wooly hair on surface. Branches are woody. Flowers are simple umbles, small, and yellow. Taproots can reach a minimum depth of 10 in. Grows 4-16 in tall.

SITE REQUIREMENTS:

Precipitation zone.
Ranges between 14-20 inches.

Elevation zone.
Adapted to 9,000 ft.

Habitat & Climate requirements.
Adapted to arid climatic conditions. On open, dry ridges in grasslands to alpine ridges.

Soil type.
Medium-course- to medium-textured soil with neutral pH.

APPLICATIONS:

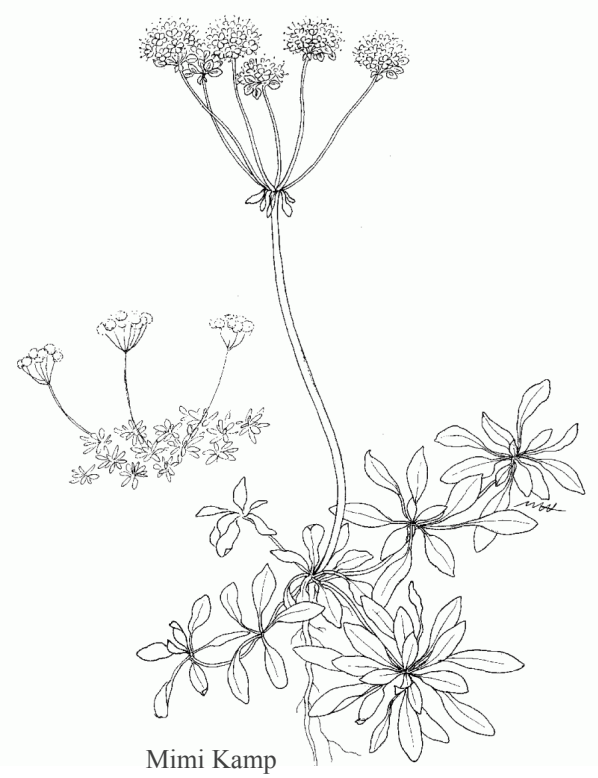
Roadside suitability.
Persistent and compatible with other plants. Branches mat over the ground and provide rapid soil stabilization. Persists in full sunlight to partial shade. Stout, woody taproot.

Establishment.
Medium germination and growth rates.

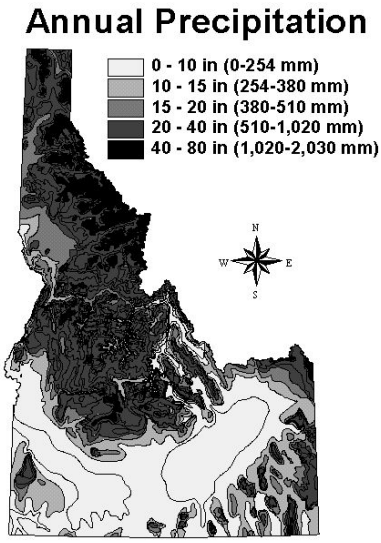
SEEDING RECOMMENDATIONS:
Plant in fall or spring. Seed 8-10 PLS lb per acre. There are up to 209,000 seeds per lb.

Suphur-flower buckwheat

Eriogonum umbellatum



Mimi Kamp



LIFE SPAN: Perennial

GROWTH HABIT: Forb

ORIGIN: Native

VEGETATIVE CHARACTERISTICS:
Leaves are basal, 1 inch long, and softly wooly or hairless. Flower stems 3 to 16 inches tall are topped by clusters of tiny sulfur yellow flower heads.

SITE REQUIREMENTS:

Precipitation zone.
8-18 inches.

Elevation zone.
700 to 12,000 feet

Habitat & Climate requirements.
Sulphur-flower buckwheat is usually found in dry, open, rocky sites with shallow, sandy soils, especially on sunny slopes and ridges.

Soil type.
Sulphur-flower buckwheat is adapted to well-drained, sandy or gravelly soils with low fertility, and will not tolerate saturated soils or shading.

APPLICATIONS:

Roadside suitability.
It has high drought, salinity and carbonate tolerance.

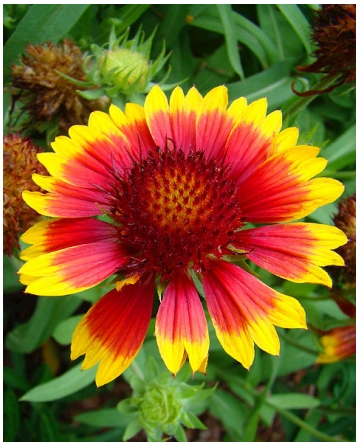
Establishment.
Sulphur-flower buckwheat can be raised from seed or as container grown plants.

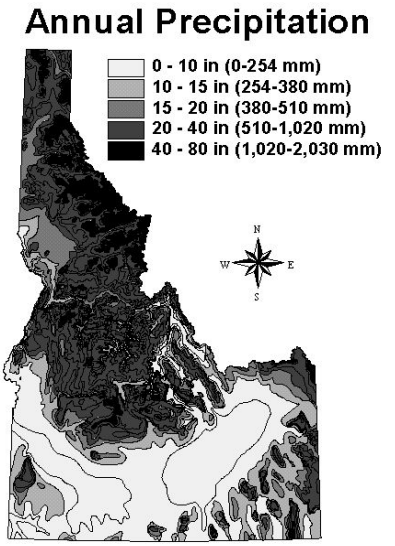
SEEDING RECOMMENDATIONS.
Seed 0.5 PLS lbs per acre.

Blanketflower

Gaillardia aristata

F.J. Hermann (1966)





LIFE SPAN: Perennial.

GROWTH HABIT: Forb.

ORIGIN: Native.

VEGETATIVE CHARACTERISTICS:

Leaves are narrow, pointed, alternate, and hairy. Stems are round, rigid, and hairy. Flowers are yellow or red and daisy-like. Roots can reach a minimum depth of 16 in. Grows 18-24 in tall.

SITE REQUIREMENTS:

Precipitation zone.
Ranges from 16-25 in.

Elevation zone.
Up to 8,000 ft.

Habitat & Climate requirements.
Adapted to very dry, open areas, gravelly roadsides and waste areas.

Soil type.
Well-drained, moderately to medium-course textured soil with neutral pH.

APPLICATIONS:

Roadside suitability.
Found on roadsides. Used for erosion control and beautification. Persists in full sun to partial shade. Tolerates drought.

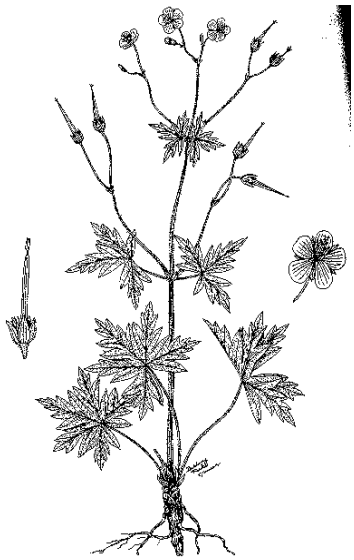
Establishment.
Pioneer species with a low moisture requirement.

SEEDING RECOMMENDATIONS:

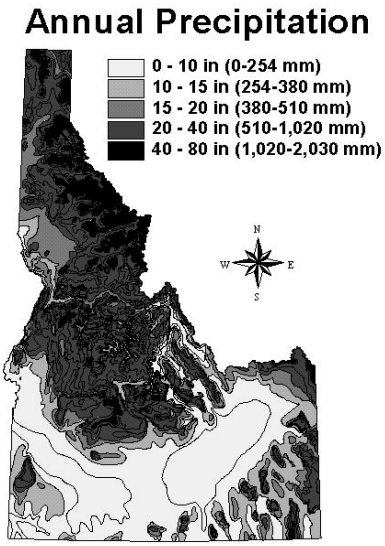
Plant in early spring. Seed 5-7 PLS lb per acre. There are 132,000 seeds per lb.

Sticky Purple Geranium

Geranium viscosissimum



James Stubbendieck et al. (1997)



LIFE SPAN: Perennial.

GROWTH HABIT: Forb.

ORIGIN: Native.

VEGETATIVE CHARACTERISTICS:
Cool-season. Stems are leafy and branched. Flowers are pale lavendar to pink with sticky hairs. Root crown is stout and woody. Taprooted with some rhizomes, reaching a minimum depth of 6 in. Grows 4-36 in tall.

SITE REQUIREMENTS:

Precipitation zone. Greater than 20 in.

Elevation zone.
Ranges from 750-10,000 ft.

Habitat & Climate requirements.
Adapted to a wide range of climatic conditions throughout temperate North America.

Soil type.
Fertile, fairly moist, course- to- medium-fine-textured soils.

APPLICATIONS:

Roadside suitability.
Moderate soil stabilization value. Found on roadsides and is highly susceptable to application of pesticides. Persists in diffuse sunlight.

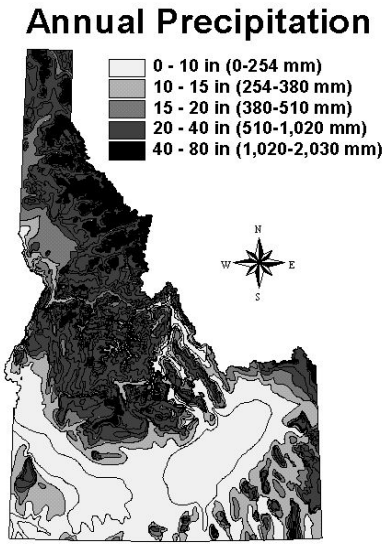
Establishment.
Propagated by sowing seed during the later part of the summer. Low to moderate moisture requirement.

SEEDING RECOMMENDATIONS:
Drill or broadcast in the fall. Seed 7-10 PLS lb per acre. There are 52,000 seeds per lb.

Blue Flax

Linum lewisii

PKCRMA



LIFE SPAN: Perennial.

GROWTH HABIT: Forb.

ORIGIN: Native.

VEGETATIVE CHARACTERISTICS:
Leaves are gray-green, alternate, narrow and linear. Stems are slender. Flowers are sky-blue and saucer-shaped in loose terminal clusters. Taproots can reach a minimum depth of 15 in. Grows 1-3 ft tall.

SITE REQUIREMENTS:

Precipitation zone.
Ranges from 12-16 in.

Elevation zone.
Ranges from 4,000-11,000 ft.

Habitat & Climate requirements.
Adapted to dry, subtropic climatic conditions of northern temperate zones. Requires 90 frost-free days and can withstand temperatures to -43 F.

Soil type.
Moderately course-to-medium-textured soils with a neutral pH. Also tolerates limestone soils.

APPLICATIONS:

Roadside suitability.
Aesthetic, persistent, and compatable with other plants. Fair soil stabilizer. Widely used for reclamation and beautification seedings. Persists in full sunlight.

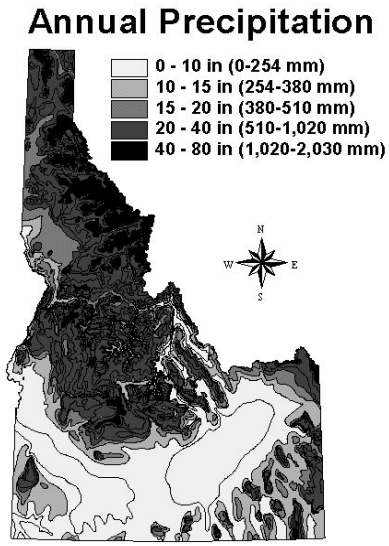
Establishment.
Establishes by seeds and plant divisions. Very good germination rate and initial establishment.

SEEDING RECOMMENDATIONS:
Plant in the spring at a depth of 0.13 in. Seed 5-7 PLS lb per acre. There are 293,000 seeds per lb.

Fernleaf Biscuitroot

Lomatium dissectum

HRMP



LIFE SPAN: Perennial.

GROWTH HABIT: Forb.

ORIGIN: Native.

VEGETATIVE CHARACTERISTICS:
Flowers are aromatic, yellow, white, or purple. Propagates vegetatively by tubers. Taproot can reach a minimum depth of 12 in. Stands 4-12 in tall.

SITE REQUIREMENTS:

Precipitation zone.
Ranges from 14-100 in.

Elevation zone.
Ranges from 0-10,000 ft.

Habitat & Climate requirements.
Adapted to full sunlight on scablands, Rocky Mountain slopes, open slopes, and exposed ridges. Requires 240 frost-free days and can withstand temperatures to 7 F.

Soil type.
Prefers well-drained, rocky soils. Can also tolerate limestone soils.

APPLICATIONS:

Roadside suitability.
Good to excellent for roadside plantings.

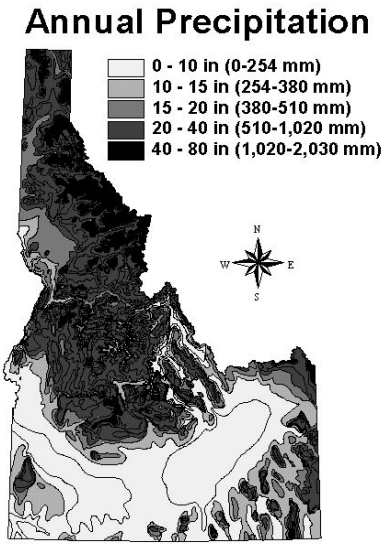
Establishment.
Limited seed source. Plant dissections are sometimes available. Cold stratification is required.

SEEDING RECOMMENDATIONS:
Plant in the fall. Seed 5-7 PLS lb per acre. There are 134,240 seeds per lb..

Firecracker Penstemon

Penstemon eatonii

Arthuer Cronquist et al. (1994)



LIFE SPAN: Perennial.

GROWTH HABIT: Forb/subshrub.

ORIGIN: Native.

VEGETATIVE CHARACTERISTICS:

Cool-season and erect. Leaves are opposite and large. Flowers are tubular and bright red. Somewhat rhizomatous with a taproot that can reach a minimum depth of 12 in. Stands 12-40 in tall.

SITE REQUIREMENTS:

Precipitation zone.
Ranges from 10-16 in.

Elevation zone.
Ranges from 3,300-8,000 ft.

Habitat & Climate requirements.
Adapted to a wide range of climatic conditions under full sunlight. Requires 165 frost-free days and can withstand temperatures to -18 F.

Soil type.
Well- to-moderately well-drained soils of moderately course texture. Does not do well in poorly-drained areas.

APPLICATIONS:

Roadside suitability.
Potential erosion control species. Survives cold, harsh winters. Natural spreader and tolerates drought.

Establishment.
Low moisture requirement. Easy to plant with good germination, seedling vigor, and final establishment. Cold stratification is required.

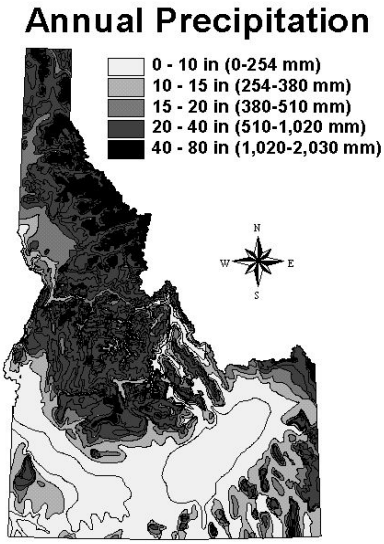
SEEDING RECOMMENDATIONS:

Plant in early spring or late fall at a depth of 0.25 in. Seed 3-6 PLS lb per acre. There are 351,050 seeds per lb.

Palmer Penstemon

Penstemon palmeri

Arthur Cronquist et al. (1994)



LIFE SPAN: Perennial, short-lived.

GROWTH HABIT: Forb.

ORIGIN: Introduced.

VEGETATIVE CHARACTERISTICS:
Foliage is glacous. Leaves are basal, opposite, and green throughout the winter. Flowers are tubular and white to pink. Roots are fibrous and can reach a minimum depth of 14 in. Stands 48 in
tall.

SITE REQUIREMENTS:

Precipitation zone.
Ranges from 10-16 in .

Elevation zone.
Ranges from 3,500-6,500 ft.

Habitat & Climate requirements.
Adapted to a wide range of climatic conditions. Requires 140 frost-free days and can withstand tempertures to -8 F.

Soil type.
Well-drained, rocky, gravely-to-clayey soils that are basic to slightly acidic.

APPLICATIONS:

Roadside suitability.
Thrives on disturbed, depleted, and exposed sites on washes and along roadsides. Moderate soil stabilizer. Used for erosion control, diversity, and beautification. Natural spreader and persists in full sunlight.

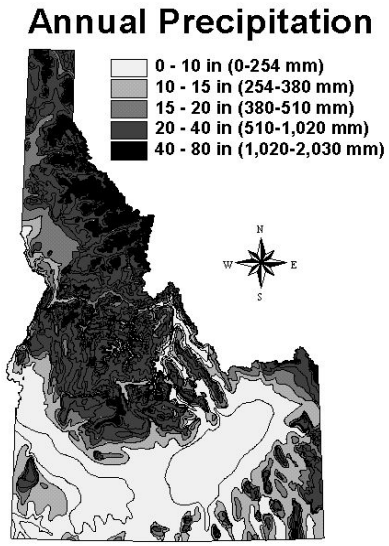
Establishment.
Easy to plant. Good initial establishment and moderate final establishment.

SEEDING RECOMMENDATIONS:
Broadcast or drill in early spring or late fall at a depth less than 0.13 in. Seed 3-6 PLS lb per acre. There are 610,000 seeds per lb.

Rocky Mountain Penstemon

Penstemon strictus

Arthur Cronquist et al. (1994)



LIFE SPAN: Perennial, long-lived.

GROWTH HABIT: Forb.

ORIGIN: Native.

VEGETATIVE CHARACTERISTICS:
Cool-season. Leaves are opposite, green, long, smooth, and curled or reflexed. Flowers are solitary and bluish purple. Underground stems are large. Roots are fine and can reach a minimum depth of 14 in. Stands 12-36 in tall.

SITE REQUIREMENTS:

Precipitation zone.
Ranges from 15-20 in.

Elevation zone.
Found up to 11,000 ft.

Habitat & Climate requirements.
Adapted to a wide range of climatic conditions throughout the mountains of the western United States. Requires 120 frost-free days and can withstand temperatures to -33 F.

Soil type.
Well-drained, medium-textured, rocky and sandy loam soils that range from weakly acidic to weakly alkaline.

APPLICATIONS:

Roadside suitability.
Used in reclamation and wildflower mixes. Persists in full sunlight.

Establishment.
Easy to establish and good seed producer.

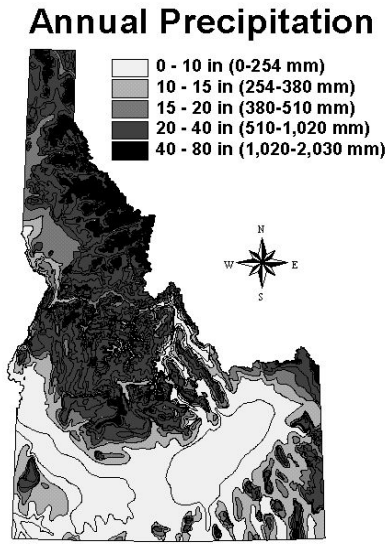
SEEDING RECOMMENDATIONS:
Broadcast or drill seed early in spring or late fall at a depth of 0.13 in. Seed 3-6 PLS lb per acre. There are 592,000 seeds per lb.

Alpine Penstemon

Penstemon venustus

Charles Grier Johnson (1993)

294



LIFE SPAN: Perennial.

GROWTH HABIT: Forb/half shrub.

ORIGIN: Native.

VEGETATIVE CHARACTERISTICS:
Cool-season. Leaves are toothed or entire and opposite. Base is woody. Flowers are several stalked and bright lavendar to purple. Taproot is strong and can reach a minimum depth of 6 in. Stands 12-24 in tall.

SITE REQUIREMENTS:

Precipitation zone.
Ranges from 20-35 in.

Elevation zone.
Ranges from 1,000-6,000 ft (305-1,830 m).

Habitat & Climate requirements.
Adapted to the climatic conditions of full sunlight on open slopes of mountain valleys and foothills. Requires 170 frost-free days and can withstand temperatures to -18 F.

Soil type.
Well- to moderately drained soils.

APPLICATIONS:

Roadside suitability.
Used for beautification and erosion control. Tolerates drought, cold, and weakly acidic conditions. Intolerant of poorly- drained soils.

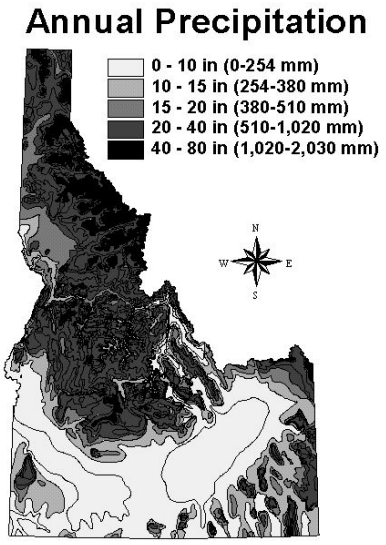
Establishment.
Good seedling vigor, rapid seed spread rate and fairly easy to establish.

SEEDING RECOMMENDATIONS:
Plant in early spring or late fall at a depth of 0.25 in. Seed 3-6 PLS lb per acre. There are 280,000 seeds per lb.

Prairie Coneflower

Ratibida columnifera

Britton, N.L., and A. Brown. 1913



LIFE SPAN: Perennial

GROWTH HABIT: Forb

ORIGIN: Native

VEGETATIVE CHARACTERISTICS:
Usually has a taproot and grows upright from a woody base to a height of 12 to 24 inches.. The numerous, pinnate leaves are deeply cut into linear or lance-shaped segments along alternately branched stems. Showy yellow ray flowers droop and surround the columnar-shaped, brown, central disk.

SITE REQUIREMENTS:

Precipitation zone.
Occurs in areas with 10 to 30 inches of annual precipitation.

Elevation zone.
Occurs in elevations of 3200-8400 ft.

Habitat and Climate requirements.
It prefers to grow in the dry, open spaces of prairie grasslands and mountain foothills and is found along roadsides, in waste and disturbed areas, and along railroad rights-of-way.

Soil type.
Prairie coneflower does well on a variety of soil types, including loams and rocky to gravelly-sandy textures. It tolerates a pH range from slightly acidic to moderately alkaline and weak saline soils.

APPLICATIONS:

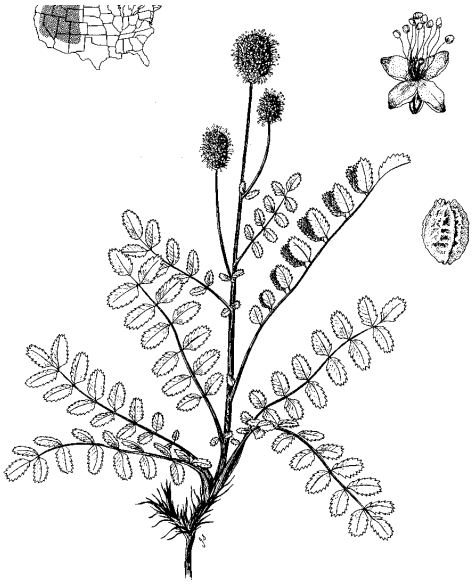
Roadside suitability.
Prairie coneflower coexists with other species and adds biodiversity to a variety of native plant communities. Drought tolerant

Establishment.
Seed should be planted into a firm, weed-free seedbed, preferably with a drill that will ensure uniform seed placement depth of ¼ to ½ inch.

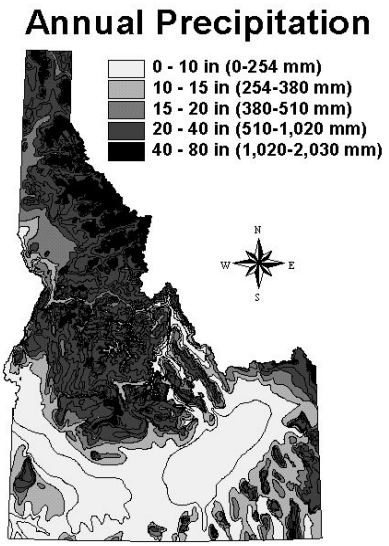
SEEDING RECOMMENDATIONS:
600,000 seeds/lb. 2-5 PLS lb per acre

Small Burnet

Sanguisorba minor



Clinton H. Wasser (1982)



LIFE SPAN: Perennial.

GROWTH HABIT: Forb.

ORIGIN: Introduced.

VEGETATIVE CHARACTERISTICS:
Branched with a thick base of stems. Leaves are alternate and pinnately compound. Flowers are pinkish white and sessile. Prominent taproot with weak rhizomes that can reach a minimum depth of 12 in. Stands 20-25 in tall.

SITE REQUIREMENTS:

Precipitation zone.
Ranges from 12-25 in.

Elevation zone.
Ranges from 1,000-6,000 ft (305-1,830 m).

Habitat & Climate requirements.
Well adapted to the climatic conditions of Intermountain regions. Requires 90 frost-free days and can withstand temperatures to -33 F.

Soil type.
Well-drained, droughty, moderately wet, acidic, and alkaline-to-weakly saline soils with low fertility.

APPLICATIONS:

Roadside suitability.
Moderate soil stabilization value. Used for erosion control and beautification. Winter-hardy and persists in full sunlight.

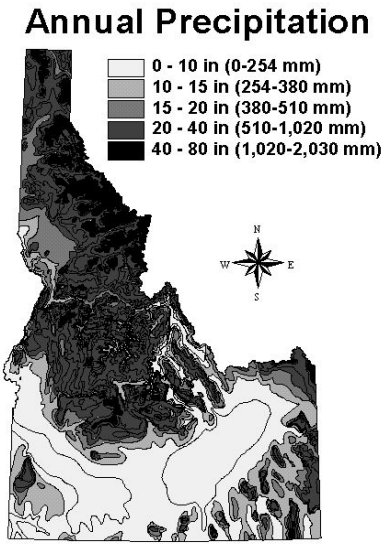
Establishment.
Easy to germinate, excellent seedling vigor, seed production, and growth rate.

SEEDING RECOMMENDATIONS:
Plant in late fall or early spring at a depth less than 0.25- 0.75 in. Seed 2-5 PLS lb per acre. There are 55,000 seeds per lb.

Scarlet Globemallow

Sphaeralcea coccinea

Britton, N.L. and A. Brown (1913)



LIFE SPAN: Perennial.

GROWTH HABIT: Forb.

ORIGIN: Native.

VEGETATIVE CHARACTERISTICS:
Erect. Stems are single or clustered and branched. Flowers are reddish-orange with tiny star-shaped hairs. Woody taproot with creeping root stalk that can reach a minimum depth of 6 in. Stands 3-12 in tall.

SITE REQUIREMENTS:

Precipitation zone.
Ranges from 8-12 in.

Elevation zone.
Ranges from 3,000-7,000 ft.

Habitat & Climate requirements.
Adapted to dry climatic conditions. Requires 115 frost-free days and can withstand temperatures to -23 F.

Soil type.
Rocky, sandy, or fine-textured soils.

APPLICATIONS:

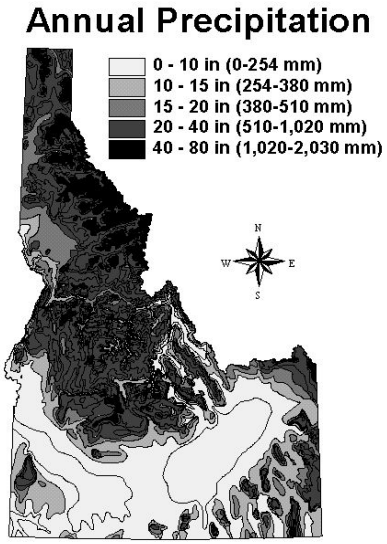
Roadside suitability.
Persistent and compatable with other plants. Good soil stabilizer. Known to colonize roadsides. Persists in full sunlight and tolerates drought.

Establishment.
Requires seed scarification as hard seed coat prevents prolific seed germination.

SEEDING RECOMMENDATIONS:
Broadcast or drill in fall or winter. Seed 4-6 PLS lb per acre . There are 500,000 seeds per lb.

Rocky Mountain Maple
Acer glabrum

Britton, N.L. and A. Brown (1913)



LIFE SPAN: Long-lived.

GROWTH HABIT: Deciduous shrub.

ORIGIN: Native.

VEGETATIVE CHARACTERISTICS:
Dwarf. Leaves are three-lobed, simple, and sharply serrate. Crown is narrow with small branches. Bark is thin, smooth, and dark reddish-brown. Roots can reach a minimum depth of 24 in. Grows 5-25 ft tall.

SITE REQUIREMENTS:

Precipitation zone.
Minimum of 12-25 in.

Elevation zone.
Ranges from 1,100-10,000 ft.

Habitat & Climate requirements.
Adapted to the climatic conditions of foothills and cold deserts on fairly dry slopes. Can withstand temperatures to -43 F.

Soil type.
Well-drained rocky, gravelly, and limestone soils.

APPLICATIONS:

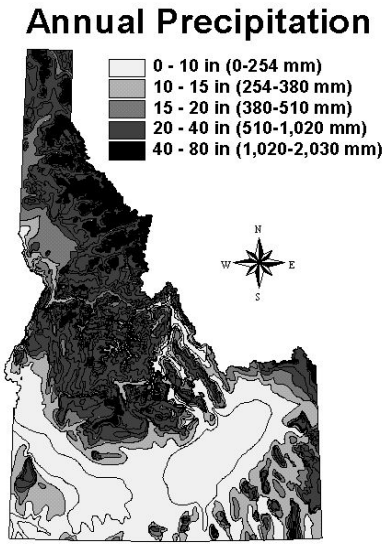
Roadside suitability.
Aesthetic and tolerates some shade. Deep roots provide good slope stabilization.

Establishment.
Erratic germination. Seedlings develop slowly. Very persistent once established. Cold stratification is required.

SEEDING RECOMMENDATIONS:
Plant in the fall. Seed 3-4 PLS lb per acre. There are 20,000 seeds per lb.

Serviceberry
Amerlanchier alnifolia

Patricia A. Patterson et al. (1985)



LIFE SPAN: Long-lived.

GROWTH HABIT: Deciduous shrub or tree.

ORIGIN: Native.

VEGETATIVE CHARACTERISTICS:
Cool season, erect, and multi-stemmed. Leaves are dark green. Twigs are dark greyish. Flowers are white-to-pinkish. Fruits are cherry-like, fleshy, and purple. Roots can reach a minimum depth of 24 in. Grows 3-15 ft tall.

SITE REQUIREMENTS:

Precipitation zone.
Minimum of 12-30 in.

Elevation zone.
Up to 9,000 ft.

Habitat & Climate requirements.
Adapted to the climatic conditions associated with open forest and canyon slopes throughout much of the Pacific Northwest. Can withstand temperatures to -38 F.

Soil type.
Well-drained, moderately-course- to fine-textured soils with neutral to weakly acid pH (5.6-8.4).

APPLICATIONS:

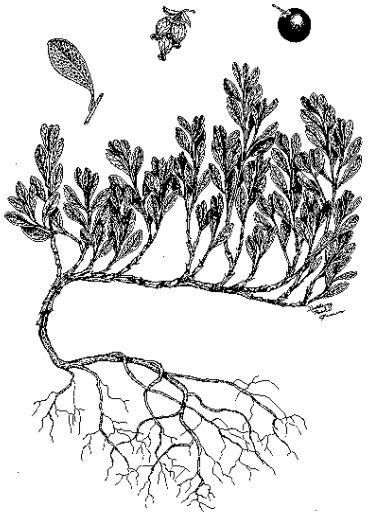
Roadside suitability.
Thicket forming. Cold-hardy and resistant to drought. Deep roots provide good slope stabilization.

Establishment.
Seed quality is often low. Seed germination is erratic. Seedlings develop at a moderate rate. Once established, very persistent. Cold stratification is required.

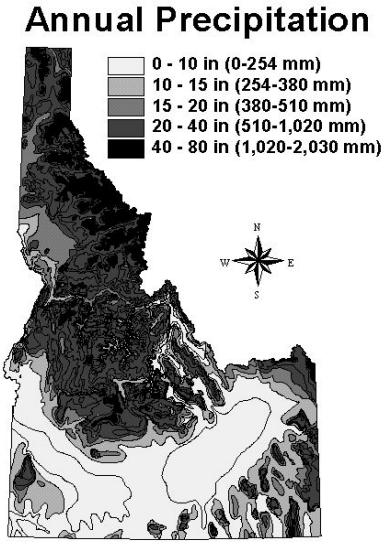
SEEDING RECOMMENDATIONS: Plant in fall or early spring at a depth of 0.25 in. Seed 3-4 PLS lb per acre. There are 25,000 seeds per lb.

Kinnikinnick

Arctostaphylus uva-ursi



James Stubbendieck et al. (1997)



LIFE SPAN: Long-lived.

GROWTH HABIT: Evergreen shrub.

ORIGIN: Native.

VEGETATIVE CHARACTERISTICS:
Leaves are small, round, and thick. Bark is red and exfoliating. Flowers are white or pinkish and urn-shaped. Fruits are red and roundish. Roots can reach a minimum depth of 10 in. Grows up to 12 in tall.

SITE REQUIREMENTS:

Precipitation zone.
Ranges from 14-45 in.

Elevation zone.
Ranges from 7,020-11,510 ft.

Habitat & Climate requirements.
Adapted to wide range of climatic conditions. In open forests throughout the Rocky Mountain region, withstands temperatures from -50 to 0 F.

Soil type.
Adapted to well-drained, moderately coarse, sandy, acidic soils (pH 5.5-8.0).

APPLICATIONS:

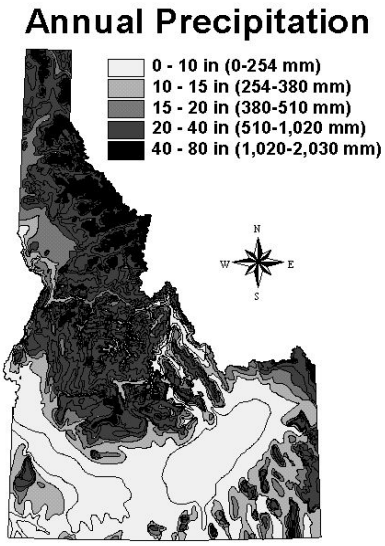
Roadside suitability.
Low and trailing. Used for landscape, watershed, and erosion control plantings. Excellent soil stabilizer.

Establishment.
Slow to establish without top soil. Propagate from seeds, stems, or root cuttings.

SEEDING RECOMMENDATIONS:
Plant in spring. Seed at 4-6 PLS lb per acre. There are 37,900 seeds per lb.

Low Sagebrush
Artemisia arbuscula

Hugh Mozingo (1987)



LIFE SPAN: Perennial.

GROWTH HABIT: Dwarfed shrub.

ORIGIN: Native

VEGETATIVE CHARACTERISTICS:
Small, stiff, shaggy, and very branched. Leaves are greyish white, and three toothed. Influorescence are narrow. Roots are fibrous with a taproot and reach a minimum depth of 10 in. Grows 4-159 in tall.

SITE REQUIREMENTS:

Precipitation zone.
Ranges from 8-20 in.

Elevation zone.
Ranges from 7,000-8,000 ft.

Habitat & Climate requirements.
Adapted to dry, rocky slopes and ridges throughout much of the Rocky Mountain region. Can withstand temperatures to -43 F.

Soil type.
Well-drained, shallow, stony soils as well as soils with heavy clay subsurface horizons (pH 5.5-8.6).

APPLICATIONS:

Roadside suitability.
Plant in a mix with native grasses. Relatively easy to establish, low growing with good root penetration for slope stabilization.

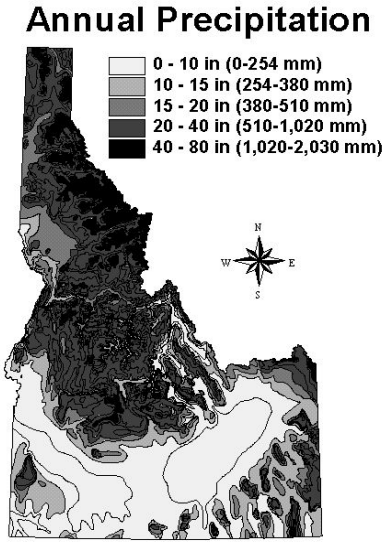
Establishment.
Germinates easily. Develops rapidly.

SEEDING RECOMMENDATIONS:
Plant in fall, winter, or spring at a depth of 0.25 in. Seed 2-5 PLS lb per acre. There are 972,000 seeds per lb.

Silver Sagebrush

Artemisia cana

James Stubbendieck et al. (1997)



LIFE SPAN: Long-lived.

GROWTH HABIT: Evergreen shrub.

ORIGIN: Native

VEGETATIVE CHARACTERISTICS:
Densely branched. Leaves are small, silvery and linear. Flowers are inconspicuous and yellow. Roots can reach a minimum depth of 20 in. Grows 5 ft tall.

SITE REQUIREMENTS:

Precipitation zone.
Ranges from 8-40 in.

Elevation zone
Ranges from 6,000-10,600 ft.

Habitat & Climate requirements.
Adapted to the climatic conditions of moist river valleys, prairies, terraces, and uplands.

Soil type.
Moist-to-moderately dry, deep loam-to-sand, moderately fine-textured, shallow soils (pH 5.1-9).

APPLICATIONS:

Roadside suitability.
Spreads by rhizomes under favorable conditions. Resprouts after a disturbance. Used for erosion control. Tolerates fire and alkalinity.

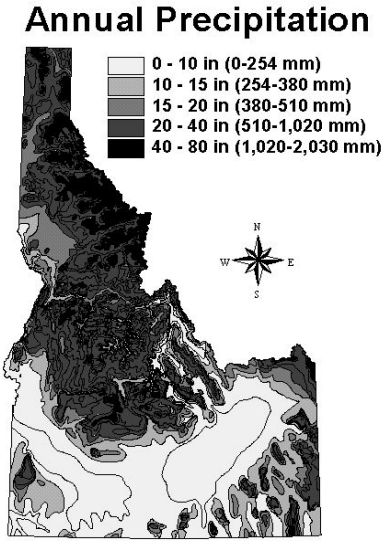
Establishment.
Fairly easy to establish. Once established, spreads readily.

SEEDING RECOMMENDATIONS:
Plant in fall or early spring. Seed 2-5 PLS lb per acre. There are 850,000 seeds per lb.

Black Sagebrush

Artemisia nova

James Stubbendieck et al (1997)



LIFE SPAN: Long-lived.

GROWTH HABIT: Evergreen shrub.

ORIGIN: Native

VEGETATIVE CHARACTERISTICS:
Small, spreading, dullish gray, and aromatic. Flowers are inconspicuous. Leaves are alternate, simple, spatulate, 3-lobed at tip, constricted just below the lobes, glands present. Roots can reach a minimum depth of 10 in. Grows less than 24 in tall.

SITE REQUIREMENTS:

Precipitation zone.
Ranges from 6-20 in.

Elevation zone.
Ranges from 4,000-8,000 ft.

Habitat & Climate requirements.
Especially adapted to dry rocky ridges, foothills, and cold deserts primarily in the Intermountain West. Can withstand temperatures to -33 F.

Soil type.
Favors shallow, dry, stony, calcareous soils (pH 7-8.5).

APPLICATIONS:

Roadside suitability.
Low growing with deep taproot. Aggressive natural spreader once established. Potential species for disturbed land plantings.

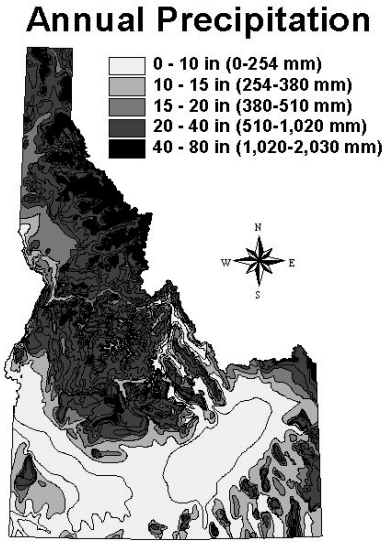
Establishment.
Fairly easy to establish with low moisture requirement.

SEEDING RECOMMENDATIONS:
Broadcast in late fall or winter. Seed 2-5 PLS lb per acre. There are 907,200 seeds per lb.

Basin Big Sagebrush

Artemisia tridentata var. tridentata

Arthur Cronquist et al. (1994)



LIFE SPAN: Long-lived.

GROWTH HABIT: Shrub.

ORIGIN: Native

VEGETATIVE CHARACTERTISTICS:
Tall, erect, rounded, and strongly aromatic. Trunk is short, branched, and woody. Leaves are wedge to fan- shaped and usually three-lobed at the tips. Flowers are yellow and inconspicuous. Roots can reach a minimum depth of 16 in. Grows 1.5-15 ft tall.

SITE REQUIREMENTS:

Precipitation zone.
Ranges from 6-35 in.

Elevation zone.
Ranges from 1,475-8,033 ft.

Habitat & Climate requirements.
Adapted to a wide range of climatic conditions throughout the semi-desert regions in the Pacific Northwest east of the Cascades.Can withstand temperatures to - 13 F.

Soil type.
Moderately shallow to deep, well-drained, alluvial clay loams. Neutral to slightly alkaline soil conditions (pH 6.5-8.5).

APPLICATIONS:

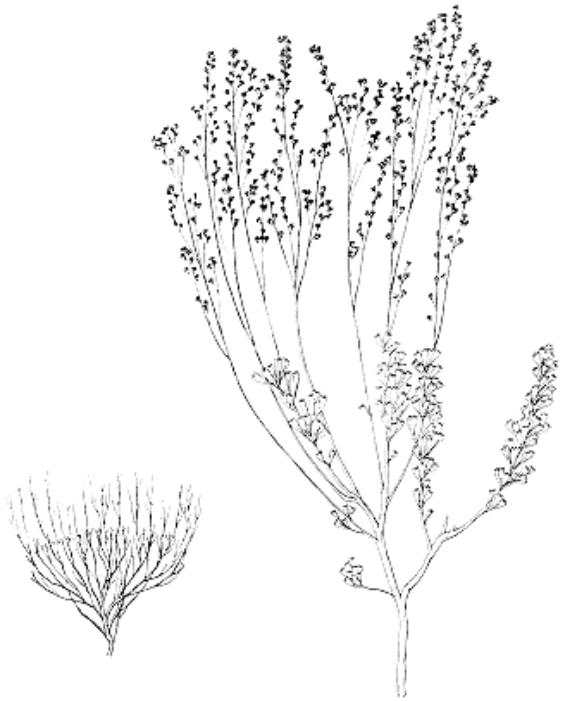
Roadside suitability.
Usefull for stabilizing backslope washes, gullies, roadcuts, and other raw exposed sites. Tolerates drought.

Establishment.
Establishes rapidly from transplanting and direct seeding. Good seed producer. Low moisture requirement.

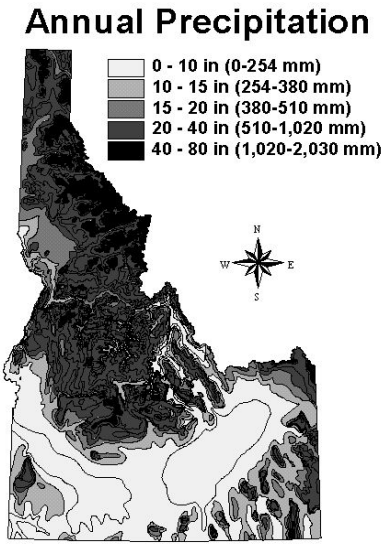
SEEDING RECOMMENDATIONS:
Plant in late fall or winter. Seed 2-5 PLS lb per acre. There are 2,500,000 seeds per lb.

Mountain Big Sagebrush

Artemesia tridentata var. vaseyana



Arthur Cronquist et al. (1994)



LIFE SPAN: Long-lived.

GROWTH HABIT: Evergreen shrub.

ORIGIN: Native.

VEGETATIVE CHARACTERISTICS:
Rounded with short branches and a woody trunk. Leaves are wedge- to fan-shaped at the tips. Flowers are inconspicuous and yellow. Roots can reach a minimum depth of 16 in. Grows 20-50 in tall.

SITE REQUIREMENTS:

Precipitation zone.
Ranges from 10-14 in.

Elevation zone.
Ranges from 4,000-10,000 ft.

Habitat & Climate requirements.
Widespread in the central Rocky Mountains and Pacific Northwest at higher montane elevations east of the Cascades. Well adapted to dry regions of upper foothills and aspen zones. Can withstand temperatures to -33 F.

Soil type.
Well-drained, moderately shallow to deep, sandy to silty loam soils, with a special affinity to granitic substrates (pH 6-8.5).

APPLICATIONS:

Roadside suitability.
Low growing shrub that is well suited for roadside revegetation. Deep rooted. Used for the outer rows of multi-row wind breaks. Tolerates drought fairly well.

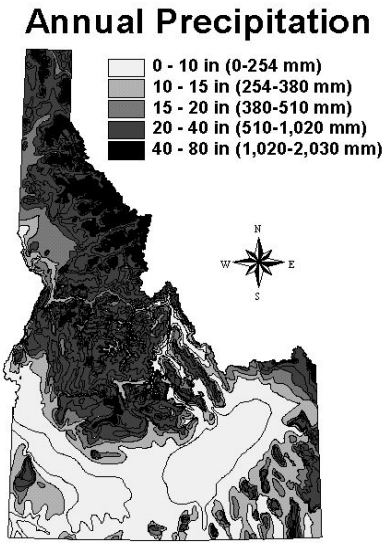
Establishment.
Easy to germinate. Medium moisture requirement.

SEEDING RECOMMENDATIONS:
Plant in fall on a compact seedbed. Seed 2-5 PLS lb per acre. There are 2,500,000 seeds per lb.

Fourwing Saltbush

Atriplex canescens

James Stubbendieck et al. (1997)



LIFE SPAN: Long-lived.

GROWTH HABIT: Evergreen shrub.

ORIGIN: Native.

VEGETATIVE CHARACTERISTICS:
Upright and branched freely with male and female plants. Leaves are greyish white and alternate. Flowers are inconspicuous. Fruits are four-winged. Roots are fibrous with a taproot that can exceed 20 ft deep. Grows 1.6-6.6 ft tall.

SITE REQUIREMENTS:

Precipitation zone.
Ranges from 6-15 in.

Elevation zone.
Up to 7,000 ft.

Habitat & Climate requirements.
Adapted to a wide range of conditions throughout the western United States from the desert to the pine forest.

Soil type.
Suited to well-drained, sandy soils. Tolerates salinity, gravelly washes, heavy clays, and alkaline soils (pH 6.6-9).

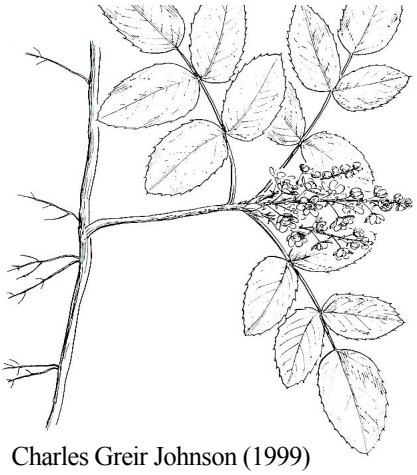
APPLICATIONS:

Roadside suitability.
Used for rangeland rehabilitation and soil stabilization. Cold- and drought-hardy. Stays green through the summer. Very deep taproot for slope stabilization.

Establishment.
Grows rapidly. Plant by direct seeding, bare root, or container transplants. Grows well from seed.

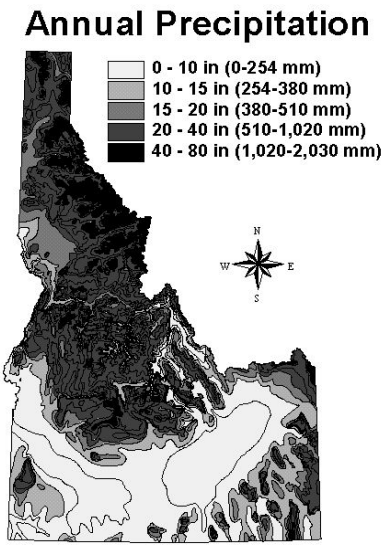
SEEDING RECOMMENDATIONS:
Plant in the fall. Seed 2-5 PLS lb per acre. There are 52,000 seeds per lb.

Oregon Grape
Beberis repens



Charles Greir Johnson (1999)

Dave Powell USDA



LIFE SPAN: Long-lived

GROWTH HABIT: Evergreen shrub.

ORIGIN: Native.

VEGETATIVE CHARACTERISTICS:
Attractive. Leaves are shiny-green. Flowers are bright yellow. Fruits are dark, waxy-blue berries. Roots are deep and creeping with rhizomes and stolons and can reach a minimum depth of 10 in. Grows 1-3 ft tall.

SITE REQUIREMENTS:

Precipitation zone.
Greater than 18 in.

Elevation zone.
Ranges from 1,000-10,000 ft.

Habitat & Climate requirements.
Adapted to rocky slopes and canyon bottoms in the shade or in dry exposed sites. Often found in open, dry coniferous forest settings. Can withstand temperatures to -23 F.

Soil type.
Well-drained loams and deep, moist soils rich in humus. Tolerates dry, stony, thin soils (pH 5.5-7.5).

APPLICATIONS:

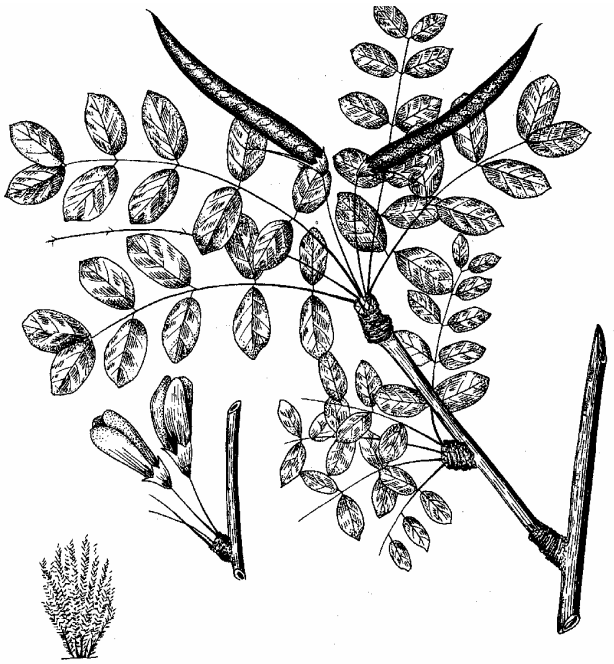
Roadside suitability.
Low growing and evergreen. Excellent ground cover andgood potential for slope stabilization and erosion control. Very extensive and deep rooting system. Very attractive plant in all seasons.

Establishment.
Medium growth rate. Moderate establishment from seed, excellent establishment from transplants.

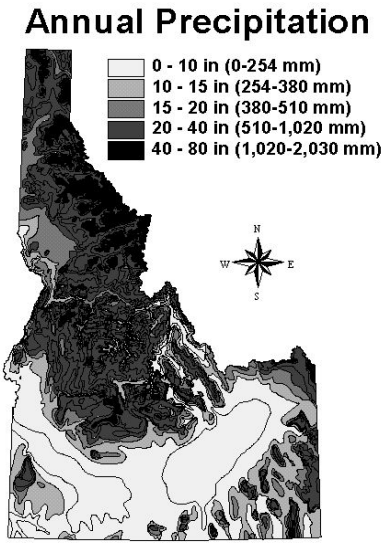
SEEDING RECOMMENDATIONS:
Plant at a depth of 0.25-0.5 in. Seed 2-5 PLS lb per acre. There are 45,000 seeds per lb.

Siberian Peashrub

Caragana arborescens



Clinton H. Wasser (1982)



LIFE SPAN: Long-lived.

GROWTH HABIT: Deciduous tree/shrub.

ORIGIN: Introduced.

VEGETATIVE CHARACTERISTICS:
Small and upright. Leaves are evenly pinnate with 8-12 leaflets. Branches are extended to the ground. Flowers are yellow and papilionaceous. Roots can reach a minimum depth of 16 in. Grows 10-20 ft tall.

SITE REQUIREMENTS:

Precipitation zone.
Minimum of 12 in.

Elevation zone.
Ranges from 2,500-4,000 ft.

Habitat and Climate requirements.
Adapted to a wide range of conditions throughout the Intermountain Region. Drought and winter hardy, withstanding temperatures to -38 F.

Soil type.
Well-drained, dry soils. Does not tolerate wet soils, but does tolerate alkali conditions (pH 6.0-9.0).

APPLICATIONS:

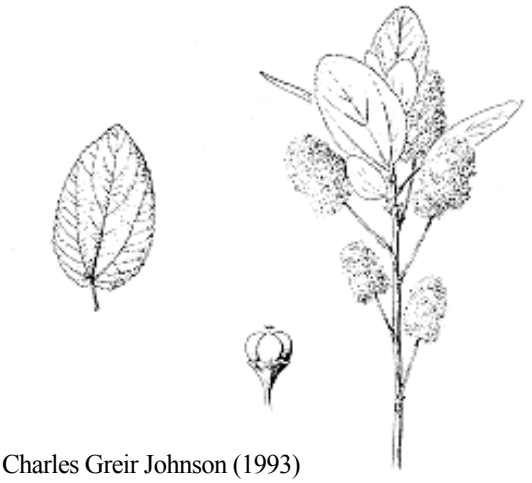
Roadside suitability.
Used for outer rows of windbreaks and recreational plantings. Winter-hardy. Tolerates drought and alkaline conditions. Nitrogen-fixing.

Establishment.
Vigorous seedling growth. Mature in 5-7 years. Moderate results from seed, excellent from transplants and sprouts.

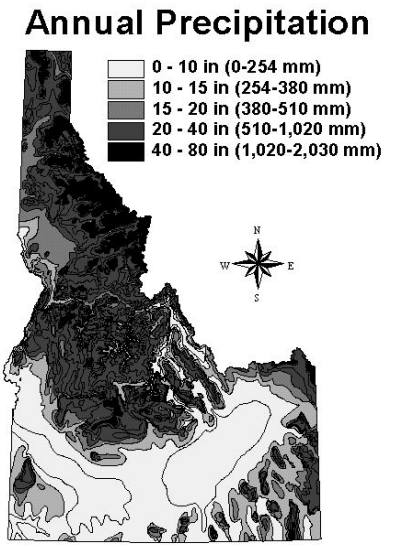
SEEDING RECOMMENDATIONS:
Seeds may be drilled or broadcast in the spring at a depth of 0.25-0.38 in . Plant 6 in apart. Seeding rate 5-7 PLS lb per acre. There are 12,000 seeds per lb.

Redstem Ceanothus

Ceanothus sanguineus



Charles Greir Johnson (1993)



LIFE SPAN: Long-lived.

GROWTH HABIT: Deciduous shrub.

ORIGIN: Native.

VEGETATIVE CHARACTERISTICS:
Erect. Leaves are shiny green, egg-shaped, three-ribbed, alternate, and simple. Twigs are reddish and flexible. Flowers are many, small, and white. Roots can reach a minimum depth of 12 in (31 cm). Grows 3-10 ft (1-3 m) tall.

SITE REQUIREMENTS:

Precipitation zone.
Minimum of 14 in (360 mm).

Elevation zone.
To 5,000 ft (1520 m).

Habitat & Climate requirements.
Adapted to a wide range of open conditions, generally as a result of fire. Can withstand temperatures to -13 F (-25 C).

Soil type.
Well-drained medium-textured with a neutral pH (6.5-8.0).

APPLICATIONS:

Roadside suitability.
Provides ground cover and soil stabilization on areas where slumping and surface erosion are common. Used to seed abandoned roadway and logging disturbances. Low shade tolerance. Sprouts after a disturbance, especially fire.

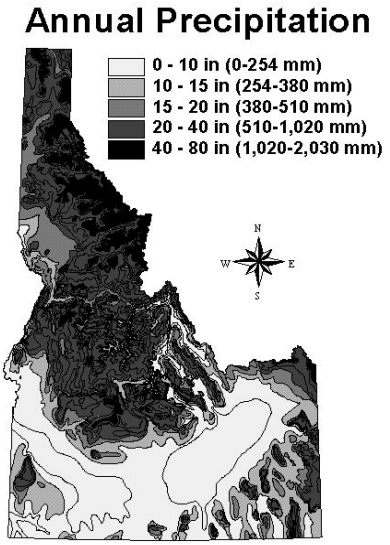
Establishment.
Medium germination rate. Good seedling establishment.

SEEDING RECOMMENDATIONS:
Plant in the fall. Seed 0.25 lb PLS per acre (0.28 kg/ha). There are 131,900 seeds per lb (290,180 seeds per kg).

Snowbush

Ceanothus velutinus

James Stubbendieck et al. (1997)



LIFE SPAN: Long-lived.

GROWTH HABIT: Evergreen shrub.

ORIGIN: Native.

VEGETATIVE CHARACTERISTICS:
Leaves are bright, glossy green, three main veins branch from leaf base. Flowers are attractive, white, fluffy masses. Roots are nitrogen-fixing. Roots can reach a minimum depth of 18 in. Grows 3-10 ft tall.

SITE REQUIREMENTS:

Precipitation zone.
Minimum of 14 in.

Elevation zone.
Ranges from 3,500-10,000 ft.

Habitat & Climate requirements.
Adapted to a wide range of dry climatic conditions. Generally on mesic to moist sites at higher elevations.

Soil type.
Well-drained, rocky, and shallow, weakly acidic, basic, and non-saline soils (pH 6.5-8.5).

APPLICATIONS:

Roadside suitability.
Useful for erosion control plantings following fire or other disturbances. Fairly tolerant of shade, drought, and fire. Nitrogen-fixing roots.

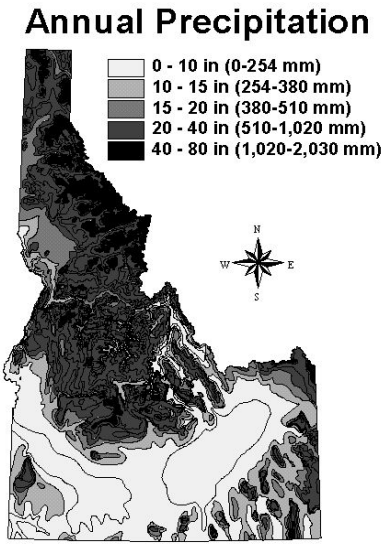
Establishment.
Seed requires heat and prechill treatments. Good germination. Fairly slow seedling development.

SEEDING RECOMMENDATIONS:
Plant in fall at a depth of 0.33 in. Seed 2-5 PLS lb per acre. There are 124,275 seeds per lb.

Winterfat

Ceratoides lanata

James Stubbendieck et al. (1997)



LIFE SPAN: Perennial.

GROWTH HABIT: Half-shrub.

ORIGIN: Native.

VEGETATIVE CHARACTERISTICS:
Base is woody and covered with dense, whitish grey, wooly hairs. Stems are herbaceous, erect, and freely branched. Flowers are inconspicuous. Roots are fibrous with a taproot that can reach a minimum depth of 10 in. Grows up to 32 in tall.

SITE REQUIREMENTS:

Precipitation zone.
Ranges from 5-25 in.

Elevation zone.
Ranges from 2,000-10,000 ft.

Habitat & Climate requirements.
Adapted to lower foothills, plains, and valleys.

Soil type.
Undeveloped, moderately-course- to fine-texture, dry, subalkaline, chalky, and calcareous soils of low fertility.

APPLICATIONS:

Roadside suitability.
Low growing half-shrub. Tolerates burning and cold environments. Intolerant of shade.

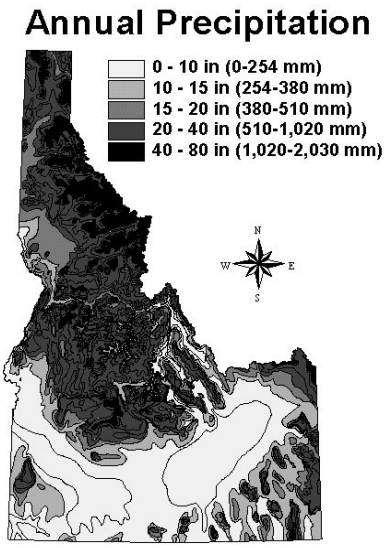
Establishment.
High seedling vigor and seeds require after-ripening for maximum germination. Seedlings are vulnerable to spring frosts.

SEEDING RECOMMENDATIONS:
Plant in the fall at a depth of 0.25-0.5 in. Hand seed 2-5 PLS lb per hill at 5 ft spacing. There are 56,700 seeds per lb.

Curlleaf Mountain Mahogany

Cercocarpus ledifolius

James Stubbendieck et al. (1997)



LIFE SPAN: Long-lived.

GROWTH HABIT: Evergreen shrub/small tree.

ORIGIN: Native.

VEGETATIVE CHARACTERISTICS:
Erect. Leaves are persistent, alternate, simple, lance-shaped, leathery, and roll in at the margins. Flowers are pale yellow. Roots are fibrous with deep taproots. Roots can reach a minimum depth of 20 in. Grows 3-20 ft tall.

SITE REQUIREMENTS:

Precipitation zone.
Minimum of 8 in.

Elevation zone.
Ranges from 2,000-9,000 ft.

Habitat & Climate requirements.
Adapted to warm, dry, rocky ridges and rim outcrops. Can withstand temperatures to -32 F.

Soil type.
Dry, shallow, limestone soils, on gravelly ridges and sometimes clay or loam soils (pH 6.0-9.0).

APPLICATIONS:

Roadside suitability.
Large evergreen shrub is drought resistant and tolerates high temperatures, well adapted to semiarid sites.

Establishment.
Ease of establishment is intermediate.

SEEDING RECOMMENDATIONS: Plant in the fall. Seed 5-8 PLS lb per acre. There are 30,000 seeds per lb.

True Mountain Mahogany

Cercocarpus montanus

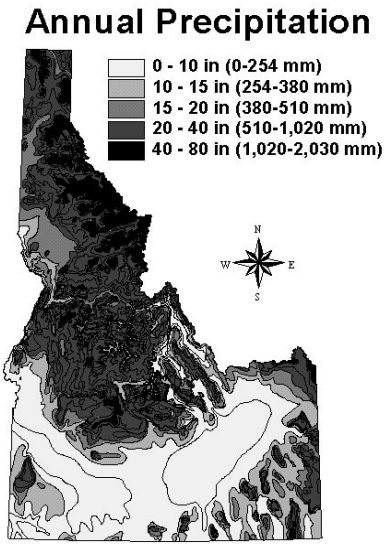
James Stubbendieck et al. (1997)

LIFE SPAN: Long-lived.

GROWTH HABIT: Deciduous shrub/small tree.

ORIGIN: Native.

VEGETATIVE CHARACTERISTICS:
Bushy. Branches are upright. Leaves are toothed, persistent, alternate, and simple. Flowers are in yellow clusters. Roots are fibrous with a deep taproot. Grows less than 12 ft tall.



SITE REQUIREMENTS:

Precipitation zone.
Minimum of 10 in.

Elevation zone.
Ranges from 4,000 to 10,000 ft.

Habitat & Climate requirements.
Adapted to dry slopes and ridges in rocky, mountain habitats. Can withstand temperatures to -38 F.

Soil type.
Course, shallow, dry to moist, fertile soils (pH 6.0-8.0).

APPLICATIONS:

Roadside suitability.
Tall and spreading. Not competitive with herbs.

Establishment.
Can be difficult to establish due to the vulnerability of seedlings to competition.

SEEDING RECOMMENDATIONS:
Sow stratified seed in the spring. Seed 5-8 PLS lb per acre. There are 59,000 seeds per lb.

Rubber Rabbitbrush

Chrysothamnus nauseosus

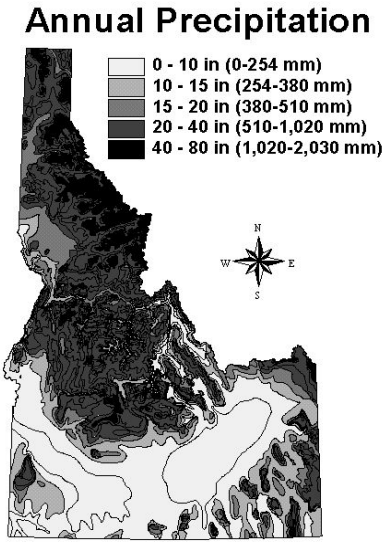
James Stubbendieck et al. (1997)

LIFE SPAN: Short-lived.

GROWTH HABIT: Deciduous shrub.

ORIGIN: Native.

VEGETATIVE CHARACTERISTICS:
Erect. Leaves are grey or white. Twigs are dense and leafy. Base is very stout and woody. Flowers are yellow discs in terminal, round clusters. Grows 12-84 in tall.



SITE REQUIREMENTS:

Precipitation zone.
Minimum of 8 in.

Elevation zone.
Ranges from 2,000-9,000 ft.

Habitat & Climate requirements.
Adapted to plains, hillsides, and dry alluvial slopes and mesas.

Soil type.
Found in all soil textures. Favors sandy or clayey soils of decomposed granite. Tolerates slightly to strongly alkaline soils.

APPLICATIONS:

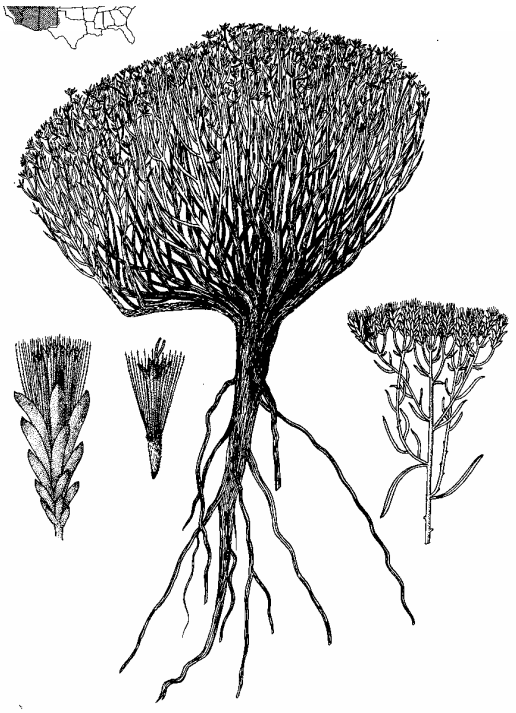
Roadside suitability.
Spreads aggressively. Deep rooted with a 8-9 year life span. Found along roadsides and on disturbed sites.

Establishment.
Establishes easily by direct seeding and transplanting.

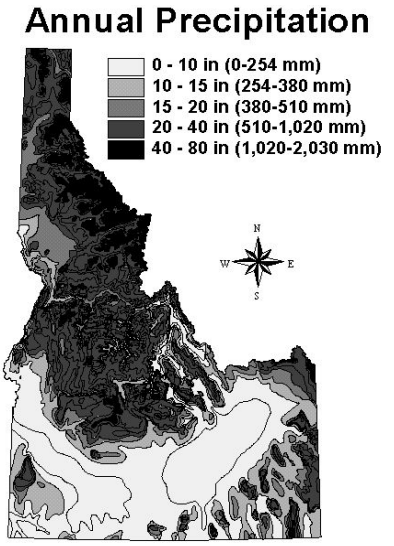
SEEDING RECOMMENDATIONS:
Plant in the fall. Seed 2-5 PLS lb per acre. There are 400,000 seeds per lb.

Green Rabbitbrush.

Chrysothamnus viscidiflorus



Clnton H. Wasser (1982)



LIFE SPAN: Short-lived.

GROWTH HABIT: Deciduous shrub.

ORIGIN: Native.

VEGETATIVE CHARACTERISTICS:
Stout, woody, and erect. Leaves are twisted, greenish, or white. Bark is semiglossy. Flowers are yellowish, flat topped, terminal cymes. Deep roots reaching a minimum depth of 14 in. Grows up to 3.3 ft tall.

SITE REQUIREMENTS:

Precipitation zone.
Minimum 6 in.

Elevation zone.
Ranges from 2,000-10,000 ft.

Habitat & Climate requirements.
Adapted dry open prairies, valleys, hillsides, foothill locations. Extending into forests at lower elevations. Can withstand temperatures to -23 F.

Soil type.
Moderately course to medium textured soils with neutral pH (7.0-8.5).

APPLICATIONS:

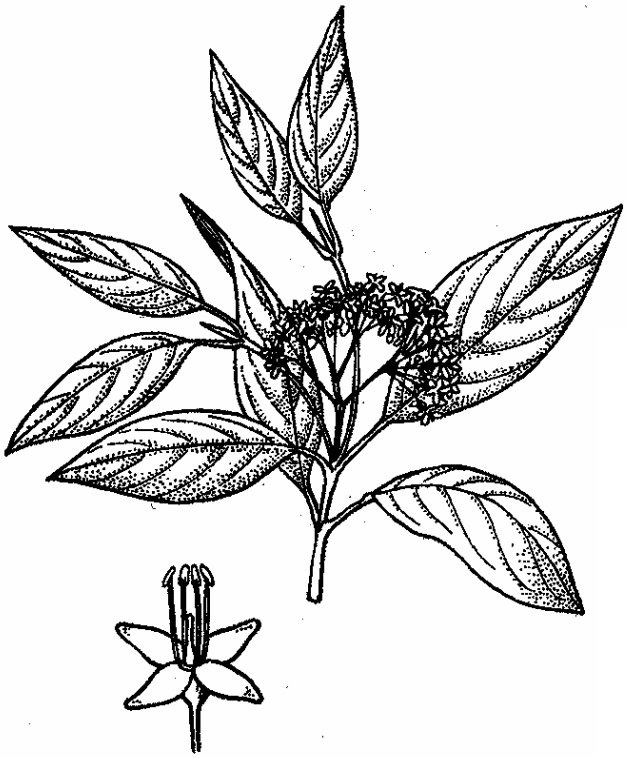
Roadside suitability.
Same as *Chrysothamnus nauseosus*.

Establishment.
Medium to high germination rate. Fairly easy to establish through direct seeding on transplants.

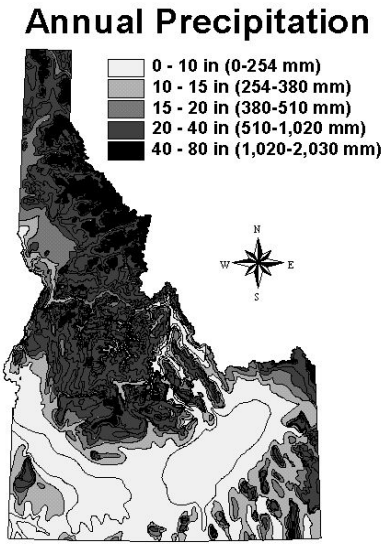
SEEDING RECOMMENDATIONS:
Plant in late fall or early spring. Seed 1-3 PLS lb per acre. There are 782,000 seeds per lb.

Redosier Dogwood

Cornus stolonifera



Robin Rose et al. (1998)



LIFE SPAN: Moderate.

GROWTH HABIT: Deciduous shrub.

ORIGIN: Native.

VEGETATIVE CHARACTERISTICS:
Leaves are dark green and ovate. Stems are attractive and red. Flowers are white, clustered, and inconspicous. Fruits are white berries. Stoloniferous. Roots can reach a minimum depth of 16 in. Grows 3-9 ft tall.

SITE REQUIREMENTS:

Precipitation zone.
Minimum of 18 in.

Elevation zone.
Ranges from 1,500-9,000 ft.

Habitat & Climate requirements.
Adapted to a wide range of cool, climatic conditions. Grows along streams mainly in sandy swamps. Can withstand temperatures to -38 F.

Soil type.
Best in medium- to course-textured moist soils. Somewhat poorly-drained, moderately acidic to neutral pH (4.8-7.0).

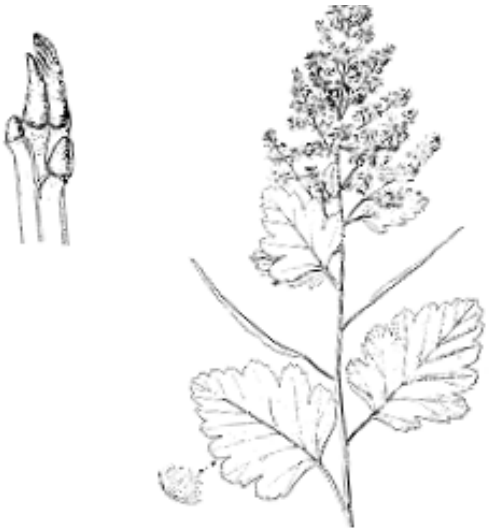
APPLICATIONS:

Roadside suitability.
Thicket forming. Widely used in soil stabilization plantings for riparian areas, streambanks, wildlife habitats, and windbreaks. Tolerates sun and shade.

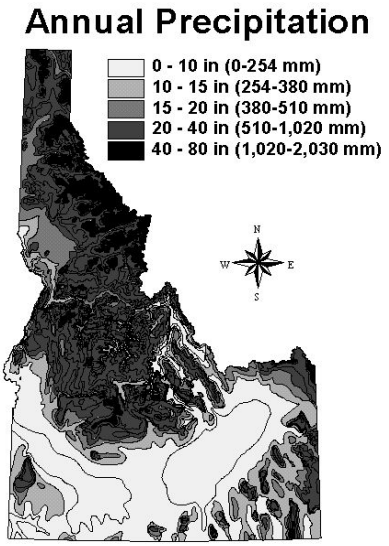
Establishment.
Seed can be used. Readily established from hardwood plantings, container plantings, or bare root stock plantings. Can be seeded, however, germination is unpredictable, and seedling establishment can be slow.

SEEDING RECOMMENDATIONS:
Seed in the fall. Seed 2-5 PLS lb per acre. There are 173,000 seeds per lb.

Oceanspray
Holodiscus discolor



Patricia A. Patterson et al. (1985)



LIFE SPAN: Long-lived.

GROWTH HABIT: Deciduous shrub.

ORIGIN: Native.

VEGETATIVE CHARACTERISTICS:
Attractive, symmetrical, and bushy. Leaves are single, basal, triangular with truncate base, margins are shallowly lobed with course teeth. Pale green above and white hairy below. Branches are spreading. Flowers are small, creamy-white and saucer-shaped. Roots can reach a minimum depth of 12 in. Grows 2-5 ft tall.

SITE REQUIREMENTS:

Precipitation zone.
Minimum of 15 in.

Elevation zone.
Ranges from 0-7,000 ft.

Habitat & Climate requirements.
Adapted to a wide range of conditions in the Pacific Northwest. Generally found in open forest stands of warm, dry tree species. Can withstand temperatures to 7 F (-14 C).

Soil type.
Well-drained, sandy, gravelly, or rocky soils. Bouldery sites of rocky basalt out-croppings or on granite (pH 6.5-7.5).

APPLICATIONS:

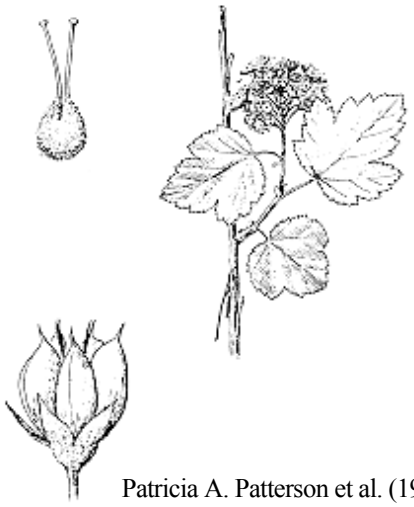
Roadside suitability.
Is often used in erosion control plantings. Thicket forming and deep rooted. Resprouts following fire.

Establishment.
Moderate growth rate. Propagate by bare root container stock or seed. Can be transplanted as live cuttings.

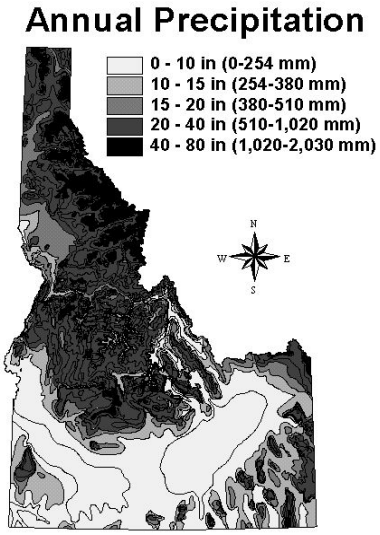
SEEDING RECOMMENDATIONS:
Plant in fall. Seed 1-2 PLS lb per acre. There are 190,000 seeds per lb.

Ninebark

Physocarpus malvaceus



Patricia A. Patterson et al. (1985)



LIFE SPAN: Long-lived

GROWTH HABIT: Deciduous shrub.

ORIGIN: Native

VEGETATIVE CHARACTERITICS:
Erect. Leaves are alternate, maple-like with three palmate lobes, and abundant. Bark is shreddy. Flowers are white and assembled in umbrella-shaped clusters. Roots are fibrous with a deep taproot that can reach a minimum depth of 24 in. Grows 3-7 ft tall.

SITE REQUIREMENTS:

Precipitation zone.
Ranges from 0-10 in .

Elevation zone.
Ranges from 5,200-10,800 ft.

Habitat and Climate requirements.
Adapted to dry, rocky slopes, cliffs, and deep canyons. Beneath dry, warm forest types as well as non-forested shrubland sites. Can withstand temperatures to -33 F.

Soil Type.
Well-drained, medium textured, organic soils. persists on drier, sandy, or rocky soils (pH 6.0-7.5)

APPLICATIONS:

Roadside suitability.
Forms dense thickets and resprouts from root crown. Potential erosion control species. Used for outer rows of multi-row wind breaks. Adapted to fire.

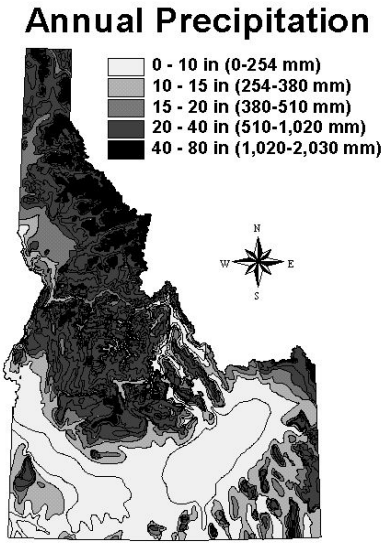
Establishment:
Germinates readily from seed. Can also propagate from root cuttings and bare root plantings.

SEEDING RECOMMENDATIONS:
Broadcast in Fall or Spring. Seed 2-5 PLS lb per acre. There are 756,000 seeds per lb.

Shrubby Cinquefoil

Potentilla fruticosa

James Stubendieck et al. (1997)



LIFE SPAN: Short-lived.

GROWTH HABIT: Deciduous low-shrub.

ORIGIN: Native.

VEGETATIVE CHARACTERISTICS:
Leaves are alternate, pinnately compound leaflets crowded with upper three often confluent at base. Stems are clustered. Flowers are yellow, buttercup-like, and born on ends of branches. Roots can reach a minimum depth of 18 in. Grows 12-24 in tall.

SITE REQUIREMENTS:

Precipitation zone.
Minimum 16 in.

Elevation zone.
Ranges from 5,500-11,000.

Habitat & Climate requirements.
Adapted to subalpine meadows, bogs, rocky grounds at higher elevations can tolerate same shading. Can withstand temperatures to -28 F.

Soil type.
Well-drained, medium-textured, moist soils (pH 5.0-8.0).

APPLICATIONS:

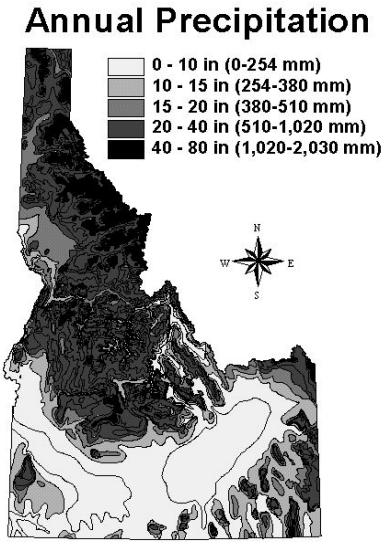
Roadside suitability.
Colonizes disturbed sites. Useful soil stabilization species. Used for roadside plantings. Sprouts following a disturbance. Tolerates cold conditions.

Establishment.
Difficult to establish from seed.

SEEDING RECOMMENDATIONS:
Plant in early spring or late fall. Seed 10-12 PLS lb per square foot. There are 1,000,000-1,300,000 seeds per lb.

Chokecherry
Prunus virginiana

James Stubbendeck et al. (1997)



LIFE SPAN: Long-lived.

GROWTH HABIT: Deciduous shrub/small tree.

ORIGIN: Native.

VEGETATIVE CHARACTERISTICS:
Dense and bushy. Leaves are deciduous, alternate, oblong-ovate and finely serrate. Dark green above and pale green below. Flowers are white, showy, and born in large terminal clusters. Fruits are round and dark purple to black when ripe. Roots can reach a minimum depth of 20 in. Height varies by variety from 3-19.5 ft.

SITE REQUIREMENTS:

Precipitation zone.
Ranges from 12-30 in.

Elevation zone.
Ranges from 4,500-9,000 ft.

Habitat & Climate requirements.
Adapted to a wide range of climatic conditions on foothills thoughout the aspen zone. Can withstand temperatures to -43 F.

Soil type.
Moderately course- to fine-textured silty soils that are moderately acidic, moderately basic, or weakly saline (pH 5.2-8.4).

APPLICATIONS:

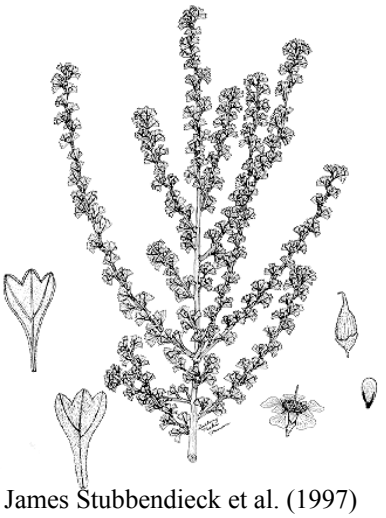
Roadside suitability.
Forms thickets and spreads by rhizomes. Potential for disturbed sites as an ornamental, erosion control, or windbreak species. Hardy, and tolerates drought.

Establishment.
Difficult to establish from seed. Moderate fertility requirement.

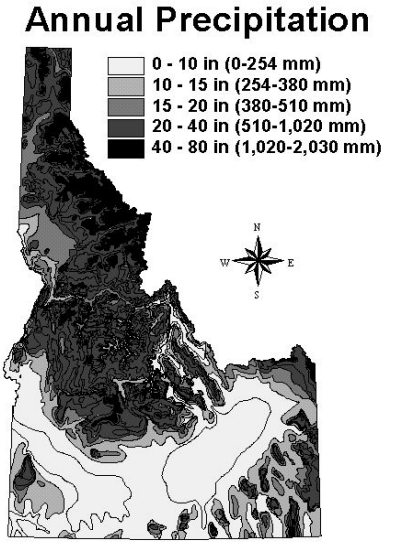
SEEDING RECOMMENDATIONS:
Plant in the fall at a depth of 0.5 in. Seed 5-8 PLS lb per acre. There are 4,800 seeds per lb.

Antelope Bitterbrush

Purshia tridentata



James Stubbendieck et al. (1997)



LIFE SPAN: Long-lived.

GROWTH HABIT: Evergreen shrub.

ORIGIN: Native.

VEGETATIVE CHARACTERISTICS:
Semi-erect and diffusely branched. Leaves are alternate, simple, wedge-shaped with a 3-lobed apex and greyish green. Twigs are gray to brown with short spur-like branches. Flowers are yellow. Roots can reach a minimum depth of 20. Grows 2-10 ft tall.

SITE REQUIREMENTS:

Precipitation zone.
Ranges from 2-25 in.

Elevation zone.
Ranges from 3,500-9,000 ft.

Habitat & Climate requirements.
Adapted to a wide range of climatic conditions throughout the cold desert shrublands and beneath Ponderosa pine at the forested interface on warm, dry sites. Can withstand temperatures to -33 F.

Soil type.
Well-drained, sandy, gravelly, or rocky soils (pH 5.6-8.4).

APPLICATIONS:

Roadside suitability.
Thrives under rigorous conditions. Tolerant of drought and cold conditions. Used in roadside plantings for soil stabilization, suited for disturbed sites.

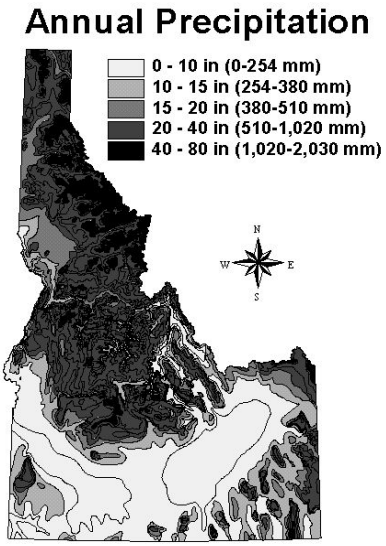
Establishment.
Grows rapidly. Seedlings are vigorous and drought tolerant. Intermediate results from seeding.

SEEDING RECOMMENDATIONS:
Drill in fall at a depth of 0.5-1 in to reduce rodent predation. Seed 1-3 PLS lb per acre. There are 15,000 seeds per lb.

Smooth Sumac

Rhus glabra

Robin Rose et al. (1998)



LIFE SPAN: Medium-lived.

GROWTH HABIT: Deciduous shrub.

ORIGIN: Native.

VEGETATIVE CHARACTERISTICS:
Elongated, dense panicles of small white flowers that develop into berry-like fruits that are dark red. Leaves are pinnately compound with 7-29 sessile, lanceolate leaflets. Roots can reach a minimum depth of 24 in. Thicket-forming shrub that grows to 4-7 ft tall.

SITE REQUIREMENTS:

Precipitation zone.
Minimum of 10 in.

Elevation zone.
Ranges from 2,700-7,500 ft.

Habitat & Climate requirements.
In well drained sites at the base of slopes, along stream channels and ravines in canyonlands in the Pacific Northwest. Can withstand temperatures to -33 F.

Soil type.
Well-drained, medium-textured, moist and fertile soil (pH 5.3-7.5).

APPLICATIONS:

Roadside suitability.
Thicket forming. Often found along roadsides and in dry waste areas from natural recruitment. A very extensive and deep rooting system.

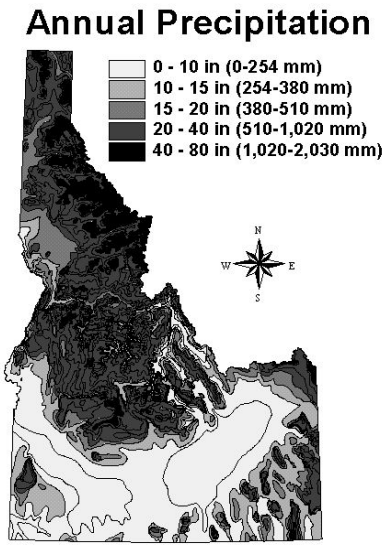
Establishment.
Establishes well from seed, cuttings or transplants.

SEEDING RECOMMENDATIONS:
Plant in fall at a depth of 0.75 in. Seed 1-3 PLS lb per acre. There are 20,000 seeds per lb.

Skunkbrush sumac

Rhus trilobata

Clnton H. Wasser (1982)



LIFE SPAN: Medium-lived.

GROWTH HABIT: Deciduous shrub.

ORIGIN: Native.

VEGETATIVE CHARACTERISTICS:
Aromatic. Leaves are alternate, simple, compound, and trifoliate. Twigs are greyish to reddish brown. Flowers are yellowish and spreading. Roots can reach a minimum depth of 16 in. Grows up to 8 ft tall.

SITE REQUIREMENTS:

Precipitation zone.
Minimum of 8 in.

Elevation zone.
Ranges from 1,900-8,000 ft.

Habitat & Climate requirements.
Adapted to dry rocky hillsides, ravines, thickets, woodland and roadsides. Can withstand temperatures to -47 F.

Soil type.
Well-drained, moderately-coarse- to medium-textured soil with neutral pH (6.5-8.0).

APPLICATIONS:

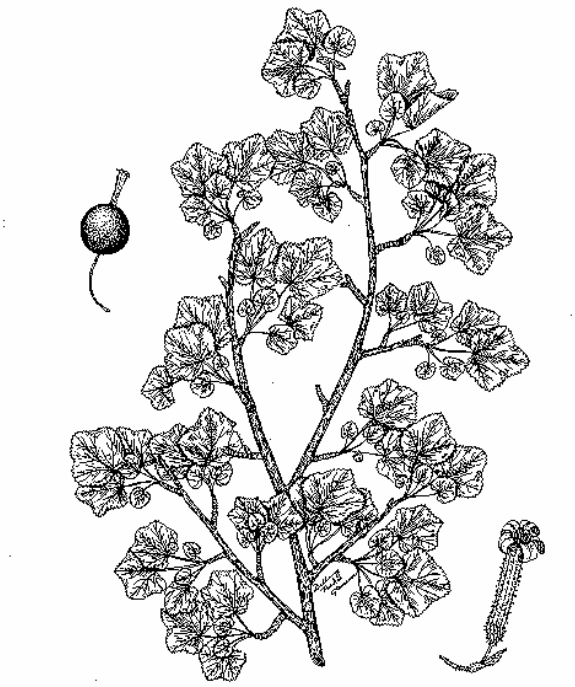
Roadside suitability.
Thicket forming. Used for stabilization and windbreak plantings. Tolerates grazing, fire, and drought. Extensive and deep rooting system.

Establishment.
From seedling, cuttings, or transplants. Seeding success is intermediate to low.

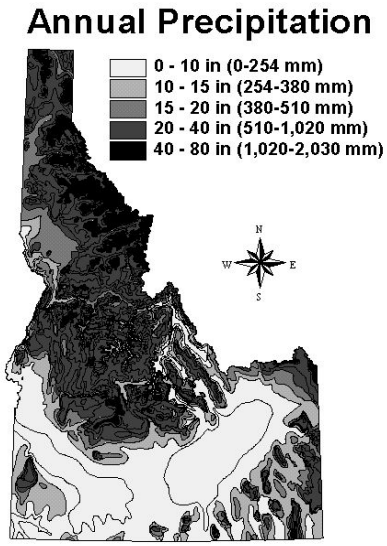
SEEDING RECOMMENDATIONS:
Plant in fall at a depth of 0.25-0.5 in. Seed 1-3 PLS lb per acre. There are 19,000 seeds per lb.

Wax Current

Ribes cereum



James Stubendieck et al. (1997)



LIFE SPAN: Long-lived.

GROWTH HABIT: Deciduous shrub.

ORIGIN: Native.

VEGETATIVE CHARACTERISTICS:
Leaves are waxy, alternate, simple, and 3-5 lobed. Stems are light or dark gray and glabrous. Flowers are fragrant, white, and pink. Fruits are yellow-red berries. Rhizomatous roots can reach a minimum depth of 12 in. Grows up to 6.5 ft tall.

SITE REQUIREMENTS:

Precipitation zone.
Approximately 14 in.

Elevation zone.
Ranges from 2,500-9,500 ft.

Habitat & Climate requirements.
Adapted to open slopes, hills, and ridges. Can withstand temperatures to -23 F.

Soil type.
Well-drained, medium-textured, dry, rocky, or sandy soils with a neutral pH (6.5-7.5).

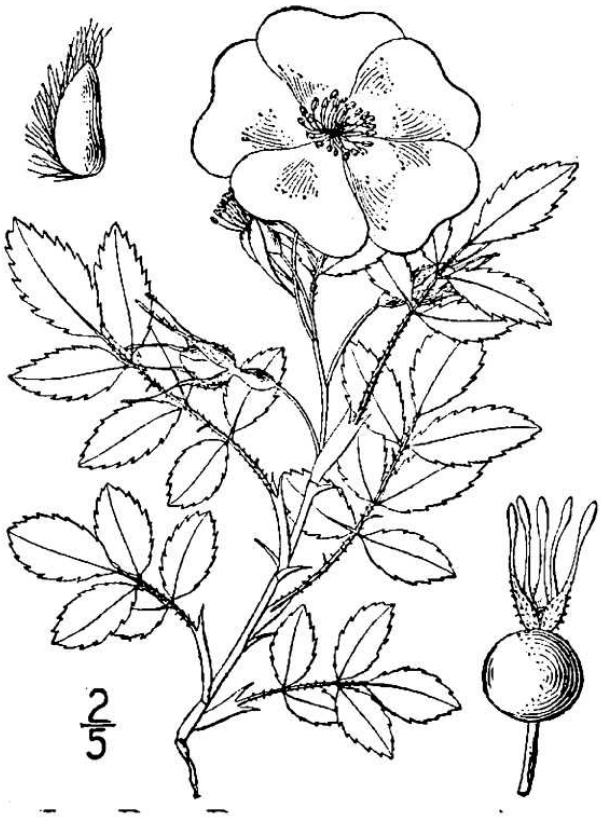
APPLICATIONS:

Roadside suitability.
Medium height, rhizomatous and deep rooted for excellent slope stability.

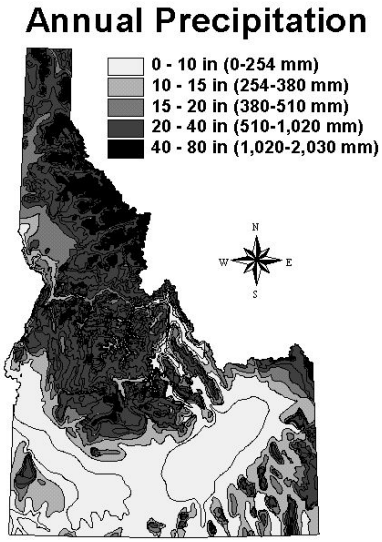
Establishment.
Medium growth rate, intermediate establishment by seed, and good establishment by transplants.

SEEDING RECOMMENDATIONS:
Plant in fall at a depth of 0.25-0.5 in. Seed 1-3 PLS lb per acre. There are 350,000 seeds per lb.

Woods' Rose
Rosa woodsii



Britton, N.L., and A. Brown. 1913



LIFE SPAN: Long-Lived

GROWTH HABIT: Shrub

ORIGIN: Native

VEGETATIVE CHARACTERISTICS:
Grows 2 to 10 feet tall and forms loose or dense thickets. Leaves are alternate, deciduous, and odd-pinnate with 5 to 9 leaflets.

SITE REQUIREMENTS:

Precipitation zone.
Grows in open and shaded areas receiving 12 to 40 inches of annual precipitation.

Elevation zone.
3,500 to 11,700

Habitat & Climate requirements.
Widely adapted species and grows in many habitat types. It is an understory plant in dry and moist forest communities.

Soil type.
Adapted to medium and coarse textured, moderately fertile soils with pH that is moderately acidic (5.0) to slightly basic.

APPLICATIONS:

Roadside suitability.
Mildly drought and flood tolerant. Aesthetically pleasing appearance.

Establishment.

SEEDING RECOMMENDATIONS:
Seed 3-5 PLS lb per acre. There are 50,967 lb per lb.

Scouler's Willow
Salix scouleriana

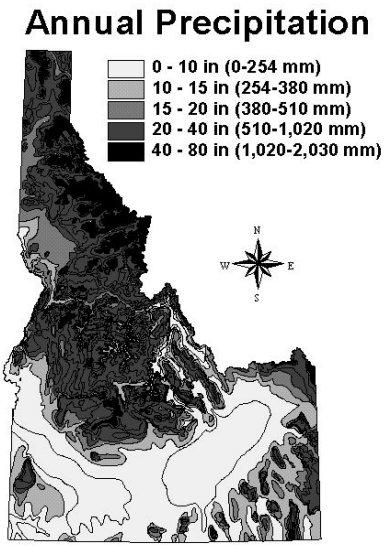
Charles Grier Johnson (1993)

LIFESPAN: Long-lived

GROWTH HABIT: Deciduous shrub/small tree.

ORIGIN: Native

VEGETATIVE CHARACTERISTICS:
Leaves are alternate, spatulate with entire margins. Twigs are tall and stout with grey hairs. Flowers are catkins. Roots spread from massive root crown and can reach a minimum depth of 12 in. Growst to 10-32 ft tall.



SITE REQUIREMENTS:

Precipitation zone.
9.5 to 63 inches

Elevation zone.
Sea level to over 10,000 ft

Habitat & Climate requirements.
It is found in drier habitats than most willows, occurring as scattered individuals on dry uplands as well as swamps, and mountain streams . Can with stand minimum temperature of -13F.

Soil type.
Scouler willow is found on shallow to moderately deep soils with a pH (6.5-8.0)

APPLICATIONS:

Roadside suitability.
Grows quickly, is moderately drought tolerant, and highly resistant to fire.

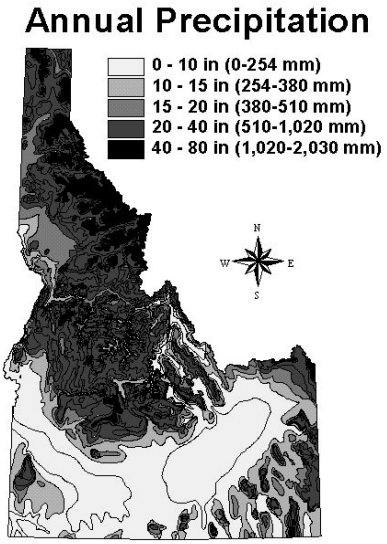
Establishment.
Scouler willow establishes on relatively stable banks and lower sideslopes in valleys

SEEDING RECOMMENDATIONS:
Transplant root cuttings in the spring. There are 6,500,000 seeds per lb.

Blue Elderberry

Sambucus cerulea

Arthur Cronquist et al. (1994)



LIFE SPAN: Intermediate-lived.

GROWTH HABIT: Deciduous shrub/small tree.

ORIGIN: Native.

VEGETATIVE CHARACTERISTICS:
Erect. Leaves are opposite and compound with toothed leaflets. Flowers are cream to white. Fruits are black berries. Roots are fibrous with a taproot that can reach 12 in. Grows 6-20 ft tall.

SITE REQUIREMENTS:

Precipitation zone.
Minimum of 12 in.

Elevation zone.
Ranges from 0-10,000 ft.

Habitat & Climate requirements.
Adapted to a wide range of climatic conditions along streams, in canyons, and on hillsides of the Western United States. Can withstand temperatures -38 F.

Soil type.
Moist, sandy, or clayey loams. Tolerates alkaline and saline soils pH (4.9-7.5).

APPLICATIONS:

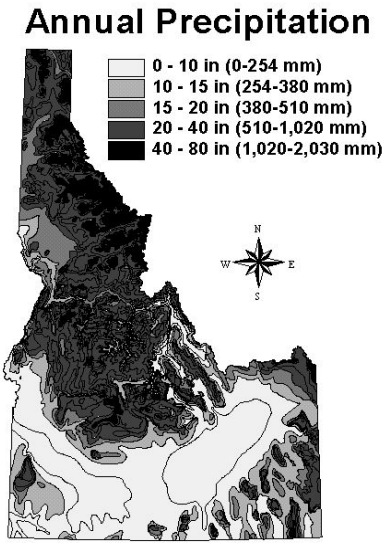
Roadside suitability.
Used for roadside plantings because of its productivity, adaptability, and ease of establishment. Extensive rooting system with deep taproot.

Establishment.
Easily established from seed cuttings and transplants.

SEEDING RECOMMENDATIONS:
Seed in the fall. Seed 8-10 PLS lb per acre. There are 216,800 seeds per lb.

Common Snowberry
Symphoricarpos albus

Patricia A. Patterson et al. (1985)



LIFE SPAN: Intermediate-lived.

GROWTH HABIT: Deciduous shrub.

ORIGIN: Native.

VEGETATIVE CHARACTERISTICS:
Erect. Branches are smooth. Flowers are white to pink, slender, and bell-shaped. Fruits are fleshy, globe-shaped, white berries. Leaves are elliptic and opposite. Roots can reach a minimum depth of 18 in. Grows 2-4 ft tall.

SITE REQUIREMENTS:

Precipitation zone.
Minimum of 15 in.

Elevation zone.
Ranges from 2,400-9,000 ft.

Habitat & Climate requirements.
Adapted to wooded hillsides and open slopes. Commonly associated with Ponderosa pine and Douglas fir open forest types. Can withstand temperatures to -38 F.

Soil type.
Well-drained, moist and dry, rocky soils of calcareous barrens, and gravelly banks.

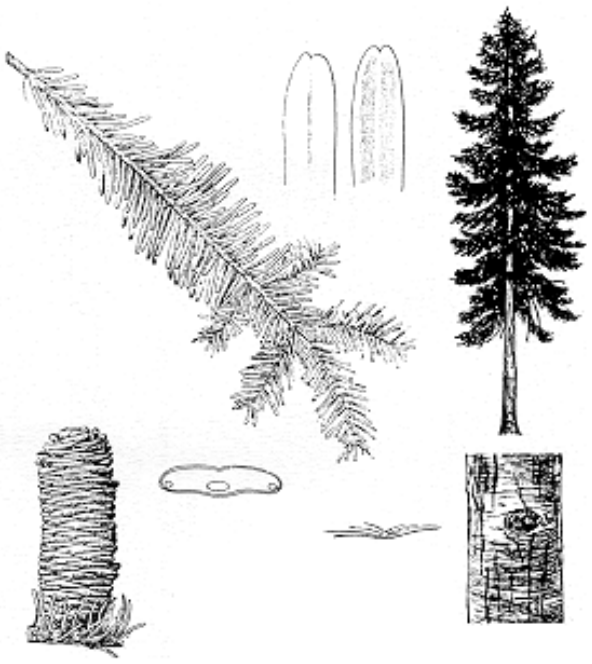
APPLICATIONS:

Roadside suitability.
Thicket forming and low growing shrub. Well suited to rocky sites and gravelly road cuts. Excellent slope stabilizer.

Establishment.
Reproduces by seeds and rhizomes. Seeds can be difficult to germinate when dormancy. Easy be established from transplants.

SEEDING RECOMMENDATIONS:
Plant in the fall. Seed 4-6 PLS lb per acre. There are 76,000 seeds per lb.

Grand Fir
Abies grandis



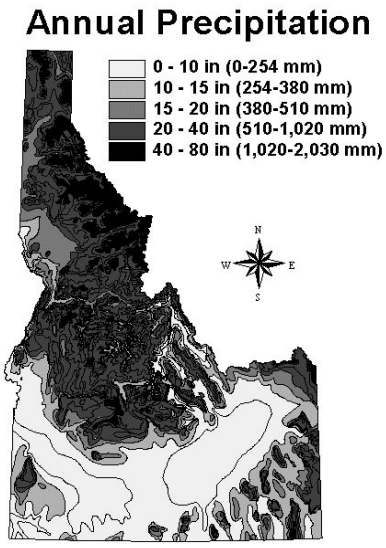
Patricia A. Patterson et al. (1985)

LIFE SPAN: Long-lived.

GROWTH HABIT: Conifer tree.

ORIGIN: Native.

VEGETATIVE CHARACTERISTICS:
Needles are shiny green on top and whitish beneath. Crown is open and dome-like with flattened branches. Bark is thin, grooved, and dark grey. Roots are deep and spreading and can reach a minimum depth of 40 in. Grows up to 250 ft tall.



SITE REQUIREMENTS:

Precipitation zone.
Ranges from 20-100 in.

Elevation zone.
Ranges from 2,300-3,275 ft in Northern Idaho.

Habitat and Climate requirements.
Adapted to cold, humid summers and moderate winters on moist mountain slopes. Can withstand temperatures to -33 F.

Soil type.
Deep, well-drained, porous, alluvial soils (pH 4.5-7.5).

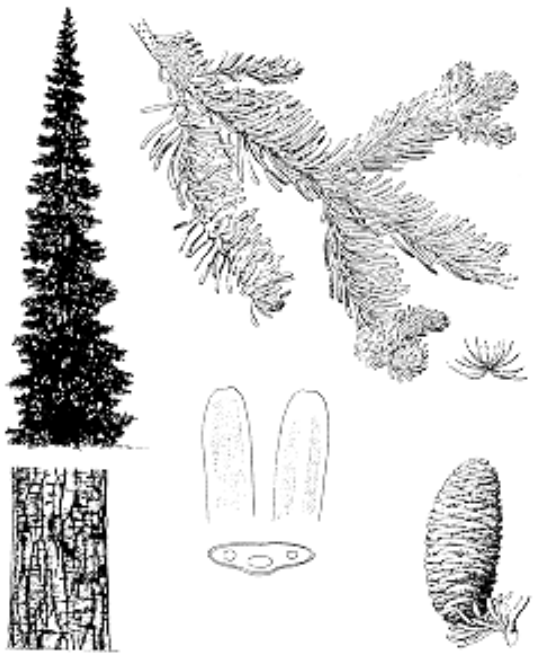
APPLICATIONS:

Roadside suitability.
Tolerates shade. Deep rooted for slope stabilization.

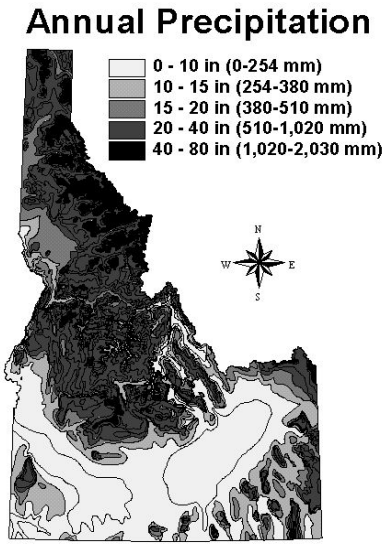
Establishment.
Fair results from seeding, excellent from transplants.

SEEDING RECOMMENDATIONS:
Seeds require cold stratification for 15-30 days prior to sowing at a depth of 0.5 cm depth covered with mulch. Seeding rate 16 lbs PLS per acre. There are 20,408 seeds per lb.

Subalpine Fir
Abies lasiocarpa



Patricia A. Patterson et al. (1985)



LIFE SPAN: Long-lived.

GROWTH HABIT: Conifer tree.

ORIGIN: Native.

VEGETATIVE CHARACTERISTICS:
Leaves are deep, blue-green, spear-like, and pointed upward on the top-sides of the branches. Crown is narrow. Bark is greyish, thin, and blistered. Stoloniferous with shallow roots. Grows up to 137 ft.

SITE REQUIREMENTS:

Precipitation zone.
Minimum of 25 in mostly in the form of snow.

Elevation zone.
Ranges from 3,500-10,500 ft.

Habitat and Climate requirements.
Adapted to the climatic conditions of cool, moist, subalpine to alpine areas. Can withstand temperatures to - 51 F.

Soil type.
Largest trees are found in moist, porous soils. Persists on dry, thin soils as well as fairly deep, loose soils (pH 4.0-6.5).

APPLICATIONS:

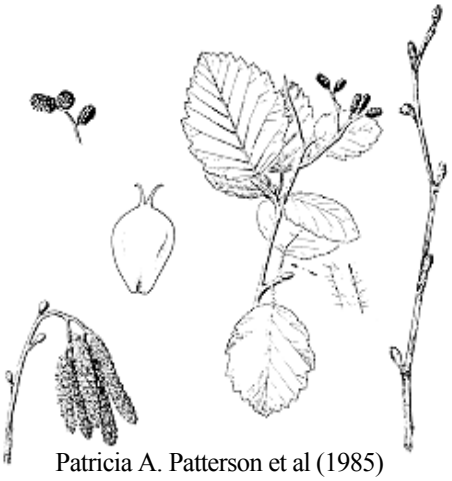
Roadside suitability.
Excellent for slope stabilization in subalpine settings. Well suited to cold, moist environments.

Establishment.
Moderate results from seed, best from transplants.

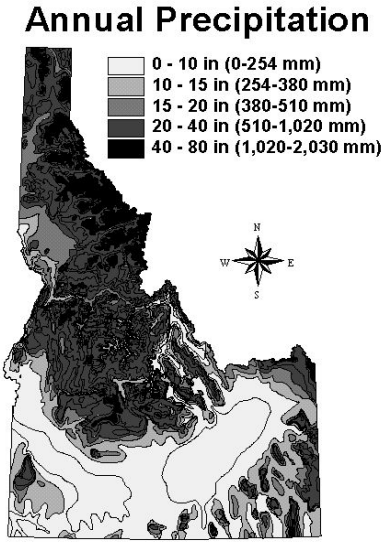
SEEDING RECOMMENDATIONS:
Plant in the spring. Seed 16 lb PLS per acre. There are 20,408 seeds per lb.

Thinleaf Alder

Alnus incana



Patricia A. Patterson et al (1985)



Michael Kuo

LIFE SPAN: Long-lived.

GROWTH HABIT: Deciduous small tree/large shrub.

ORIGIN: Native.

VEGETATIVE CHARACTERISTICS:
Leaves are dark green and ovate to oblong and glaberous. Stems are slender and bent. Crown is dome-like. Bark is thin, smooth, and dirty greenish gray. Grows up to 40 ft tall.

SITE REQUIREMENTS:

Precipitation zone.
20 in or more.

Elevation zone.
Ranges from 2,500-8,000 ft.

Habitat and Climate requirements.
Adapted to the climatic conditions of riparian and subirrigated areas within the Pacific Northwest. Can withstand temperatures to -33 F.

Soil type.
Moist rocky soils along streams and wetlands (pH 5.5-7.0).

APPLICATIONS:

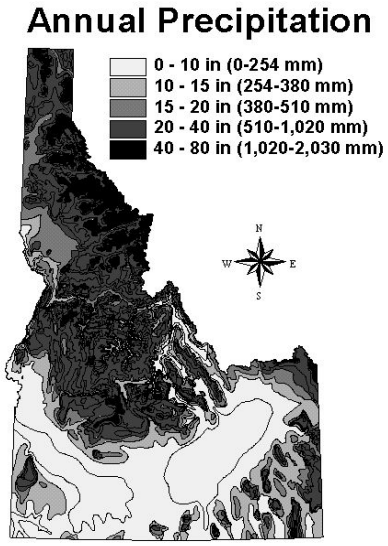
Roadside suitability.
Forms thickets and has nitrogen-fixing root nodules. Deep rooted and rhizomatous.

Establishment.
Easy to establish from transplants and moderate results from seed.

SEEDING RECOMMENDATIONS:
Seed in the spring at a depth of 0.13-0.25 in. Seed rate 5 lbs per acre. There are 10,000 seeds per lb.

Hackberry
Celtis reticulata

Charles Grier Johnson (1993)



LIFE SPAN: Long-lived.

GROWTH HABIT: Small tree.

ORIGIN: Native.

VEGETATIVE CHARACTERISTICS:
Bush tree with a small rounded crown. Bark has corky ridges. Leaves are thick and sandpapery. Fruit is spherical, reddish to orange. Strong taproot with spreading fibrous roots, reaching a minimum depth of 16 in. Grows 9.8-20 ft tall.

SITE REQUIREMENTS:

Precipitation zone.
Minimum 17 in.

Elevation zone.
Ranges from 820-4,754 ft.

Habitat and Climate requirements.
Found along the Snake River and Salmon River canyons on southeast to westerly aspects on open slopes along waterways. Can withstand temperatures to -13 F.

Soil type.
Rocky, well-drained, wet soils (pH 7.0-8.0).

APPLICATIONS:

Roadside suitability.
Used for environmental forestry and shelterbelt plantings. Resprouts following a disturbance. Potential species for rehabilitation in arid areas along waterways. Deep taproot with spreading fibrous roots for excellent slope stabilization.

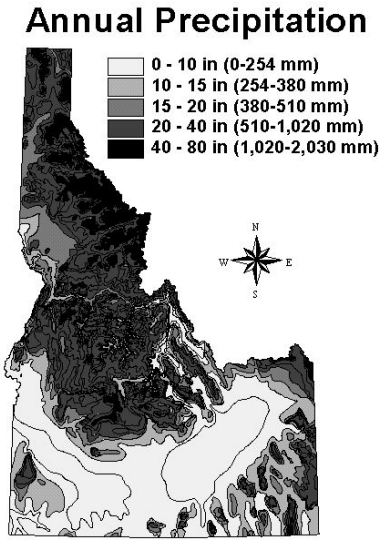
Establishment.
Slow growing. Poor establishment from seed, excellent from transplant.

SEEDING RECOMMENDATIONS:
There are 4,870 seeds per lb, however not recommended to establish from seed.

Black Hawthorn

Crataegus douglasii

A. Brown. 1913



LIFE SPAN: Moderately long-lived

GROWTH HABIT: Small tree

ORIGIN: Native

VEGETATIVE CHARACTERISTICS:
Can grow to 35 ft tall, with straight, strong but few thorns ranging from 0.5 to 1 inch long. Stems are usually clustered from the base or from a point just above the ground surface.

SITE REQUIREMENTS:

Precipitation zone.
16-260 in

Elevation zone.
lower elevations ranging from 2,200–5,400 ft

Habitat & Climate requirements.
It grows best in full sunlight with sufficient moisture levels. It is predominantly an understory species and seldom found in pure stands.

Soil Type.
Black hawthorn generally occurs on deep, moist, fine-textured soils

APPLICATIONS:

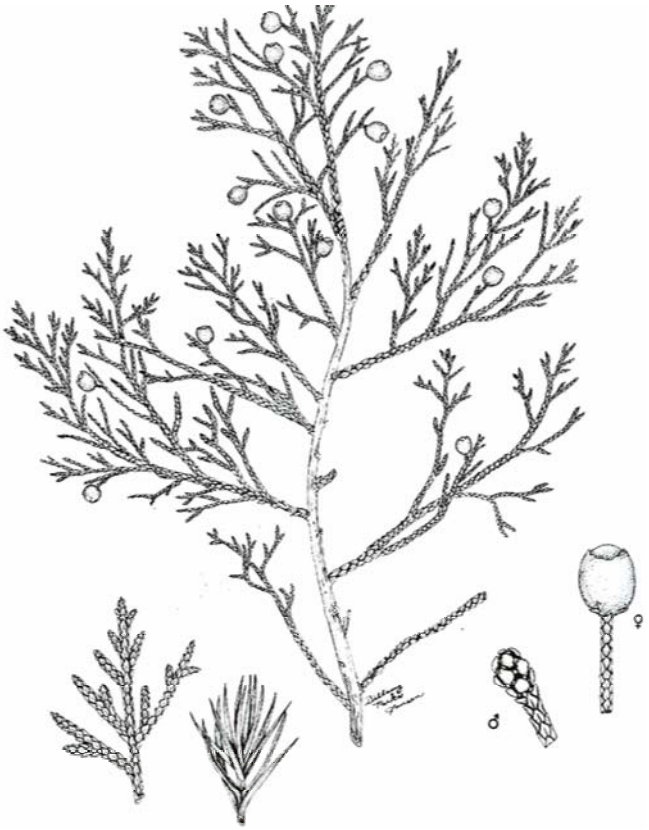
Roadside suitability.
It is fire tolerant and will re-sprout and produce suckers following fire disturbance. Black hawthorn can be planted to stabilize banks, for shelterbelts, and for erosion control along ditches and highways.

Establishment.
Containerized trees should be planted when they are no more than eight feet tall, in the fall or spring. Balled and bur lapped trees should be planted in early spring.

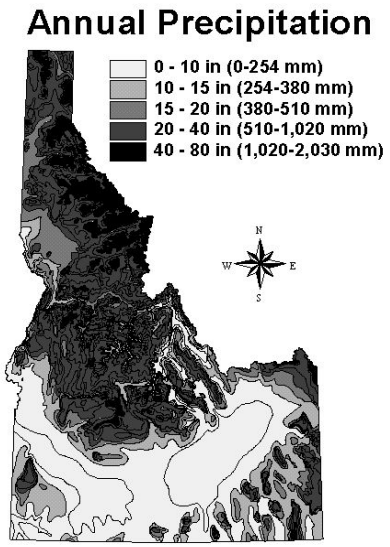
SEEDING RECOMMENDATIONS:
Approximate seed per pound: 22,600

Rocky Mountain Juniper

Juniperus scopulorum



James Stubbendiek (1997)



LIFE SPAN: Long-lived.

GROWTH HABIT: Evergreen tree/bushy shrub.

ORIGIN: Native.

VEGETATIVE CHARACTERISTICS:
Dioecious. Leaves are dark green, scale-like, and pointed. Crown is irregular and rounded. Bark is stringy. Fruits are pea sized, clear-blue berries. Roots can reach a minimum depth of 20 in. Grows 20-50 ft tall.

SITE REQUIREMENTS:

Precipitation zone.
Ranges from 10-20 in.

Elevation zone.
Ranges from 5,000-9,000 ft.

Habitat and Climate requirements.
Adapted to a wide range of climatic conditions throughout the Rocky Mountain West. Best suited to moist sites at higher elevations. Can withstand temperatures to -38 F.

Soil type.
Adapted to a wide range of soils. Optimum conditions on rocky, gravelly, or sandy soils (pH 5.0-8.0).

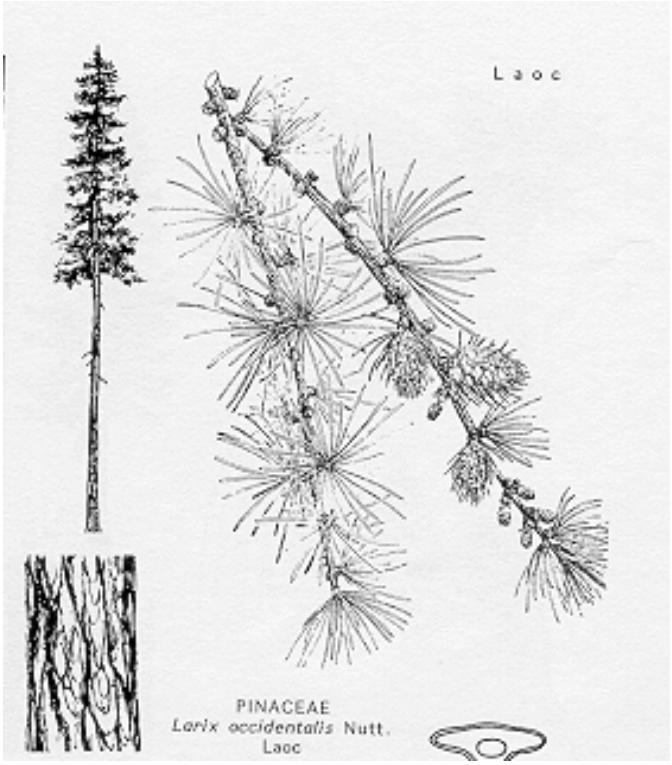
APPLICATIONS:

Roadside suitability.
Used for windbreaks. Tolerates high water tables. Resistant to drought. Deep rooted and excellent slope stabilizer.

Establishment.
Medium to rapid growth rate. Difficult to establish from seed, excellent results from transplants.

SEEDING RECOMMENDATIONS:
Sow seeds in the fall. Seed 16 PLS lb per acre. There are 27,000 seeds per lb.

Western Larch
Larix occidentalis



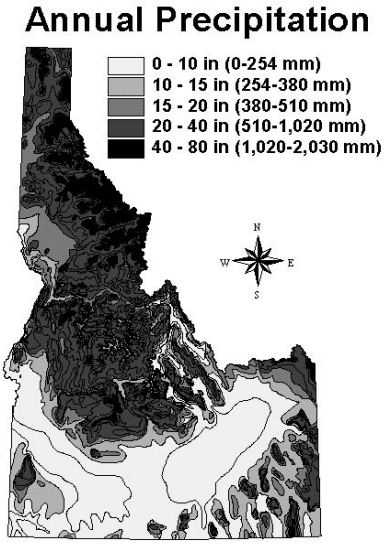
Patricia A. Patterson et al. (1985)

LIFE SPAN: Long-lived.

GROWTH HABIT: Deciduous conifer tree.

ORIGIN: Native.

VEGETATIVE CHARACTERISTICS:
Large coniferous tree, long, straight stem with relatively short, horizontal, straight branches. Leaves are deciduous and born in clusters of 25-40 on spur shoots. Roots are deep and wide spreading reaching a minimum depth of 20 in. Grows 164 ft tall.



SITE REQUIREMENTS:

Precipitation zone.
Ranges from 20-30 in.

Elevation zone.
Ranges from 2,000-7,000 ft.

Habitat and Climate requirements.
Adapted to north or west facing slopes with rain in the spring and fall and hot and dry summers. Can withstand temperatures to -43 F.

Soil type.
Deep, moist, porous, gravelly slopes (pH 6.0-7.0).

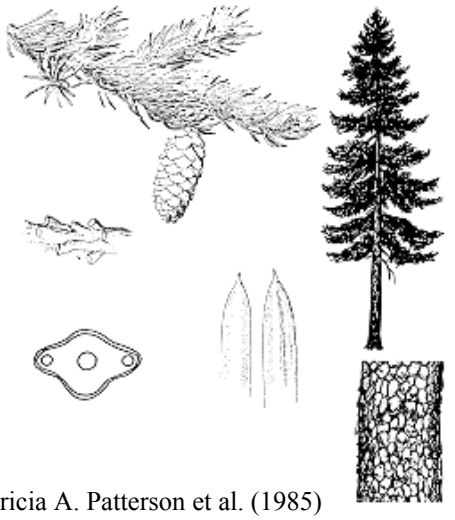
APPLICATIONS:

Roadside suitability.
Windfirm and fire resistant. Recommended for reforestation and rehabilitation plantings. Tolerates drought. Deep rooted and aesthetic.

Establishment.
High germination rate. Establishes readily from seed and transplants.

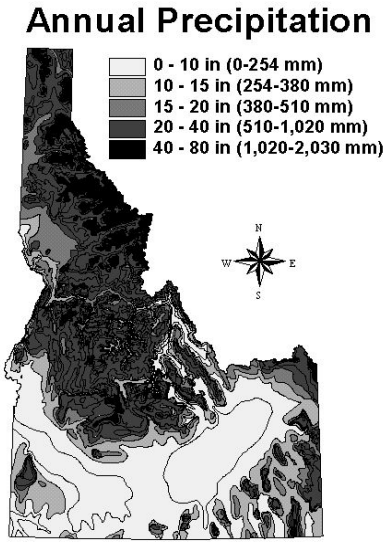
SEEDING RECOMMENDATIONS:
Plant in the fall or spring at a depth of 0.13-0.25 in. There are 98,182-197,411 seeds per lb.

Engleman Spruce
Picea englemannii



Patricia A. Patterson et al. (1985)

Walter Siegmund



LIFE SPAN: Long-lived.

GROWTH HABIT: Conifer tree.

ORIGIN: Native.

VEGETATIVE CHARACTERISTICS:
Leaves are deep, blue-green, rigid needles. Crown is spiral with branches extending to the ground. Bark is thin, scaley, and brownish red. Roots are shallow and spreading, reaching a minimum depth of 20 in. Grows up to 180 ft tall.

SITE REQUIREMENTS:

Precipitation zone.
Greater than 25 in, largely in the form of snow.

Elevation zone.
Ranges from 1,500-5,000 ft.

Habitat and Climate requirements.
Adapted to the climatic conditions of cold humid sites and wet frost pockets in the montane zone. Prominent at edges of meadows, streams and lakes. Can withstand temperatures to -50 F.

Soil type.
Moist, well-drained, rich and loamy soils (pH 6.0-8.0).

APPLICATIONS:

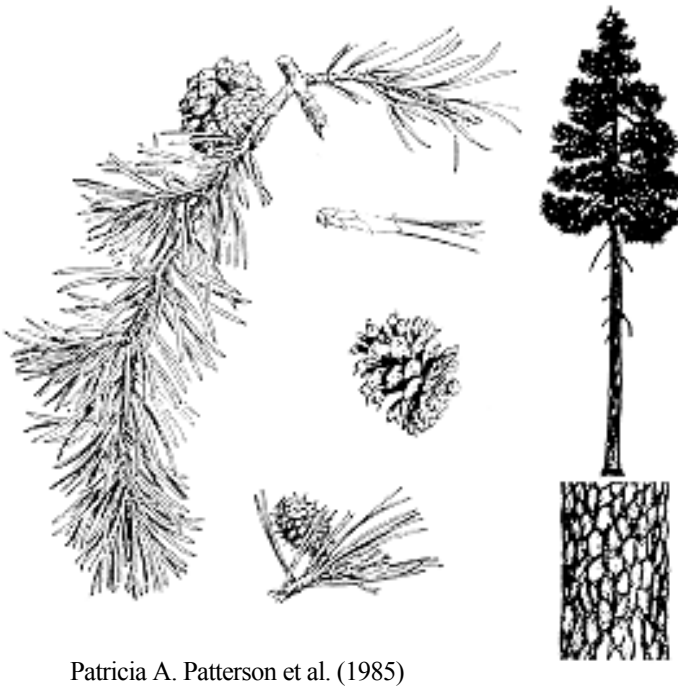
Roadside suitability.
Tolerates shade and cold. Not as deep rooted as other conifers. Aesthetic.

Establishment.
Prolific seeder and vigorus. Germinates best on moist mineral soil following cold stratification. Propagate by transplanting or seeding.

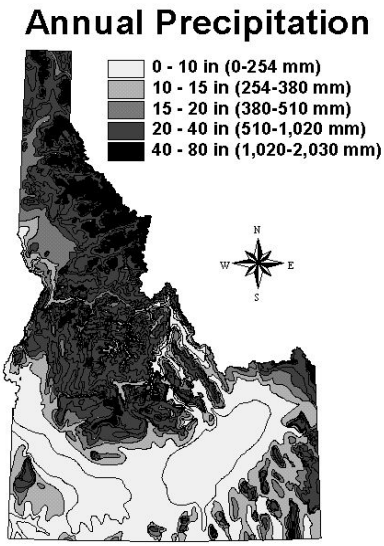
SEEDING RECOMMENDATIONS:
Plant in the fall. Seed 16 PLS lb per acre. There are 12,000 seeds per lb.

Lodgepole Pine

Pinus contorta



Patricia A. Patterson et al. (1985)



LIFE SPAN: Relatively short-lived.

GROWTH HABIT: Conifer tree.

ORIGIN: Native.

VEGETATIVE CHARACTERISTICS:
Relatively short tree, small stem and crown. Leaves are yellow-green, long, and stiff in needle-like clusters of 2-3. Roots are shallow, reaching a minimum depth of 20 in. Grows 50-100 ft tall.

SITE REQUIREMENTS:

Precipitation zone.
Ranges from 30-60 in.

Elevation zone.
Ranges from 4,000-11,000 ft.

Habitat and Climate requirements.
Adapted to a wide range of climatic conditions throughout the Pacific Northwest. Can withstand temperatures to -70 F.

Soil type.
Moist, well-drained, sandy-gravelly loams. Tolerates wet, acidic environments as well as thin, volcanic soils (pH 6.2-7.5).

APPLICATIONS:

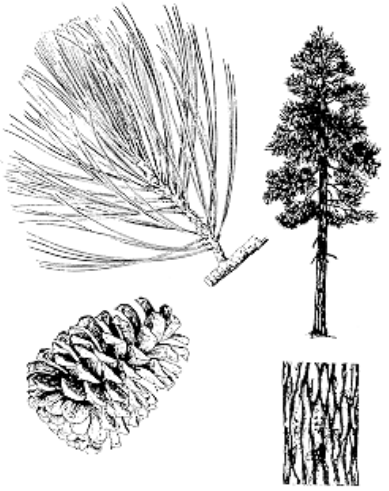
Roadside suitability.
Medium-sized. Reproduces rapidly after a fire. Persists in frost pockets. Establishes and grows under a wide range of conditions.

Establishment.
Vigorous reproduction from seeds and transplants.

SEEDING RECOMMENDATIONS:
Plant in the fall. Seed 20 PLS lb per acre. There are 95,000 seeds per lb.

Ponderosa Pine

Pinus ponderosa



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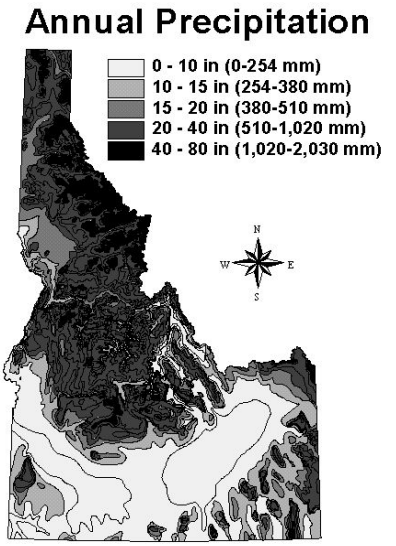


LIFE SPAN: Long-lived.

GROWTH HABIT: Conifer tree.

ORIGIN: Native.

VEGETATIVE CHARACTERISTICS:
Leaves are long, dark-green, and needle-like in fascicles of 3. Crown is round to broadly cylindrical. Bark is gray-brown to reddish brown and deeply furrowed with age. Roots are moderately deep and wide spreading, reaching a minimum depth of 20 in. Grows 80-200 ft tall.

SITE REQUIREMENTS:

Precipitation zone.
Minimum of 10 in or more.

Elevation zone.
Ranges from 2,000-9,000 ft.

Habitat and Climate requirements.
Adapted to a wide range of dry areas and on southern exposures in the Rocky Mountain region. Can withstand temperatures to -36 F.

Soil type.
Adapted to a variety of soil conditions, generally in well-drained soils with a pH of 4.5 to 9.

APPLICATIONS:

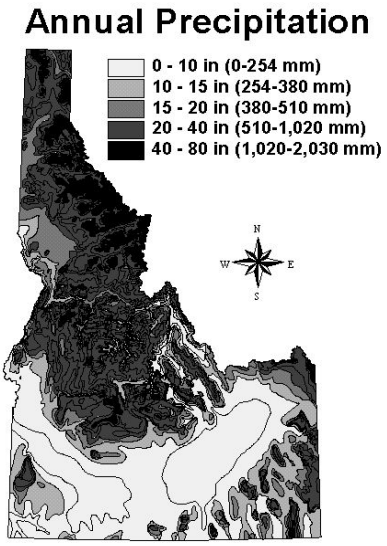
Roadside suitability.
Used for landscaping and has excellent longevity in windbreaks. Requires good drainage and plenty of sunlight, however, adapted to a wide range of climatic and soil conditions. Deep rooted and aesthetic.

Establishment.
Reproduction is vigorous and readily establishes from seeding or transplants.

SEEDING RECOMMENDATIONS: Plant in the fall. Seed 15 PLS lb per acre. There are 12,000 seeds per lb.

Quaking Aspen
Populus tremuloides

Patricia A. Patterson et al. (1985)



LIFE SPAN: Relatively short-lived.

GROWTH HABIT: Deciduous tree.

ORIGIN: Native.

VEGETATIVE CHARACTERISTICS:
A small to medium tree, forming dense colonies. Leaves are broadly ovate and yellow-green. Crown is rounded. Bark is green to white, thin and smooth, with black, scar-like marks. Rhizomatous roots reaching a minimum depth of 32 in. Grows 75 ft tall.

SITE REQUIREMENTS:

Precipitation zone.
Ranges from 7-40 in.

Elevation zone.
Wide range of elevations in the Rocky Mountain region. Generally above 3,000 ft.

Habitat and Climate requirements.
Moist, upland woods, mountain slopes and along streams.

Soil type.
Well-drained, rich, humous soils. Occurs on nearly all soil types (pH 6.0-9.0).

APPLICATIONS:

Roadside suitability.
Thicket forming. Establishes rapidly after a fire. Requires moist soils. Good slope stabilization and aesthetic.

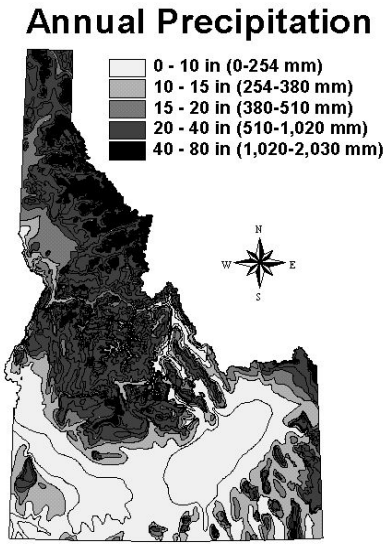
Establishment.
Establishes from seed or transplants.

SEEDING RECOMMENDATIONS:
Plant in the fall. Seed 16 PLS lb per acre. There are 12,000 seeds per lb.

Douglas Fir

Pseudotsuga menziesii

Patricia A. Patterson et al. (1985)



LIFE SPAN: Long-lived.

GROWTH HABIT: Conifer tree.

ORIGIN: Native.

VEGETATIVE CHARACTERISTICS:
Leaves are dark to pale green and linear. Crown is compact and pyramidal with graceful, drooping branches. Flowers are inconspicuous. Roots are lateral, well-developed, strong, widespreading and can reach a minimum depth of 26 in. Grows 100-120 ft tall.

SITE REQUIREMENTS:

Precipitation zone.
Ranges from 15-100 in.

Elevation zone.
Ranges from 2,000-11,000 ft.

Habitat and Climate requirements.
Adapted to a wide range of conditions from moist to dry sites in the mid-montane forests. Most abundant in low to middle elevations. Can withstand temperatures to -33 F.

Soil type.
Well-drained, moist, deep, porous, gravelly, loam soils (pH 5.0-7.5).

APPLICATIONS:

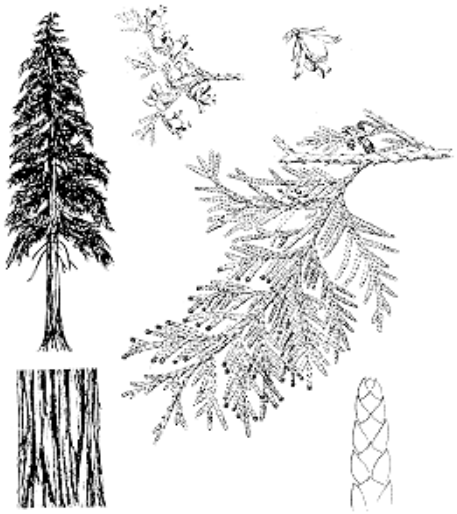
Roadside suitability.
Tolerates shade and drought. Fairly easy to establish. Deep rooted and resistent to drought.

Establishment.
Reproduction is abundant and vigoruos. Prolific seeder. Prechilling will speed up germination. Can be established from seeds and transplants.

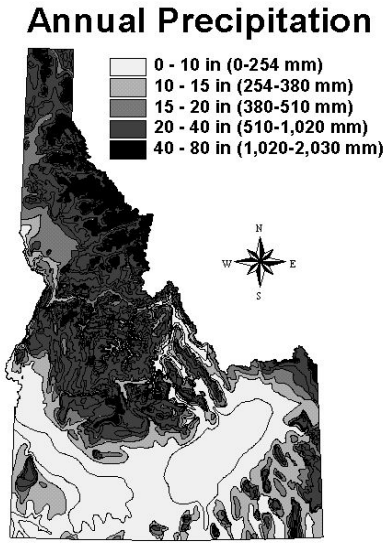
SEEDING RECOMMENDATIONS:
Plant in the fall. Seed 10 PLS lb per acre. There are 38,000 seeds per lb.

Western Redcedar

Thuja plicata



Patricia A. Patterson et al. (1985)



Walter Siegmund

LIFE SPAN: Long-lived.

GROWTH HABIT: Conifer tree.

ORIGIN: Native.

VEGETATIVE CHARACTERISTICS:
Leaves are scale-like, dark, yellow-green, and flat. Crown is cone-shaped with spray-like branches that spread down and outward. Trunk is fluted. Bark is red. Roots are shallow and widespreading. Grows up to 200 ft tall.

SITE REQUIREMENTS:

Precipitation zone.
Ranges from 35-257 in.

Elevation zone.
Ranges from 2,000-7,000 ft.

Habitat and Climate requirements.
Adapted to rich, moist to wet (often saturated) sites. Found in foothill to montane settings throughout the Pacific Northwest. Can withstand temperatures to -33 F.

Soil type.
Rich soils with abundant moisture (pH 5.0-7.5).

APPLICATIONS:

Roadside suitability.
Makes a nice hedge if planted closely. Used for reforestation and riparian enhancement. Roots are fairly shallow, however can be established in dense stands. Shade tolerant.

Establishment.
Rapid growth. High moisture requirement. Not easily established from seed, however, transplants are easily established.

SEEDING RECOMMENDATIONS:
Establishment from seeding is not recommended, however transplants in early spring are quite successful.

GRASSES

Scientific Name	Common Name	Origin	Growth Habit	Height (in)	Precip. (in)	Elev. (ft)	Seeding rate (PLS/lb)	Seeds/lb
Agropyron cristatum	Crested Wheatgrass	I	BUNCHGRASS	24-39	0-18	0-7000	3-7	265,250
Agropyron dasystachyum	Thickspike wheatgrass	N	SOD-FORMER	16-32	8-20	3800-10000	6-8	154,000
Agropyron intermedium	Intermediate wheatgrass	I	SOD-FORMER	24-48	>14	3500-9000	8-10	88,000
Agropyron riparium	Streambank wheatgrass	N	SOD-FORMER	16-32	10-25	3800-10000	6-8	156,000
Agropyron sibericum	Siberian wheatgrass	I	BUNCHGRASS	24-35	6-12	0-7000	3-7	170,000
Agropyron smithii	Western wheatgrass	N	SOD-FORMER	12-36	10-14	1000-9000	6-8	110,000
Agropyron spicatum	Bluebunch wheatgrass	N	BUNCHGRASS	12-24	10-40	500-10000	8-14	140,000
Agropyron trachycaulum	Slender wheatgrass	N	BUNCHGRASS	24-30	12-30	4500-12000	6-8	159,000
Agropyron trichophorum	Pubescent wheatgrass	I	SOD-FORMER	13-14	11-16	-	6-8	100,000
Bromus carinatus	Mountain brome	N	BUNCHGRASS	15-30	12-16	500-10000	6-8	64,000
Bromus inermis	Smooth brome	I	SOD-FORMER	13-25	12-18	>4000	4-5	125,000
Bromus vulgaris	Columbia brome	N	BUNCHGRASS	18-47	11-20	2500-5500	-	119,000
Calamagrostis rubescens	Pinegrass	N	SOD-FORMER	24-40	18-40	0-10000	1-2	2,646,000
Dactylis glomerata	Orchardgrass	I	BUNCHGRASS	24-47	11-20	6500-9000	2-3	654,000
Deschampsia Caespitosa	Tufted Hairgrass	N	BUNCHGRASS	18-24	20-40	5000-13000	2-4	1,500,000
Elymus cinereus	Basin Wildrye	N	BUNCHGRASS	24-96	5-20	0-9000	6-10	130,000
Elymus glaucus	Blue Wildrye	N	BUNCHGRASS	24-47	12-40	0-6000	9	155,000
Festuca arundinacea	Tall fescue	I	BUNCHGRASS	20-80	15-40	500-10000	3-6	227,000
Festuca idahoensis	Idaho Fescue	N	BUNCHGRASS	12-39	10-40	800-12000	3-6	450,000
Festuca longifolia	Hard fescue	I	BUNCHGRASS	12-14	12-40	500-12000	3-6	565,000
Festuca ovina	Sheep fescue	I	BUNCHGRASS	8-16	9-24	3500-11000	3-6	680,000
Festuca rubra	Red fescue	N	BUNCHGRASS	16-39	18-40	3700-8000	3-6	615,000
Festuca Scrabrella	Rough fescue	N	BUNCHGRASS	12-48	20-40	0-10000	3-6	200,000
Hordeum vulgare	Barley	I	BUNCHGRASS	23-47	>12	0-7000	3-6	12,500
Koeleria cristata	Prairie junegrass	N	BUNCHGRASS	12-24	12-20	0-7500	2-5	2,315,400
Nasella viridula	Green needlegrass	N	BUNCHGRASS	18-36	12-18	0-5000	8	181,000
Oryzopsis hymenoides	Indian ricegrass	N	BUNCHGRASS	4-24	0-15	0-8200	6-12	141,000
Phleum pretense	Timothy	I	BUNCHGRASS	19-39	>16	0-8400	1-3	1,300,000
Poa canbyi	Canby bluegrass	N	BUNCHGRASS	13-24	9-20	0-5000	2-4	926,000
Poa compressa	Canada bluegrass	I	SOD-FORMER	6-20	15-40	-	1-4	2,500,000
Poa nevadaensis	Nevada bluegrass	N	BUNCHGRASS	20-40	10-15	-	-	1,082,000
Poa Pratensis	Kentucky bluegrass	I	SOD-FORMER	0-40	>18	0-10000	2-3	2,177,000
Poa sandbergii	Sandberg bluegrass	N	BUNCHGRASS	1-12	>8	1000-12000	2-4	925,000
Sitanion hystrix	Bottlebrush squirreltail	N	BUNCHGRASS	4-20	6-16	-	5-12	192,000
Schoenoplectus acutus	Hardstem Bulrush	N	BUNCHGRASS	36-144	10-12	<2300	-	-
Sporobolus airoides	Alkali sacaton	N	BUNCHGRASS	20-40	6-10	3500-8000	2-3	1,750,000
Sporobolus cryptandrus	Sand dropseed	N	BUNCHGRASS	12-40	10-40	0-8000	1-2	5,298,000
Stipa comate	Needle and thread	N	BUNCHGRASS	12-24	<9	300-5000	6-8	115,000
Stipa occidentallis	Western needlegrass	N	BUNCHGRASS	12-30	10-20	4500-10000	3-5	311,000
Stipa thurberiana	Thurber's needlegrass	N	BUNCHGRASS	12-20	8-15	6500-9000	6-8	150,000
Triticum aestivum	Spring wheat	I	BUNCHGRASS	13-25	>12	0-10000	3-6	11,000

GRASSLIKES								
Scientific name	Common name	Origin	Growth Habit	Height (in)	Precip. (in)	Elev. (ft)	Seeding rate (PLS/lb)	Seeds/lb
Carex nebrascensis	Nebraska Sedge	N	Sedge	8-47	-	0-9000	5	534,100
Juncus balticus	Baltic rush	N	Rush	<43	-	<1000	1-2	109,301,000

LEGUMES								
Scientific name	Common name	Origin	Growth habit	Height (in)	Precip. (in)	Elev. (ft)	Seeding rate (PLS/lb)	Seeds/lb
Hedysarum boreale	Northern Sweetvetch	N	LEGUME	10-24	>10	8500	8-10	33,600
Lupinus argenteus	Silvery lupine	N	LEGUME	8-24	8-35	1000-3000	4-7	-
Lupinus caudatus	Tailcup Lupine	N	LEGUME	12-24	-	0-10500	4-7	135,000
Lupines sericeus	Silky Lupine	N	LEGUME	26-56	10-20	1500-10000	4-7	-
Medicago sativa	Alfalfa	I	LEGUME	<24	12-18	<7500	1-2	210,000
Onobrychis viciaefolia	Sanfoin	I	LEGUME	25	15-18	>4000	2-4	-
Trifolium repens	White dutch	I	LEGUME	<12	>20	0-14000	2-4	850,000

FORBS								
Scientific name	Common name	Origin	Growth habit	Height (in)	Precip. (in)	Elev. (ft)	Seeding rate (PLS/lb)	Seeds/lb
Achillea Millefolium	Western yarrow	N	FORB	12-36	>20	200-9000	0.5-2	2,770,000
Arnica Cordifolia	Heartleaf arnica	N	FORB	6-24	10-35	1000-11000	4-7	220,000
Aster glaucodes	Gray aster	N	FORB	24-60	14-30	4000-10000	5	540,000
Balsamorhiza sagittata	Arrowleaf balsamroot	N	FORB	16-30	8-14	4300-8300	10-12	27,000
Delphinium bicolor	Low larkspur	N	FORB	-	8-12	3000-10000	3	-
Erigonum flavum	Yellow Buckwheat	N	FORB	4-16	14-20	9000	8-10	209,000
Erigonum umbellatum	Sulphur-flower buckwheat	N	FORB	<24	8-18	700-12000	0.5	-
Gaillardia aristida	Blanketflower	N	FORB	18-24	16-25	0-8000	5-7	132,000
Geranium Viscosissimum	Sticky Purple geranium	N	FORB	4-36	>20	750-10000	7-10	52,000
Linum lewisii	Blue Flax	N	FORB	12-45	12-16	4000-11000	5-7	293,000
Lomatium dissectum	Fern-leaf biscuitroot	N	FORB	4-12	14-100	0-10000	5-7	134,240
Penstemon eatonii	Firecracker Penstemon	N	FORB	12-40	10-16	3300-8000	3-6	351,050
Penstemon palmeri	Palmer penstemon	I	FORB	48	10-16	3500-6500	3-6	610,000
Penstemon strictus	Rocky Mountain penstemon	N	FORB	12-36	15-20	0-11000	3-6	592,000
Penstemon venustis	Alpine penstemon	N	FORB	12-24	20-35	1000-6000	3-6	280,000
Sanguisorba minor	Small burnet	I	FORB	20-25	12-25	1000-6000	2-5	55,000
Sphaeralcea coccinea	Scarlet globemallow	N	FORB	3-12	8-12	3000-7000	4	500,000

SHRUBS

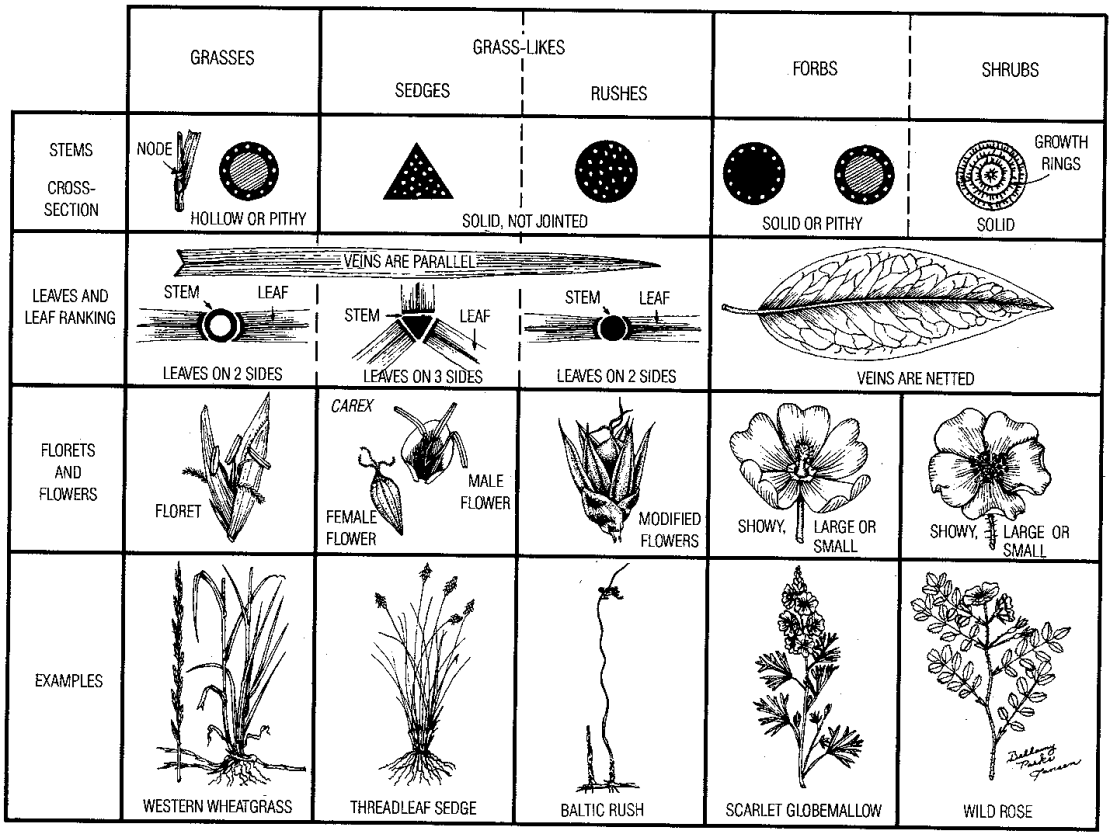
Scientific name	Common name	Origin	Growth habit	Height (in)	Precip. (in)	Elev. (ft)	Seeding rate (PLS/lb)	Seeds/lb
Acer glabrum	Rocky mountain maple	N	SHRUB	5-25	12-25	1100-10000	3-4	20,000
Amerlanchier alnifolia	Serviceberry	N	SHRUB	36-180	12-30	0-9000	3-4	25,000
Arctostaphylus uva-ursi	Kinnikinnick	N	SHRUB	0-12	14-45	7025-11510	4-6	37,900
Artemisia arbuscula	Low sagebrush	N	SHRUB	4-159	8-20	7000-8000	2-5	972,000
Artemisia cana	Silver sagebush	N	SHRUB	60	8-40	6000-10600	2-5	850,000
Artemisia nova	Black sagebrush	N	SHRUB	<24	6-20	4000-8000	2-5	907,200
Artemisia tridentate	Basin big sagebrush	N	SHRUB	18-180	6-35	1475-8033	2-5	2,500,000
Artemisia vaseyana	Mountain big sagebrush	N	SHRUB	20-50	10-14	4000-10000	2-5	2,500,000
Atriplex canescens	Fourwing saltbrush	N	SHRUB	20-80	6-15	0-7000	2-5	52,000
Berberis repens	Oregon grape	N	SHRUB	12-36	>18	1000-10000	2-5	45,000
Ceanothus sanguineus	Redstem ceanothus	N	SHRUB	10-20	>12	2500-4000	5-7	12,000
Ceanothus velutinus	Snowbrush ceanothus	N	SHRUB	36-120	>14	3500-10000	2-5	124,275
Ceratoides lanata	Winterfat	N	SHRUB	0-32	5-25	2000-10000	2-5	56,700
Cercocarpus ledifolius	Curlleaf mountain mahogany	N	SHRUB	3-20	>8	2000-9000	5-8	30,000
Cercocarpus montanus	True mountain	N	SHRUB	<12	>10	4000-10000	5-8	59,000
Chrysothamnus nauseosus	Rubber rabbitbrush	N	SHRUB	12-84	>8	2000-9000	2-5	400,000
Chrysothamnus viscidiflores	Green rabbitbrush	N	SHRUB	40	>6	2000-10000	1-3	782,000
Cornus stolonifera	Redosier dogwood	N	SHRUB	36-108	>18	1500-9000	2-5	173,000
Holodiscus discolor	Oceanspray	N	SHRUB	24-60	>15	0-7000	1-2	190,000
Physocarpus malvaceus	Ninebark	N	SHRUB	36-84	0-10	5200-10800	2-5	756,000
Potentilla fruticosa	Shrubby cinquefoil	N	SHRUB	12-24	>16	5500-11000	10-12	1,000,000
Prunus virginiana	Chokecherry	N	SHRUB	36-228	12-30	4500-9000	5-8	4,800
Purshia tridentate	Antelope bitterbrush	N	SHRUB	24-120	2-25	3500-9000	1-3	15,000
Rhus glabra	Smooth sumac	N	SHRUB	48-84	>10	2700-7500	1-3	20,000
Rhus trilobata	Skunkbrush sumac	N	SHRUB	0-96	>8	1900-8000	1-3	19,000
Ribes cereum	Wax current	N	SHRUB	0-78	14	2500-9500	1-3	350,000
Rosa woodsii	Woods' rose	N	SHRUB	24-120	12-40	3500-11700	-	-
Salix scouleriana	Scouler willow	N	SHRUB	120-384	9-63	>10000	-	6,500,000
Sambucus cerulean	Blue elderberry	N	SHRUB	72-240	>12	0-10000	8-10	216,800
Symphoricarpos albus	Common snowberry	N	SHRUB	24-48	>15	2400-9000	4-6	76,000

TREES

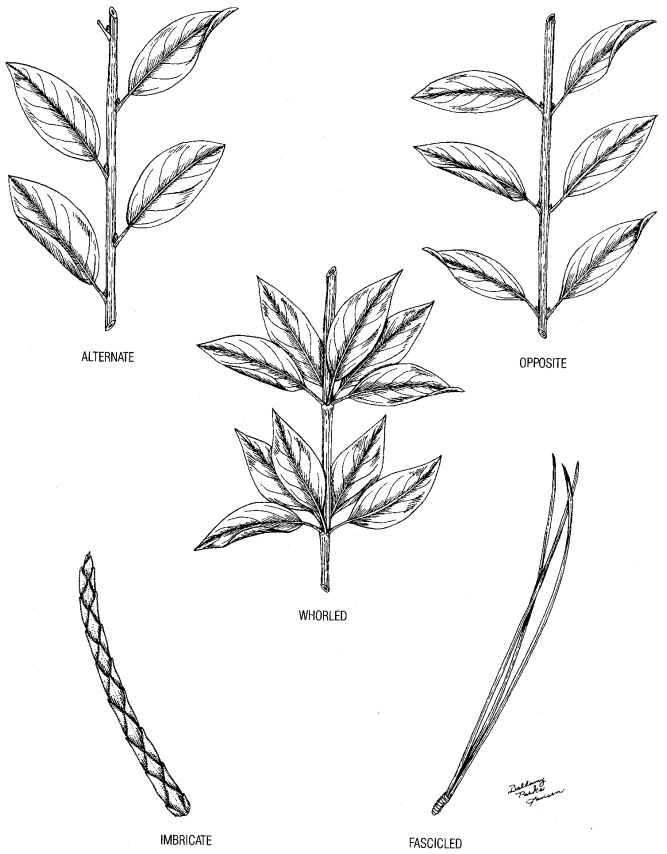
Scientific name	Common name	Origin	Growth habit	Height (ft)	Precip. (in)	Elev. (ft)	Seedling rate (PLS/lb)	Seeds/lb
Abies grandis	Grand fir	N	TREE	250	20-100	2300-3275	16	20,408
Abies lasiocarpa	Subalpine fir	N	TREE	137	>25	3500-10500	16	20,408
Alnus incana	Thinleaf alder	N	TREE	40	>20	2500-8000	5	10,000
Celtis reticulate	Hackberry	N	TREE	10-20	>17	820-4754	-	4,870
Crataegus douglasii	Black hawthorn	N	TREE	35	16-260	2200-5400	-	22,000
Juniperus scopulorum	Rocky mtn juniper	N	TREE	20-50	10-20	5000-9000	16	27,000
Larix occidentalis	Western larch	N	TREE	164	20-30	2000-7000	-	197,411
Picea englemannii	Engleman spruce	N	TREE	180	25	1500-5000	16	12,000
Pinus contorta	Lodgepole pine	N	TREE	50-100	30-60	4000-10000	20	95,000
Pinus ponderosa	Ponderosa pine	N	TREE	80-200	>10	2000-9000	15	12,000
Populus tremuloides	Quaking aspen	N	TREE	75	7-40	>3000	16	12,000
Pseudotsuga menziesii	Dougla fir	N	TREE	100-120	15-100	2000-11000	10	38,000
Thuja plicata	Western Redcedar	N	TREE	200	35-257	2000-7000	-	-

Appendix A

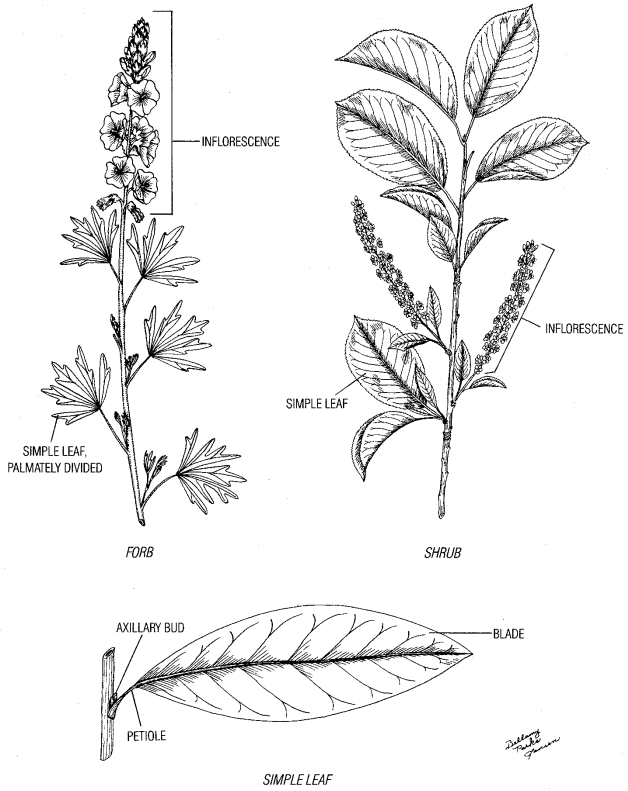
General Plant Identification



Plant Group Descriptions – This table shows a simple breakdown of plant groups, including grasses, grasslikes, forbs, and shrubs and contains the most defining characteristics of each group.

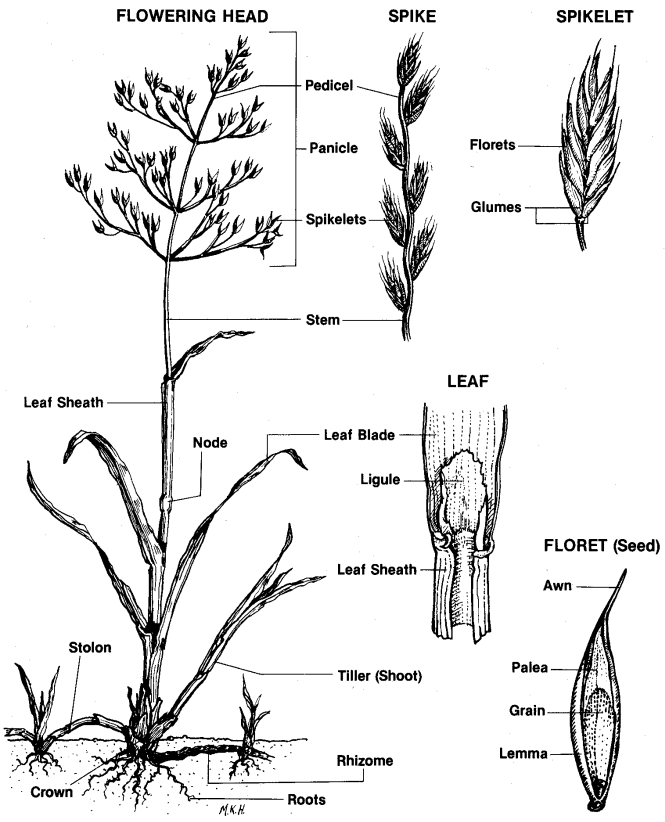


Leaf Arrangement



Structure of Forbs and Shrubs

STRUCTURE OF GRASSES



Structure of Grasses

Appendix B

Glossary

Glossary

Based on definitions from:

North Dakota and Minnesota Range Plants. North Dakota Extension Publication # EB 69. By Kevin K. Sedivec and William T. Baker. North Dakota State University, Fargo, ND. 1997.

&

Idaho Soils Atlas. By Raymond J. Baker, Robert E. McDole, and Glen Logan. University of Idaho, Moscow, ID. 1983.

&

Field Guide to Forest Plants of Northern Idaho. General Technical Report INT-180. 1997. By Patricia A. Patterson, Kenneth E. Neiman, and Jonalea R. Tonn. USDA, FS.

&

North American Range Plants. By James Stubbendieck, Stephen L. Hatch, and Charles H. Butterfield. University of Nebraska. Lincoln, NE. 1997.

Acidic. An acid forming soil with low pH.

Aerial. An elevated position.

Alkali. A soil with a high pH (8.5 or more) with high exchangeable sodium which may interfere the plant growth.

Alluvial Material. Sand, gravel, or silt transported and deposited on land by moving water.

Alpine. Mountain heights above the timberline.

Alternate. Located singly at each node; not opposite or whorled.

Argillic. Consisting of clay, clayey.

Arid. A climate that lacks sufficient moisture for crop production without irrigation.

Aromatic. Fragrant or having odor; bearing essential oils.

Awn. A terminal, bristlelike appendage.

Basal. Located at or near the base of the plant.

Basic. Containing a base; alkaline.

Branchlet. The final division of the branch.

Bulb. An underground bud with thick, fleshy scales.

Caryopsis. A small, one-seeded fruit.

Catkin. A spike-like inflorescence of unisexual, apetalous, bracteate flowers.

Compound. Made up of two or more parts.

Corolla. All of the petals considered collectively.

Corymb. Strictly a simple, racemose, inflorescence that is flat-topped or round-topped because the outer pedicels are progressively longer than the inner; form of a corymb.

Crown. The upper part of a tree, including the living branches with their foliage.

Culm. The stem of grass or sedge.

Cylindrical. Shaped like a cylinder.

Cyme. A broad, flat inflorescence with the central flower blooming first.

Diffuse. Widely spreading.

Digitate. Compound with members arising from one point; palmately compound.

Divided. Separated or cut into distinct parts by inclusions extending to near the base or midrib.

Elliptic. Oval in shape, widest at the middle, and tapering equally to both rounded ends.

Elongate. Narrow; the length many times the width or thickness.

Entire. Whole; with a continuous margin.

Exfoliate. Shedding in flakes or thin layers.

Fertile. Capable of producing fruit; does not refer to stamen presence or absence in grasses.

Fibrous. Resembling or composed of fibers.

Flexuous. Bent alternately in opposite directions. A wavy form.

Fluted. Channeled; furrowed, as a column.

Friable. Crumbles easily.

Glabrous. Smooth and without hairs.

Glaucous. Covered with a whitish, waxy bloom that rubs off easily.

Horizon. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil forming processes.

Humid. Moist, damp air.

Inflorescence. A flower-cluster of a plant; the arrangement of the flowers on the axis.

Invasive. Having the nature of invasion.

Involute. Rolled inward, so that the lower side of an organ is exposed and the upper concealed.

Lance-shaped. Much longer than broad, widest near the base, and tapering to the apex.

Lax. Loose.

Layering. A shoot or twig of a plant, undetached from the stalk, bent down, and partially covered with soil so that it may take root.

Loam. Soil material that is 7-27 percent clay particles, 20-50 percent silt particles, and less than 52 percent and particles.

Lobe. A partial division of an organ, especially if rounded.

Margin. An edge, border.

Montane. Mountainous.

Mottled. Marked with spots or blotches.

Neutral. Not acidic or alkaline.

Oblong. Longer than broad with the sides nearly parallel.

Opposite. Arranged two at each node, on opposite sides of the axis.

Organic. Plant or animal residue in the soil in various stages of decomposition.

Ovate. Egg-shaped with the broader part near the base.

Panicle. An irregular compound inflorescence with pedicillate flowers.

Papilionaceous. Butterfly-like corolla with standard, wings, and keel.

Perennial. Lasting several years.

Pinnate. Compound leaf with leaflets arranged on both sides of the axis; odd pinnate if terminal leaflet is present, even-pinnate if terminal leaflet is absent.

Porous. Full of pores or tiny holes.

Propagate. To multiply; reproduce.

Pubescent. Covered with short, soft, downy hairs; a general term for any kind of hairiness.

PLS. Pure live seed.

Raceme. A simple, elongated inflorescence with pedicellate flowers.

Ray. Outer floret of Asteraceae with straplike corolla, no stamens, functionally pistillate; the branch of an umble.

Reflexed. Abruptly bent or turned downward.

Rhizome. An underground stem, usually extending laterally and rooting at the nodes.

Robust. Healthy; full-sized.

Saline. A nonsodic soil containing sufficient soluble salts to impair productivity.

Scabrous. Rough; feeling rough to the touch.

Scale. Any thin, dry, appressed organ (usually a leaf or bract).

Seedbed. A bed of soil where plants are grown.

Serrate. With sharp teeth pointing forward.

Sheath. A tubular structure surrounding part or all of an organ; the portion of a grass leaf that surrounds the stem.

Silt. Individual mineral particles that range in diameter from the upper limit of clay (0.002 mm) to the lower limit of very fine sand (0.05 mm).

Simple. Not compound or branched.

Sod. Creating a dense mat with interwoven root systems.

Sodic. Containing sodium.

Solitary. Alone; one by itself.

Spike. A simple, elongated inflorescence with sessile flowers.

Spikelet. A small or secondary spike.

Stalk. The stem or axis of a plant.

Stolon. A horizontal stem that roots at the top or at the nodes; runner.

Stoloniferous. Bearing stolons.

Taproot. The primary descending root.

Temperate. A climate that is neither very hot nor very cold.

Terminal. Borne at or belonging to the extremity.

Tiller. A shoot from an adventitious bud at the base of a plant.

Tooth. A pointed projection or division.

Trifoliate. Having three leaflets.

Tropic. Very hot, sultry climate.

Tuber. A thick, short branch, usually subterranean, with numerous buds.

Tuft. Cluster; bunch.

Umble. A flat-topped or rounded inflorescence in which pedicels or peduncles arise from a common point.

Viability. Being able to survive under conditions of wide geographical distribution.

Vigor. Active or healthy growth.

Wiry. Being thin and resilient.

Appendix C

References

Species
&
Sketches

Species references

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Appendix D

Index

Index

Scientific Name	Common Name	Pg #	Scientific Name	Common Name	Pg #
Abies grandis	Grand fir	105	*Festuca longifolia*	Hard fescue	20
Abies lasiocarpa	Subalpine fir	106	*Festuca ovina*	Sheep fescue	21
Acer glabrum	Rocky mountain maple	73	*Festuca rubra*	Red fescue	22
Achillea millefolium	Western yarrow	54	*Festuca scabrella*	Rough fescue	23
Agropyron cristatum	Crested wheatgrass	1	*Geranium viscosissimum*	Sticky geranium	62
Agropyron dasystachum	Thickspike wheatgrass	2	*Hedysarum boreale*	Northern sweetvetch	46
Agropyron intermedium	Intermediate wheatgrass	3	*Holodiscus discolor*	Ocean spray	92
Agropyron riparium	Streambank wheatgrass	4	*Hordeum vulgare*	Barley	24
Agropyron sibericum	Siberian wheatgrass	5	*Juncus balticus*	Baltic rush	44
Agropyron smithii	Western wheatgrasss	6	*Juniperus scopulorem*	Rocky mtn juniper	110
Agropyron spicatum	Bluebunch wheatgrass	7	*Larix occidentalis*	Western larch	111
Agropyron trachycaulum	Slender wheatgrass	8	*Linum lewisii*	Blue flax	63
Agropyron trichophorum	Pubescent wheatgrass	9	*Lomatium dissectum*	Ferleaf biscuitroot	64
Alnus incana	Thinleaf alder	107	*Lupinus argenteus*	Silvery lupine	47
Amelanchier alnifolia	Serviceberry	74	*Lupinus caudatus*	Tailcup lupine	48
Actostaphylus uva-ursi	Kinnikinnick	75	*Lupinus sericeus*	Silky lupine	49
Arnica cordifolia	Heartleaf arnica	55	*Medicago sativa*	Alfalfa	50
Artemisia arbuscula	Low sagebrush	76	*Nasella viridula*	Green needlegrass	26
Artemisia cana	Silver sagebrush	77	*Onobrychis viciaefolia*	Sanfoin	51
Artemisia nova	Black sagebrush	78	*Oryzopsis hymenoides*	Indian ricegrass	27
Artemisia tridentate	Basin big sagebrush	79	*Penstemon eatonii*	Firecracker penstemon	65
Artemisia vaseyana	Mountain big sagebrush	80	*Penstemon palmeri*	Palmer penstemon	66
Aster glaucodes	Gray aster	56	*Penstemon strictus*	Rocky mtn penstemon	67
Atriplex canescens	Fourwing saltbrush	81	*Penstemon venustus*	Alpine penstemon	68
Balsamorhiza sagittata	Arrowleaf balsamroot	57	*Phleum pratense*	Timothy	28
Beberis repens	Creeping Oregon grape	82	*Physocarpus malvaceus*	Ninebark	93
Bromus carinatus	Mountain brome	10	*Picea englemannii*	Engleman spruce	112
Bromus inermis	Smooth brome	11	*Pinus contorta*	Lodgepole pine	113
Bromus vulgaris	Columbia brome	12	*Pinus ponderosa*	Ponderosa pine	114
Calamagrostis rubescens	Pinegrass	13	*Poa canbyi*	Canby bluegrass	29
Caragana arborescens	Siberian peashrub	83	*Poa compressa*	Canada bluegrass	30
Carex nebrascensis	Nebraska sedge	43	*Poa nevadaensis*	Nevada bluegrass	31
Ceanothus sanguineus	Redstem ceanothus	84	*Poa pratensis*	Kentucky blugrass	32
Ceratoides lanata	Winterfat	86	*Poa sandbergii*	Sandberg bluegrass	33
Cercocarpus ledifolius	Curlleaf mtn mahogany	87	*Populus tremuloides*	Quaking aspen	115
Cercocarpus montanus	True mtn mahogany	88	*Potentilla fruticosa*	Shrubby cinquefoil	94
Chrysothamnus nauseosus	Rubber rabbitbrush	89	*Prunus virginiana*	Chokecherry	95
Chrysothamnus viscidiflorus	Green rabbitbrush	90	*Pseudotsuga menziesii*	Douglas fir	116
Crataegus douglasii	Black hawthorne	109	*Purshia tridentate*	Antelope bitterbrush	96
Dactylis glomerata	Orchardgrass	14	*Ratibida columnifera*	Prairie Coneflower	69
Delphinium bicolor	Low larkspur	58	*Rhus glabra*	Smooth sumac	97
Deschampsia cespitosa	Tufted hairgrass	15	*Rhus trilobata*	Skunkbrush sumac	98
Elymus cinereus	Basin wildrye	16	*Ribes cereum*	Wax current	99
Elymus glaucus	Blue wildrye	17	*Rosa woodsii*	Woods' rose	100
Erigonum flavum	Yellow buckwheat	59	*Salix scouleriana*	Scouler willow	101
Erigonum umbellatum	Sulphur-flower buckwheat	60	*Sambucus coerulea*	Blue elderberry	102
Festuca arundinacea	Tall fescue	18	*Symphoricarpos albus*	Common snowberry	103
Festuca idahoensis	Idaho fescue	19	*Thuja plicata*	Western Redcedar	117

Appendix E

Topsoil Application
for
Revegetation of Roadsides

Topsoil Application for Revegetation of Roadsides

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ABSTRACT

Revegetation is the best solution to long-term erosion control problems on roadsides. Success of vegetation establishment on new road-cuts is dependent on the re-application of isolated topsoil following excavation and construction. Topsoil contains the essential nutrients and microorganisms required for plant growth. Vegetation establishment, promoted by the presence of topsoil, reduces surface erosion caused by unstable slopes. Available research and related publications are cited on the differences between topsoil and subsoil; the presence or absence of microbial activity and microorganism population changes over time in stockpiled topsoil; stockpile maintenance; and re-spreading stockpiled topsoil. The purpose of this report is to provide available research in a form that will aid in using stockpiled topsoil to promote long-term establishment of vegetation on roadsides.

INTRODUCTION

Bare soil surfaces are created when soil is excavated and moved during road construction. These newly established road-cuts are a source of surface soil erosion. Vegetation offers the best long-term protection against erosional forces of wind and rain on slopes and provides some degree of protection against shallow mass movement (Gray and Leiser 1982). Soil surfaces on roadsides have different physical, chemical, and morphological characteristics than the soil on the sites prior to road construction because topsoil and subsoil are commonly removed +simultaneously (Staht *et al*. 1988).

Topsoil is the dark-colored surface soil that contains essential nutrients and microorganisms necessary for successful vegetation establishment. Subsoil is the lighter-colored, mineral and clay layer location beneath the topsoil that contains little organic matter and is not conducive to vegetation growth (Persson and Funke 1988).

Topsoil and subsoil are mixed when excavated simultaneously. As a result, vegetation establishment is difficult to accomplish because nutrients and microorganisms available to seedlings upon germination are reduced, and soil structure is altered. Conservation of topsoil by stockpiling it for re-application following excavation and road construction generally increases the success of vegetation establishment on new road-cuts.

Over time, there are biological, chemical, and structural changes that occur in stockpiled topsoil as anaerobic conditions develop. These conditions can be prevented and manipulated by proper management techniques in order to ensure the preservation of essential topsoil characteristics necessary to accomplish successful vegetation establishment on new road-cuts. Stockpiles, for the purpose of this report, are mounds of stored topsoil that may range from 3.5 ft. to more than 19 ft. in depth. Topsoil is stored in these mounds until a disturbed site, such as a road-cut, is ready for reclamation.

Although much is known about soil remediation, conservation, morphology, genesis,

fertility, and microbiology, there is little research on the application of topsoil to roadsides as a medium for vegetation establishment. A summary of available research and related publications on the use of reapplied topsoil to disturbed sites will be a useful tool in determining if stockpiled topsoil can increase establishment and persistence of vegetation on roadsides.

The objective of this report is to provide a comprehensive literature review on stockpiling topsoil which includes information on topsoil and subsoil characteristics, the presence or absence of microbial activity in stockpiled topsoil, and stockpile maintenance and re-spreading techniques. The information presented here is intended to supplement preexisting information on revegetation and can be used by the Idaho Transportation Department to improve roadside revegetation success throughout Idaho. The value of this review extends also to other agencies and organizations responsible for successful vegetation establishment and erosion control.

TOPSOIL AND SUBSOIL CHARACTERISTICS

Topsoil and subsoil have distinct differences. Topsoil is dark in color, defined as the top 6-12 in. of soil, and acts as a media for root growth. It generally includes the A- horizon of the soil profile, which is the surface horizon of a mineral soil. The A-horizon is defined by McDaniel *et al.* (1997) as a layer of soil parallel to the ground surface with unique physical, chemical, and biological properties. The A-horizon is dark-colored because of its high levels of carbon and organic matter. This layer is important in maintaining soil fertility and providing a favorable environment for root growth. Topsoil replacement has been shown to improve organic carbon on reclamation sites, and is the most effective way to ensure long-term success of desirable plant establishment.

Subsoil is made up of the B-horizon which tends to contain more clay and minerals than the A-horizon and has fewer plant roots associated with it. The B-horizon is often exposed to the

surface during road construction. Exposure of the B-horizon reduces the success of vegetation establishment and increases the potential for surface erosion. Studies indicate that topsoil containing the A-horizon is a highly effective amendment for the improvement of chemical, physical, and biological properties of disturbed sites (Visser *et al*. 1984) because it is a natural medium for plant growth. A field study by McGinnies and Nicholas (1980) noted greater seedling establishment on mine spoil plots treated with re-applied topsoil compared to non-topsoiled mine spoil treatments. Following the first growing season, the researchers noticed a positive vegetative response on all mine spoils treated with re-applied topsoil.

MICROORGANISMS IN TOPSOIL

The success of revegetation on topsoiled sites is not attributed purely to the different physical characteristics of topsoil and subsoil. Microbial populations, such as bacteria and fungi that depend on topsoil for survival, play a critical role in vegetation establishment. Bacteria and fungi interact with plants in the rhizosphere, the ecological niche that comprises the surface of plant roots and the surrounding soil (Atlas and Bartha 1993). Topsoil contains the rhizosphere where the density of microorganisms is highest.

Studies point out that interactions between plant roots and soil microorganisms found in topsoil mutually satisfy nutritional requirements for soil microorganisms and associated vegetation. Microorganisms fulfill their nutritional needs and benefit plants in a variety of ways. They increase nutrient recycling and solubilization of minerals; synthesize vitamins, amino acids, auxins, and gibberellins (stimulants for plant growth); and deter plant pathogens (Atlas and Bartha 1993). When microbial populations are absent in the rhizosphere, plant growth can be impaired (Atlas and Bartha 1993).

Soil fungi produce essential metabolites for plant uptake, alter the pH to more favorable conditions, promote mineral nutrient cycles, and alter the availability of magnesium and

potassium (Ingham 1997). Read (1997) explained that hyphae (threads that make up the vegetative portion of a fungus) are the main structural elements of mycorrhizal fungi. They have a symbiotic association with plant roots. These mycorrhizal associations are present in the root systems of most indigenous plant species (Steinbacher 1997). Hyphae either penetrate the cells of the plant root to form an "endomycorrhiza" or, as in most trees, they ensheath the root to produce an "ectomycorrihiza". The importance of these microorganisms in topsoil has been emphasized by Stahl *et al.* (1988), who cite a number of studies where the presence of mycorrrhizal fungi has improved the revegetation of disturbed lands.

Atlas and Bartha (1993) reported that soil microorganisms can protect plant roots from toxic levels of minerals by oxidizing them to a less toxic state. They further suggested that some bacteria synthesize compounds to increase the rate of seed germination and the development of root hairs to aid in plant growth. Other bacteria are capable of producing organic compounds to further stimulate plant growth.

ISOLATING AND REMOVING TOPSOIL

Microbial populations found in topsoil may be altered when topsoil is removed and put into a stockpile. Stripping soil is not a new technique in the road construction process. Nevertheless, stripping topsoil separately from subsoil is a new idea and may require a change in mechanical procedures. This process requires extra steps and more labor to avoid mixing topsoil with subsoil. After the topsoil is identified, it is then stripped from one construction site and either reapplied on another site that is ready for reclamation or hauled and stockpiled until the construction site is reclaimed (Stark and Redente 1987).

The extent to which topsoil is altered due to excavation and compaction from heavy earth-moving machinery during removal or in stockpile construction is unknown. Johnson *et al.* (1991) believed that the physical operations involved in stripping and construction of stockpiles subjected soil to forces that may have dramatic effects on physical properties of soil. Generally,

the bulk density of stockpiled topsoil stripped from a road-cut is greater than that of similar undisturbed topsoil (Potter *et al.* 1988). Abdul-Kareem and McRae (1987) stated that along with physical properties, biological and chemical properties are changed in stockpiled topsoil as a result of the mechanized process of construction. If these stockpiles remain *in situ* for long periods of time before soil is reused there can be a substantial reduction in the "quality" of the topsoil. Basically, over long periods of time the revegetative capacity of soil in stockpiles declines. Nevertheless, it is believed that retaining topsoil for re-application on disturbed sites is beneficial for the long-term success of revegetation efforts and erosion control.

STOCKPILING TOPSOIL

In stockpiles, the "quality" of soil deteriorates over time. Abdul-Kareem and McRae (1987) believed that the most significant change is a reduction in organic matter content. New stockpiles do not receive the input of organic matter from plant roots or animals as occurs in intact topsoil prior to stockpile construction. There is high heterogeneity in organic matter within a stockpile. The variation of buried vegetation from zone to zone within the stockpile and inadvertent mixing with subsoil during stripping and mound construction affect the amount and locations of microbial populations throughout the topsoil stockpile (Johnson *et al.* 1991).

Stockpiled topsoil has decreased fertility as compared to undisturbed fresh soil (Persson and Funke 1988). The reduction of microorganism numbers is partially responsible for this. However, a revegetation study by Stark and Redente (1987) found that the stockpiled material produced greater above-ground total biomass than fresh soil treatments following revegetation. In this same study, the researchers found that fresh soil had substantially higher bitterbrush seedling emergence, production, and mycorrhizal colonization; stockpiled soil had slightly higher grass production. Stark and Redente (1987) also found that the use of stockpiled topsoil on reclaimed mine sites resulted in increased grass production. The adverse effect stockpiles

have on mycorrhizal inoculum (mentioned earlier) causes a reduction in the establishment and production of plant species that have a high dependency on mycorrhizae for nutrient uptake. This study suggested that stockpiled topsoil reduces shrub emergence because of their greater dependence on fungal inoculation. Grass production, however, is not negatively affected because grasses are not as dependent on mycorrhizae for nutrient uptake.

Duration of Storage

The suitability of topsoil for revegetation declines with long-term storage (Doll *et al.* 1894). As noted earlier, changes in the microbial environment occur over time. Surprisingly, Persson and Funke (1988) found that actual counts of bacteria, actinomycetes, and fungi did not decline with long-term storage; however, their relative distribution changed. Miller and Cameron (1976) reported that numbers of bacteria, fungi, actinomycetes, and algae were indeed reduced in stockpiled soils between 10 and 29 months when compared to nearby undisturbed sites. No differences in species diversity between stockpiled or undisturbed treatment sites were noted. During the initial period of stockpile storage, there were generally few significant differences between estimates of total viable organisms gathered from plate counts. Bacterial counts often are higher at the onset of stockpile construction, however, suggesting that the flush of decomposition caused by the physical disturbances of soil excavation releases previously-trapped organic matter (Johnson *et al.* 1991). Rives *et al.* (1980) reported that storing topsoil for three years reduced the levels of viable inocula relative to levels in adjacent undisturbed soil. Nevertheless, they found that during the three-year storage period, levels of viable propagules remained high enough to produce 81.7% infection by fungus in the root bioassays (Rives *et al.* 1980).

Changes in Microorganisms

Changes in the type, quantity, activity, and inoculation potentials of microorganisms are

expected when topsoil is stockpiled. Johnson *et al.* (1991) found that numbers of bacteria, fungi, actinomycetes, and algae in stockpiled soil were all lower than those in nearby undisturbed sites. However, fungi propagule numbers tended to be higher in topsoiled plots than in plots without topsoil (Lindemann *et al.* 1984) and there was no change in species diversity of bacteria and fungi in the stockpiled topsoil as compared to topsoil from non-disturbed sites. Williamson and Johnson (1990) found that the total biomass of bacteria and fungi varied among different stockpiles, but often was similar to that of unburied soil although most bacteria collected from the stockpiled topsoil was non-viable. Along with a decrease in microbial biomass, stockpiled soils had a considerable increase in mineral nitrogen content (Ross and Carins 1981). The increase in nitrogen appears to coincide with the depth of topsoil and the presence of anaerobic conditions.

Depth-related effects on the microbiology of stockpiled topsoil seem to be fairly consistent across studies. At the upper surface of stockpiles, fungal numbers were lower than in undisturbed soil (Visser *et al.* 1984). At lower depths, pH values were lower because anaerobic conditions increase with depth leading to a decrease in pH (Ross and Carins 1981). Generally, microbial numbers were similar to undisturbed soil while aerobic nitrifying bacteria decreased greatly compared to the undisturbed soils (Persson and Funke 1988). More specifically, Williamson and Johnson (1990) found that there was a decrease in viable aerobic bacteria, an increase in the occurrence of endospore-forming bacteria, and a decrease in fungal biomass at depths of 3.2 ft.

Depth by itself affects the microbial environment, but length of storage combined with depth may also be a factor causing change. Time-depth-related effects on microorganism numbers in stockpiled soil were noted by O'Flanagan *et al.* (1963), who found that numbers of aerobic microorganisms declined with depths up to 6.5 ft. in a three-year-old mound. Thereafter, numbers of aerobic microorganisms remained similar down to 16 ft. Studies have indicated that

following restoration and revegetation using stockpiled topsoil, anaerobes and aerobes can increase rapidly (O'Flanagan *et al.* 1963; Persson and Funke 1988; Williamson and Johnson 1990), and sufficient mycorrhizal populations are intact to inoculate newly established vegetation (Abdul-Kareem and McRae 1987).

Maintenance of Stockpiles

Erosion can occur if stockpiles sit for long periods of time. An effective method of reducing erosion is to establish vegetation on the topsoil mound. When studying the production potential of stockpiled soil, Stark and Redente (1987) found that the vegetated portions of a stockpile have higher mychorrhizal inoculation potential than non-vegetated portions of the same stockpile. Also, after re-spreading the topsoil, there was higher grass production on the non-vegetated topsoil and higher seedling emergence of bitterbrush on the vegetated topsoil. This conclusion may be explained in terms of nutrient levels and mychorrhizal colonization. Specifically, the bitterbrush emergence was higher on the vegetated portion of stockpiled topsoil because it has greater dependency on mycorrhizal fungi than do grasses. Likewise, grass production was higher on the non-vegetated portion because grass does not need a strong association with mycorrhizal fungi.

IMMEDIATE RE-APPLICATION OF TOPSOIL

An alternative to stockpiling topsoil is to immediately reapply it to a road-cut as each step of construction is completed. Compared to stockpiled topsoil, freshly stripped topsoil enhances overall reclamation success because it has better chemical, physical, and biological properties than stored soil (Stahl *et al.* 1988). Rives *et al.* (1980) found that relatively high levels of viable fungal propagules were maintained by directly hauling topsoil onto disturbed sites rather than stockpiling it for later use. Furthermore, compared to stockpiled topsoil, fresh topsoil has a greater potential for improved water infiltration, water storage, nutrition, soil

structure, and microorganism inoculation, all of which enhance the potential for successful revegetation efforts (Schuman *et al.* 1998).

TOPSOIL APPLICATION

Application of topsoil is recommended on 2:1 slopes or flatter, where native soils are unsuitable for vegetative growth. The replacement of topsoil includes replacing its' seed bank. Many species native to the area will be represented in the seed bank, and can re-establish and add to the diversity of the vegetative establishment. Approved compost and/or manufactured organic soil amendments can be added to the topsoil to increase the organic content of the soil. Topsoil may also be added to rock mulch to enhance slope protection and provide soil medium for seed germination and plant growth. Upon completion of road construction, topsoil from stockpiles may be applied to exposed surfaces of road-cuts. It is important to apply topsoil over compatible soil textures. Failure to do so could cause topsoil to slough as water flows between the two soil layers of different permeability. Also, topsoil should not be applied when the subsoil is frozen or extremely wet. Where quanitites of topsoil are limited, it is recommended to cover the more critically disturbed areas to the proper depth, rather than cover all areas. Thickness of topsoil should approximate original conditions. Redente *et al.* (1997) found that a thin layer of topsoil (6 in) over a non-toxic mine spoil in Colorado was sufficient for the establishment and continued productivity of rangeland vegetation. After 10 years, Rendente *et al.* (1997) observed no difference in above-ground biomass between thick (23 in) and thin (6 in) layers of topsoil treatments.

Species composition, however, was different between the two groups. Grasses were dominant on sites with a thick layer of topsoil, while forbs were dominant on sites with a thin layer of topsoil. Differences in species composition were likely a result of the time-depth-related effects described earlier. Furthermore, there were more species occurring on the thin layer

treatments compared to the thick layer treatments, suggesting that shallow depths of re-spread topsoil can support productive and diverse plant communities.

CONCLUSIONS

The presence of topsoil to re-establish soil microorganisms is essential for the revegetation of disturbed areas. Topsoil provides essential nutrients and microorganisms that are critical to the success of vegetation establishment. Johnson *et al.* (1991) concluded that the microbiology of stockpiled topsoils is highly complex. This report identifies the functioning of topsoil as a media for root growth and its importance for maintaining soil fertility. Isolating and removing topsoil may be an expensive step in the road construction process, yet it is invaluable to the long-term re-establishment of vegetation on the disturbed site. Stockpiling topsoil is generally unavoidable, as is the loss of some the benefits of topsoil. The extent of deterioration of topsoil in stockpiles has been greatly overestimated. With proper care, losses of viable soil can be minimized when topsoil is removed, piled, and re-applied.

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