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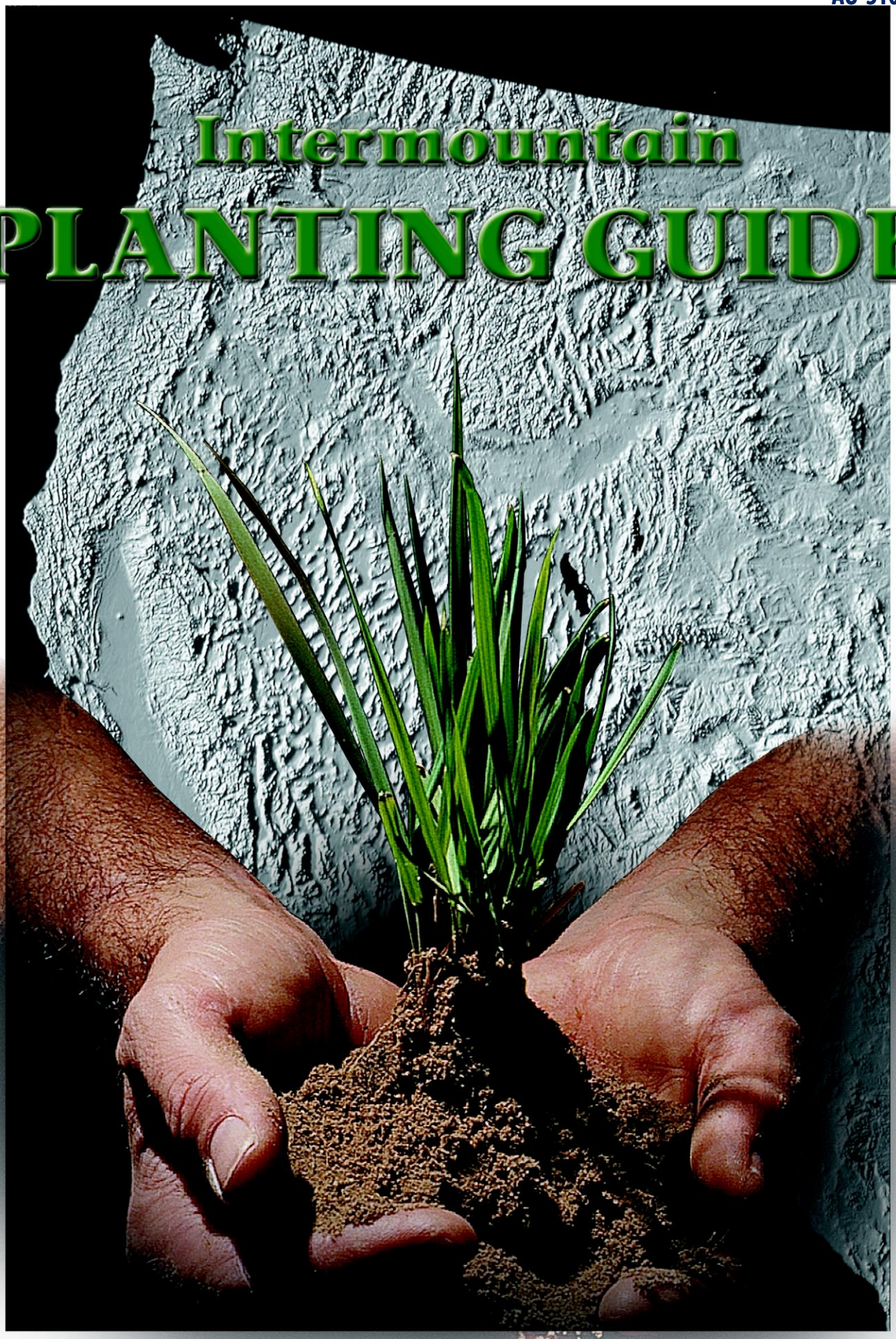
Intermountain PLANTING GUIDE



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KEY TO PLANTING TABLES

FACTORS AFFECTING A SUCCESSFUL SEEDING

INTRODUCTION

The first consideration prior to seeding is to determine the present level of management being applied to the proposed site. Many sites will recover or improve without seeding if proper management is implemented. Soil is the primary natural resource and its conservation is the most important consideration in seedings. According to soil scientists it can take a thousand years to replace 1 inch of lost fertile top soil, especially in dry rangeland environments. The retention and enhancement of soil should be the primary consideration in all management decisions, including choice of plant materials. When soils are mismanaged, resulting in moderate to severe degradation, watersheds begin to fail, pastures and ranges cease to produce as they once did, weeds begin to replace healthy perennial vegetation, recreation and scenic values are decreased, and management options become limited. Too often, planting mixtures are designed to answer economic concerns, aesthetic views, or political and environmental agendas without first addressing the immediate need to protect the soil.

Evaluate the following questions before proceeding to plant:

- What are my management goals?
- Do I have a reasonable understanding of soil and species management? If not, will a new expensive seeding soon return to an unacceptable condition?
- Are enough desirable plants still present on the proposed seeding site to promote recovery without planting if proper management is applied?
- How risky is a new seeding? What impact will disturbance of soils and plant life have on the biological health of the area? Will the expected increase in forage offset the possibility of weed invasion or loss of stable soils and sensitive native plant communities?
- Is overuse or abuse currently a problem on the site? If appropriate grazing distribution, pasture rest and rotation, time of use, fertilization, irrigation and weed control is initiated, will the stand and vigor of existing plant materials improve to an acceptable level without re-vegetation?
- Could classes of animals with different forage preferences be applied to suppress or eliminate undesirable species, while giving desirable plants an enhanced opportunity to recover and expand without seeding?
- Is it possible to manage and manipulate undesirable plant materials with herbicides or bioagents as opposed to radical cultivation and planting procedures?

SEED QUALITY

Insist that seed purchased have a complete seed analysis tag or label on each bag or container including results of a current germination test. Federal and State laws mandate that seed cannot be legally sold without a complete analysis label. Analysis information and net weight may be written on either the bag, an attached tag, or both. The bag itself must show at least the lot number, which must correspond to the lot number listed on the analysis tag. An analysis label must include (see Figure 1):

Kind:	Basin Wildrye	Origin:	Utah
Variety:	Magnar (VNS)	Lot No:	MBW-0016
Purity:	95.36%	(Cert. No.):	(G-2090)
Inert:	4.15%	Germination:	95% (TZ)
Other Crop:	0.38%	(Dormant/Hard Seed):	(0.00%)
Weed Seed:	0.11%	(Total Viability):	(95%)
Noxious Weeds:	0.00%	Test Date:	17 Oct. 2000

Quality Seed Co. • 919 Conditioner St • Seed City, UT 84000-0000

Figure 1. Example of a complete seed lot label. Items listed in (parentheses) are applicable in certain circumstances; see text.

1. Variety and kind: Kind is the species or crop. If the seed is supposed to be a certain variety, it must be on the label; otherwise "Variety Not Stated" (VNS) can be listed. VNS labeling is not allowed for small grains in some states, and all varieties having Title 5 Plant Variety Protection (PVP) must be sold by variety name and as certified seed (see CERTIFIED SEED section that follows).

2. Purity: Purity + Inert Matter + Weed Seed + Other Crop Seed percentages are components of the label that must add up to 100%. Most grass seed should contain no more than 1 to 15% inert matter or it will be difficult to plant. Even if the percentage of inert matter is low, seed containing pieces of stem or unthreshed cluster, may block passage through a drill. The acceptable purity and inert matter of shrubs and forbs and some native grasses will vary by species; for additional information contact your State Seed Laboratory.

3. Other crop seed: Other crop seed may be present up to 5%, at which level the seed lot must be labeled as a mixture and all of the species listed on the label. If the types of other crop seed is a concern, the buyer may request a complete seed analysis report for the lot which lists other crop species and number of seeds per pound individually.

4. Weed seed: The analysis must indicate that no prohibited noxious weed seeds are present. The name and number of seeds per pound of any restricted noxious weeds must be listed on the label. Weeds defined as noxious and the number of seeds per pound allowed for restricted noxious weeds vary from state to state, but any seed lot must meet the regulations of the state where it is being sold. Common weed seed should not total more than 0.5% by weight (except grass seed containing weedy Bromus species, which may not exceed 3.0%). This may vary according to state seed laws. Of course, the less weed seed the better, and some weeds are worse than others for pasture/range plantings. A seed analysis report will list the weed species and number of seeds per pound individually.

5. For alfalfa and red clover seed, the state of origin must be listed on the tag. For tree and shrub seed, the origin (state) and elevation (when possible) of the collection site should be listed on the label.

6. If the lot is certified, the certification number should be listed on the analysis tag; in most states an additional certification tag (see Certification Seed section following) is attached to the bag or container. The seed lot number on the bag, analysis tag, and certification tag must all match.

7. Germination: Total viability includes the sum of all seeds (of the "kind" listed on the label) actually germinating using standardized laboratory methods, plus hard seed and/or dormant seed. Dormant seed is viable but requires time or a physiological stimulus to induce germination. Hard seed is alive but has a thick seed coat that must be broken down mechanically, by frosting action, or by organisms in the soil before it will germinate. The higher the germination (total viability), the better. Viability of most grass species is normally above 85% and should not be lower than 60%, while desirable viability percentages of some native grasses, shrubs and forbs can vary widely according to species. Germination may be given as a percent followed by (TZ), which means that a staining technique using tetrazolium chloride was used to evaluate the viability of the seed. This technique is an acceptable substitute for the actual germination test in many states and is much quicker (24 hrs vs 1-4 weeks for actual germination). The seed is soaked in the TZ solution, which causes live (respirating) tissue in the seed to turn a red color. A trained seed analyst can then correlate the pattern and intensity of the red staining with seed viability.

Germination test date: Make sure the germination test date is listed on the label and is current. Grasses and broadleaf forbs (including alfalfa and clovers) must be updated every 9 to 18 months depending on state seed laws; viability tests for all flowers, trees, and shrubs must be updated every 9 months. Some species such as forage kochia may have short shelf-life and need special storage conditions to retain viability. These species should be tested more frequently to assure that there has been no reduction in germinability at the time of purchase or use.

8. The name and address of the company offering the seed for sale to the end user must be listed on the analysis tag.

Pure Live Seed (PLS): Many species are sold on a PLS basis, with price adjusted accordingly. PLS = percent purity x percent total viability. How to use PLS: If your planting plan calls for a certain number of PLS pounds per acre, how much bulk seed is needed? To calculate this amount, divide the PLS percentage into the number of pounds recommended. Example: You want to plant 5 PLS lb of intermediate wheatgrass per acre. The analysis label indicates 85% pure seed and 79% germination; 0.85 x 0.79 = 0.67 PLS. Divide 0.67 into 5 lb/acre = 7.5 lb of bulk seed/acre needed to plant 5 PLS lb/acre. Note that you will plant a proportionally extra amount of any contaminants (such as weed seed) per acre to attain the desired PLS lb/acre. PLS may also be used to evaluate the "best buy" between lots of seed. For example, Lot A of Basin Wildrye seed is offered for $8.00/lb with purity of 96% and germination of 92%. Lot B is offered for $7.25/lb with a purity of 91% and a

germination of 84%. Lot A costs $9.06 per PLS pound. [$8.00 ÷ (.96 x .92) = $9.06], while Lot B costs $9.48 per PLS lb [$7.25 ÷ (.91 x .84) = $9.48].

Look at the seed before planting. If the seed doesn't appear to match what is written on the label, send a representative sample to a seed laboratory. You may call a State Department of Agriculture or Seed Certification representative to help sample and evaluate the seed.

CERTIFIED SEED

Seed is not certified unless there is an official tag attached to or printed on the bag that clearly states CERTIFIED SEED (blue tag), REGISTERED SEED (purple tag) or FOUNDATION SEED (white tag). If seed is from a wild collection or field grown native plant, the seed certification tags may state SOURCE IDENTIFIED SEED (yellow tag), SELECTED CLASS SEED (green tag) or TEST CLASS SEED (blue tag). Don't be misled by someone who says that the seed "came from a certified field," "we don't have the tags yet," or "it's just as good as certified." Bags of certified seed must have appropriate tags. Additional information can be obtained from your state Seed Certification Agency.

With certified seed you can be assured that the seed in the bag is the variety claimed. This is very important as new varieties are developed. A seed laboratory normally does not verify that the identity of a certain variety or ecotype listed on a seed sample is correct as claimed. For instance, there is no easy way to confirm that crested wheatgrass seed is actually Hycrest or Nordan or Ephraim or CD II or Douglas or Road Crest unless it is certified. Likewise, to know the origin of native plant germplasm so as to ensure it will be adapted to the planting site, insist on Source identified, Selected, or Tested seed of the proper ecotype.

Certification also means that the seed meets high quality standards for mechanical purity and germination, and contains strictly limited amounts of other crop seed, weed seed, inert matter, and diseased seed. (NOTE: Some seed lots of varieties in short supply may be labeled "SUBSTANDARD" on the certification tag if quality factors not affecting varietal identity and genetic purity don't meet normal certification standards; the substandard factor will be listed on the certification tag.)

Many newer varieties have been granted protection (similar to a copyright or patent) under the U.S. Plant Variety Protection (PVP) act. This means that growers/seedsmen must have permission of the variety owner to produce seed. Many PVP varieties are further protected by an elective provision of the Act (Title 5) such that they may be sold only as a class of certified seed. These include Douglas, CD II, and Road Crest crested wheatgrass, Vavilov Siberian wheatgrass, NewHy RS hybrid wheatgrass, Rush intermediate wheatgrass, many alfalfa varieties, and many varieties of other crops.

ESTABLISHING AND MANAGING AN IRRIGATED PASTURE SEEDING

TIME OF SEEDING

Many seasonal seeding options are available when considering irrigated plantings. Plantings can be made almost any time during the growing period if sufficient irrigation water is available, and can be applied often enough to allow the soil surface to remain moist and favorable for seed germination and seedling emergence. Plantings made in mid-summer heat and periods of persistent wind are very susceptible to drought, and require careful management to succeed. Small seeded varieties of grasses and legumes are extremely sensitive to crusting soils that often inhibit or reduce their ability to emerge. Mortality due to crusting can be minimized by frequent irrigations that keep the soil surface moist. If low humidity, wind and high temperatures persist, it is more effective to irrigate in the early evening so soils will remain moist during the night allowing seedlings to emerge.

Spring is the optimum season to establish irrigated seedings. High humidity, lower temperatures, and abundant soil moisture provide excellent conditions for germination and root development while significantly reducing the risk of seedling mortality due to surface crusting. In the spring too much moisture is occasionally a problem keeping soil too wet to permit tillage and seeding, thus delaying seedling emergence until the hotter, drier portions of the summer. Caution should be used when spring seeding legumes to ensure temperatures are warm enough to minimize frost damage. Fall plantings are most successful from late August to mid-September (depending on elevation) in most valleys of the Intermountain Region. Cooling temperatures, less wind, and increasing humidity enhance the opportunity for good plant establishment. Newly seeded plants should be about 2

to 3 inches in height or have three leaves prior to the onset of severe winter temperatures. Seedings made after mid-September risk winter kill as a result of poorly developed root systems. Most small grass and legume seedings require at least 6 weeks of active growth prior to killing frost to assure seedling establishment.

SEEDBED PREPARATION

An optimum seedbed is firm, but not hard surfaced (footprint about one quarter inch deep), fine but not powdered, moist but not wet, and free of competition from existing plants. Firmness is usually accomplished by using a cultipacker, roller harrow, or spike tooth harrowing multiple times. Such preparations retain soil moisture and reduce soil air space, keeping the germinating seed in good contact with soil and moisture. A firm seedbed promotes movement of moisture upward during the night to reduce the potential of soil crusting and seedling mortality. A firm seedbed also enhances accurate seed placement and uniform seedling emergence.

Unless erosion or abnormal conditions exist, nurse crops are generally not recommended since most annual crops create competition for the smaller emerging perennial grasses and forbs. Where wind or water create potential erosion or where seedling dessication is a problem, plant small seeded species directly into grain stubble with a no-till or minimum-till drill. If soil conditions are moderately firm and slightly moist, a conventional grain drill properly equipped for planting small seeds may work effectively.

SEEDING DEPTH

Perennial grasses, legumes, and forbs have small seeds and are particularly sensitive to excessive planting depths. Great care should be taken not to exceed proper seed depth, which is generally 1/4 to 1/2 inch for grasses and 1/8 to 1/4 inch for most legumes and forbs. A general rule of thumb states that seeds should be planted approximately five times the width of the seed at its narrowest point. It is estimated, for each additional 1/2 inch small seeded varieties are placed below their optimum seeding depth, 30 - 50% mortality is likely to occur. An emerging seedling is dependent on energy stored in the seed for initial growth until the leaves begin to develop. Since most small seeds contain limited energy food reserves, it is very difficult to emerge and survive from excessive depths. Coarse textured (sandy) soils require less energy for seedlings to emerge than fine textured soils. This requires minor adjustments in seeding depth according to soil type.

EQUIPMENT

Planting equipment for small seeded grasses and legumes should have good seed box agitation so light, awned, or irregularly sized seeds do not bridge over the openings. Agitation works in combination with accurate monitoring to allow even flow of a wide range of species used in planting mixes. Accurate seeding depth is critical, and is typically accomplished with depth control bands attached to double disk openers or manual and hydraulic depth control. Firming the soil over the seed with press wheels, or rolling devices promotes good seed to soil contact. Sometimes weight added to the press wheels will help compensate for soft seed beds. It is possible to use regular grain drills if fitted with depth bands, seed monitoring, and firming devices. A common equipment error in planting small seeded grasses or legumes, is to assume that a drill equipped and set for planting grain will adequately plant small seeded species. Oftentimes the seed is placed too deep using a grain drill and the planting fails to establish.

Small legumes, such as alfalfa, are heavier and smaller than most grass seeds and in mixes can move rapidly through lighter seed to the bottom of the seeder box. They are more evenly distributed in a mix if they can be planted from a separate seed box, or placed in seeders that have constant seed box agitation. The addition of rice hulls to seed mixes keeps different species in balance and assists in even seed flow through conventional drills.

Broadcast seeding can be an effective planting method. In this method seed is broadcast onto a well prepared seedbed followed by a roller harrow or a cultipacker equipped with indent rollers that press the seed into the seedbed surface.

CHOICE OF PLANT MATERIAL

Irrigated species that are adapted for pasture and hay plantings in the Intermountain Region are limited. However, the choice of varieties within some of the species is extensive. After choosing a species from the guide tables, **always** turn to the description section of this guide to determine the specific varieties available that are adapted to a particular site. The guide recommends varieties that have a history of production and persistence, or that have been evaluated and proven effective for use in the Intermountain Region.

Planting recommendations in this guide were developed by combining the collective experiences of the compilers and contributors. The information represents our collective recommendations and should not be considered as the only viable options. In our judgment they represent seed mixes and planting

recommendations that have potential for success. Certainly, there are many other available plant materials and seed mixes that may be equally useful. The USDA-ARS and Utah State University Extension Service neither guarantee nor warrant the use of these recommendations and imply no approval to the exclusion of other plant materials, seed mixes or methods that may also be suitable.

Greater yields of forage and increased biodiversity are produced when grasses and legumes are grown in mixtures as opposed to single species plantings. Legumes fix atmospheric nitrogen and make it available to companion grasses, thus increasing the production and nutritional value of the pasture. Mixing grasses with bloat producing legumes significantly reduces the risk of bloat. Legumes that cause bloat such as alfalfa and clover should not make up more than 25% of a mixed pasture. There are some species such as cicer milkvetch, sainfoin, and birdsfoot trefoil that are non-bloat causing legumes.

FERTILIZATION

Adequate levels of all nutrients must be available for optimum forage production. It is recommended that a soil test be conducted to determine the status of nutrients such as phosphorus, potassium, sulfur, and zinc prior to establishing a new stand. It is best to apply and incorporate these nutrients at recommended rates before seeding. A soil test is also important to determine soil texture, salt (salinity) levels, and soil pH. These are important considerations in selecting the appropriate forage for the site. By varying fertilizer application on existing forage stands it is possible to push grass-legume mixes to more grass by increasing nitrogen or more legume by increasing phosphorus and potassium.

After establishment nitrogen is essential to maintain high yields and good forage quality and should be applied one year after seeding. Rates of nitrogen applied depend on the production potential of the site and the composition of legumes in the stand (see Table 1). Apply nitrogen as early as possible in the spring. When applying nitrogen at rates greater than 100 pounds/acre consider splitting the nitrogen into two or more separate applications, one made in early spring and one in June. In-season applications of nitrogen should be timed with rainfall or irrigation events to move the fertilizer into the soil.

IRRIGATION

Proper irrigation of pastures requires an understanding of fundamental soil, water and plant relationships. In addition, irrigation must be coordinated with other pasture management practices such as grazing, fertilizer application and weed control to maximize pasture production. In a rotationally grazed pasture the grazing period may be from 1 to 7 days, followed by a 3 to 4 week rest period. Thus, irrigation can be applied immediately following removal of animals from the pasture and between grazing periods as needed. Irrigation should be completed well in advance (3 to 5 days) of the next grazing cycle to reduce animal compaction of the wetted soils.

The timing and amount of irrigation water required by pastures, like any other crop, depend on the soil water holding capacity, weather conditions and crop growth. Unless there is a limiting layer in the soil, most of the plant roots in a pasture will be found in the top 2 to 3 feet, except for a few deeply rooted species such as alfalfa. (See Tables 2 and 3)

The soil water holding capacity varies from about 1 inch per foot of depth in a sandy soil to about 2 inches per foot depth in a loamy soil. (See Table 3) This means that in a sandy soil, approximately 2-1/2 inches of water is available for plant use in the 2-1/2 foot root zone; whereas, in a loamy soil approximately 5 inches of water would be available for the pasture to use in the same 2-1/2 foot root depth. For best growth of pastures, it is recommended that irrigation take place when

TABLE 1. NITROGEN RECOMMENDATIONS FOR GRASS AND GRASS-LEGUME MIXTURES.

	YIELD POTENTIAL OF THE SITE			
	1-2 TONS/ACRE	2-4 TONS/ACRE	4-6 TONS/ACRE	6-8 TONS/ACRE
STAND COMPOSITION	NITROGEN RECOMMENDATIONS (POUNDS/ACRE)			
PURE GRASS	50	75	100-150*	150-200*
GRASS + 25% LEGUME	25	50	75	100
GRASS + 50% LEGUME	0	25	50	75
GRASS + 75% LEGUME	0	0	25	50

* SPLIT APPLICATIONS ARE MOST EFFECTIVE.

approximately 50% of the water has been used or depleted out of the root zone. This means that for a pasture on a sandy soil, the irrigation would need to occur when approximately 1-1/4 inches of water has been used by the pasture. About 2-1/2 inches of water would be used in between irrigations on a loamy soil.

As an example of scheduling irrigations, assume the crop water use rate is 1/4 inch per day. On a sandy soil, to maintain a pasture at its most vigorous growth, irrigation would be needed approximately every 5 days. About 1-1/4 inches of water should be added to the soil. This is because in 5 days, 1-1/4 inches of water would be depleted at a rate of 1/4 of an inch per day. However, on a loamy soil the pasture would be irrigated about every 10 days with 2-1/2 inches of irrigation water for the same consumptive use rate of 1/4 inch per day.

Grass pastures need to be irrigated about twice as often as a deeper-rooted alfalfa crop. However, because it is shallower rooted, only about half the amount of water could be stored in the root zone of the pasture with each irrigation compared to an alfalfa field. Irrigation on pastures need to be more frequent with lighter amounts than on some other crops. This means that a loamy soil with a 5-day grazing period followed by 25 days of rest, would need to be irrigated approximately 5 days prior to the beginning of grazing, receive another irrigation immediately after grazing, and one approximately 10 days later. Thus during a 4-week grazing cycle, there would be three 2-1/2 inch irrigations if the crop-water use rate continued at 1/4 of an inch a day.

Air temperatures and other weather conditions change from early April through the middle of the summer and continue on into the fall. This suggests that the daily crop water use rate of pastures is relatively low in the spring, increases toward the end of June through July and then begins decreasing from August through October. The amount of vegetation present also affects the rate at which pastures will use water. For example, grass that is approximately10 inches tall will use more water than grass that is 4 to 5 inches tall. Water consumption decreases during grazing and increases during the recovery period prior to the next grazing.

Frequency of irrigation will vary according to species used. Irrigated pasture grasses such as perennial ryegrass, orchardgrass, and meadow brome have high demands for water, whereas smooth brome and intermediate wheatgrass have moderate moisture requirements. For optimum plant production, it is important to irrigate often enough to promote uninterrupted plant growth. Too little irrigation water will restrict forage production, while too much leaches nitrogen fertilizer into lower soil levels making it unavailable to shallow rooted plants.

WEED CONTROL

Trade names used in this publication are for clarification only. No discrimination is intended and no endorsement is given by Utah State University or USDA-ARS. This guide is not intended to provide adequate information for application of herbicides. Before using any product mentioned in this publication, read carefully and observe all directions, precautionary statements and other information appearing on the appropriate EPA registered product label. Due to changing labels, laws, and regulations, the authors can assume no liability for the recommendations. Any use of a pesticide contrary to label instructions is neither legal nor recommended.

Weed control is especially critical when establishing new seedings. Weedy annual broadleaf and grass species develop rapidly causing extensive water and nutrient competition with slower maturing perennial grasses, legumes, and forbs. As perennial forage plants fully establish, the opposite occurs, with annual weed populations unable to compete against the well devel-

TABLE 2. TYPICAL CROP ROOTING DEPTHS CAPACITIES.

CROP	ROOTING DEPTH (FT)
ALFALFA	5
CORN	4
SMALL GRAINS	3-4
POTATOES	2-3
GRASS PASTURE	1.5-3
VEGETABLES	1.5-2
TURF	0.5-1.5

TABLE 3. TYPICAL AVAILABLE WATER HOLDING OF VARIOUS SOILS.

SOIL TYPE	WATER HOLDING CAPACITY
	(INCHES/FOOT)
COARSE SAND	0.50
FINE SAND	0.75
LOAMY SAND	1.00
FINE LOAMY SAND	1.25-2.00
SILT LOAM	1.75-2.00
SILTY CLAY LOAM	2.00
CLAY LOAM	2.00
HEAVY CLAY	1.75-2.00

Herbicides Approved for Use in New (Seedling) Grass Pastures

SITE PREPARATION / PRE-PLANT

Gramoxone Extra (paraquat)	For control of annual grasses and annual broadleaf weeds prior to or on the day of planting. (1.5 to 2.5 pt product/acre.)
Roundup Ultra (glyphosate)	For control of annual and perennial weeds before planting or renovation. Wait 7-12 days before cultivation, disking or plowing. (12 oz to 5 qt product/acre: rate depends on weed type, pasture variety, and label.)

POSTEMERGENCE

Ally/Escort (metsulfuron)	For control of many annual broadleaf weeds and suppression of some perennial broadleaf weeds. Not for use on ryegrass. Post or pre-emergence applications. May cause stunting of fescue. (0.1 to 0.4 oz product/acre, depending on variety and label.)
Amber (triasulfuron)	For control of many annual broadleaf weeds and suppression of some perennial broadleaf weeds in smooth brome, timothy, certain wheatgrasses, and other perennial grasses. Do not apply until at least 60 days after emergence of desirable seedling grasses. (0.28 to 0.56 oz product/acre depending on variety and label.)
Clarity (dicamba)	For control of most annual broadleaf weeds and suppression of many perennial broadleaf weeds, woody brush, and vines. (0.25 to 1.5 pt product/acre.)
Curtail (clopyralid+2,4-D)	For control of most annual broadleaf weeds and suppression of many perennial broadleaf weeds, including Canada thistle and Russian knapweed. Do not use on newly seeded areas until grass is well established. (2 to 4 qt of 4 EC product/acre.)
Garlon/Remedy (triclopyr)	For control of most annual broadleaf weeds and suppression of many perennial broadleaf weeds and woody species. (1 to 2 qt of 3L product/acre, or 0.75 to 1.5 qt of 4EC product/acre.)
Grazon P+D (picloram + 2,4-D)	For control of most annual broadleaf weeds and many perennial broadleaf weeds. (2 to 4 pt product/acre.)
MCPA (various brands)	For control of many annual broadleaf weeds including Canada thistle, Russian knapweed, and spotted knapweed. (1 to 2 qt of 4L or 4EC product per acre.)
Transline (clopyralid)	For control of many annual broadleaf weeds and many perennial broadleaf weeds, including Canada thistle, Russian knapweed, and spotted knapweed. (0.5 to 1 qt product/acre.)
Tordon 22K (picloram)	For control of most annual broadleaf weeds and many perennial broadleaf weeds, including Canada thistle, Russian knapweed, and spotted knapweed. (0.5 to 1 qt product/acre.)
2,4-D (various brands)	For control of many annual broadleaf weeds and control or suppression of certain perennial broadleaf weeds and sagebrush. (1.5 to 2.9 qt of 4L or 4EC product/acre, or 0.75 to 3.8 pt of 6EC product/acre.)

oped perennial plants. Herbicide application for broadleaf weed control in grasses is a common practice during the early establishment phase of irrigated pastures. However, when grass seedlings are young (less than the 5 leaf stage) caution should be exercised in the amount of herbicides, such as 2,4-D and dicamba, that are applied for broadleaf weed control. Applicators should be aware that small grass seedlings (less than 5 leaf stage), especially those under stress from drought or cold temperatures, can experience high mortality with application of some herbicides.

Options for herbicide control of broadleaf weeds in legume or legume-grass mixes are limited, since most chemicals designed to eradicate broadleaf weeds also kill the desired legumes. If legumes are seeded alone or in a mix the field should be relatively weed free before planting. Clipping or mowing often opens the plant canopy and allows the slower growing perennials to receive the additional light and nutrients necessary for early establishment. Annual weeds are generally killed or their growth is severely inhibited when mowed at the early seedhead stage. However, if mowing occurs prior to this stage while the growing point is below the clipping height, they can tiller out, causing increased competition. Grasses normally respond to a clipping height of 4 to 6 inches by increased tillering and more rapid plant development.

GRAZING SYSTEMS

Plant maturity is the most important factor affecting animal utilization of pastures. During spring and early summer plants are very nutritious, palatable and exhibit excellent digestibility and uniformity of growth. Plants adapted to the Intermountain Region or cool-season plants grow rapidly during cooler seasonal periods; but significantly reduce production and quality as higher summer temperatures slow the growth process. As plants become more mature, animals will selectively graze, with some areas being overgrazed and others experiencing little use. Managed grazing can decrease or eliminate uneven vegetation growth.

The number of animals grazing a pasture requires close attention. Obtaining optimum forage yield requires a target grazing intensity that promotes vigorous plant regrowth. Plants have specific points where initial growth is generated. They are located at different heights according to species. If plants are grazed too low, growing points (meristems) are removed and regrowth inhibited. However, if grass plants are allowed to joint (mature beyond the vegetative stage) then new growth must initiate from the plant base and regrowth is decreased. To maximize production, grazing should occur at a level which will protect the lower growing points while assuring that sufficient forage is removed to keep the plant from bolting and maturing. Since most pastures include plant mixtures, it is common to graze no lower than 4 to 6 inches while not allowing regrowth to exceed 10-12 inches. (See Table 4.)

It is important to leave some vegetation carryover at the end of the grazing season to provide food reserves for plant survival during winter dormancy. If plants are overused and weakened, their growth will be reduced during the following spring. A rule of thumb is to leave 3 to 4 inches of growth in the fall.

Maintaining the proper number of animals on a pasture requires close monitoring since plant growth varies substantially during the growing period. Figure 2 illustrates the fluctuating rate of plant growth throughout the season. To accommodate seasonal changes in growth rate, options should be available to increase or decrease animal numbers to correspond with forage availability or to mechanically harvest excess forage during rapid growth phases and provide additional feed during slower growth periods.

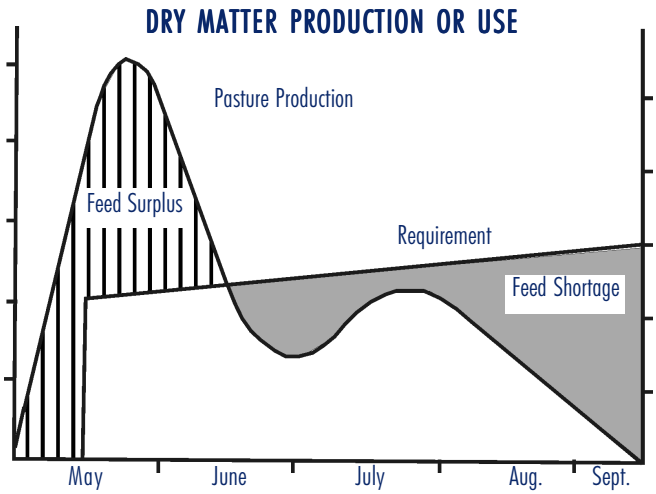


Figure 2. Forage availability throughout the grazing season.

Continuous Grazing

Continuous grazing systems require the least amount of management. It has lower costs, fewer management decisions, less fencing and fewer watering stations than other grazing systems. However, it results in a deterioration of specific plants and a reduction in amount of forage. Livestock are turned into a common area where they are maintained through the growing season. It is difficult to control the stage of plant growth (which promotes uneven utilization) as animals routinely reuse areas previously grazed. Regrowth is more palatable resulting in diminished forage production, weakened plants, and potential weed invasion.

Continuous grazing favors the least palatable species in a mix, because animals constantly apply use to the preferred species and reduce their persistence and longevity. Areas that are not consistently grazed host mature vegetation that becomes less appealing and coarse textured. Occasional clipping of the underused areas or species encourages a more uniform acceptability by livestock. Stocking rates should be low enough to insure sufficient carryover of forage to protect desirable plants during the winter. This system is the least desirable.

Rotational Grazing

A rotational grazing system divides the pasture into separate paddocks which are grazed equally and in turn. This system requires closer management than continuous grazing, as larger numbers of animals are concentrated in smaller areas. Movements to adjacent paddocks occur at specified intervals that vary depending upon plant growth and vigor during the grazing season. Rotational grazing allows early grazing to take place in a different paddock at the beginning of each year when pastures are susceptible to soil compaction and species are most sensitive to overuse.

The rotational use of forage is more efficient than continuous grazing and promotes uniform regrowth, thus the entire pasture remains more palatable. Rotational grazing may not increase seasonal productivity, but total digestible nutrients can be significantly higher than in paddocks grazed continuously. Forage is rapidly removed at the optimum stage of development, after which it is allowed a rest period to permit active growth for 2 to 4 weeks before it is grazed again. Flexibility allows the operator to adjust the number of grazing animals or length of grazing period according to

TABLE 4. GROWTH STAGE FOR HARVESTING FORAGE.

Plant Species	Minimum leaf length reached prior to initiating grazing (in)	Minimum stubble height to remain following grazing or hay harvest (in)[1/]
Kentucky bluegrass	6	3
Smooth bromegrass	8	4
Meadow bromegrass	8	4
Reed canarygrass	10	6
Tall fescue	8	4
Orchardgrass	8	4
Timothy	8	4
Creeping foxtail	10	4
Tall wheatgrass	10	8
Intermediate wheatgrass	8	4
Siberian wheatgrass	6	3
Crested wheatgrass	6	3
Russian wildrye	8	4
Alfalfa	14	3
White clover	8	3
Red clover	6	3
Alsike clover	6	3
Sweet clover	8	4
Trefoil	8	3
Sainfoin	12	6
Milkvetch	8	4
White dutch clover	4	2

[1/] This is the minimum stubble height which should remain after the grazing period or hay operation. When a grass-legume mixture is harvested for hay, generally use the most limiting stubble height for the mixture.

Note: This table was taken from the "Pasture and Hayland Management" Specification. USDA-SCS-Idaho. September 1986.

production and plant needs. A hay or silage crop can be removed from a given paddock during peak growth periods if forage production begins to exceed grazing use. After crop removal the paddock is placed in the normal grazing rotation when it again reaches the appropriate growth stage.

For at least a week after grazing, even during favorable growing conditions, plants grow slowly due to the reduction in leaf surface and root growth. As the size and number of leaves increase, net photosynthesis increases, resulting in an increase of forage production. Without a proper rest period, plant reserves are reduced followed by a decrease in total production. Moderate applications of nitrogen fertilizer during the regrowth period will significantly increase forage production. Nitrogen fixing legumes such as alfalfa or clover provide needed nitrogen to companion grasses, increasing their yield and quality.

Intensive Grazing (Strip Grazing)

Intense grazing systems require close management and advanced planning. The manager must have a knowledge of forages and be able to assess plant-animal responses and implement grazing schedules. Pastures are strip grazed by moving electric fences forward to an ungrazed segment every one to several days with a second fence placed to prevent livestock from returning to the previously grazed pasture. This system is gaining popularity among dairy operations and beef producers in the Intermountain Region, especially those who are faced with allotment reductions on public lands, and are trying to increase animal numbers on private pastures.

Intensive grazing requires large numbers of animals be given access to small segments of pasture, thus maximizing forage utilization and eliminating selective pressure on any particular species in a mixed pasture. The system optimizes the period of regrowth assuring that future grazing of the paddock will produce forage of high nutritive value. The factor controlling animal intake is forage availability. Strip grazing can be used to limit intake where limited feed supply requires conservation or maximizing daily energy intake for animals requiring high energy needs.

A major advantage of this system is the option of separating producing animals from non-producers or young growing animals from mature animals. This is usually accomplished by a leader follower or first-last grazer system where young and producing animals are allowed to graze in the paddock and selectively graze for the most nutritious feed immediately in front of the maintenance herd. The non-producers serve as the clean-up herd.

ESTABLISHING AND MANAGING A RANGELAND AND DRY PASTURELAND SEEDING

TIME OF SEEDING

Seeding to correspond with favorable moisture conditions is the most important factor in establishing a good rangeland planting. Generally arid rangeland and dryland pasture seedings should be planted in late fall. Fall plantings should be made late enough to delay germination (dormant seedings) until the following spring when young seedlings can take advantage of cooler temperatures and moisture from winter snowfall. Most grass, forb, legume, and shrub seeds will survive the winter.

Early fall seedings can be risky if germination does not occur soon enough to allow moderate root development prior to winter when immature seedlings exposed to freezing temperatures can experience severe winter mortality, particularly in areas of limited snow cover. Early fall seedings are not generally recommended on rangelands or dryland pasture.

SEEDBED PREPARATION

If seedbeds have been disked or plowed for competition, weed, or brush control, it is very important to mechanically firm the soil, or fallow for a sufficient period to allow the soil to settle, additional weed control, and moisture to begin recharging in the soil profile. Where possible, prepare seedbeds with as little soil disturbance as possible to retain soil moisture and organic matter. This can be accomplished with combinations of chemical fallow, and/or minimum till or no-till drill seeding. Undisturbed soil with reduced competition in sensitive ecosystems creates an excellent environment for germination and establishment of seedlings.

In drier ecosystems, loose, dry-soil surfaces permit rapid evaporation. This condition often is the difference between good and poor stands. Care should be taken when disturbing soils that are light (sandy) or unstable to protect them from wind and water erosion.

SEEDING DEPTH

Irregular range landscapes and rough surface conditions are difficult to navigate and can affect seeding depth accuracy. Depth of seeding varies with seed size, species, and soil type. On coarse (sands) textured soils seeds should be planted deeper than on lighter textured (clay-silt) soils. Generally grass seeds should be planted no deeper than 1/4 to 1/2 inch. Most small legumes and forbs establish effectively when planted only 1/8 to 1/4 inch deep. There are a few forbs and some shrubs such as winterfat, sagebrush, and forage kochia that do best when broadcast on unprepared surfaces. Since resources that promote seedling development (i.e., water and nutrients) are generally lacking on dryland sites as compared to irrigated pastures, it is very critical to pay close attention to accurate seed placement on rangeland sites.

EQUIPMENT

Range plantings are among the most difficult to accomplish successfully. Variable landscapes and rough topography combine with shallow and rocky soils require the use of specialized equipment capable of withstanding rugged conditions. Due to difficult seeding circumstances, special attention must be given to seed placement and monitoring. Grasses and legumes vary a great deal in seed size, shape, and weight. These variations necessitate planting equipment capable of accurate seed monitoring and placement while navigating difficult surfaces.

Imprint planters, traditional rangeland drills and variations of chaining and railing implements are commonly used to seed rangelands where rugged conditions limit the use of conventional drills. However, modern drills equipped with precision seed placement and good seed monitoring devices are available and perform well on moderately difficult landscapes. Surface broadcast seeding followed by indenting roller harrows that press seed into the soil surface have proven favorable when litter and obstructions allow their use.

CHOICE OF PLANT MATERIALS

Since rangeland communities are so diverse in nature, the choice of species depends on numerous factors such as elevation, length of growing season, soil types, erosion potential, topographical exposure, temperatures, associated species, expected precipitation, fire resistance, the expected purpose of the seeding and availability of seed. Seeded species and varieties must be adapted to the site. **After choosing species options from the planting guide seeding recommendation tables, turn to the species description section** to determine the best varieties to tailor the seeding to a specific site. Since no one species meets all of the varied conditions of a site, mixes enhance seeding success, provide increased resistance to insects and parasites, extend the grazing period, provide wildlife habitat diversity, and generally increase production and soil protection. Species mixtures also provide insurance against a variety of environmental hazards, enhance forage production, and forage quality for wildlife and livestock.

This planting guide is designed to responsibly emphasize materials that are the most reliable to establish and stabilize ecosystems. It is recognized that plant populations can be altered over time, but soils once lost may not be replaced. Even more important than the quality of the plant material is assurance of soil protection.

FERTILIZATION

Application of fertilizer on arid rangelands is not recommended. It is usually beneficial only during abnormally wet years, and applications on dry years can reduce forage yields and seriously reduce plant vigor. Please see the irrigated pasture section of this guide for additional information on fertilization.

WEED CONTROL

Successful seeding on rangelands is directly related to competition and weed control. Many native range plant species are especially poor competitors against weedy varieties particularly in the initial phases of establishment. Little label information is available on the tolerance of many native range plants to herbicides applied in the seedling stage. There are herbicides registered for use on rangelands and you should consult your local NRCS offices before selecting a herbicide. Don't overlook opportunities to reduce competition through cultural or biological procedures, such as disking, plowing, railing, mowing, grazing, and fire.

Reseeding for mine spoil reclamation, erosion control, watershed protection, greenstripping, military training, road right of ways, and control of heavy shrubbery can make herbicide application cost effective. Time of application is critical on sensitive rangelands where precipitation and length of active plant growth can occur during a narrow window of opportunity.

Refer to the irrigated pasture section of this guide (page 9) to find additional information on herbicides that can effectively be used on rangelands for weed management. Visit your Extension county agent or NRCS office for recommendations for brush management.

GRAZING SYSTEMS

Most plant materials on dryland and range plantings require 1 to 2 years of deferred grazing to ensure adequate plant establishment. Please refer to irrigated section (page 10) for additional information on grazing systems.

ESTABLISHING AND MANAGING A SOIL STABILIZATION SEEDING

Soil is a renewable resource that is constantly produced by the effect of physical/chemical weathering of rock and biological activities. This process produces new soil very slowly. It is estimated that 1 inch of new top soil is created every 1000 years, especially on areas with reduced vegetation and limited moisture. It is very important that every consideration involved with plant material, management and seeding method first consider the impact they impose on soil health and conservation. Any decision by land owners or managers that might degrade or sacrifice stable soils to promote economic, political, or environmental agendas should be considered an unsound practice often with irreversible consequences.

High rates of erosion promote the destruction of wildland, wildlife and livestock habitat, aesthetic values, and causes economic hardships for those who manage, earn a living from and depend on land resources. Two major forces that drive soil erosion are wind and water. Soil erosion is mainly a result of rainfall events, snowmelt, and wind blowing over exposed dry terrain. Reduced soil erosion is best accomplished by maintaining the soil's productive capacity and by managing the site within limits that eliminate degradation. Sand particles are easily detached but resist transport, while clay is harder to detach, but is easily moved once dislocated. Silt is easy to detach and transport making it the most serious threat for potential erosion.

Natural factors that tend to increase water erosion are: percent slope, aspect (direction the slope faces, north, south, east or west) and the length of slope. The steeper and longer the slope, the higher the potential for water erosion. The aspect indicates how much solar radiation potential is available for plant growth. In the Northern Hemisphere south and west aspects are normally hotter, drier and less productive, with east and north slopes being cooler, wetter and capable of producing more vegetation. With wind erosion, long, flat, dry soil surfaces have the highest potential for erosion. The best management tool to protect soils from the effects of moving/falling water and blowing wind, is to establish plant material that is healthy and has enough vegetation to reduce wind velocity, intercept rainfall and slow running water on land surfaces. Plants with spreading or rhizomatous root systems are best suited for holding the soil, while bunch type plants are less effective.

Factors effecting soil erosion include: wild fires, controlled burns, domestic and wildlife grazing activities, duration and time of use, and all aspects connected with forage seeding and production. It is critical to assure that adequate vegetation is available during high erosion periods. In the Intermountain Region this includes the summer thunderstorm period when heavy rainfall often occurs in a short amount of time, early spring when dry, fast moving winds blow from the south in advance of cold fronts, and when snowmelt occurs.

Problems also occur during seed bed preparation and prior to seeding. Usually the ground is worked with tillage implements that reduce vegetation cover leaving soil with little protection from wind and water erosion. The time between seeding and stand establishment (usually 12 to 24 months for perennial plants) is crucial, due to a lack of vegetation that would prohibit soil erosion. No-till or minimum-till plantings are an excellent option to reduce soil erosion, and retain soil humus and moisture in the plant establishment zone. This method is accomplished by seeding directly into dead vegetation with no, or little, seed bed preparation. Chemical fallow is generally required for competition control prior to a no-till planting. Depending on soil types and existing root structures it may require several months after chemical application for treated roots to deteriorate sufficiently to allow the no-till drill planter furrow opening to close around the seed. Without irrigation the seed remains exposed and fails to germinate. Dryland pasture and range species do not require deep seeding, usually only 1/4 to 1/2 inch deep.

Drilling should be done across the slope or on the contour to help prevent water erosion. Planting perpendicular to prevailing winds helps reduce wind velocity. Seedings can be accomplished with most agricultural drills provided they can accurately place the seed, firm the soil over the seed, and provide sufficient agitation to assure small, light, and irregular shaped seeds are consistently planted. Obvious problems arise with rocky, shrubby or severely irregular landscapes. In these situations arial broadcasting followed by some type of packing or chaining may be required, but usually results in a significant reduction in seedling establishment compared to drilling and requires a higher seeding rate.

Other soil management problems occur when animals are allowed to overgraze or misuse a rangeland. Grazing at critical times can be detrimental to the vegetation, and may create situations where soil movement and deposition are accelerated. With careful vegetation management soil erosion can be held at levels that allow sustainable use of range and pasture land for future generations.

SEEDING ALTERNATIVES FOR PASTURES OF THE INTERMOUNTAIN REGION

IRRIGATED PASTURE PLANTINGS

TABLE I-1. ADEQUATE IRRIGATION WATER (LBS.PLS/ACRE)

	No Soil Limitations			Heavy Clay	Sandy Soils	
	Seed-Mix Options		[1]Single	[1]Single		[1]Single
Species	A	B	Species	Species	Seed-Mix	Species
Grasses						
Perennial ryegrass (I)[2]			14			
Smooth brome (I)		9		15	9	15
Orchardgrass (I)	5	5			5	
Tall fescue (I)			14	14		14
Meadow brome (I)	9					
Choose One						
Legume						
White clover (I)	1	1	1	1		
Red clover (I)	1	1	1			
Alfalfa (I)	1	1	1	1	1	1
Cicer milkvetch (I)	1	1	1	1	1	1

Other Adapted Species:

Forbs: birdsfoot trefoil (I) and sainfoin (I).

[1] Choose only one species of grass. Seeding rate for a single grass species planted with a legume.

[2] (I)=Introduced

NOTE: After choosing species from the above table, refer to Appendix A for additional information on species and varieties for help in determining the seed mix for a specific site.

TABLE I-2. ADEQUATE IRRIGATION SALINE SOILS (LBS.PLS/ACRE)

Species	Light Salinity [1]Single Species	Moderate Salinity [1]Single Species	Severe Salinity [1]Single Species
Grasses			
Tall wheatgrass (I)[2]		15	15
Tall fescue (I)	14	15	
NewHy hybrid (I)	18	18	
Choose One			
Legume			
Alsike clover (I)	1	1	
Strawberry clover (I)			1
Birdsfoot trefoil (I)	1		

Other Adapted Species:

Grasses : Use the following species under moderate to severe salinity conditions: alkali sacaton (I) and beardless wildrye (N).

[1] Choose only one species of grass. Seeding rate for a single grass species planted with a legume.

[2] (N)=Native and (I)=Introduced

NOTE: After choosing species from the above table, refer to Appendix A for additional information on species and varieties for help in determining the seed mix for a specific site.

IRRIGATED PASTURE PLANTINGS

TABLE I-3. INADEQUATE IRRIGATION (SPRING AND EARLY SUMMER IRRIGATION) (LBS.PLS/ACRE)

	No Soil Limitation					Clay Soils			Sandy/Gravel
	Seed-Mix Options				[1]Single	Seed-Mix Options		[1]Single	[1]Single
Species	A	B	C	D	Species	A	B	Species	Species
Grasses									
Intermediate wheatgrass (I)[2]	7	8	7		14	7	7	14	14
Tall wheatgrass (I)								14	
Tall fescue (I)					14			14	
Smooth brome (I)	7				14	7		14	
Dryland orchardgrass (I)		6		6					
NewHy hybrid (I)			9	9	18		9		
Choose One									
Legume									
Alfalfa (I)	1	1	1	1	1	1	1	1	1
Sainfoin(I)	1	1	1	1	1				

Other Adapted Species:

Grasses: Altai wildrye (I) and basin wildrye (N).

[1] Choose only one species of grass. Represents seeding rate for a single grass species planted with a legume.

[2] (N)=Native and (I)=Introduced

NOTE: After choosing species from the above table, refer to Appendix A for additional information on species and varieties for help in determining the seed mix for a specific site.

TABLE I-4. INADEQUATE IRRIGATION SALINE SOILS (LBS.PLS/ACRE)

Species	Light Salinity		Moderate Salinity	Severe Salinity
	Seed-Mix	[1]Single Species	[1]Single Species	[1]Single Species
Grasses				
Tall wheatgrass (I)[2]			14	14
Tall fescue (I)		14	14	
NewHy hybrid (I)	9	18	18	
Intermediate wheatgrass (I)	7	14		
Choose One				
Legume				
Alsike clover (I)	1	1	1	
Strawberry clover (I)				1
Birdsfoot trefoil (I)	1	1		

Other Adapted Species:

Grasses : Use the following other species under moderate salinity and drought conditions:
alkali sacaton (I), Altai wildrye (I), and basin wildrye (N).
Note: Use beardless wildrye (N) under severe salinity.

[1] Choose only one species of grass. Seeding rate for a single grass species planted with a legume.

[2] (N)=Native and (I)=Introduced

NOTE: After choosing species from the above table, refer to Appendix A for additional information on species and varieties for help in determining the seed mix for a specific site.

IRRIGATED PASTURE PLANTINGS

TABLE I-5. WATER TABLE (LBS.PLS/ACRE)

Species	Water table more than 20" below soil surface [1]Single Species	Water table less than 20" below soil surface [1]Single Species	Standing water for extended period [1]Single Species
Grasses			
Tall fescue (I) [2]	14	14	
Tall wheatgrass (I)	14		
Creeping foxtail (I)		10	10
Reed canarygrass (I)		10	10
NewHy hybrid (I)	18		
Timothy		10	10
Choose One Legume			
Alsike clover (I)	1	1	
Birdsfoot trefoil (I)	1	1	

Other Adapted Species:

Grasses :

Note: Use the folowing species when water tables are more than 20 inches below the surface: western wheatgrass (N) and Altai wildrye (I).

Legumes: Strawberry clover (I).

[1] Choose only one species of grass. Seeding rate for a single grass species planted with a legume.

[2] (N)=Native and (I)=Introduced

NOTE: After choosing species from the above table, refer to Appendix A for additional information on species and varieties for help in determining the seed mix for a specific site.

SEEDING ALTERNATIVES FOR RANGELANDS OF THE INTERMOUNTAIN REGION

RANGELAND PLANTINGS

HIGH MOUNTAIN ECOSYSTEM

TABLE R-1. SUBALPINE (35" + ANN. PRECIP.) (LBS.PLS/ACRE)

Species	No Soil Limitation			
	Seed-Mix Options			
	A	B	C	D
Grasses				
Mountain brome (N) [1]	5		6	
Smooth brome (I)				8
Big bluegrass (N)		2	2	2
Meadow brome (I)		8	2	
Slender wheatgrass (N)	5			
Legume				
White clover (I)		1	1	1

Other Adapted Species:

Grasses: blue wildrye (N) and Garrison meadow foxtail (I).

Forbs and Legumes: mountain lupine (N), sweetanise (N), Wasatch and Rocky Mountain penstemon (N), cow parsnip (N), and porter ligusticum (N).

[1] (N)=Native and (I)=Introduced

NOTE: After choosing species from the above table, refer to Appendix A for additional information on species and varieties that will help in determining a seed mix for a specific site.

NOTE: Where possible, attempts have been made to include at least one seeding option where all recommended plant materials are native. Users should be aware that native plants can be more difficult to establish and often require additional care in seeding to achieve adequate stands.

RANGELAND PLANTINGS

HIGH MOUNTAIN ECOSYSTEM

TABLE R-2. MIXED CONIFER (30" + ANN. PRECIP.) (LBS.PLS/ACRE)

Species	No Soil Limitation				
	Seed-Mix Options				
	A	B	C	D	E
Grasses					
Orchardgrass (I) [1]			2	2	2
Meadow brome (I)				4	
Big bluegrass (N)	2	2	2	2	2
Mountain brome (N)	5	5			4
Smooth brome (I)			4		
Slender wheatgrass (N)	4	4	2	2	2
Legume					
White clover (I)		1	1	1	1

Other Adapted Species:

Grasses: creeping foxtail (I) and blue wildrye (N).

Forbs and Legumes: sweetanise (N), and Rocky Mountain penstemon (N),

Shrubs: Mountain sagebrush (N), Woods rose (N), red elderberry (N), snowberry (N), and golden currant (N).

[1] (N)=Native and (I)=Introduced

NOTE: After choosing species from the above table, refer to Appendix A for additional information on speciesand varieties that will help in determining a seed mix for a specific site.

NOTE: Where possible, attempts have been made to include at least one seeding option where all recommended plant materials are native. Users should be aware that native plants can be more difficult to establish and often require additional care in seeding to achieve adequate stands.

RANGELAND PLANTINGS

HIGH MOUNTAIN ECOSYSTEM

TABLE R-3. ASPEN, CONIFER AND MAPLE (25"-30" ANN. PRECIP.) (LBS.PLS/ACRE)

	Moderate to Deep Soils				Shallow or Sandy Soils
	Seed-Mix Options				Mix
Species	A	B	C	D	A
Grasses					
Meadow brome (I) [1]				4	
Mountain brome (N)	5		4		
Smooth brome (I)		4			5
Orchardgrass (I)		2	2	2	
Big bluegrass (N)	2	2	2	2	2
Slender wheatgrass (N)	4	2	2	2	3
Legume					
White clover (I)		1	1	1	
Alfalfa (I)		1	1	1	1

Other Adapted Species:

Grasses: blue wildrye (N) and creeping foxtail (I).

Forbs and Legumes: showy golden eye (N), sweetanise (N), crownvetch (I), Rocky Mountain penstemon (N) cicer milkvetch (I), and sainfoin (I).

Shrubs: mountain big sagebrush (N), red and blue elderberry (N), snowberry (N), maple (N), and Wood's rose (N).

[1] (N)=Native and (I)=Introduced

NOTE: After choosing species from the above table, refer to Appendix A for additional information on species and varieties that will help in determining a seed mix for a specific site.

NOTE: Where possible, attempts have been made to include at least one seeding option where all recommended plant materials are native. Users should be aware that native plants can be more difficult to establish and often require additional care in seeding to achieve adequate stands.

RANGELAND PLANTINGS

HIGH MOUNTAIN ECOSYSTEM

TABLE R-4. MOUNTAIN BIG SAGEBRUSH-GRASS (18" - 25" ANN. PRECIP.) (LBS.PLS/ACRE)

Species	Moderate to Deep Loamy Soils			Clay Soils	
	Seed-Mix Options			Seed-Mix Options	
	A	B	C	A	B
Grasses					
Bluebunch wheatgrass (N) [1]	2				
Orchardgrass (I)			3		
Big bluegrass (N)	2	3			
Slender wheatgrass (N)	2	2	2		
Smooth brome (I)		5		6	
Intermediate wheatgrass (I)				4	6
Mountain brome (N)	5		5		4
Choose One					
Legume or Forb					
Small burnet (I)	1	1	1		
Alfalfa (I)		1	1	1	1

Other Adapted Species:

Grasses: basin wildrye (N), meadow brome (I), western wheatgrass (N), Idaho fescue (N), green needlegrass(N), Snake River wheatgrass (N), thickspike wheatgrass (N), and hard fescue (I). Note: Snake River wheatgrass can be used as an alternate for bluebunch wheatgrass.

Forbs and Legumes: Rocky Mountain & Wasatch penstemon (N), blueleaf aster (N), Utah sweetvetch (N), sainfoin (I), showy golden eye (N), blue flax (N), arrowleaf balsamroot (N), and cicer milkvetch (I).

Shrubs: blue elderberry (N), chokecherry (N), bitterbrush (N), serviceberry (N), mountain big sagebrush (N), woods rose (N), cliffrose (N), green ephedra, (N), true mountain mohogany (N), and curleaf mountain mohogany.

[1] (N)=Native and (I)=Introduced

NOTE: After choosing species from the above table, refer to Appendix A for additional information on species and varieties that will help in determining a seed mix for a specific site.

NOTE: Where possible, attempts have been made to include at least one seeding option where all recommended plant materials are native. Users should be aware that native plants can be more difficult to establish and often require additional care in seeding to achieve adequate stands.

RANGELAND PLANTINGS

UPLAND ECOSYSTEM

TABLE R-5. BIG SAGEBRUSH & PINYON JUNIPER-GRASS (14"-18" ANN. PRECIP.) (LBS.PLS/ACRE)

	No Soil Limitation				Clay Soils	Light/Shallow Soils	
	Seed-Mix Options				Seed-Mix	Seed-Mix Options	
Species	A	B	C	D		A	B
Grasses							
Bluebunch wheatgrass (N)[1]	5	5	3			4	
Thickspike wheatgrass (N)	5	5	3			4	
Intermediate wheatgrass (I)			4	4	4		
Western wheatgrass (N)	1	1			2		
Russian wildrye (I)				3	4		5
Indian ricegrass (N)	1					2	
Crested wheatgrass (I)				3			5
Choose One							
Legume or Forb							
Small burnet (I)	1	1	1	1			
Blue flax (N)	1	1	1	1	1	1	1
Alfalfa (I)		1	1	1	1		1
Sainfoin (I)		2	2	2	2		2

Other Adapted Species:

Grasses: basin wildrye (N), green needlegrass (N), tall wheatgrass (I), sheep fescue (I), mountain brome (N), and slender wheatgrass (N).

Forbs and Legumes: Rocky Mountain and Palmer penstemon (N), Utah sweetvetch (N), and cicer milkvetch (I).

Shrubs: mountain big sagebrush (N), bitterbrush (N), cliffrose (N), green ephedra (N), four-wing saltbush (N), winterfat (N), forage kochia (I), and black sagebrush (N).

[1] (N)=Native and (I)=Introduced

NOTE: After choosing species from the above table, refer to Appendix A for additional information on species and varieties that will help in determining a seed mix for a specific site.

NOTE: Where possible, attempts have been made to include at least one seeding option where all recommended plant materials are native. Users should be aware that native plants can be more difficult to establish and often require additional care in seeding to achieve adequate stands.

RANGELAND PLANTINGS

UPLAND ECOSYSTEM

TABLE R-6. BIG SAGEBRUSH-GRASS (12"-16" ANN. PRECIP.) (LBS.PLS/ACRE)

	Moderate to Deep Soils			Clay Soils		Shallow/ Sandy Soils		
	Seed-Mix Options			Seed-Mix Options		Seed-Mix Options		
Species	A	B	C	A	B	A	B	C
Grasses								
Crested wheatgrass (I)[1]		3			3			5
Siberian wheatgrass (I)							5	
Intermediate wheatgrass (I)		4	4	3	4		5	
Russian wildrye (I)		3		4	3			5
Western wheatgrass (N)				3				
Bluebunch wheatgrass (N	4		3			4		
Thickspike wheatgrass (N)	4		4			4		
Indian ricegrass (N)	2					2		
Choose One								
Legume or Forb								
Blue flax (N)	1	1	1	1	1	1	1	1
Alfalfa (I)		1	1	1	1		1	1
Sainfoin (I)		2	2	2	2		2	2

Other Adapted Species:

Grasses: needle and threadgrass (N), bottlebrush squirreltail (N), and Snake River wheatgrass
NOTE:'Secar' (N) as an alternative to bluebunch wheatgrass.

Forbs and Legumes: Palmer penstemon (N), and globemallow (N).

Shrubs: fourwing saltbush (N), winterfat (N), bitterbrush (N), Wyoming big sagebrush (N), cliffrose (N), and black sagebrush (N).

[1] (N)=Native and (I)=Introduced

NOTE: After choosing species from the above table, refer to Appendix A for additional information on species and varieties that will help in determining a seed mix for a specific site.

NOTE: Where possible, attempts have been made to include at least one seeding option where all recommended plant materials are native. Users should be aware that native plants can be more difficult to establish and often require additional care in seeding to achieve adequate stands.

RANGELAND PLANTINGS

SEMI-DESERT ECOSYSTEM

TABLE R-7. WYOMING BIG SAGEBRUSH (8"-12" ANN. PRECIP.) (LBS.PLS/ACRE)

	Moderate to Deep Soils			Clay Soils		Shallow, Sandy Soils		
	Seed-Mix Options			Seed-Mix Options		Seed-Mix Options		Single
Species	A	B	C	A	B	A	B	Species
Grasses								
Crested wheatgrass (I) [2]		3	6	4	5			
Siberian wheatgrass (I)							6	10
Russian wildrye (I)		3	4	3	5			
Thickspike wheatgrass (N)	3	2		3		7	4	
Snake River wheatgrass(N)	3	2						
Bottlebrush squirreltail (N)	1							
Indian ricegrass (N)	2					3		
Shrub or Forb								
Blue flax (N)	1	1	1	1	1	1	1	
Forage kochia (I)[1]		0.5-1	0.5-1	0.5-1	0.5-1		0.5-1	0.5-1

Other Adapted Species:

Grasses: galleta grass (N), Snake River wheatgrass (N) 'Secar' as an alternative to bluebunch wheatgrass (N), needle and threadgrass (N), and Salina wildrye (N).

Forbs and Legumes: Palmer penstemon (N), globemallow (N), alfalfa (I) (at higher percipitation).

Shrubs: fourwing saltbush (N), winterfat (N), Wyoming big sagebrush (N), and shadscale (N).

[1] Forage kochia has been successfully seeded in areas receiving 6" of precipitation.

[2] (N)=Native and (I)=Introduced

NOTE: After choosing species from the above table, refer to Appendix A for additional information on species and varieties that will help in determining a seed mix for a specific site.

NOTE: Where possible attempts have been made to include at least one seeding option where all recommended plant materials are native. Users should be aware that native plants can be more difficult to establish and often require additional care in seeding to achieve adequate stands.

RANGELAND PLANTINGS

SEMI-DESERT ECOSYSTEM

TABLE R-8. BLACK GREASEWOOD AND SALTBUSH (8"-12" ANN. PRECIP.) (LBS.PLS/ACRE)

Species	Shallow Water Table		Deep Water Table
	Seed-Mix	Single Species	Seed-Mix
Grasses			
Tall wheatgrass (I) [2]	6	10	3
Crested wheatgrass (I)			3
Russian wildrye (I)			3
Western wheatgrass (N)	4	10	3
Choose One			
Shrub			
Shadscale (N)			2
Forage kochia (I) [1]			1
Winterfat (N)			2

Other Adapted Species:

Grasses: alkali sacaton (N).

Note: Use beardless wildrye (N), only in areas with shallow water tables and saline soils.

Shrubs: Fourwing saltbush (N).

[1] Forage kochia has been successfully seeded in areas receiving 6" of precipitation.

[2] (N)=Native and (I)=Introduced

NOTE: After choosing species from the above table, refer to Appendix A for additional information on species and varieties that will help in determining a seed mix for a specific site.

RANGELAND PLANTINGS

SEMI-DESERT ECOSYSTEM

TABLE R-9. SHADSCALE, SALTBUSH/WINTERFAT (8"-10" ANN. PRECIP.) (LBS.PLS/ACRE)

	Clay Soils Seed-Mix Options		Sandy or Well Drained Soils
Species	A	B	Seed-Mix
Grasses			
Siberian wheatgrass (I) [2]			5
Crested wheatgrass (I)		5	
Russian wildrye (I)		5	
Needle and threadgrass	2		
Indian ricegrass (N)	4		3
Bottlebrush squirreltail (N)	4		
Sand dropseed (N)	1		2
Choose One			
Shrub			
Shadscale	1	1	1
Forage kochia (I) [1]	0.5-1	0.5-1	0.5-1
Winterfat (N)	2	2	2
Shadscale (N)	2	2	2

Other Adapted Species:

Grasses: Salina wildrye (N).

Note: Use alkali sacaton (N) and western wheatgrass (N) only in areas that have shallow water tables and saline soils.

Forbs and Legumes: Globemallow (N).

Shrubs: gardner saltbush (N), fourwing saltbush (N), and Nevada ephedra (N).

[1] Forage kochia has been successfully seeded in areas receiving 6" of precipitation.

[2] (N)=Native and (I)=Introduced

NOTE: After choosing species from the above table, refer to Appendix A for additional information on species and varieties that will help in determining a seed mix for a specific site.

NOTE: Where possible, attempts have been made to include at least one seeding option where all recommended plant materials are native. Users should be aware that native plants can be more difficult to establish and often require additional care in seeding to achieve adequate stands.

SEEDING ALTERNATIVES FOR STABILIZATION PLANTINGS IN THE INTERMOUNTAIN REGION

STABILIZATION PLANTINGS

ROADSIDES, CONSTRUCTION AND OTHER DISTURBED SITES

TABLE S-1. HIGH MOUNTAIN SUBALPINE, ASPEN AND CONIFER (22"-35" ANN. PRECIP.) (LBS.PLS/ACRE)

	No Soil Limitation				Clay Soils		Light/Shallow Soils
	Seed-Mix Options				Seed-Mix Options		
Species	A	B	C	D	A	B	Seed-Mix
Grasses							
Intermediate wheatgrass (I) [1]			7	5	7		12
Kentucky bluegrass (I)		5		3			
Smooth brome (I)				5	7	12	
Slender wheatgrass (N)	8	5	7	5	3	5	5
Mountain brome (N)	8		7				
Hard fescue (I)		5					3
Creeping red fescue (N)	4	5		2	2	2	
Choose One							
Legume							
Mountain lupine (N)	1	1	1	1	1	1	1
Penstemon (N)	1	1	1	1	1	1	1
White clover (I)		1	1	1	1	1	1
Birdsfoot trefoil (I)		1	1	1	1	1	1
Utah sweetvetch (I)		1	1	1	1	1	1

Other Adapted Species:

Grasses: meadow brome (I) and Canada bluegrass (N).

Note: On wet soils consider creeping foxtail (N), timothy (I), and tall fescue (I).

Forbs and Legumes: Pacific aster (N), Canada goldenrod (N), Louisiana sage (N), showy goldeneye (N), crownvetch (I), and sweetanise (N).

Shrubs: gooseberry currant (N), red elderberry (N), Mountain big sagebrush (N), Wood's rose (N), maple (N), and golden willow (N).

[1] (N)=Native and (I)=Introduced

NOTE: After choosing species from the above table, refer to Appendix A for additional information on species and varieties that will help in determining a seed mix for a specific site.

NOTE: Where possible, attempts have been made to include at least one seeding option where all recommended plant materials are native. Users should be aware that native plants can be more difficult to establish and often require additional care in seeding to achieve adequate stands.

TABLE S-2. MOUNTAIN BIG SAGEBRUSH, OAK AND MAPLE (16"-22" ANN. PRECIP.) (LBS.PLS/ACRE)

	No Soil Limitation				Clay Soils		Light/Shallow Soils		
	Seed-Mix Options				Seed-Mix Options		Seed-Mix Options		
Species	A	B	C	D	A	B	A	B	C
Grasses									
Intermediate wheatgrass (I)[1]		10	10	6	5	7	12		8
Smooth brome (I)		10		6	5				
Crested wheatgrass (I)								10	7
Russian wildrye (I)					5				
Western wheatgrass (N)	5				5	3	4	5	
Hard fescue (I)	5								
NewHy hybrid (I)			10	7		7			
Slender wheatgrass (N)	5								
Thickspike wheatgrass (N)	5					3	4	5	5
Choose One									
Legume or Forb									
Blue flax (N)	1	1	1	1	1	1	1	1	1
Palmer penstemon (N)	1	1	1	1	1	1			
Alpine penstemon (N)	1	1	1	1	1	1			
Alfalfa (I)		1	1	1	1	1	1	1	1

Other Adapted Species:

Grasses: sheep fescue (I), mountain brome (N), and bluebunch wheatgrass.

Note: In gullies and basins others to considers are basin wildrye (N), Altai wildrye (I), and tall wheat grass (I),

Forbs and Legumes: Pacific aster (N), Rocky Mountain penstemon (N), Utah sweetvetch (N), small burnet (I), sainfoin (I), and cicer milkvetch (I).

Shrubs: maple (N), basin big sagebrush (N), fourwing saltbush (N), golden currant (N), blue elderberry (N), skunkbush sumac (N), Woods rose (N), bitterbrush (N), cliffrose (N), true and curleaf mahogany (N), Saskatoon service berry (N), and green ephedra (N)

[1] (N)=Native and (I)=Introduced

NOTE: After choosing species from the above table, refer to Appendix A for additional information on species and varieties that will help in determining a seed mix for a specific site.

NOTE: Where possible, attempts have been made to include at least one seeding option where all recommended plant materials are native. Users should be aware that native plants can be more difficult to establish and often require additional care in seeding to achieve adequate stands.

STABILIZATION PLANTINGS

ROADSIDES, CONSTRUCTION AND OTHER DISTURBED SITES

TABLE S-3. UPLAND PINYON-JUNIPER AND WYOMING BIG SAGEBRUSH-GRASS (12"-16" ANN. PRECIP.) (LBS.PLS/ACRE)

	No Soil Limitation				Clay Soils			Light/Shallow Soils		
	Seed-Mix Options				Seed-Mix Options			Seed-Mix Options		
Species	A	B	C	D	A	B	C	A	B	C
Grasses										
Siberian wheatgrass (I) [1]									7	5
Intermediate wheatgrass (I)		12	8	7		8	8		9	6
Crested wheatgrass (I)		8	6	5		7	6			
Russian wildrye (I)							6			
Western wheatgrass (N)	7				8	5		7		
Thickspike wheatgrass (N)	7		5	4	8			7		5
Indian ricegrass (N)	3							3		3
Sheep fescue (I)	3			3	3			3	4	
Choose One										
Legume or Shrub										
Alfalfa (I)		1	1	1		1	1			
Blue flax (N)	1	1	1	1	1	1	1	1	1	1
Globemallow (N)	1	1	1	1		1	1	1	1	1
Firecracker penstemon (N)	1	1	1	1						
Forage kochia (I)		0.5-1	0.5-1	0.5-1		0.5-1	0.5-1		0.5-1	0.5-1

Other Adapted Species:

Grasses: slender wheatgrass (N), sandrop seed (N), blue bunch or Snake River wheatgrass (N), and needle and threadgrass (N).

Forbs and Legumes: Pacific aster (N) and small burnet (I),

Shrubs: winterfat (N), Wyoming big sagebrush (N), bitterbrush (N), cliffrose (N), and fourwing saltbush (N).

[1] (N)=Native and (I)=Introduced

NOTE: After choosing species from the above table, refer to Appendix A for additional information on species and varieties that will help in determining a seed mix for a specific site.

NOTE: Where possible, attempts have been made to include at least one seeding option where all recommended plant materials are native. Users should be aware that native plants can be more difficult to establish and often require additional care in seeding to achieve adequate stands.

STABILIZATION PLANTINGS

ROADSIDES, CONSTRUCTION AND OTHER DISTURBED SITES

TABLE S-4. SEMI DESERT AND SALT DESERT SHRUB (8"-12" ANN. PRECIP.) (LBS.PLS/ACRE)

	All Soils			
	Seed-Mix Options			
Species	A	B	C	D
Grasses				
Siberian wheatgrass (I) [1]		10	14	10
Russian wildrye (I)		10		
Indian ricegrass (N)	5		6	5
Bottlebrush squirreltail (N)	5			5
Sand dropseed (N)	3			
Alkali sacaton (N)	3			
Choose One				
Forb or Shrub				
Globemallow (N)	1	1	1	1
Forage kochia (I)		2	2	2
Fourwing saltbush (N)	2	2	2	2

Other Adapted Species:

Grasses: needle and threadgrass (N)

Shrubs: winterfat (N), spiny hopsage (N), gardner saltbush (N), and shadscale (N).

[1] (N)=Native and (I)=Introduced

NOTE: After choosing species from the above table, refer to Appendix A for additional information on species and varieties that will help in determining a seed mix for a specific site.

NOTE: Where possible, attempts have been made to include at least one seeding option where all recommended plant materials are native. Users should be aware that native plants can be more difficult to establish and often require additional care in seeding to achieve adequate stands.

ESTABLISHMENT AND MANAGEMENT OF RIPARIAN WETLANDS

Establishment of riparian plant species depends on proper selection of species, plant material procurement and handling, planting location, and establishment techniques. The success of a project is dependent on the complete integration of these steps. When planning a project, it is important to observe the existing vegetation and its location in relationship to the stream and water table. Match the potential native woody and herbaceous species that presently exist on the site. Attempt to match as close as possible the riparian zones (Figure 3) where the different species normally grow.

Plants with flexible stems and rhizomatous root systems are usually located from the top of the zone through the bank zone (Figure 3). Small to medium shrubs are found in the overbank zone and beyond. Large shrub species and tree species are usually found in the transitional zone and the upland zone. They should not be planted in the other zones because of their large stems. These large stems do not flex when high velocity stream flows hit them. In addition, the large stems tend to block debris and ice that can cause significant bank erosion. Wetland herbaceous species can be found throughout the streambank cross section, although most emergent aquatics will be found in the toe zone. See Chart 1 for a list of grass and grasslike plant materials and Chart 2 for shrubs and trees to be used in the stabilization of riparian areas.

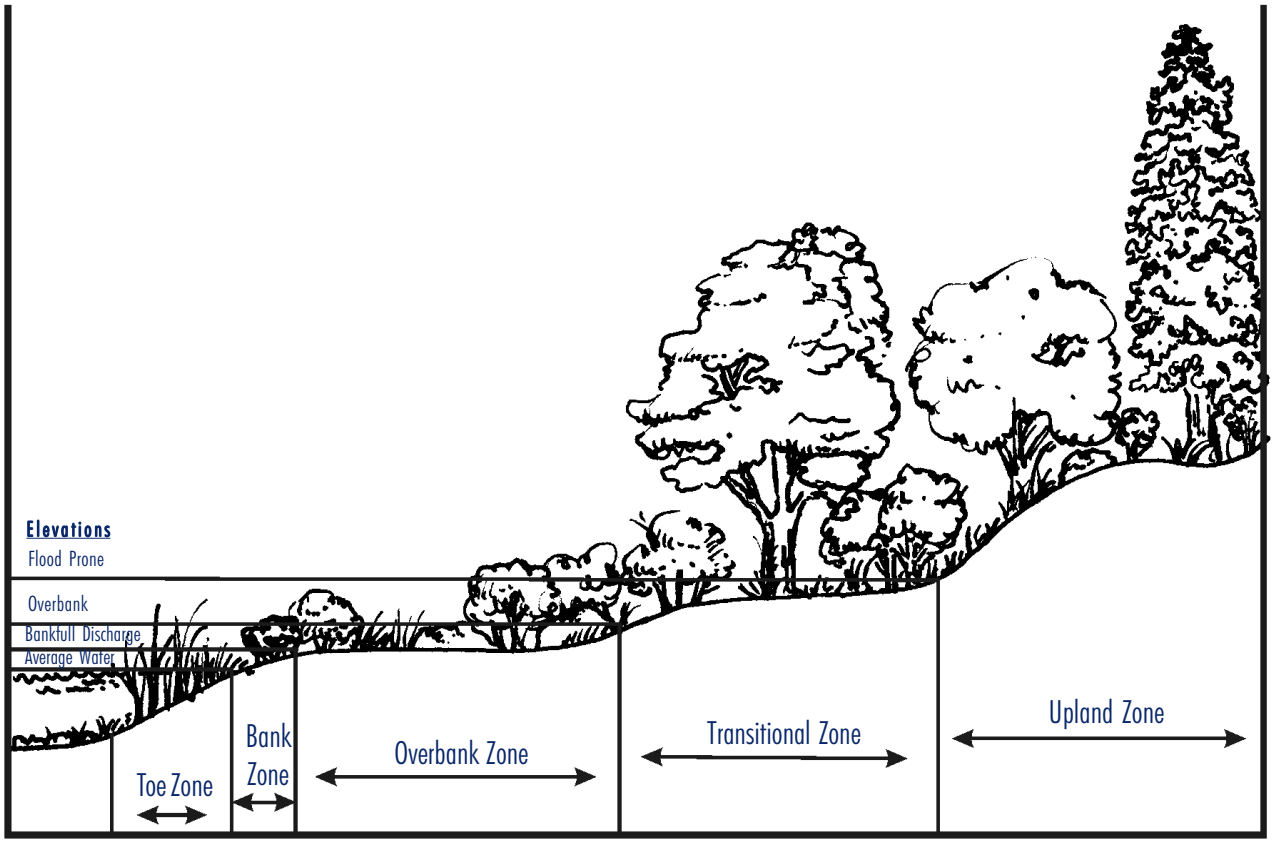


Figure 3. Illustration of Riparian Zones. Riparian Planting Zones can be used to determine where riparian species should be planted in relation to water line. This is a general depiction of a riparian zone. Not all streams look like this one. In the real world, some of these zones may be absent.

CHART 1. STABILIZATION OF RIPARIAN/UPLAND AREAS (GRASSES AND GRASSLIKE)

Species	Elevation Range[1]	RootType	Hydrologic Regime	Use in Riparian Zones[2]	Commercial[3] Availability	Height	Rate of [4] Spread	Acidity Tolerance	Salinity Tolerance	Wildlife Value	Flood Tolerance [5]
Alkali grass	Low-Mid.	Fibrous	Seasonally-Saturated	3,4,5	Seed & Plug	6-12"	Medium	Low	High	Small mammal cover	H
Bentgrass, Redtop	Low-Mid.	Rhizomes	Seasonally-Flooded	3,4,5	Seed	18-36"	Rapid	High	Low	Waterfowl food	M
Bluegrass, Kentucky	Low-High	Rhizomes	Seasonally-Saturated Well Drained	3,4,5	Seed	6-18"	Rapid	Low	Low	Waterfowl, small mammal and big game	M
Brome, Meadow	Low-High	Mildly Rhizomatous	Seasonally-Saturated Well Drained	4,5	Seed	24-48"	Medium	Low	Low	Big game and small mammal food	M
Brome, Smooth	Low-High	Rhizomatous	Seasonally-Saturated Well Drained	4,5	Seed	18-40"	Rapid	Low	Low	Waterfowl, small mammals and big game	M
Bulrush, Alkali	Low-Mid.	Rhizomatous	Up to 6" Water Depth	2,3,4.5	Seed & Plugs	24-36"	Medium	Low	High	Waterfowl cover and food	H
Bulrush, Hardstem	Low-High	Rhizomatous	Up to 36" Water Depth	2,3,4	Seed & Plugs	Up to 6’	Rapid	Low	Med.	Waterfowl food and cover, small mammal	H
Bulrush, Threesquare	Low-Mid.	Rhizomatous	Up to 6" Water	2,3,4	Seed & Plugs	24-48"	Rapid	Low	Med	Waterfowl food and cover, small mammal	H
Canarygrass, Reed	Low-Mid.	Rhizomatous	Seasonally-Flooded	2,3,4,5	Seed & Plugs	24-48"	Rapid	Low	Low	Waterfowl food cover	H
Cattail	Low-Mid.	Rhizomatous	Up to 12" Water Depth	2,3,4	Seed & Plugs	Up to 6’	Rapid	Med.	High	Waterfowl food cover, small mammal	H
Cordgrass, Prairie	Low-Mid.	Rhizomatous	Seasonally-Flooded	2,3,4,5	Seed & Plugs	24-48"	Rapid	Low	Med	Small game cover	H
Fescue, Hard	Low-Mid.	Bunch	Seasonally-Saturated Well Drained	5	Seed	6-18"	Slow	Med.	Low		M
Fescue, Red	Low-Mid.	Rhizomatous	Seasonally-Saturated Well Drained	4,5	Seed	6-12"	Medium	Med	Low		M
Fescue, Sheep	Low-Mid.	Bunch	Seasonally-Saturated Well Drained	5	Seed	6-18"	Slow	Med.	Low		M
Fescue, Tall	Low-Mid.	Bunch	Seasonally-Flooded	2,3,4,5	Seed	24-48"	Med	High	Med-high		M
Foxtail, Creeping	Low-Mid.	Rhizomatous	Seasonally-Flooded	3,4,5	Seed	24-48"	Rapid	Med.	Low	Waterfowl, small mammal, and big game	H

Species	Elevation Range[1]	Root Type	Hydrologic Regime	Use in Riparian Zones[2]	Commercial[3] Availability	Height	Rate of[4] Spread	Acidity Tolerance	Salinity Tolerance	Wildlife Value	Flood Tolerance[5]
Hairgrass, Tufted	Mid.-High	Fibrous	Seasonally-Saturated	3,4	Seed	18-30"	Medium	Med.	Med.	Small mammal cover	H
Mannagrass	Mid.-High	Rhizomatous	Seasonally-Flooded	3,4,5	Seed & Plugs	l24-36"	Rapid		Low	Waterfowl and big game food	H
Orchardgrass	Low-Mid.	Bunch	Well Drained	5	Seed	24-48"	Slow	Low	Low	Waterfowl, small mammal, and big game	L
Reed grass, Blue-joint	Mid.-High	Rhizomatous	Seasonally-Saturated	3,4,5	Seed & Plugs	24-36"	Medium	Med.	Low	Small mammal food and upland bird cover	H
Rush, Baltic	Low-High	Rhizomatous	Seasonally-Saturated	2,3,4	Seed & Potted	18-24"	Medium	Med.	Med.	Waterfowl food	H
Rush, Marten's	Mid.-High	Rhizomatous	Saturated	3,4,5	Seed & Plugs	4-16"	Medium				H
Rush, Poverty	Mid.-High	Rhizomatous	Saturated	3,4,5	Plugs	6-12"	Medium				M
Saltgrass, Inland	Low-Mid	Rhizomatous	Seasonally-Saturated	3,4,5	Seed & Plugs	12-18"	Medium	Low	High		H
Sedge, Beaked	Low-High	Rhizomatous	Seasonally-Saturated	2,3,4	Plugs	10-40"	Rapid	Med.	Low	Waterfowl food	H
Sedge, Nebraska	Low-High	Rhizomatous	Seasonally-Saturated	2,3,4	Seed & Plugs	10-24"	Medium	Low	Med.	Waterfowl and mammal food	H
Sedge, Water	Mid.-High	Rhizomatous	Up to 3" Water	2,3,4	Seed & Plugs	10-24"	Medium	Med.	Low	Waterfowl food and cover, small mammal	H
Sloughgrass	Low-Mid	Stoloniferous Annual	Seasonally-Flooded	3,4,5	Seed & Plugs	36"	Rapid			Waterfowl food and cover	H
Spikerush	Low-High	Rhizomatous	Seasonally-Flooded Up to 6" Water Depth	2,3,4	Seed & Plugs	6-30"	Rapid	Low	Med.	Waterfowl food	H
Timothy	Low-High	Bunch	Seasonally-Flooded	3,4,5	Seed	24-48"	Medium	Med.	Low	Waterfowl,small mammal, and big game	H
Vervain, Blue	Low-Mid.	Fibrous	Seasonally-Saturated	2,3,4	Seed & Plugs	18-30"	Slow		Low	Upland bird food	M
Wheatgrass, Crested	Low-Mid.	Bunch	Well Drained	5	Seed	12-24"	Slow	Low	Med.	Big game and small mammal food	L
Wheatgrass, Intermediate	Low-Mid.	Rhizomatous	Seasonally-Saturated Well Drained	5	Seed	24-48"	Medium	Med.	Med.	Small mammal and big game food	L
Wheatgrass, NewHy Hybrid	Low-Mid.	Moderate Rhizomatous	Seasonally-Saturated	3,4,5	Seed	8-18"	Medium	Med.	Med-high	Small mammal and big game food	M

Species	Elevation Range[1]	Root Type	Hydrologic Regime	Use in Riparian Zones[2]	Commercial[3] Availability	Height	Rate of[4] Spread	Acidity Tolerance	Salinity Tolerance	Wildlife Value	Flood Tolerance[5]
Wheatgrass, Pubescent	Low-Mid.	Mildly Rhizomatous	Seasonally-Saturated Well Drained	5	Seed	24-48"	Medium	Med.	Med.	Small mammal and big game food	L
Wheatgrass, Siberian	Low-Mid.	Bunch	Well Drained	5	Seed	12-24 "	Slow	Low	Med.	Small mammal and big game food	L
Wheatgrass, Streambank	Low-Mid.	Moderately Rhizomatous	Seasonally-Saturated	5	Seed	6-24"	Medium	Low	Med.	Small mammal and big game food	M
Wheatgrass, Tall	Low-Mid.	Bunch	Seasonally-Flooded	3,4,5	Seed	30-60"	Slow	Low	High		M
Wheatgrass, Thickspike	Low-Mid.	Moderately Rhizomatous	Seasonally-Saturated	5	Seed	8-24"	Medium	Low	Med.	Small mammal and big game food	M
Wheatgrass, Western	Low-Mid.	Rhizomatous	Seasonally-Flooded	4,5	Seed	8-20"	Rapid	Med.	Med.		M

1/ Elevation Range: Low (2,000-4,500 ft), Middle (4,500-7,000 ft), and High (7,000-10,000 ft).

2/ Riparian Zones: 1-Toe zone, 2-Bank zone, 3-Overbank zone, 4-Transitional zone, and 5-Upland zone.

3/ Refers to availability of species in nursery trade.

4/ Refers to the horizontal rate of growth: Rapid–More than 1.0 ft/yr, Medium–0.5 ft/yr, and Slow–less than 0.2 ft/yr.

5/ Flood Tolerance: High-10-30+ days, Medium-6-10 days, and Low-1-5 days.

CHART 2. SHRUBS AND TREES FOR STABILIZATION OF RIPARIAN AREAS

Species	Size/Form	Elevation Range[1]	Root Type	Rooting Ability from Cuttings	Use in Riparian Zones[2]	Commercial Availability[3]	Deposition Tolerance[4]	Flooding Tolerance[5]	Drought Tolerance	Salinity Tolerance	Wildlife Value
Alder, Red	Med. Tree	Mid.-High	Shallow	Poor Spreading	3,4	Yes	Med.	Med.	Low	Low	Big game browse and upland bird food
Alder, Sitka	Sm.-Med. Tree	Mid.-High	Shallow Spreading	Poor	2,3	Yes	Med.	Med.	Low	Low	Big game browse and upland bird food
Alder, Thinleaf	Sm.-Med. Tree	Mid.-High	Shallow Spreading	Poor	2,3	Yes	Med.	Med.	Low	Low	Big game browse and upland bird food
Aspen, Quaking	Med. Tree	Mid.-High	Shallow	Poor	4	Yes	Low	Low	Med.	Med.	Big game browse
Birch, Water	Lg. Shrub to Sm. Tree	Mid.-High	Shallow to Deep Spreading	Poor	2,3	Yes	Med.	Med.	Low	Low	Big game browse and upland bird food
Boxelder	Med. Tree	Low-Mid.	Moderately Spreading	Poor	4	Yes	High	High	High	Med.	
Buffaloberry, Silver	Lg. Shrub	Low-Mid.	Rhizomatous	Poor	4	Yes					Fruits are eaten by birds and small mammals
Chokecherry	Med.-Lg Shrub	Low-Mid.	Rhizomatous	Good from root cuttings	4	Yes	Low	Low	Low-Med.	Low-Med.	Fruits are eaten by birds and small mammals
Cinquefoil, Shrubby	Sm. Shrub	Low-Mid.	Shallow to Deep Spreading	Poor	3,4	Yes			High		Big game browse
Cottonwood, Black	Lg. Tree	Low-Mid.	Shallow	Very Good Fibrous	4	Yes	Med.	Med.	Med.		Big game browse
Cottonwood, Fremont	Lg. Tree	Low-Mid	Shallow Fibrous	Very Good	4	Yes	Med.	Med.	Med.	Med.	Big game browse
Cottonwood, Narrowleaf	Lg. Tree	Mid.	Shallow	Very Good	4	Yes	Med.	Med.	High	Med.	Big game browse
Currant, Golden	Sm.-Med. Shrub	Low-Mid	Spreading	Good (in greenhouse)	3	Yes					Fruits are eaten birds and small mammals

Species	Size/Form	Elevation Range[1]	Root Type	Rooting Ability from cuttings	Use in Riparian Zones[2]	Commercial Availability[3]	Depositition Tolerance[4]	Flooding Tolerance[5]	Drought Tolerance	Salinity Tolerance	Wildlife Value
Current, Wax/Squaw	Sm.-Med. Shrub	Mid.-High	Spreading	Fair	3,4	Yes					Big game browse, Fruits are eaten by birds and small mammals
Dogwood, Redosier	Med. Shrub	Mid.	Shallow	Moderate	2,3,4	Yes	Low	High	Med.	Low	Big game browse, upland bird food
Elderberry, Blue	Sm. Tree	Mid.	Rhizomatous	Poor	4	Yes	Med.	Med.	Med.	Low	Fruits are important for birds
Elderberry, Red	Med. Shrub	Mid.-High	Spreading	Poor	4	Yes	Med.	Med.	Med.	Low	Big game browse, fruits are eaten by small birds and mammals
Hawthorn, Black	Sm. Tree	Low-Mid.	Shallow to Deep Spreading	Poor	3,4	Yes	Med.	Low	High	Low	Browse and cover for wildlife
Mockorange	Sm.-Med. Shrub	Low-Mid.	Spreading Fibrous	Poor	3,4	Yes					Big game browse
Rose, Wood's	Sm.-Med. Tree	Low-Mid.	Shallow to Deep	Good (in greenhouse)	2,3,4	Yes		Low	Low-High	Low	Rosehips eaten by wildlife
Silverberry	Med. Shrub	Low-Mid.	Shallow to Deep Spreading	Very Good	3,4	Yes	High	High	Med.	Med.	Big game browse
Snowberry, Common	Sm. Shrub	Low-Mid.	Spreading	Very Good	3,4	Yes	Med.	Med.	Med.	Low	Fruits are eaten by birds and small mammals
Sumac, Skunkbush	Med.-Lg. Shrub	Low-Mid.	Deep Spreading Rhizomatous	Poor	4	Yes	High	Med.-High	Med.-High	Med.	Fruits are eaten birds and small mammals
Willow, Black	Lg. Tree	Low-Mid.	Shallow to Deep	Good	2,3	Yes	Med.	Med.-High	Low-Med.	Low	Browse and cover for wildlife
Willow, Booth	Med. Shrub	Mid.	Shallow to Deep	Moderate	2,3	Limited	High	Med.-High	Low-Med.	Low	Browse and cover for wildlife
Willow, Coyote	Med. Shrub	Low-Mid.	Rhizomatous	Very Good	2,3	Yes	High	Med.-High	Low-Med.	Low	Browse and cover for wildlife

Species	Size/Form	Elevation Range[1]	Root Type	Rooting ability from cuttings	Use in Riparian Zones[2]	Commercial Availability[3]	Depositition Tolerance[4]	Flooding Tolerance[5]	Drought Tolerance	Salinity Tolerance	Wildlife Value
Willow, Drummond	Sm.-Med. Shrub	Mid.-High	Shallow to Deep	Good	2,3	Limited	High	Med.-High	Low-Med.	Low	Browse and cover for wildlife
Willow, Geyer	Med.Shrub	Mid.	Shallow to Deep	Good	2,3	Limited	High	Med.-High	Low-Med.	Low	Browse and cover for wildlife
Willow, Lemmon	Sm.-Med. Shrub	Mid.-High	Shallow to Deep	Good	2,3	No	High	Med.-High	Low-Med.	Low	Browse and cover for wildlife
Willow Mackenzie	Sm. Tree	Low-Mid.	Shallow to Deep	Good	2,3	Limited	High	Med.-High	Low-Med.	Low	Browse and cover for wildlife
Willow, Pacific	Sm. Tree	Low-Mid.	Shallow to Deep	Good	2,3	Yes	High	Med.-High	Low-Med.	Low	Browse and cover for wildlife
Willow, Peachleaf	Sm. Tree	Low	Fibrous	Very Good	2,3	Limited	High	High	Low	Med.	Browse and cover for wildlife
Willow, Plainleaf	Sm. Shrub	Mid.-High	Shallow to Deep	Moderate	2,3	No	High	Med.-High	Low-Med.	Low	Browse and cover for wildlife
Willow, Scouler	Lg. Shrub	Low-Mid.	Shallow to Deep	Need to treat with hirmone	3	Yes	High	Med.-High	Low-Med.	High	Browse and cover for wildlife
Willow, Sitka	Sm.-Med. Tree	Low-Mid.	Shallow to Deep	Moderate	2,3	Limited	High	Med.-High	Low-Med.	Low	Browse and cover for wildlife
Willow, White/ Golden	Med.-Lg. Tree	Low-Mid.	Shallow to Deep	Good	5	Yes	High	High	Med.	Low-Med.	Browse and cover for wildlife
Willow, Yellow	Med.-Lg. Shrub	Low	Shallow to Deep	Good	2,3	Limited	Med.	Med.-High	Low-Med.	Med.	Browse and cover for wildlife

1/ Elevation Range: Low (2,000-4,500 ft), Middle (4,500-7,000 ft), and High (7,000-10,000 ft).

2/ Riparian Zones: 1-Toe zone, 2-Bank zone, 3-Overbank zone, 4-Transitional zone, and 5-Upland zone.

3/ Refers to availability of species in nursery trade.

4/ Regrowth following shallow coverage by soil.

5/ Flood Tolerance: High-10-30+ days, Medium-6-10 days, and Low-1-5 days.

ESTABLISHMENT AND MANAGEMENT OF CONSTRUCTED WETLAND SYSTEMS

A thorough inventory of the planting site is necessary and will result in fewer problems at planting time. After adequate planning and site inventory, the following factors should be considered:

- The planting site needs to be weed-free and soils firm.
- Ensure the wetland bottom is level with minimal undulations that might result in watering problems following planting.
- Sites require a pre-irrigation to completely fill the soil profile so settling will not occur after planting.

Planting plugs/transplants can be accomplished with two methods:

1. Water Planting Method – Fill the wetland with water to a depth of 2 to 4 inches after which planters hand dig holes for plug placement. After placing the plug in the hole, the soil is stomped tightly around it. If the water is deep enough, styrofoam coolers can be filled with plants and floated behind the planter.

2. Tree Planter Method – After pre-irrigation of the wetland and sufficient soil drying, a tractor driven planter can be used to plant the plugs. This will decrease the number of planters needed, but may increase the cost of planting.

- After planting, care must be taken not to drown the plants. In early growth stages plants have not developed aerechymous structures that allow them to breathe in anaerobic soil. During the first growing season, the water level in the wetland should be slowly increased to encourage growth of shoots and above plant parts.
- Early establishing wetland plants respond to a fluctuating water level. Water levels in wetland and riparian systems are constantly rising and falling with natural events. Duplicating this condition artificially tends to increase the rate of plant spread.
- When applying the Water Planting Method, let the standing water evaporate to saturation (without standing water), before adding water to the system. Depending on the soils, climate and topography of the riparian system, this could take 5 to 10 days.
- When using the Water Planting Method, fill the wetland with 2-4 inches of water immediately after planting. Allow the soil to dry down to saturation levels (with no standing water) prior to adding more water to the system.
- Watering frequency should be based on soils, climate and daily maximum temperatures. Generally, water should be filled to a 2 to 3 inch level then drained down naturally for the first month after planting. Evaporation drainage time normally takes about 7 to 10 days. Refill the system for 15 to 20 days before draining again.
- During the second month following the planting, increase the fill level to about 6 to 8 inches, and the third month increase the fill level to 10 to 12 inches. A rule of thumb indicates that plants need 1/4 to 1/3 vegetative exposure above the waterline. This allows the plants to breathe. It is not a great concern if plants are submerged for a couple of days. However, stressing the plants for lengthy periods with too much, or too little, water will cause heavy mortality.
- Weed control is necessary for the first growing season, and continues to be a maintenance concern during the life of the project. Weeds rapidly move into the system, especially if water levels are low and fluctuating. The best control method is pulling the weedy plants. Wicking the weeds with approved herbicides is also an effective procedure.
- Watch for small gully or rill formation during the plant establishment phase. This often occurs before plants have developed and spread enough to prevent erosion. Shovel work will normally repair small rills, while larger gullies can be filled by using weed free grass bales.
- Wetland plantings are normally made in spring or early summer. Fall and winter plantings are not recommended due to frost heaving of transplants. Optimum wetland plantings are accomplished in June with warm temperatures, long days, and abundance of water.
- There has been much discussion and concern about using native versus exotic plants in constructed wetlands. Wetlands are probably the least understood when trying to determine what species were historically native. Migratory waterfowl travel thousands of miles and visit hundreds of wetlands leaving seeds of many different plants they eat along the way. Suffice it to say

that local or naturalized plants that most effectively handle fluctuations in temperatures, water levels, soils, pH should be used to stabilize and vegetate constructed wetlands. Ordering plants from nurseries long distances away from your planting site often results in failures. Acquiring the right species (Figure 4), for the right site and water level is extremely important and most often varies from site to site.

- There is some question on whether transplants should be planted with or without soil on the roots. Some reports indicate 20 to 30% increased plant survival if soil is left on the roots. A larger microbial population is usually transferred to the new planting site if soil remains. However, transplants with soil attached will weigh more, and require additional space during transporting. If transplants are collected in weedy areas and soil remains attached, there is an increased risk of weed contamination entering the target planting site.

- Generally plugs are planted about 18 to 20 inches apart. Usually this spacing will allow plants to grow together within the first growing season, assuming rhizomatous species are used. A significant number of plugs must be purchased or collected. Plantings at wider spaces require a longer period of time to stabilize. This is not necessarily negative, but will require additional planning since the wetland will not reach its full water level until the end of the second year.

- The size of transplant material will affect the ease with which the wetland can be planted and maintained. Small plugs, 2" X 2" X 6", are slow to establish, demonstrate less ability to compete with weeds, and require additional water management to assure they do not drown.

- Fertilizer application is not normally necessary since wetland plugs grow in most types of soil. However, soil samples should always be taken in the planning process. If the plugs are greenhouse grown, small amounts of time release fertilizer (16-16-16 or 20-20-20) can be added to the soil mix. If wild transplants are used, the fertilizer should be placed in the hole prior to planting. A general application of fertilizer across the bottom of the wetland is not suggested since it ignites a flush of weeds that competes with newly planted materials. Fertilizer applied before planting, where cultivation both incorporates the fertilizer and eliminates emerging weeds, achieves better results.

- Constructed wetlands cannot succeed without close maintenance. In addition to weed problems other potential obstacles such as wildlife damage exist. Fresh wetland plantings are like ice cream to hungry geese. Beaver and muskrats can rapidly dig holes in dikes surrounding the wetland and cause blowouts. They are all capable of destroying a newly planted wetland. Numerous options are available for wildlife control until plants are established. Contact your local Fish and Game Conservation Officers for assistance.

- See Figure 4 for species adaptations when constructing a wetland. Also see Appendix A for a more detailed description of each species.

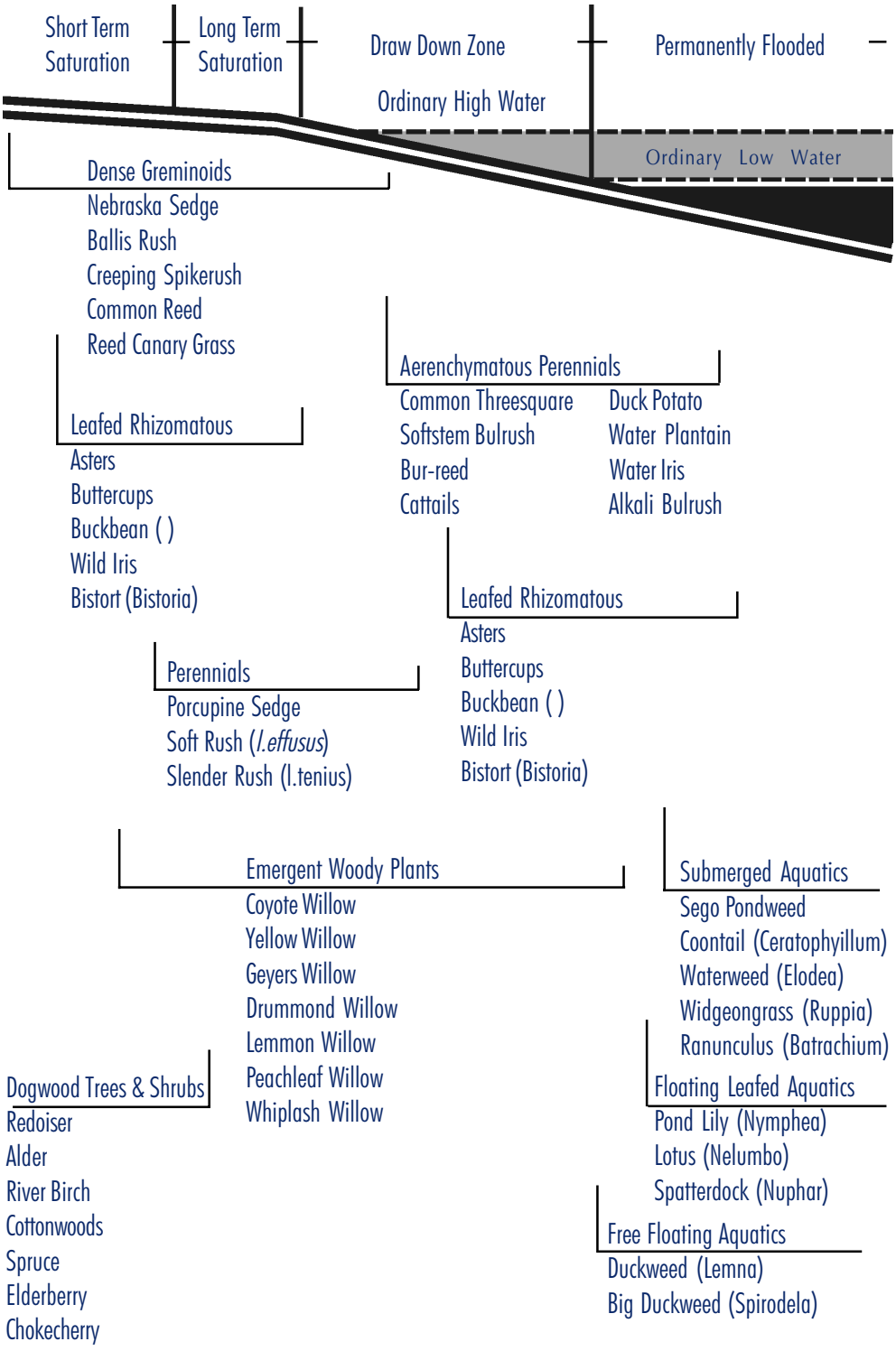


Figure 4. Species and adaptations when constructing a wetland.

APPENDIX A: SPECIES DESCRIPTIONS

CHARACTERISTICS OF GRASSES

CHARACTERISTICS OF GRASSLIKE SPECIES (RUSHES, SEDGES)

CHARACTERISTICS OF FORBES AND LEGUMES

CHARACTERISTICS OF WOODY PLANTS

(Shrubs, Willows, Trees)

CHARACTERISTICS OF GRASSES

BLUEGRASS, BIG

[*Poa ampla*; Native]

Introduction – Big bluegrass is a long-lived, native bunchgrass, with leaves that are blue-green, and is adapted to early spring grazing. It is an important grass of the sagebrush vegetation zone in the western United States. Big bluegrass will hybridize readily with rhizome-producing bluegrasses (Canada and Kentucky bluegrass) resulting in hybrid plants with short rhizomes. Big bluegrass greens up approximately 4 weeks before crested wheatgrass in the spring. Without sufficient moisture, big bluegrass becomes unpalatable in early summer. Once established, it is one of the most persistent of all the cool season grasses. Big bluegrass has excellent cold tolerance, but is less drought tolerant than other cool-season grasses.

Adaptation – Native bluegrasses are important forage species adapted to the cooler, moist regions of the western rangelands. They occur in a great variety of sites, from sand dunes to high mountain meadows. The majority, however, favor rich, moist, well-drained soils that are characteristic of meadows, grassy parks along stream banks, shaded woodlands, open sagebrush sites, mountain brush, and ponderosa pine ranges. Despite their need for moisture, the bluegrasses are often found growing on drier, infertile, open side hills, and waste places. Big bluegrass, Canada bluegrass, and Sandberg bluegrass are used for reseeding depleted rangelands. Big bluegrass is adapted to areas that have an effective annual precipitation between 9 and 15 in. It will not tolerate early spring flooding, high water tables, or poor drainage. It will tolerate weakly acid and alkaline soils, but will not grow under saline conditions.

Limitations – Big bluegrass has relatively low seedling vigor and requires 4 to 8 years to reach full productivity. Because young plants are easily pulled up, grazing should be deferred until roots are well anchored.

Uses – Big bluegrass is used almost exclusively on rangeland where mountain big sage brush is prominent or high mountain meadows where it is utilized by wildlife and domestic livestock. Early in spring and fall, big bluegrass is one of the most palatable of all range grasses. Big bluegrass should be grazed in spring when it reaches a height of 8 in. However, grazing big bluegrass in the head stage will reduce stand the following year. Regrowth after spring grazing can be grazed in fall, but it is recommended that a 6 inch stubble be left going into winter. Overgrazing and severe trampling are injurious to native stands of big bluegrass and without proper protective grazing, a range will deteriorate rapidly. When properly managed, big bluegrass will compete with cheatgrass. Wildlife, particularly upland game birds, choose fields of big bluegrass for nesting sites. Big bluegrass has been used successfully for reseeding burned-over forest lands in pine forests of the West. Recommended planting depth should not exceed 1/4 in.

Adapted Varieties – The variety **Sherman** big bluegrass is the only commercially available seed. Sherman big bluegrass is intended for range reseeding (seeding mixes) and revegetating disturbed sites. It is noted for its early spring growth, and fine textured blue colored leaves. Sherman big bluegrass has been successfully used in conservation seedings alone or with alfalfa on dryland sites. In addition, it has been used for reseeding burned-over forest lands in pine zones of the western states.

BLUEGRASS, CANADA

[*Poa compressa*; Introduced]

Introduction – Canada bluegrass is a long-lived, sod-forming perennial with bluish- or grayish-green leaves.

Bluegrass, Canada

It was introduced from Europe and naturalized throughout much of North America. Canada bluegrass is an attractive low maintenance plant which provides excellent ground cover and erosion control on roadsides, ditch banks, borrow pits, dam sites, under trees, and on recreational areas. Once established, Canada bluegrass is very persistent and will do better than Kentucky bluegrass on poorer, drier sites.

Adaptation – Canada bluegrass is distributed widely throughout the cooler regions of western rangelands. It is best adapted to regions that receive an effective annual precipitation of 20 to 40 in. It has a wide range of soil adaptations from stiff, clay soils of low fertility to sandy-gravelly soils. Within these poor soils, where the subsoil has been exposed, it is found growing along roadsides, gardens, meadows, parks, and dry stream banks. Canada bluegrass can tolerate shade and moderately acidic soils.

Limitations – As a pasture grass, Canada bluegrass does not withstand heavy grazing.

Uses – In addition to conservation plantings on disturbed areas, Canada bluegrass is used as a forage by livestock and wildlife, but must be managed closely. Canada bluegrass forage is nutritious and highly palatable early in spring. Canada bluegrass recovers quickly after heavy grazing and trampling. The recommended planting depth is between 1/4 and 1/2 in.

Adapted Varieties – Two commercially available varieties of Canada bluegrass are **Canon** and **Reubens**, both of which are recommended for low-maintenance turf and erosion control on disturbed sites. The variety Canon is noted for its winter hardiness and early spring green-up. It also has improved leafiness, disease resistance, persistence, and yield. Reubens is recommended for a low-maintenance turf and erosion control cover in areas of low fertility, irregular moisture supply, and where mowing is difficult.

BLUEGRASS, SANDBERG

[*Poa sandbergii*; Native]

Introduction – Sandberg bluegrass is a relatively low producing perennial, bunchgrass that grows as small tufts no more than a foot in diameter. It is widely distributed throughout the western range where it is considered an important range grass for soil stabilization and forage for wildlife and livestock. Once established, sandberg bluegrass is perhaps the most drought tolerant of the bluegrasses.

Adaptation – Sandberg bluegrass is adapted to mountains, uplands, and semi-deserts on lighter textured and stony loam soils. It inhabits a wide range of elevations, ranging from 1,000 ft in Washington to 12,000 ft in northern New Mexico. Under 10 to 20 in of moisture

Bluegrass, Sandberg

annually, Sandberg bluegrass provides high quality forage and is somewhat tolerant of heavy trampling.

Limitations – Forage yields are very low, seed viability is poor, and forage quality declines rapidly as it matures.

Uses – Sandberg bluegrass can withstand considerable grazing pressure. On large areas of western semi-desert range, overgrazing has killed most of the bunchgrasses except Sandberg bluegrass. In fall, when air-cured, the leaf blades are grazed by wildlife and livestock. In addition to fall grazing, Sandberg bluegrass will be one of the first grasses to green-up in the spring. When seeding Sandberg bluegrass, the small seed should not be placed deeper than 1/4 in. It is excellent in low rainfall native mixes.

Adapted Varieties – One ecotype is nearing release by the Forest Service and the NRCS (Aberdeen).

BROME, MEADOW

[*Bromus riparius*; Introduced]

Introduction – Meadow brome is a long lived perennial that offers promise on non-irrigated or irrigated pasture. Meadow brome can extend the grazing season as well as increase total forage production. Forage yields in meadow brome are higher than in smooth brome. It recovers from grazing faster than smooth brome and has better fall regrowth. Meadow brome can be distinguished from smooth brome by the presence of awns, hairy leaves and stems, and the lack of aggressive rhizomes.

Brome, Meadow

Adaptation – Meadow brome has a tendency for limited vegetative spread under dryland conditions with moderate rhizome development under irrigation. Stands of meadow brome do not decline in productivity as rapidly as do sod forming grasses (smooth brome). Leaves are pubescent and light green in color. Meadow brome heads about 1 to 2 weeks earlier than smooth brome. Seed appears similar, with the exception that meadow brome seed is much larger with a longer awn. It is adapted to slightly acid to mildly alkaline soils on dryland pasture where annual precipitation exceeds 15 in. It is moderately shade tolerant, winter hardy, and recovers quickly after grazing. Meadow brome is adapted to the mountain brush, aspen, conifer forest, and subalpine zones. It is less dormant under high summer temperatures than smooth brome.

Limitations – Meadow brome is slower to establish than smooth brome and it is sensitive to spring flooding.

Plant Nutrient Needs – Split applications of nitrogen during the growing season have shown an increase in forage production and regrowth after clipping or grazing.

Hay and Pasture Management – As a hay species, meadow brome is less aggressive than smooth brome and retains a better balance in hay fields when planted with legumes and bunch grasses such as orchardgrass. Meadow brome is palatable and is an early source of spring forage. One major advantage over smooth brome is its quick regrowth after cutting. Animals should not be allowed to graze meadow brome until the forage is 8 to 12 in high and they should be removed when forage is grazed to a stubble height of 3 to 4 in. A typical rest period of 3 to 4 weeks is required for maximum forage and the health of the stand. Fall regrowth should be approximately 6 inches prior to winter.

Adapted Varieities – For a little over 20 years, **Regar** was the only available meadow brome variety in North America. The variety Regar is characterized as early-maturing with moderate vegetative spread and good regrowth. Most seed suppliers carry the variety Regar. Recently two new cultivars, **Fleet** and **Paddock** were released through Agricultural Canada at Saskatoon. Fleet has improved seed production, a smaller awn, and reduced seed shattering. The variety Paddock has good plant vigor with increased basal leaf production and a smaller awn that often breaks off at maturity.

BROME, MOUNTAIN

[*Bromus carinatus*; Native]

Introduction – Traditionally, mountain brome (*Bromus marginatus* Nees ex Steud.) was distinguished from California brome (*B. carinatus*) based on awns shorter than 1/4 in compared to awns longer than 1/4 in. Recent studies have demonstrated that this character is not consistent within populations. Based on that data, within this manual, mountain brome and California brome will be combined into one species and treated as *B. carinatus*. Mountain brome is a native perennial short-lived bunchgrass indigenous to mountainous regions of the western U.S. Mountain brome can take up to 3 years to reach full productivity and is not as persistent as smooth brome. It grows to a height of 1 to 4 ft with leaves 6 to 12 in long and 1/4 to 1/2 in wide. It establishes quickly on disturbed sites and it is moderately palatable and shade tolerant. It is utilized by grazing animals and is a good seed producer.

Adaptation – Mountain brome is adapted to moderately moist habitats from sagebrush valleys to subalpine forests and meadows in higher mountain elevations up to 10,000 ft and as low as 2,000 ft along the Pacific Coast in California. It is frequently observed in the spruce, aspen, and ponderosa pine zones. Mountain brome prefers rich, deep soils, but will establish and grow on rather poor, depleted soils, where water is limiting. Because of its short-lived nature, mountain brome will be replaced over time by long-lived species. It is widespread in western North America from Alaska, British Columbia, south to California, into west Texas,

and throughout most of Mexico. Typically, these grasses grow in scattered bunches, but there are reports of it forming a fairly dense sod, particularly in central and northern Utah. Recommended sites include weedy openings at medium to high altitudes and timber burns.

Limitations – Mountain brome is moderately shade tolerant and at maturity the forage becomes coarse and fibrous. Since mountain brome is short-lived, it must be allowed to go to seed every 2 to 3 years to adequately reseed itself and prolong the life of the stand. Sometimes smut (*Ustilago bromivora*) attacks the seed heads, however, this is usually not a serious problem on rangelands. It may be a problem in seed production fields.

Hay and Pasture Management – With its large leafy plants, mountain brome rates among the best forage grasses on western ranges for all classes of livestock. It is fairly resistant to grazing and drought. When grazed early in the season mountain brome produces excellent regrowth that can be utilized late into the fall. Recommended seeding depth is 1/4 to 1/2 in.

Adapted Varieties – **Bromar** mountain brome was released for the Intermountain area and the Pacific Northwest where it is commonly used in mixtures with sweet clover and red clover for pastures or green manure in short rotation management. Bromar establishes quickly, is later maturing, and has earlier spring recovery than typical mountain brome. In addition, it has increased forage production and larger seeds. The germplasm release of mountain brome "Garnet" was selected for superior head smut resistance and has similar attributes to Bromar.

BROME, SMOOTH

[*Bromus inermis*; Introduced]

Introduction – Smooth brome is a long-lived aggressive sod-forming grass. It is very palatable, moderately productive, and shade tolerant. It is a cool season grass that produces leafy vegetative growth early in the season and stems with large seed panicles in early summer. Currently, smooth brome is the most widely used of the cultivated bromes. It has gained considerable prominence in the Intermountain Region for pasture and hay production, as a component in grass-legume mixtures, and as an erosion control species. It has poor regrowth characteristics when compared to meadow or mountain brome.

Adaptation – In dry summer periods, smooth brome becomes dormant until the return of short cool days and fall precipitation. It is best adapted to moist, well drained soils, but grows under a wide range of soil and moisture conditions. Smooth brome is utilized on both

Brome, Smooth

irrigated and dryland sites. It is fairly tolerant of alkaline and less tolerant of saline and acidic soils. It is winter hardy. Smooth brome cultivars have traditionally been divided into three adaptation types: northern, southern, and intermediate. Only southern and intermediate types are currently recommended for use in the Intermountain Region. It is well adapted to erosion control plantings due to its aggressive rhizomatous growth habit.

Limitations – Even though smooth brome is one of the most widely used pasture grasses, it has several shortcomings. Because of the increased length of the seed (long and narrow) it often plugs seed drills making it difficult to plant. Smooth brome may take up to 3 years to reach full production. Seedlings are often weak, but once established, plants spread vegetatively. Due to its aggressive nature, smooth brome often out competes other species in a mix, subsequently becoming the dominate species. It recovers slowly when cut for hay and tends to become sod bound, reducing forage and seed yields. Sod-bound pastures can be improved through root cultivation and increased applications of nitrogen. During the heat of mid-summer, smooth brome yields are reduced and quality declines. It has some drought tolerance and will often establish in dryland areas with 12 to 14 in precipitation, but needs 16-18 in to effectively produce.

Plant Nutrient Needs – On a grass pasture of smooth brome, split applications (two or three) of nitrogen fertilizer at 40-60 lbs per acre give a better distribution of smooth brome forage throughout the growing season. If smooth brome is planted in a grass-legume mixture, nitrogen fertilizer should be limited to 40-50 lbs per acre in a single application. Large amounts of

nitrogen in a grass-legume mixture favors the grass and the legumes may be eliminated from the pasture.

Hay and Pasture Management – In a pasture setting, smooth brome begins growth early in the spring. Due to a vigorous rhizome system smooth brome is not likely to be eliminated because of over grazing. Its major drawback as a pasture plant is its inability to provide a consistent supply of forage throughout the growing season. A rapid flush of growth occurs in the spring followed by a reduction in growth rate until fall re-growth occurs. If smooth brome is going to be grazed throughout the year, it must be grazed lightly in spring so growing points are not removed, which reduces further plant growth. Regrowth after grazing is slower in smooth brome than other pasture grasses (orchardgrass, meadow brome, fescue, and perennial ryegrass) and a longer resting period (35-45 days) is recommended to insure adequate forage production. Early grazing and the use of adequate amounts of fertilizer can increase forage production and minimize the smooth brome mid summer forage slump. Late fall or early spring root cultivation is necessary to stimulate growth and maintain high production. The recommended planting depth for smooth brome seeds is 1/4 to 1/2 in.

Adapted Varieties – The intermediate type variety **Manchar** is best adapted to higher elevation mountain rangelands. Manchar is recommended for forage plantings on meadows, hay or pasture in the Intermountain Region. Manchar is characterized by moderate spread, improved seedling vigor, and increased seed and forage yields. The southern type variety **Lincoln** is best adapted to mountain brush and favorable sites in the sagebrush and pinyon-juniper zone. Lincoln is recommended as plant material for erosion control and waterways; it produces less forage but is more aggressive in vegetative spread than Manchar. At present, there are no northern type smooth bromes recommended specifically for the Intermountain Region.

CANARYGRASS, REED

[*Phalaris arundinacea*; Native]

Introduction – Reed canarygrass is a vigorous, sod-forming, long-lived, native perennial grass that grows throughout the northern United States. Stands of reed canarygrass can reach up to 8 ft tall with the majority of the leaves remaining near the base of the plant. Reed canarygrass is difficult to establish from seed, but once established under optimum conditions produces excellent spring forage. Due to its extensive spreading root system and dense growth, reed canarygrass provides excellent erosion control along stream banks, shorelines, and water ways. Reed canarygrass is unsurpassed among cool-season grasses for land utilization of N and other nutrients that occur in municipal and industrial waste effluents. It also provides food and nesting cover for birds.

Canarygrass, Reed

Adaptation – Reed canarygrass is adapted to a wide range of soil conditions. In addition, it can withstand continuous water inundation for 70 days in cool weather. It also invades wet areas along river banks, sloughs, and canals where it thrives on land with a high water table. It does well on soils that range from moderately acidic to weakly saline-alkaline. It will tolerate saline soils when accompanied with frequent irrigations or natural flooding. Reed canarygrass is adapted to soils that range in pH from 4.9 to 8.2. When irrigated, reed canarygrass is more persistent than other grasses and it has been considered a weed as it spreads into irrigation ditches, canals, streams, and other waterways. It has moderate drought tolerance on upland soils that receive above 18 in annual precipitation. Reed canarygrass is cold tolerant and will withstand temperatures well below -30 degrees F. Reed canarygrass is adapted to soils too wet for bromegrass, fescue, orchardgrass and meadow foxtail.

Limitations – Lack of palatability when grown in a species mixture is the most frequently cited reason why this grass has not become a leading forage in its area of adaptation. Reed canarygrass contains alkaloids that have been correlated to reduced forage intake. Seed of reed canarygrass has reduced seed germination and does not store for long periods of time (up to 3 to 4 years). Due to reduced seedling vigor, 2 to 3 years may be required to reach full productivity. Elimination of weed competition is essential when establishing new plantings of reed canarygrass. Due to poor germination and seedling vigor, reed canarygrass is occasionally planted by placing plugs several feet apart in cultivated areas. These plugs will frequently spread between 2 and 5 ft per year after initial establishment.

Plant Nutrient Needs – On upland soils, reed canarygrass becomes sod-bound and unproductive within several years unless it is well fertilized with nitrogen.

Hay and Pasture Management – Reed canarygrass is primarily adapted for permanent hay or pasture on sites too wet for good performance of other forage plants. The forage should be grazed prior to heading as both quality and palatability decline rapidly after heading. If mechanically harvesting hay, remember that in late spring and early summer field accessibility is not likely. Reed canarygrass begins growth early in the spring and if moisture and fertility are adequate, provides a constant distribution of forage throughout the growing season. Reed canarygrass should be grazed when the forage is close to 12 in tall. However, this species is intolerant of continued close grazing and should not be grazed or clipped shorter than about 6 in. Mature reed canarygrass will not be utilized by livestock. Short rotational grazing with increased stocking rates provides the best utilization of reed canarygrass. Grazing systems that rotate animal use approximately every 2 weeks, maintain forage in a more palatable condition. The digestibility of early growth in reed canarygrass is often equal to that of first-bloom alfalfa. Seed planting depth should not exceed 1/2 in.

Adapted Varieties – A limited number of reed canarygrass cultivars have been developed. The variety **Vantage** was developed at Iowa State University and has better seed retention and heads 2 to 3 days earlier than the cultivar **Rise.** The varieties **Venture** and **Palaton** were released by the Minnesota Agricultural Experiment Station and the USDA as the first commercial varieties with enhanced palatability, low gramine, and low alkaloids. **Rival** is another low-alkaloid variety, however it has higher concentrations of some alkaloids than Venture and Palaton.

DROPSEED, SAND

[*Sporobolus cryptandrus*; Native]

Introduction – Sand dropseed is commonly found growing on sandy soils in the Intermountain Region with summer precipitation patterns. It is used in revegetation programs. Sand dropseed is moderately eaten by livestock and is utilized as a winter forage when other, more palatable species, are unavailable.

Adaptation – Although this species is common in all western states, except California, it is most important in parts of the Snake, Salmon, and Clearwater River

Dropseed, Sand

drainages in Idaho and Oregon. It most commonly appears at lower elevations on sandy soils. However, it has been observed on dry coarse soils up to 8,000 ft. It is best adapted to desert areas that receive 8 to12 in of annual precipitation. Sand dropseed is extremely drought tolerant. In its northern range, sand dropseed occurs in association with cheatgrass, bluebunch wheatgrass, Indian ricegrass, Idaho fescue, shadscale, and Galleta grass in sagebrush, salt desert zones, and in canyons throughout the Intermountain Region. In its southern range it is often associated with side-oats grama, muhly grasses, and beardgrasses. This plant is a prolific seeder and when protected or grazed properly, tends to increase on poor condition rangelands.

Limitations – The seed coat of sand dropseed is very hard and scarifying the seed before planting results in better germination.

Uses – Sand dropseed is used as a component in many reseeding projects on western rangelands. Its forage is fairly palatable and utilized by both wildlife and livestock. However, in many places throughout the west this species has been greatly reduced by overgrazing.

FESCUE, CREEPING RED

[*Festuca rubra*; Native]

Introduction – Creeping red fescue is a long-lived, low growing, competitive (but slow developing), perennial grass that is native to North America and Europe. It has dark green basal leaves with a reddish lower sheath. Stems are nearly leafless and range in height from 6 to 25 in. Due to its spreading ability, creeping red fescue is used for erosion control along roads, highways, streams, and other disturbed areas where precipitation exceeds 15 in. It is less drought tolerant than sheep fescue. Creeping red fescue is mainly used to provide ground cover for turf. It is particularly important in shaded locations and on sandy soils. In addition, it provides ground cover for wildlife.

Adaptation – Creeping red fescue does best in high rainfall areas or where it is irrigated. It tolerates spring flooding, limited water logging, and grows well under irrigation. It is adapted to gravelly, calcareous, well drained soils in cool, temperate climates throughout the northern hemisphere. It prefers a soil pH of 5.5 to 6.5, but can survive on soils with higher acidity. It requires more moisture than hard or sheep fescue, but can be grown as a dryland cover crop in coastal regions or other areas with average annual precipitation greater than 18 in. It tolerates low fertility soils fairly well and is moderately tolerant of saline soils. Creeping red fescue will persist in sun or shade.

Limitations – Creeping red fescue is only moderately drought tolerant and must have adequate water to produce satisfactory yields. When snow cover is heavy, reports suggest that the forage is susceptible to snow mold that seriously weakens the stands. Creeping red fescue is also susceptible to winter crown and root rots.

Plant Nutrient Needs – Under pasture management, nitrogen, phosphate, and potassium fertilizer should be added to the field at or before planting. Other nutrients should be included based on soil test results.

Hay and Pasture Management – Since most of its forage remains below the cutting edge of the harvesting equipment, hay yields are generally low in creeping red fescue. Subsequently, creeping red fescue has not been recognized as an important harvested forage. Creeping red fescue is most suited to pasture production where it is tolerant of close grazing. If creeping red fescue is grazed at proper stocking rates with adequate rest periods between grazing, it can become a high-yielding permanent pasture that maintains or even increases in yield over years. Seedlings of creeping red fescue are vigorous and easily established. Newly seeded areas require protection from heavy trampling or grazing for at least one year or until the stand is well established. Creeping red fescue greens up early in spring followed by reduced growth during mid summer and increased growth in fall. Palatability is only fair. Leaves of creeping red fescue retain their nutritive value into late fall and early winter. To improve the forage quality of creeping red fescue it should be grown with one or more legumes. Planting depth of creeping red fescue should not exceed 1/4 in.

Adapted Varieties – Most of the available varieties are for use as turf in lawns or on disturbed sites for revegetation. The variety **Dawson** was released for use in mixtures with other fescues on extremely saline soils associated with highly disturbed areas. The variety **Recent** was released for hay and pasture production.

FESCUE, HARD

[*Festuca ovina* var. duriuscula; Introduced]

FESCUE, SHEEP - includes hard fescue

[*Festuca ovina* and *Festuca trachyphylis*; Introduced]

Introduction – Sheep fescue is a long-lived, drought hardy bunchgrass. Sheep and hard fescue (*F. ovina* var. *duriuscula* Koch.) are perennial bunchgrasses that are native to the northern hemisphere of the Old World. Alpine fescue (*Festuca ovina* var. *brachyphylla* (Schult. Piper) is native to North America where it inhabits rocky slopes at high altitudes mostly above the timberline. It has broader, longer, coarser (less palatable), more lax leaves and is less drought tolerant than sheep fescue. Alpine fescue is smaller due to its subalpine environment than sheep and hard fescue. Sheep fescue is mainly used to protect soil on highly erodible landscapes and for weed control.

Adaptation – Sheep fescue prefers dry, sandy, gravelly, or rocky soils at elevations ranging from 3,000 to 7,000 ft that receive between 10 and 18 in of annual precipitation. It will tolerate low fertility, finer, moist soils, and shaded areas. Once established it competes well with other grass species and weeds. It often grows in association with other bunchgrasses, rabbitbrush, and sagebrush. Hard fescue is compatible with other species at higher elevation sites that receive between 12 and 22+ in of precipitation.

Limitations – Reseedings with sheep fescue on mountain ranges in the Intermountain Region have not been very promising in the past. It is a good seed

producer; however, seedling vigor is extremely low making it difficult to establish productive stands. It will not tolerate wet or saline-alkaline soils. Because of its tough basal leaves mowing is difficult.

Uses and Management – The primary use of sheep and hard fescue is for seeding erodible mountain soils where grazing is less desirable and ground cover and weed control is the goal. Spring seedings have been more successful than fall seedings. Dryland plantings should be made as early as possible in the spring. Once established, sheep and hard fescue are effective barriers to weed invasion. Sheep fescue is fairly resistant to grazing if managed properly. However, since it lacks strong seedling recruitment and rhizomes (spreading stems), it can be easily overgrazed causing extensive damage to the stand. If grazed or mowed, a 2 to 4 in stubble should be left. Sheep fescue is one of the first range grasses to green up in early spring. Seed placement of sheep and hard fescue should be about 1/4 in.

Adapted Varieties – With the exception of **Covar** sheep fescue and **Durar** hard fescue, all available varieties were selected and released as low maintenance turf grasses. Covar was released to control soil erosion and revegetation of disturbed areas. Covar is blue-green in color and is somewhat slow to establish. However, once established, it is very persistent, competitive, winter-hardy, and drought tolerant. It is adapted to well-drained soils with an annual precipitation of 10 in. Durar hard fescue was released for soil erosion and revegetation on disturbed lands in areas of 14 to 27 in of annual precipitation. Durar has smoother, wider, longer, greener, and tougher leaves than Covar sheep fescue and is less drought tolerant. Durar is widely adapted to well-drained soils.

FESCUE, TALL

[*Festuca arundinacea*; Introduced]

Introduction – Tall fescue is a long-lived, deep rooted, high producing, cool-season bunchgrass for use under a wide range of soil and climatic conditions associated with irrigated and semi-irrigated pastures of the intermountain valleys of the Intermountain Region. With the advent of irrigated pastures, tall fescue has became an important pasture species that can be either grazed or hayed and will persist under hot summers and cold winters. Tall fescue is less palatable than other pasture grasses, and when planted with other grasses may become the dominant grass over time. Under optimum conditions, tall fescue can reach a height of nearly 5 ft.

Adaptation – For optimum yields tall fescue is best adapted to moist soils rich in humus or clays in irrigated, subirrigated, or moderately wet environments receiving 18 in of annual precipitation. It is one of the more drought-tolerant pasture grasses. Tall fescue is tolerant of soils that vary from strongly acidic (pH 4.7) to alkaline (pH 9.5).

Limitations – Tall fescue is not well adapted to sandy soils having long periods of drought. Its seedlings generally take one growing season to become fully established. Forage production and animal preference are greatly reduced in tall fescue during late July and August in the Intermountain Region and production needs should be adjusted. Fungal endophyte problems can occur when livestock graze tall fescue in single species stands. This problem can be reduced, if not eliminated, by using endophyte-free seed at planting time. Symptoms of fescue toxicity include reduced weight gain/or milk production, rapid breathing, and increased body temperatures resulting in the animals always standing in the shade or watering holes. Tall fescue cultivars that are endophyte-free are readily available at most seed dealers (make sure to request endophyte-free cultivars).

Fescue, Tall

Plant Nutrient Needs – Forage yields of tall fescue respond to additional units of nitrogen. Apply 150 to 200 lbs of nitrogen per acre either in split applications (75 to 100 lbs of nitrogen each) or in a single spring application.

Hay and Pasture Management – Tall fescue makes excellent hay and should be harvested when the first seed heads begin to appear. Subsequent harvests can be made as growth permits. However, tall fescue is best suited for pasture production and produces most abundantly with irrigation and high fertility. Once established, tall fescue pastures can withstand heavier animal traffic than almost any other pasture grass. The grass is palatable to livestock when the leaves are young and succulent. However, it becomes coarse,

tough, and unpalatable with age. Tall fescue can be continuously or rotationally grazed leaving 2 to 4 in of stubble. Stocking rates should be high enough to remove available forage evenly and quickly or large clumpy stands will follow. Frequent grazing causes new tillers to be generated and produces a dense turf-like sod. If grazing endophyte infected tall fescue pastures, animals should not be allowed to graze during periods when temperatures and humidity are high. Tall fescue is an excellent low-cost winter forage. Tall fescue can be seeded with a legume to improve palatability and nutritive value. Ladino, red clovers or alfalfa can be grown with tall fescue. The recommended planting depth for tall fescue is 1/4 to 1/2 inch.

Adapted Varieties – Most forage type tall fescue varieties were developed for hay and/or pasture production under continuous to short-rotation grazing. Forage type varieties have soft laxer leaves. Due to the large number of varieties currently on the market, it is recommended that you consult the seed supplier in your area for up to date varieties or blends. Because there are many commercially available turf type tall fescue varieties and forage types that have the endophyte, make sure you request an endophyte-free forage type tall fescue. Commonly grown tall fescue varieties in the Intermountain Region include **Alta**, **Fawn**, and **Forager**. The cultivar **Johnstone**, which is a hybrid between ryegrass and fescue, is used for pasture and hay.

FOXTAIL, CREEPING

[*Alopecurus arundinaceus*; Introduced]

Introduction – Creeping foxtail is a long-lived perennial grass that is adapted to a wide range of poorly drained and strongly acidic soils from sea level to high meadows where it is utilized as pasture, hay, or silage. Creeping foxtail is similar morphologically to meadow foxtail, but has more vigorous rhizomes and wider leaves. Creeping foxtail seed is generally black, hairy, and occasionally may have awns. Because of its high moisture tolerance and vigorous rhizomes, creeping foxtail controls erosion along streambanks, shorelines, and waterways. However, because of its aggressive rhizomes, it can become a weed problem along canals, ditches, and other waterways. The name "creeping foxtail" has often been confused with foxtail barley, *Hordeum jubatum* L., a weedy grass species. When headed, creeping foxtail resembles timothy, not foxtail barley.

Adaptation – Creeping foxtail is adapted to wet meadows from the central U.S. to the Pacific Northwest, where it is adapted to a wide range of soils. It performs well on sand, loam, clay, peat, and muck soils. It is tolerant of moderately acid (pH 5.6-6.0) and alkaline (pH 7.9-8.4) soils and has persisted on very wet soils with higher pH's. Creeping foxtail can tolerate up to 35 in of standing water for 45 days without injury. Creeping foxtail is not drought tolerant or resistant to continuous high temperatures; however, it has excellent cold tolerance at high elevations or northern latitudes.

Limitations – The major limitation to establishing creeping foxtail is seed that is light and hairy. The seed does not flow through traditional equipment unless the fine hairs are removed. Seed may be mixed with coarsely cracked grain or with two bushels of rice hulls per acre to prevent bridging in the seed equipment. In addition, seedlings of creeping foxtail are small and weak after emergence and growth is slow during the early stages of plant development. Seed shattering at maturity is a problem with creeping foxtail. The seed head ripens from the top of the head down. Because the seed is light, it is easily spread by air and water and may cause problems in waterways and native riparian areas.

Foxtail, Creeping

Plant Nutrient Needs – Creeping foxtail is responsive to high levels of nitrogen. However, under high levels of nitrogen fertilizer the potential for unsafe nitrate accumulations in foxtail is present. Adequate

nitrogen fertilization based on a soil test is required to maintain productive hay and pasture.

Hay and Pasture Management – Creeping foxtail is best used as a pasture grass on ground that can support increased stocking rates. Creeping foxtail is an excellent early season grazing grass compared to other cool-season species. On high elevations and wet meadows, creeping foxtail is used extensively for hay however early pasture use may be limited by wet soils. It produces excellent forage if harvested before flowering. Under a more intensive management, creeping foxtail responds to added nitrogen fertilizer with increased yields and rapid regrowth following harvest. Digestibility and crude protein are higher in foxtail than reed canarygrass. Creeping foxtail resists grazing and is preferred by animals over smooth bromegrass, reed canarygrass, and tall wheatgrass. It has good palatability early; however, it matures earlier than most species after which it becomes less palatable. Seed placement in the soil should not exceed 1/4 to 1/2 inch.

Adapted Varieties – **Garrison** is the most widely grown creeping foxtail variety in North America. It possesses vigorous rhizomes and is well adapted to wetland sites in temperate regions. Spikelets of Garrision shatter readily at maturity making seed harvest difficult. The variety **Dan** which was released in Canada was intended for hay and pasture production. It has good winter hardiness and moderate resistance to smut. Another Canadian variety **Mountain**, was selected for rapid early spring and fall growth, seed yield, and resistance to diseases.

NEEDLEGRASS, LETTERMAN

[*Stipa lettermanii*; Native]

Introduction – Letterman needlegrass is a native perennial bunchgrass adapted to mountain valleys and parklands at 6,000 to 10,500 ft elevation. It also does well in watershed areas.

Adaptation – Letterman needlegrass is best adapted to sites that include mountain loam, clay loam and semi-wet meadows receiving from 16 to 35 in of annual precipitation. It is frequently observed inhabiting the upper sagebrush and woodland zones to the dry, open parks and hillsides at subalpine elevations. It is often associated with lanceleaf yellowbrush, bluegrasses, western yarrow, and wheatgrasses in aspen and tall forb communities. Under heavy grazing, letterman needlegrass persists and often invades ranges that were once occupied with diverse standing tall forbs, wheatgrasses and bluegrass. The recommended planting depth is between 1/4 and 1/2 inch.

Uses – The major use of letterman needlegrass is as a conservation plant on highly disturbed or overgrazed areas.

NEEDLE AND THREADGRASS

[*Stipa comata*; Native]

Introduction – Needle and threadgrass is known for its long (4 to 5 inches) twisted awn. It is a deep-rooted bunchgrass that depends upon seed for reproduction.

Adaptation – Needle and threadgrass is widely distributed throughout the Western states and Great Plains. It ranges in habitat from dry, sandy or gravelly plains extending into the mountains at elevations between 4,000 and 8,000 ft. It is commonly associated with sagebrush, pinyon-juniper, and ponderosa pine zones of the Rocky Mountains and semi-deserts of the southwest.

Limitations – Due to the coarse leaves and long-twisted awns, needle and threadgrass is less preferred than other forages in mixed seedings. Animal injury can occur if grazing needle and threadgrass when the seeds are mature.

Uses – The forage value of needle and threadgrass is good during the early part of the growing season before the awns develop and again after the seeds are dropped in the fall.

NEEDLEGRASS, GREEN

[*Stipa viridula*; Native]

Introduction – Green needlegrass is a cool-season perennial bunchgrass that ranges from British Columbia to Minnesota, Kansas, New Mexico, Arizona, Nevada, and eastern Washington. Many of the needlegrasses occur as important components within natural plant communities and are important forage species in many areas. Of the needlegrasses, only green needlegrass, which is used on reclamation projects, has been successfully commercialized for seed production.

Adaptation – Green needlegrass is adapted to a wide range of soils, but prefers clayey soils on sites receiving 12 to 20 in of annual precipitation. It often occupies the plains and foothills at fairly low elevations and is common on mountain meadows and open hillsides up to 9,000 ft in Wyoming and Montana. At the southern limit of its range, green needlegrass occupies dry, open parks and canyons within the ponderosa pine belt.

Limitations – Green needlegrass has high seed dormancy. However, combinations of scarification and wet prechilling can reduce seed dormancy and improve seed germination. The presence of long awns (3/4 to 1 1/4 in) on green needlegrass cause it to be avoided by livestock and wildlife at maturity. In addition, green needlegrass is not as productive or persistent in its areas of adaptation as are the other cool-season grasses.

Uses – Due to early spring green-up many of the needlegrasses are important forage species in their natural plant communities. Because of its drought

tolerance, green needlegrass has been used on reclamation seedings. Suggested plant depth is between 1/4 and 1/2 in.

Adapted Varieties – Two selections of green needlegrass are commercially available. **Green stipagrass**, which is noted for its increased forage and seed yield, seedling growth and regrowth characters when compared to common green needlegrass, and the variety **Lodorm,** selected for its low seed dormancy.

NEEDLEGRASS, THURBERS
[*Stipa thurberiana*; Native]

Introduction – Thurbers needlegrass is a cool-season native, perennial bunchgrass that is found on western rangelands where it generally occurs as components of natural plant communities and is an important forage grass in many areas.

Adaptation – Thurbers needlegrass inhabits dry, well-drained soil on plains, ridges and in open forests throughout Washington, Oregon, Idaho, Wyoming, and California where it occurs in scattered clumps.

Limitations – The sharp-pointed awn may injure grazing animals by working into their eyes, ears, and nose.

Uses – Thurbers needlegrass is important for grazing in natural plant communities because of early forage availability when other species are not productive. Due to its exceptional drought tolerance, thurbers needlegrass is recommend for land reclamation seedings.

ORCHARDGRASS
[*Dactylis glomerata*; Introduced]

Introduction – Orchardgrass is a medium to long-lived, high producing perennial bunchgrass adapted to well drained soils. It produces long folded, light green leaves most of which are at the base of the plant. The flowering stems have few leaves and are 35 to 50 in high; the seed head is a panicle 3 to 6 in long.

Adaptation – Orchardgrass is shade tolerant and palatable to livestock and wildlife, especially in the early part of the season. It is a widely preferred species for hay, pasture, or silage. Orchardgrass is compatible with alfalfa and clover. It can be grown under irrigation or on dryland where the effective precipitation is at least 18 in. This species is also an excellent grass for range plantings on mountain brush, aspen, and mix conifers.

Limitations – One of the major limitations restricting the use of orchardgrass is its need for high moisture. Orchardgrass is significantly more drought tolerant than timothy, but less than smooth brome, meadow brome, and tall fescue. Orchardgrass is moderately winter hardy and it will not survive severe northern climatic conditions if snow cover is lacking. It is less winter hardy than smooth and meadow bromegrass or timothy and is more vulnerable to diseases and insects than many pasture grasses. Orchardgrass requires soil with good internal drainage; it thrives in low lying areas only if they are well drained. Snow mold becomes a problem in areas where winter snows are deep and melt late. In the Intermountain Region, where humidity is generally low, reduction in forage production due to disease and insect damage is minor in orchardgrass.

Plant Nutrient Needs – At high levels of nitrogen and adequate water, orchardgrass is among the most productive cool-season grasses in the Intermountain Region. In general, split applications of nitrogen (N) give a better distribution of feed throughout the year. For hay, silage, or green chop, apply between 50-100 lbs N per acre in late fall or early spring and 50-75 lbs N per acre after each cutting. Due to nutrient recycling within grazed

Orchardgrass

pastures, three split applications of 40-60 lbs N per acre are recommended. For optimum production in orchardgrass, the soil pH should range between 5.8 and 7.5. In addition, on soils with low soil phosphorus, seedling regrowth may be slowed.

Hay and Pasture Management – Under hay management, orchardgrass should be harvested in boot stage. Any delay in harvest after heading (i.e., head emergence or early bloom) will increase the yield but reduce the quality and regrowth. If orchardgrass is harvested late, stands tend to become bunchy. Orchardgrass is well suited for pasture use since it regrows rapidly after grazing. It greens up early in the spring with excellent fall regrowth. Due to its palatability, repeated grazing below 3 to 4 in severely weakens the plant. Grazing management should include a rest period that allows 8 to 12 in of regrowth in order to maintain a healthy stand. Due to its bunchgrass growth habit, it could be planted in mixtures with moderately rhizomatous species rather than strongly rhizomatous grasses which will dominate the mature stand.

Adapted Varieties – There are early- mid- and late season varieties. Late maturing varieties are preferred in mixtures with alfalfa. Later maturing varieties of orchardgrass are higher in digestibility and protein than earlier varieties on the same date. The variety **Latar** is a late-maturing hay type orchardgrass and is recommended as the grass component with alfalfa mixtures. The variety **Paiute** is more drought tolerant than other strains and adapted to pinyon-juniper and mountain brush sites that receive at least 16 in of annual precipitation. Early maturing varieties adapted to the Intermountain Region include **Ambassador**, **Dawn**, and **Potomac**. These varieties are known for their improved seedling vigor, high yield, and good recovery after harvesting.

RICEGRASS, INDIAN

[*Oryzopsis hymenoides*; Native]

Introduction – Indian ricegrass is a cool-season perennial bunchgrass that is native to the arid and semiarid regions of the western United States where it is considered a valuable winter forage species. This species is one of the most drought tolerant native rangeland grasses. It is also recommended for mine land reclamation projects.

Adaptation – Indian ricegrass's area of adaptation extends from the Nebraska sandhills west to the eastern slopes of the Cascade and Sierra-Nevada ranges and from Mexico to Canada at elevations up to 8,000 ft. Indian ricegrass prefers soils that contain up to 75% sand and receive at least 7 in of average annual precipitation. Within this region Indian ricegrass occupies low-lying salt desert ranges up through the pinyon-juniper belt where it grows in association with sand dropseed, black sagebrush, winterfat, shadscale, blue grama, galleta, wheatgrass species, needle and thread, and red threeawn. Indian ricegrass will tolerate moderately alkaline soils.

Ricegrass, Indian

Limitations – The major limitation in the use of Indian ricegrass is its high seed dormancy, which results in poor first year germination. As a result of high seed dormancy, most attempts to establish Indian ricegrass on sites with less than 12 in of annual precipitation have been unsuccessful. However on sites with 12 in or greater annual precipitation, plantings of Indian ricegrass are more likely to succeed. Seed dormancy can be reduced by sulfuric acid or mechanical scarification or using older lots of seed.

Uses – Indian ricegrass is valued as a high quality winter forage by all classes of livestock and wildlife. It cures well and is frequently stock piled for winter forage. Over grazing has greatly reduced the occurrence of this species on native sites. It should be noted that without grazing, stands of Indian ricegrass begin to decline by the fifth year. Indian ricegrass is of only minor importance on mountainous summer ranges. Planting depth can be up to 3 inches on sandy soils

depending on pre-treatments and soil types. Untreated seeds must be planted deeper than most species so moisture will break down the hard seed coat and promote germination.

Adapted Varieties – In the past, adapted varieties included **Nezpar**, which is adapted to northern areas and **Paloma** which is better adapted to southern areas. The most recent variety of Indian ricegrass is **Rimrock**, which has similar growth habit and forage quality to the other cultivars but is less susceptible to seed shattering.

RYEGRASS, PERENNIAL

[*Lolium perenne*; Introduced]

Introduction – Perennial ryegrass is a temperate (cool-season) short-lived perennial bunchgrass grass that is utilized in many forage-livestock systems. Because of its high forage quality and rapid establishment, perennial ryegrass has become an important forage within the coastal northwest, irrigated intermountain valleys of the west, midwest, and northeastern regions of North America. Most of the forage is concentrated near the base of the plant. Plant height ranges from 12 to 24 in. The spikelets are attached to the stems at right angles compared to other common grasses. Perennial ryegrass lacks awns, whereas annual ryegrass has awns. Other morphological characters of the two species are similar.

Adaptation – Perennial ryegrass should be restricted to the higher moisture and moderate temperature regions of the Intermountain Region. To produce high yields, perennial ryegrass requires 30 to 50 in of rainfall or supplemental irrigation annually and it possesses high fertility requirements. It is adapted to a wide range of soils. Perennial ryegrass will grow on soils that have a pH (soil acidity) between 5 and 8 with maximum yields being produced when the pH is between 6 (slightly acidic soil) and 7 (neutral soil). Well established stands of perennial ryegrass remain productive for 3 to 4 years. However, in most cases producers over-seed fields with up to 5 lbs of perennial ryegrass seed per acre each year either in early spring or late fall.

Ryegrass, Perennial

Limitations – Perennial ryegrass is not adapted to extended periods of heat or drought. In the Intermountain Region, during the later part of July and through August, perennial ryegrass production declines due to high temperatures and water stress. In general, when temperatures exceed 80 degrees F forage production declines. Within the Intermountain Region, perennial ryegrass is much less persistent than other perennial pasture grass species such as orchardgrass, tall fescue, timothy, meadow and smooth brome, and Kentucky bluegrass. Perennial ryegrass will not tolerate standing water for extended periods of time. If grazed too early after seeding, excellent stands can be reduced to poor stands. Perennial ryegrass contains the fungal endophyte *Acremonium lolii* which is linked to the occurrence of a neurological disorder in livestock known as ryegrass staggers. There have been reports of ryegrass staggers in Oregon and California.

Plant Nutrient Needs – Perennial ryegrass production increases with additional split applications of nitrogen. It is recommended that 45 lbs per acre of nitrogen follow each grazing cycle. Economically if only one application is feasible, then apply 150 lbs of N per acre in the spring.

Hay and Pasture Management – The principal use for perennial ryegrass is for pasture. Newly seeded perennial ryegrass pastures can be grazed within 2 months, if the vegetation is 10 to 12 in high. However, caution should be taken to insure that the plants are well established (4 to 5 leaf stage) or early grazing will result in poor stand persistence. Established stands can be grazed when vegetation is 4 to 10 in tall, but should not be grazed shorter than 1 in. Rest periods of 21 to 28 days are generally required between grazing. During the spring when forage production is at an optimum, the rest period duration may be reduced, with portions of the ryegrass pastures being hayed or taken as silage. This prevents the forage from becoming coarse and unpalatable later in the growing season. If ryegrass plants are allowed to produce seed heads before they are harvested, the subsequent regrowth will be much slower reducing forage production and quality throughout the grazing season. Under mechanical harvesting, the cutting height should be 3 in. Perennial ryegrass should be planted in a grass-legume mix, but due to a strong animal grazing preference towards perennial ryegrass

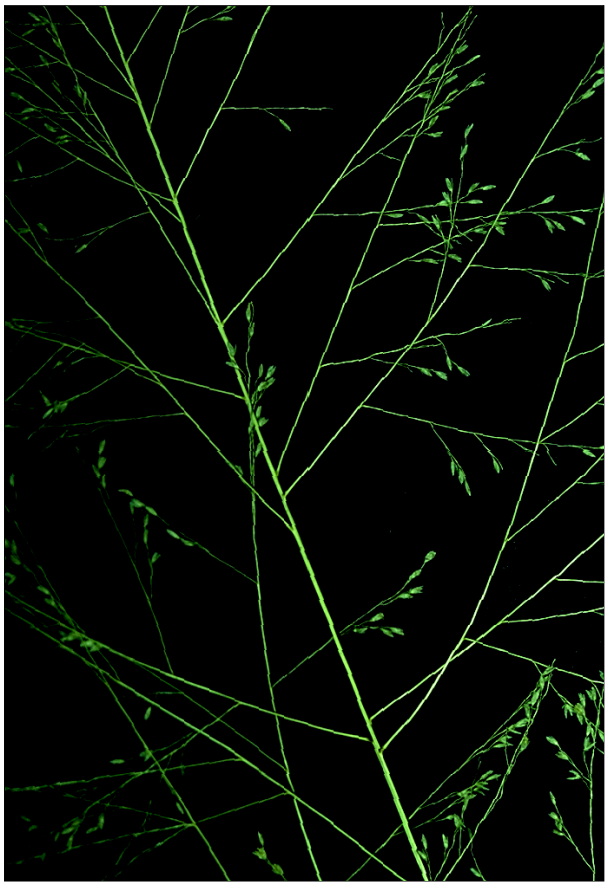
over other pasture grasses, should not be planted with other grasses for grazing. When planting perennial ryegrass fields, seed placement should not exceed 1/2 in.

Adapted Varieties – Most forage type perennial ryegrass varieties were developed for short-rotation pastures or green chop. Typically, perennial ryegrass varieties from Europe are more persistent through Intermountain West winters. Forage type varieties are characterized by having fewer, but larger tillers and wider leaves. Due to the large number of varieties currently on the market, it is recommended that you consult the seed supplier in your area for up to date varieties or blends. When requesting seed, make sure you request a forage type perennial ryegrass.

SACATON, ALKALI

[*Sporobolus airoides*; Native]

Introduction – Alkali sacaton is a robust, perennial bunch grass that is widely distributed from Washington to South Dakota, western Texas, and California. Throughout its northern range, alkali sacaton is of little importance; however, in the Southwest it is considered to be an important forage grass on alkali flats. In addition to a forage grass, alkali sacaton is utilized for erosion control. In its northern range, the forage value is considered poor compared to other available species.



Sacaton, Alkali

Adaptation – Alkali sacaton is best adapted to semi-desert alkali flats and meadows at elevations from 600 to 8,000 ft that receive 12 to 18 in of precipitation annually. Although alkali sacaton does best on alkali soils, it also persists on rocky sites, open plains, valleys, and bottom lands that are associated with arid and semiarid areas. It is commonly associated in plant communities supporting western wheatgrass, galleta, sideoats grama, pinyon-juniper, and greasewood.

Uses – Alkali sacaton should be grazed during the early part of the growing season. It becomes coarse, tough, and unpalatable as it matures. Alkali sacaton is not a good winter forage. It withstands the encroachment of shifting sand better than most grasses and is valued as an erosion control grass. Alkali sacaton is difficult to establish.

Adapted Varieties – Varieties **Salado** and **Saltalk**, which is considered more winter hardy, are intended for use on range reseedings, erosion control, and revegetation of disturbed areas on saline and alkaline sites.

SQUIRRELTAIL, BOTTLEBRUSH

[*Elymus elymoides*; Native]

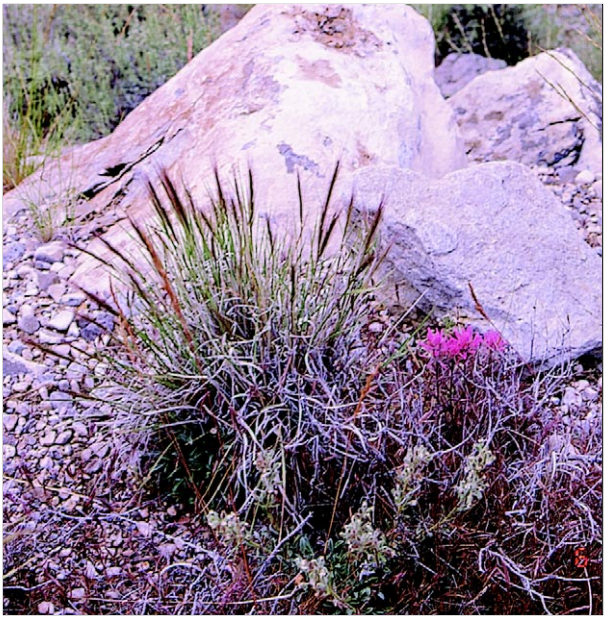
Introduction – Bottlebrush squirreltail is a short-lived, perennial bunchgrass, 6 to 22 in tall. It has fair seedling vigor. Bottlebrush squirreltail provides energy for grazing animals in winter and greens up early in spring. However, it becomes unpalatable at maturity. Squirreltail is utilized as a soil cover plant on erosion control seedings and as a successional species in rangeland plantings.

Adaptation – Bottlebrush squirreltail is well adapted to a variety of soils on hillsides, plains, and saline/alkali flats. It establishes well in areas that support sagebrush, shadscale, wheatgrasses, and pinyon-juniper that receive 8 to 18 in of annual precipitation.

Limitations – The bristly spikes (awns) of bottlebrush squirreltail are objectionable to livestock and create difficulty in seed handling, cleaning, harvesting and planting. When bristles are present, squirreltail is poorly utilized, particularly later in the growing season.

Uses – In the desert regions of Utah and Nevada it is considered an acceptable fall and winter forage. In addition bottlebrush squirreltail is used with limited success for reclamation and restoration of rangelands dominated by weedy species.

Available Germplasm – The only commercially available germplasm of bottlebrush squirreltail is **Sand Hollow**, however, additional sources of seed include wildland collected. Sand Hollow squirreltail was originally collected in Gem County, Idaho, and is



Squirreltail, Bottlebrush

adapted to sandy soils throughout the mountain foothills of the Snake River Plain in southern Idaho, Oregon, Nevada, and Utah. Its intended use is for reclamation and restoration of rangelands dominated by annual grasses.

TIMOTHY

[*Phleum pratense*; Introduced]

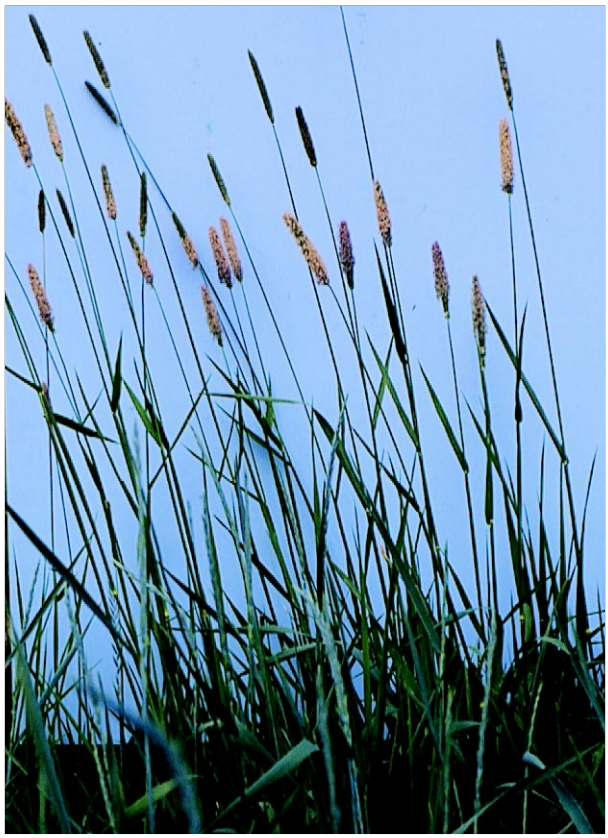
Introduction – Timothy is a widely grown forage grass in cool and humid regions of northeastern and northwestern North America. It is a palatable bunchgrass that performs well with moderate to high yields on wet fertile meadowlands. Timothy is frequently used as a ground cover to control erosion on cut-over or burned-over forest.

Adaptation – Timothy is adapted to cool, moist climates at high elevations where effective precipitation is 18 in or more. Recommended sites include moist mountain sites, ponderosa pine zones, meadows, aspens, and open forest. It can survive extremely hard, cold winters where snow cover may be limited. Timothy will not tolerate dry or hot periods throughout the growing season. It is tolerant of low soil acidity, moderately water logged soils, and can withstand spring flooding. Timothy can persist and produce adequate yields on clay, silt, and sandy soils, provided adequate moisture is available. Seedlings are vigorous and with adequate moisture, seedling establishment is fairly rapid. Of all the pasture grasses timothy is the latest to reach maturity.

Limitations – Perhaps the greatest limitation in timothy plantings is the rapid decline in forage quality as the plant matures. Timothy should not be grazed or cut prior to the heads emerging from the plants. Timothy produces an open sod that is easily weakened if heavily grazed and stands will be short-lived unless reseeding takes place. Recovery after grazing is much slower in timothy than for most other pasture grasses. Established timothy plants are intolerant of shade. Due to the small seed size of timothy, modifications to conventional drills or use of ricehulls are often needed to insure an even seed flow at the proper seeding depth.

Plant Nutrient Needs – Timothy is fairly tolerant of low fertility soils, however, the application of fertilizer, particularly nitrogen, increases both yield and protein. Multiple applications of 50 to 60 lbs of nitrogen in spring and then 50 lbs after each cutting (usually two harvests) or grazing event is recommended. If only one application is possible then apply 100 to 150 lbs of nitrogen in spring. When timothy is planted in a legume mixture, nitrogen may be eliminated from the fertilizer application. Timothy responds well to applications of phosphorus and potassium when limited in the soil. Plant production is the highest on soils that are between a pH of 6 and 7 (neutral).

Hay and Pasture Management – Timothy is a hay-type forage grass that it is easily weakened by frequent cutting or grazing. Cutting timothy once or twice for a hay crop and grazing the aftermath is a common



Timothy

practice in livestock farming. Most of the dry matter production will be produced in spring. Under grazing management, timothy should not be allowed to mature into the jointing stage before grazing is initiated. Timothy can be grazed in spring when vegetative growth reaches 3 to 4 in. It will tolerate moderate continuous grazing, but rotational grazing with a minimum recovery period of 3 to 4 weeks will improve timothy production and persistence. Forage production during mid July through August declines rapidly in timothy pastures. Forage quality of timothy is among the highest of the cool-season grasses early in the growing season when vegetative, but decreases rapidly as reproductive growth is initiated. Timothy seeds are extremely small and care should be taken to plant the seeds no more than 1/4 in.

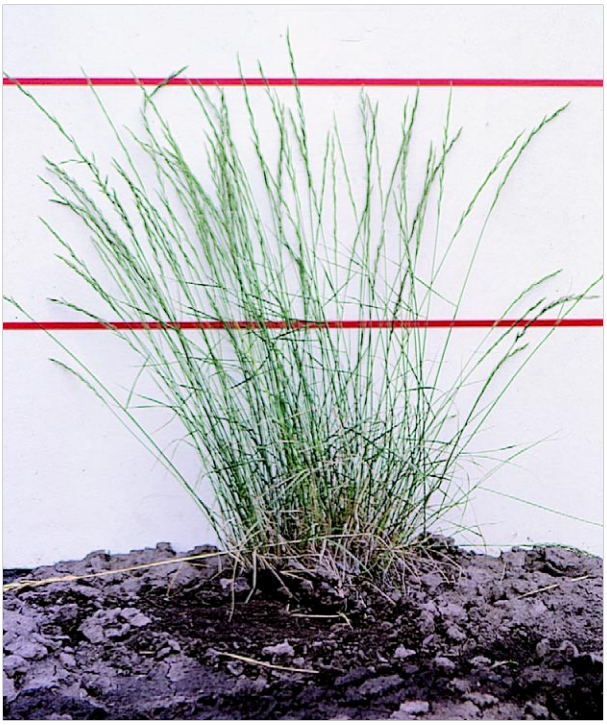
Adapted Varieties – There are early- mid- and late season varieties. Early maturing cultivars have higher digestible dry matter than later maturing varieties when harvested at the same growth stage. Adapted varieties are **Climax** and **Mohawk**. Due to the large number of varieties currently on the market, it is recommended that you consult the seed supplier in your area for up to date cultivars or blends.

WHEATGRASS, BLUEBUNCH

[*Pseudoroegneria spicata*; Native]

Introduction – Bluebunch wheatgrass is a long-lived, drought-tolerant native bunchgrass that begins growth early in spring and regrows with the onset of fall rains. It is an important native grass of the Palouse Prairie and Intermountain sagebrush zones where it provides forage for livestock and wildlife. Because of its high nutritional value and palatability, bluebunch wheatgrass is considered to be one of the most valuable native range grasses.

Adaptation – Bluebunch wheatgrass is widely adapted, ranging from high elevations in the Sonoran Desert north to Washington, Montana, Colorado. It is adapted to dry mountain slopes, sagebrush, ponderosa pine, mountain-brush, and pinyon-juniper ranges receiving 10 to 20 in of precipitation annually. Bluebunch wheatgrass prefers coarse-textured soils, but will establish and persist on deep well-drained loamy soils. In the Palouse Prairie of eastern Washington, bluebunch wheatgrass is often associated with Idaho fescue on deeper soils and Sandberg bluegrass on shallower soils. In the Intermountain Region, bluebunch wheatgrass occurs as a co-dominant species with big sagebrush, pinyon juniper, and mountain brush on arid sites that receive 10 to 20 in of annual precipitation.



Wheatgrass, Bluebunch

Limitations – Bluebunch wheatgrass regrows rapidly after grazing; however, it will not tolerate heavy or repeated grazing during the growing season. In mixed stands, bluebunch wheatgrass is preferentially grazed causing stands to decline rapidly. Poor seedling vigor in bluebunch wheatgrass requires several years for stands to reach full productivity. During seedling establishment, plants should be allowed to reach maturity (seedhead development) before grazing.

Hay and Pasture Management – Bluebunch wheatgrass is not recommended as a hay crop. It can withstand early light grazing before elongation of flowering stems and heavier grazing after seed ripening, but not in between. Grazing systems should be adjusted to remove only 50% of the annual forage. The recommended planting depth should not exceed 1/2 inch.

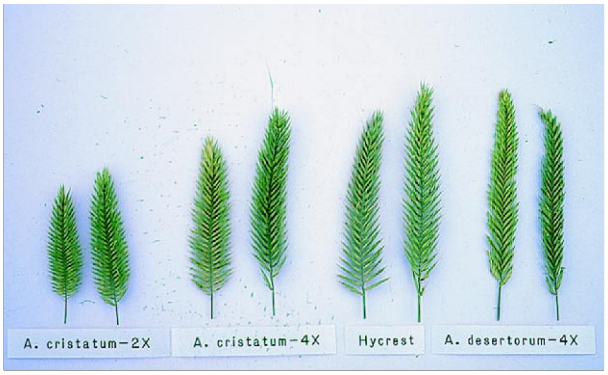
Adapted Varieties – The variety **Whitmar** originated from a population collected in the Palouse of eastern Washington. Whitmar's poor seedling vigor has impeded its general acceptance. The variety **Goldar** originated from the Umatilla National Forest, Asotin County, Washington. Goldar is noted for improved drought resistance and ability to persist on harsh sites. It is slightly more cold tolerant than Whitmar. Goldar is well adapted to areas above 3,000 ft elevation with over 10 in of annual precipitation. **Secar**, previously considered to be bluebunch wheatgrass, but identified as Snake River wheatgrass, is more vigorous and productive than bluebunch wheatgrass (see Snake River wheatgrass).

WHEATGRASS, CRESTED

[*Agropyron cristatum*, and *A. desertorum*]

Introduction – Crested wheatgrass is a long-lived, drought tolerant, bunch to moderately rhizomatous range grass that is adapted to a wide range of ecological sites and zones receiving as little as 10 in of precipitation. Forage production and palatability are high from mid April to mid June, but begin to decline rapidly by early July. Crested wheatgrass has good seedling vigor. Within the crested wheatgrasses two morphological types are recognized; Fairway (*A. cristatum*), and Standard (*A. desertorum).* The fairway type has short-broad heads that taper at the top with smaller seeds, has shorter stature and finer leaves and stems than the standard types. The standard type heads are longer than the fairway type, but vary in seed head shape from comb-like to oblong. In North America, the Standard type is most common with the Fairway type more prevalent in Canada.

Wheatgrass, Crested



Fairway Hycrest Nordan

Adaptation – In North America, crested wheatgrass is particularly well adapted to the northern and central Great Plains, and the Intermountain Region. In general, crested wheatgrass has excellent drought resistance and has been used successfully on rangeland sites receiving from 10 to 20 in of annual precipitation. Standard-type cultivars are more drought tolerant than the fairway-type. Crested wheatgrass does well on most fertile soils and is moderately tolerant of high alkaline soils. All crested wheatgrasses have excellent seedling vigor which results in stands that are relatively easy to establish under harsh environmental conditions. The crested wheatgrasses are adapted to foot hills, sagebrush, ponderosa pine, mountain brush, and pinyon-juniper ranges. Crested wheatgrass is one of a few grasses that has the ability to compete with difficult to control weedy annuals such as cheatgrass, halogeton, and medusahead.

Although crested wheatgrass is normally a bunchgrass without spreading roots, accessions with varying degrees of rhizome development have been acquired from Iran and Turkey. These introductions are shorter in stature and have finer leaves than typical crested wheatgrass. These have real potential for a low maintenance turf grass on semiarid sites. The root spreading characteristic is less prominent below 14 in of annual precipitation, but is rapidly expressed when precipitation exceeds this amount.

Limitations – Crested wheatgrass will tolerate short periods of spring flooding if they do not exceed 7 to 10 days. It is intolerant of soils with high water tables. Crested wheatgrass is less tolerant of soil salinity than tall wheatgrass, western wheatgrass, and quackgrass. At elevations above 6,500 ft in the Intermountain Region, expect reduced plant vigor and poor stands of crested wheatgrass. In general, crested wheatgrass is not adapted to moist soils and cool-short growing days with high humidity.

Plant Nutrient Needs – The quality and seasonal distribution of crested wheatgrass forage is improved significantly by the application of 50 lbs per acre of nitrogen fertilizer in the spring and fall of each year. When planted in a mixture with forbs and legumes, the nitrogen component can be eliminated. Many unproductive crested wheatgrass pastures can be brought into productivity with several applications of nitrogen. Under droughty conditions applications of nitrogen fertilizer can severely reduce productive stands.

Hay and Pasture Management – Crested wheatgrass produces abundant forage and is more widely used for grazing than hay. The greatest utility of crested wheatgrass is likely achieved when it is used as a cool-season component in a grazing system with native range species that are more productive during the hot summer period. Crested wheatgrass compares well

with other grasses in hay yield and quality during early spring, but forage quality deteriorates rapidly after heading. In the northern regions of the Intermountain Region, the standard type remains greener longer than the fairway type under severe drought and can withstand longer drought periods without stand reduction. It is generally recommended that it be grazed most heavily during the spring and early summer. Compared to native prairie range, it yields about twice as much and can be stocked heavier during the spring growing season. However, crested wheatgrass does not tolerate continuous overgrazing and approximately 3 in of regrowth should remain at the end of the grazing season. Seeds should be planted no deeper than 1/2 in.

Adapted Varieties – Fairway and standard type varieties are widely adapted to most soil types which receive an effective precipitation of 10 to 12 in annually. The standard type variety **Douglas** requires 13 to 15 in of effective precipitation annually. Adapted bunch type varieties include **Hycrest**, **CD-II** (superior seedling vigor), **Nordan**, and **Fairway** crested wheatgrasses. Adapted spreading crested wheatgrass varieties include **Ephraim** and recently released **RoadCrest** which with spreading roots and low canopy becomes a good choice for roadside stabilization and beautification.

WHEATGRASS, INTERMEDIATE

[*Thinopyrum intermedium*; Introduced]

Introduction – Traditionally, intermediate and pubescent wheatgrass (*Agropyron trichophorum* (Link) Richt.) have been distinguished based on the presence or absence of pubescence on the leaves and seed heads. Recent studies have demonstrated that this character is not consistent for the two grasses across all environments. Based on that data, within this manual, pubescent wheatgrass will be treated as a type of intermediate wheatgrass. Intermediate wheatgrass is a moderate sod-forming, late maturing, long-lived (15 to 20 years) grass suited for use as hay and pasture, alone or with alfalfa. Forage production begins early in spring, and remains green and palatable into summer providing soil moisture is adequate. Intermediate wheatgrass retains fair forage quality after frosts in fall and can be used as a late fall or early winter forage. Because of its ability to form a sod quickly, intermediate wheatgrass has been used as a reclamation plant for soil stabilization.

Adaptation – Intermediate wheatgrass grows best on well-drained, fertile soils that receive 12 to 18 in of annual precipitation. It is recommended for sagebrush sites and high mountain areas up to 9,000 ft. It is moderately tolerant of shade and alkalinity. As a general rule, intermediate wheatgrass is adapted to sites currently occupied by smooth bromegrass. Yields and stand persistence can be increased in intermediate wheatgrass if grown with a legume. In drier areas (less than 15 in of precipitation) intermediate wheatgrass yields more than smooth brome and crested wheatgrass; however, after several years intermediate wheatgrass yields decline. The pubescent form of intermediate wheatgrass is recommended for pasture plantings in regions with less fertile soils that receive 14 to16 in of precipitation.

Limitations – Intermediate wheatgrass is not as drought resistant or winter hardy as crested wheatgrass. Winter injury in intermediate wheatgrass is intensified when plants are stressed for water entering the fall. Intermediate wheatgrass will not persist on high saline sites or soils with high water tables. Intermediate wheatgrass is sensitive to intensive grazing and should be rested during each grazing cycle. Forage quality of intermediate wheatgrass declines rapidly as the plant matures.

Plant Nutrient Needs – Under irrigation or limited irrigation, an annual application of 50 to 100 lbs/acre of nitrogen fertilizer extends the forage production further into the summer where it is recommended for short-season irrigation.

Hay and Pasture Management – Intermediate wheatgrass is a highly palatable forage under limited irrigation and on dryland sites receiving more than 15 in of annual precipitation from early spring to late summer. Due to its late maturity (1 to 2 weeks later than crested wheatgrass), intermediate wheatgrass is a preferred

Wheatgrass, Intermediate

grass component in mixtures with alfalfa and other legumes. On dryland sites receiving greater than 15 in of precipitation, mixtures of intermediate wheatgrass and alfalfa out produced crested wheatgrass-alfalfa mixtures and smooth brome-alfalfa mixtures. Because of intermediate wheatgrasses relatively late maturity and quality retention after frost, it has been effectively used for grazing during fall and early winter in the Intermountain Region. Careful management is essential to the longevity of intermediate wheatgrass stands. It does not withstand continuous or close grazing or haying, particularly, at the earlier stages of establishment. Recommended planting depth should be no deeper than 1/2 inch. Intermediate wheatgrass seed is large and seeding can be made with conventional grain drills.

Adapted Varieties – Adapted varieties include: **Greenar** which is selected for forage production and compatibility with alfalfa, **Oahe** which has improved seed production and rust resistance, **Tegmar** which is a low-growing cultivar noted for its erosion control, sod-forming, and seedling vigor, and **Luna,** the most commonly used pubescent type in the Intermountain Region and the most drought tolerant. Several new varieties include **Reliant** which is selected for improved persistence, forage quality, compatibility with alfalfa, and forage and seed yields. It is adapted to regions of the Northern Great Plains and Intermountain regions where annual precipitation or irrigation averages more than 14 in. The variety **Manska** is adapted to the northern Great Plains and Intermountain Region and is noted for its high nutritive value, based on in-vitro dry matter digestibility and animal performance. **Rush** was selected for superior seedling emergence and vigor, good spring recovery, longer green period, and improved forage production. It is recommended for soil erosion control, roadside stabilization, mine spoil stabilization, hay and pasture under dryland and irrigation for livestock and wildlife.

WHEATGRASS, NewHy

[*Elymus hoffmannii*; Introduced x Native]

Introduction – 'NewHy'-RS hybrid wheatgrass is a cross between quackgrass and bluebunch wheatgrass. This cross combines the vigor, productivity, salinity tolerance, and persistence of quackgrass with the drought resistance, bunch growth habit, seed and forage quality of bluebunch wheatgrass. The rhizome development in NewHy could be compared to intermediate wheatgrass.

Adaptation – This new hybrid cultivar is recommended for range sites and pastures with moderate salinity problems that receive at least 14 to 16 in of effective annual precipitation. Forage quality is excellent. NewHy begins growth early in spring and retains a more succulent and palatable forage for livestock and wildlife later in the growing season than all other wheatgrasses on semiarid sites.

Wheatgrass, NewHy

Limitations – Under high soil fertility and adequate irrigation, forage yields of NewHy are lower than other pasture grasses (i.e., orchardgrass, meadow brome, and tall fescue). However, on saline soils where irrigation is limited or absent, NewHy will persist and provide high quality forage when other pasture grasses are short lived and lack productivity.

Plant Nutrient Needs – NewHy is very responsive and somewhat dependent on applications of nitrogen throughout the growing season. Split applications of approximately 50 lbs of nitrogen per acre after each cutting or grazing cycle are recommended. However, if only one application is possible apply 150 to 200 lbs of nitrogen per acre in the spring of the year.

Hay and Pasture Management – Under hay management, NewHy should be cut at the pre-heading stage to maximize forage quality. When harvested later, forage quality declines with plant maturity. Under proper management, expect two crops of hay from a NewHy field. Another option is to harvest a hay crop in early summer and graze the regrowth in late fall or early winter as winter forage. NewHy can tolerate moderate grazing pressure after establishment. Under intensive management, NewHy requires at least 25 days between grazing events. However, during hotter portions of the summer, resting periods should be

extended from 25 to 35 days. Over a 3 year period, NewHy performed well under an intensive defoliation study with six cuttings per year. Salinity tolerance of NewHy approaches tall wheatgrass. On saline soils as either a hay or pasture crop, the forage quality (palatability and nutritional value) of NewHy is better than that of tall wheatgrass. To enhance forage production, NewHy should be planted with a legume. It is recommended that NewHy seed be planted no deeper than 1/2 inch.

Adapted Varieties – The variety **NewHy**.

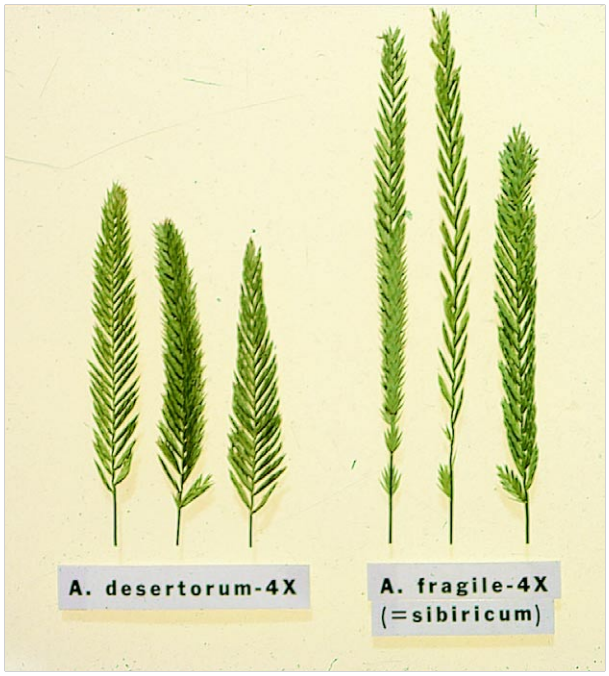
WHEATGRASS, SIBERIAN
[*A. fragilie*; Introduced]

Introduction – Siberian wheatgrass is a long-lived, drought tolerant, bunch-type range grass that is adapted to a wide range of ecological sites and zones receiving as little as 7 to 8 in of precipitation. Forage production and palatability are high from mid April to mid June, but begin to decline rapidly by early July. Siberian wheatgrass has good seedling vigor. Seed heads of Siberian wheatgrass are longer and much narrower than the standard and fairway crested wheatgrasses. Siberian wheatgrasses are awnless, with finer leaves and retain their greenness and palatability later into the summer than standard and fairway type crested wheatgrasses.

Adaptation – In North America, Siberian wheatgrass is particularly well adapted to arid and semiarid regions of the northern and central Great Plains, and the Intermountain Region. In general, Siberian wheatgrass is a long-lived perennial that has excellent drought resistance and has been used successfully on rangeland sites receiving from 7 to 20 in of annual precipitation. Siberian wheatgrass is noted for its ability to establish quickly on sandy soils. Siberian wheatgrasses are adapted to foot hills, sagebrush, ponderosa pine, mountain brush, and pinyon-juniper ranges. Siberian wheatgrass is one of a few grasses that can compete with difficult to control weedy annuals such as cheatgrass, halogeton, and medusahead wildrye in arid environments.

Limitations – Siberian wheatgrass will tolerate short periods of spring flooding if they do not exceed 7 to 10 days. It is intolerant of soils with high water tables. Siberian wheatgrass is less tolerant of soil salinity than tall wheatgrass, western wheatgrass, and New-Hy. At elevations above 6,500 ft in the Intermountain Region, expect reduced plant vigor and stands of Siberian wheatgrass.

Plant Nutrient Needs – The quality and seasonal distribution of Siberian wheatgrass forage is improved significantly by the application of 50 lbs per acre of nitrogen fertilizer in the spring and fall of each year.



Nordan Vavilov

Under droughty conditions applications of nitrogen fertilizer can severely reduce productive stands.

Hay and Pasture Management – The greatest utility of Siberian wheatgrass is likely achieved when it is used as a cool-season component in a grazing system with native range species on arid and semiarid rangelands. It is generally recommended that it be grazed most heavily during the spring and early summer. Compared to native prairie range, it yields about twice as much and can be stocked heavier during the spring growing season. However, Siberian wheatgrass does not tolerate over-grazing and approximately 3 in of regrowth should be left at the end of the season. Seeds should be planted no deeper than 1/2 in.

Adapted Varieties – The Siberian type wheatgrass occupies sites where standard crested wheatgrass will grow; however, it should be the plant material of choice on drier sandier sites that receive between 7 and 12 in of effective precipitation annually. Adapted varieties include **P-27** and the recently released, higher seedling vigor variety **Vavilov**.

WHEATGRASS, SLENDER
[*Elymus trachycaulus*; Native]

Introduction – Slender wheatgrass is a short-lived, native bunchgrass with good seedling vigor and moderate palatability. This self-fertilizing bunchgrass was the first native grass to be used in revegetation programs in the western U.S. and Canada. Slender wheatgrass tolerates a wide range of conditions and adapts well to high altitude ranges and more favorable

Wheatgrass, Slender

sites on sagebrush, pine zone, aspen, and tall-mountain brush regions. Due to its rapid seed germination and establishment, moderate salt tolerance, and compatibility with other species, slender wheatgrass is a valuable component in erosion-control and mine land reclamation seed mixes. In addition, slender wheatgrass has been widely used as a cover or nurse crop during establishment of longer lived species.

Adaptation – Slender wheatgrass is widely adapted throughout the western U.S. and Canada where it grows at elevations from 4,500 to 10,000 ft along dry to moderately wet roadsides, streambanks, meadows and woodlands from the valley bottoms to subalpine and alpine elevations in aspen and open coniferous forests. It is most common in Montana and Wyoming where it has been reported between 3,000 and 7,000 ft. It is less drought tolerant than many of the wheatgrasses, including crested and bluebunch wheatgrass, and prefers loams and sandy loams in areas receiving at least 12 in of annual precipitation. Salinity tolerance of slender wheatgrass is similar to that of Russian wildrye and less than that of tall wheatgrass or NewHy.

Limitations – Slender wheatgrass is short lived. It yields well for the first 3 to 4 years, and then stand density decreases rapidly. It is not as competitive with weeds as other wheatgrasses, but it is shade tolerant. It does not tolerate waterlogged soils. Slender wheatgrass is highly susceptible to the grass billbug (*Sphenophorus* spp.). Slender wheatgrass is not resistant to close grazing and continual heavy grazing reduces stands quickly.

Uses – Slender wheatgrass is most commonly used as a component of a mix in fire rehabilitation where it eventually gives way to longer-lived perennials. Only under a short rotation (alternating with annuals) cropping system should slender wheatgrass be used as a hay crop. When used for hay, it should be sown in mixtures with more permanent grasses which will dominate as slender wheatgrass dies out. Its protein content is lower than that of crested wheatgrass and smooth bromegrass during the early part of the season and at maturity, but is equal at mid-season. As a pasture grass, slender wheatgrass begins its growth relatively early in the spring and produces an abundance of palatable forage that is utilized by all classes of livestock and wildlife. When stockpiled, slender wheatgrass forage cures well and provides nutritious feed for winter grazing. Proper management of slender wheatgrass pastures is critical since it will not tolerate continuous grazing. The seed is larger than that of crested wheatgrass and is easily seeded with conventional seed drills. The recommended planting depth for slender wheatgrass is 1/2 to 3/4 inch.

Adapted Varieties – Four varieties, **Primar**, **Revenue**, **Pryor**, and **San Luis**, are available commercially. The variety Primar was released in 1933 based on superior vegetative vigor, early spring growth, alkali tolerance, and resistence to plant diseases. Primar is recommended for use in sweetclover-grass conservation mixtures. Revenue slender wheatgrass was released in 1970 and demonstrated better seedling establishment and vigor, salinity tolerance, forage quality, and yield. The variety San Luis was released in 1984 and noted for its rapid seedling establishment. In addition, it also matures later and has better persistence than the other slender wheatgrass cultivars. The most recent slender wheatgrass variety, Pryor, was released in 1988 and is noted for its superior salt tolerance, in addition, it has excellent seedling vigor. Pryor is recommended in the northern portions of the Intermountain Region as a short-term rotation for either hay or pasture as a nurse crop for initial cover and soil stabilization.

WHEATGRASS, SNAKE RIVER
[*Elymus wawawaiensis*; Native]

Introduction – Snake River wheatgrass is a long-lived, perennial bunchgrass native to Hells Canyon of the Snake River and its tributaries in Washington and northern Idaho. Morphologically, this taxon is similar to bluebunch wheatgrass, but genetically it is related to thickspike wheatgrass. It is adaptable to most areas suitable for bluebunch wheatgrass, but is more vigorous and drought tolerant. In addition, it has good seedling vigor. Snake River wheatgrass has been successfully established on sites that receive as little as 8 in of annual precipitation.

Adapted Varieties – The variety **Secar** was originally released as a bluebunch wheatgrass variety in 1981. It was later transferred to Snake River wheatgrass. Secar was derived from a collection made near Lewiston, Idaho. It is adapted to 8 in plus rainfall zones at lower elevations of the Pacific Northwest on Intermountain big and Wyoming sagebrush sites. It is an early maturing bunchgrass with good seedling vigor and establishes well in native seed mixes under drought conditions.

WHEATGRASS, TALL
[*Thinopyrum ponticum*; Introduced]

Introduction – Tall wheatgrass is a long-lived, coarse, vigorous, perennial bunchgrass with leaves that are long and erect. It is the latest maturing of the grasses adapted to the temperate rangelands of the West. Tall wheatgrass is particularly noted for its capacity to produce forage and persist in areas that are too alkaline or saline for other forage crops. Tall wheatgrass remains green 3 to 6 weeks later than most other range grasses and is often valued as a source of forage during late summer, fall, and early winter. Tall wheatgrass has comparatively large seeds and good seedling vigor. It has been used in wildlife plantings to provide nesting sites and food for upland game birds. Tall wheatgrass plantings are valuable wind barriers against drifting snow and soil erosion.

Adaptation – Tall wheatgrass is adapted to semiarid rangelands that receive a minimum of 14 in of precipitation annually, irrigated or sub-irrigated soils, or imperfectly drained alkali soils at elevations from 4,300 to 6,000 ft. In North America, it is widely used throughout the Intermountain West and the northern Great Plains in salty areas in association with greasewood and salt-grass. On saline soils, tall wheatgrass is easily established with good cultural methods. In soils where the salt concentration is around EC-16, it may require that the soluble salts be leached out or flushed with irrigation water before planting occurs. In the Intermountain Region, tall wheatgrass flowers late in July and seed ripens in September. Tall wheatgrass is winter hardy.

Limitations – The major limitation in establishing tall wheatgrass stands are that young seedlings are slow to establish. To ensure a successful seeding, it is recommended that one growing season be required for establishing tall wheatgrass on irrigated land and two growing seasons on drylands. The newly established plants should be allowed to mature and set seed before harvesting or grazing. Under extremely dry conditions, tall wheatgrass does not live long. Due to its late maturity, competitive ability, and tendency to become coarse during the growing season, it is recommended that tall wheatgrass be seeded alone rather than in a mixture with other grasses.

Hay and Pasture Management – Tall wheatgrass produces high yields of fair quality hay and can be harvested as silage. At the early heading stage, tall wheatgrass is higher in digestible protein and total digestible nutrients than most wheatgrasses. Tall wheatgrass, because of its late maturity, provides a long grazing period when used for pasture. An 8 in stubble should remain at the season's end to prevent animals from grazing too close the following year. Grazing should not be initiated the following season until at least 10 in of new growth have accumulated above the stubble. Palatability is fair early in the season, but the mature plant becomes very unpalatable and must be managed so it is utilized during early stages of growth. When planted in pure stands and fenced, tall wheatgrass is readily grazed by sheep, cattle, and horses. It must be heavily grazed (stocking rate) to maintain the plants in the vegetative state. However, tall wheatgrass does not tolerate continuous close grazing and requires a resting period between grazing events. It is a good winter forage for livestock; however, supplemental protein must be provided. Recommended planting depth is between 1/4 and 3/4 inches.

Adapted Varieties – The variety **Alkar** is widely used in the Pacific Northwest and the Intermountain Region on alkaline soils. Varieties **Jose** and **Largo** are widely used for soil improvement and pasture on saline and alkaline soils in New Mexico, Colorado, Utah, and Arizona at elevations up to 7,500 ft. A newer variety, **Platte,** has not gained wide acceptance in the Intermountain Region. This variety is noted for its winter hardiness and improved forage and seed production. It is particularly well adapted to alkaline sites in lower valleys of Platte River drainage in Nebraska.

WHEATGRASS, STREAMBANK

[*Elymus lanceolatus*; Native]

WHEATGRASS, THICKSPIKE

[*Elymus lanceolatus*; Native]

Introduction – Thickspike wheatgrass is a long-lived native of the northern Great Plains and Intermountain regions of North America. Streambank wheatgrass (*Elymus lanceolatus* spp. *psammophilus* Guillett & Senn) resembles thickspike wheatgrass morphologically. The major difference between the two grasses is the lack of hairs on the heads and seeds of streambank wheatgrass. Due to its low growing, sod-forming habit, streambank wheatgrass is valued primarily as a special purpose ground cover. It is particularly well suited for soil and water conservation on disturbed range sites and other dryland areas subject to erosion such as surface mines, roadsides, airports, recreational areas and construction sites, where it requires a minimum of maintenance. The thickspike wheatgrasses are forage types with most of the forage production taking place during the late spring and early summer when wheatgrasses such as crested wheatgrass are more mature and lower in nutritional value.

Adaptation – Thickspike wheatgrass is a sod-forming grass that is adapted to a wide range of soils. It prefers medium to coarse textured soils. It has perhaps the widest range of ecological adaptation of all wheatgrasses, extending from sand dunes to alkaline areas. However, it is only moderately tolerant to acidic and alkaline soils. Within the Intermountain Region, thickspike wheatgrass is found on the lower dry plains in central Idaho and up to 10,000 ft in the Wasatch mountains. Thickspike wheatgrass has good seedling vigor, better drought tolerance than western wheatgrass, and can withstand periodic flooding. Its seedlings are small and inconspicuous when young, but are drought resistant. They compete fairly well with weeds and other native grasses.

Wheatgrass, Streambank

Limitations – Mature stands of thickspike wheatgrass may become sod bound, and unproductive. However, rhizome development in thickspike wheatgrass is less than streambank and western wheatgrass. Stands of thickspike and streambank wheatgrass should not be grazed for at least one full growing year after planting.

Hay and Pasture Management – Thickspike wheatgrass is not commonly used for hay, and is more productive when utilized as a component of rangeland mixtures. Streambank wheatgrass is not recommended for forage production. Thickspike wheatgrass cures on the stem and retains much of its nutritional value. Thickspike wheatgrass begins growth early in spring and provides adequate grazing for wildlife and livestock until early fall when it becomes wiry. When grazing, 6 in of new growth should be attained in spring before grazing is initiated. Due to an aggressive rhizome, thickspike and streambank wheatgrass can withstand moderate grazing and considerable trampling. Planting depth should not exceed 1/4 to 1/2 inch.

Adapted Varieties – Adapted thickspike wheatgrass varieties include **Bannock**, **Critana**, **Schwendimar**, and **Elbee**. Bannock thickspike wheatgrass is adapted to the Northwest and Intermountain regions where precipitation averages 8 in or above. It prefers moderately deep loamy soils, but it does grow in sandy to clayey soils. It is noted for rapid establishment, moderate sod formation, high forage production, and ability to survive and thrive under dry conditions. Critana thickspike wheatgrass is drought tolerant, exhibits good seedling vigor, moderate to heavy sod formation, and readily establishes on critically disturbed sites. Schwendimar thickspike wheatgrass originated from wind blown sands along the Columbia River near The Dalles, Oregon. It is adapted to northwest sites with 8 in or greater precipitation and is recommended primarily for quick stabilization of coarse textured soils. Seed availability of Schwendimar is limited. Elbee thickspike wheatgrass is noted for its improved forage and seed yield and aggressive rhizomes. This cultivar has shown some susceptibility to leaf and stem rust under irrigation. Sodar, the only variety of streambank wheatgrass, is noted for its drought tolerance (8 in or greater annual precipitation), excellent seedling vigor, aggressive rhizomes once established, and its ability to compete with weeds. It is most commonly used for stabilization of disturbed sites.

WHEATGRASS, WESTERN

[*Pascopyrum smithii*; Native]

Introduction – Western wheatgrass is native to North America and is distributed throughout the western two-thirds of North America. It is an important rangeland and pasture grass in the central and northern Great Plains. It is long-lived, late-maturing, spreading, cool-season grass with coarse blue-green leaves. Because of its aggressive sod-forming characteristics, western wheatgrass is well adapted for stabilizing soils on sites subject to excessive erosion as well as rangelands disturbed by surface-mining operations, construction, overgrazing, brush control, and fires. Western wheatgrass is winter hardy and can survive drought along with flooding that occurs in shallow lake beds or excess surface drainage from spring run-off. Under arid and semiarid conditions, western wheatgrass is often confused morphologically with thickspike wheatgrass. In the Great Plains, it is often the dominant grass on salty and clay soils in abandoned farm land.

Adaptation – Western wheatgrass is adapted to a wide range of soils, but in the Intermountain area prefers the heavy and somewhat alkaline soils characteristic of shallow lake beds or along intermittent water courses that receive excess surface drainage. It requires moderate to high soil moisture and is most adapted to regions receiving 12 in or more annual precipitation. When annual precipitation exceeds 20+ inches, western wheatgrass usually becomes very aggressive forming grass monocultures. It has more resistance to alkali and saline soils than any of the native wheatgrasses. It is commonly found on open plains, hillsides, and bench lands. In addition, western wheatgrass can grow through thick layers of silt along streams and can withstand considerable flooding. As a mature plant, western wheatgrass can compete with weedy annual grasses. Western wheatgrass is commonly associated with blue grama and the needlegrasses of the Great Plains and with bluebunch and thickspike wheatgrasses and various shrubs of the Intermountain Region, where it is an important constituent of spring, summer, and early fall ranges. Its elevation range is 1,000 to 9,000 ft.

Limitations – Western wheatgrass germinates poorly and has low seedling vigor. It often requires 2 or 3 years to develop well established stands. As a result, plants are usually scattered and within 3 to 4 years may begin to dominate the site. Western wheatgrass is a poor seed producer. As a cool-season grass, western wheatgrass tends to become coarse and unpalatable during the hot summer period, which leads to selective grazing of other bunchgrasses grown in association with it. Consequently, continuous grazing of mixed stands often leads to a dominance by western wheatgrass.

Hay and Pasture Management – In the Intermountain Region, western wheatgrass is rarely used in haying operations. Forage yields depend largely upon the amount of moisture received during the early part of the growing season. Western wheatgrass produces excellent yields on spring flooded sites. Older stands of western wheatgrass often become sod bound with reduced forage yields. The reduction in forage yield can usually be overcome by pitting, chiseling, disking, and interseeding into older stands of western wheatgrass. When used as pasture, western wheatgrass is considered to be an excellent source of forage during the spring and early summer, where the protein content is reported between 16 and 18%. However, the quality of its forage declines rapidly as plants mature later in the season, and animals will prefer other species grown in association with it. Western wheatgrass is tolerant of grazing if 50 to 60% of the annual growth is allowed to remain (3 or 4 in stubble). When grazing, a rest period is required to maintain healthy mixed stands of western wheatgrass. Under continuous heavy grazing, western wheatgrass will disappear from stands. Despite stiff leaves, western wheatgrass cures well on the stem and provides good winter grazing if protein supplements are provided. Recommended planting depth should not exceed 1/2 inch.

Adapted Varieties – Varieties of western wheatgrass include **Barton**, **Rosana**, **Arriba**, **Rodan**, **Flintlock**, and **Walsh**. The variety Barton is recommended as a pasture, hay, and conservation plant in western Kansas, central and western Nebraska, and adjoining areas in Oklahoma and Colorado. Rosana western wheatgrass

Wheatgrass, Western

is adapted to the northern Rocky Mountains and adjacent Great Plains where it is used as a forage on irrigated pastures for hay and grazing, as well as in overflow sites and range seedings. Varieties Arriba and Flintlock were released for dryland hay production, grazing, and conservation seedings in the western part of the Central Plains and in the southwestern United States. The most recent variety releases include Walsh and Rodan. Walsh was released in Canada for its improved forage and seed yield, leafiness, freedom from disease, aggressive rhizomes, and uniform plant height. Its intended use is as a conservation and forage species in areas typical of Canadian prairies. Rodan was released in North Dakota as an upland drought-resistant type selected for improved seedling vigor and resistance to disease.

WILDRYE, ALTAI

[*Leymus angustus*; Introduced]

Introduction – Altai wildrye is a long-lived perennial with short creeping rhizomes that has excellent winter hardiness and drought resistance. Altai wildrye is native to western Siberia, the Altai mountain region between Siberia and Mongolia, and widely distributed throughout Kazakhstan.

Adaptation – It is most often found on semi-desert, alkaline meadows, steeps, and on sandy or rocky river and lake valleys. It is well adapted to loam and clay soils. Altai wildrye is almost as productive as tall wheatgrass on saline soils.

Limitations – The most serious limitations of Altai wildrye are slow seedling growth and low seed yields.

Wildrye, Altai

Uses – Forage of Altai wildrye cures well and maintains its nutritional value better during the late summer and early fall than many cool-season grasses. Erect culms and moderate forage quality make Altai wildrye a valuable species for extending the grazing season into the fall and winter.

Adapted Varieties – The oldest released and most widely used variety is **Prairieland**, which was selected for improved seed and forage yield, seed quality, and freedom from leaf spot. The most recent cultivar releases are **Eejay** and **Pearl**, which were selected for high seed and forage yield, emergence from deep seeding, seed quality, and resistance to leaf spot disease.

WILDRYE, BASIN

[*Leymus cinereus*; Native]

Introduction – Basin wildrye is a hardy, robust, long-lived perennial bunchgrass native throughout the western United States. It is tall, coarse, and highly palatable early in the spring, but becomes unpalatable with maturity. It is utilized by livestock and wildlife during calving for forage and cover. Poor seedling vigor usually results in sparse stands, but it is one of the highest producing grasses once established. It can be used as a component in native mixtures with other adapted plants to reseed rangelands, mine spoils, highway right-of-ways or other disturbed areas.

Adaptation – Basin wildrye is widely distributed throughout British Columbia to Saskatchewan, south to California, and east to Arizona and Colorado where it is adapted to fine-textured soils in valley bottoms, along roadsides, streams and in gullies. In sagebrush ecosystems, it is often found on well drained river banks or water courses, in ravines and other sites with high holding capacity. It is adapted to areas with an average annual precipitation of more than 8 in. It is moderately tolerant of alkaline and saline soils. Basin wildrye is often associated with other wheatgrasses, rabbitbrush, and sagebrush.

Limitations – As with other wildrye species, basin wildrye is usually difficult to establish. Poor seed fill along with low germination and seedling survival have limited its usefulness for range revegetation. New seedlings should not be grazed or harvested until late summer or fall of the second growing season. In addition, in regions where ergot is common, black sclerotia is frequently observed protruding from the spikelets. If abundant, this fungus should be considered poisonous to livestock, with the potential to cause abortions.

Hay and Pasture Management – When managed properly, basin wildrye is a valuable forage for winter grazing on western rangelands. However, overgrazing in many of these areas has depleted native stands. Avoid close grazing or clipping that may result in heavy plant loss in a single season. Also remove livestock from calving areas when growth initiates in the spring. It is recommended that a 12 in stubble height be left when grazed and a 10 in stubble be left when cutting for hay, silage, or green chop. Forage quality of basin wildrye in the winter is greatly reduced (crude protein around 3-5%), therefore if utilizing basin wildrye as a winter forage, protein supplements will be needed to ensure adequate animal health. Mature plants are unpalatable and need to be managed so they are utilized sooner in the growing season. Seedbeds should be firm with seeds planted between 1/4 and 1/2 in deep.

Adapted Varieties – Two varieties of basin wildrye are commercially available, **Magnar** and **Trailhead**. Magnar was selected for its improved seedling vigor, increased germination, and uniformity. It is characterized by its blue-green leaves and is more upright. Trailhead is more persistent than Magnar under severe drought stress. They are best adapted to range sites receiving between 10 to 20 in of annual precipitation at elevations between 1,900 to 9,000 ft.

Wildrye, Basin

WILDRYE, BEARDLESS

[*Leymus triticoides*; Native]

Introduction – Beardless wildrye is a sod-forming, salt tolerant, long-lived, perennial grass that is common throughout the west. It is observed more frequently along the Humboldt River in Nevada, often in association with giant and basin wildrye. Native stands of beardless wildrye are frequently cut for hay or utilized as a conservation grass on sites that are highly erodible. Despite its ability to persist and produce forage on harsh alkaline sites, it has not been used extensively in seeding mixtures because it is difficult to establish.

Adaptation – Beardless wildrye is adapted to poorly drained alkaline sites, and dryland saline seep discharge areas that receive from 8 to 12 in of rainfall annually. It can be effectively established on moist alkaline soils at low and medium elevations, and along

Wildrye, Beardless

streams and moist saline seep areas. Beardless wildrye's salt tolerance makes it a good weed control plant in saline irrigated pastures.

Limitations – Beardless wildrye is difficult to establish largely because of seed dormancy and poor seedling vigor. It does not compete well with weeds and other grasses during establishment. However, once established it is very rhizomatous and maintains stands for many years. The dormancy in the seeds is apparently due to impermeability of the outer seed coat.

Uses – Fall plantings of beardless wildrye are required because the seed must receive a cold treatment to germinate. This cool-season perennial rhizomatous grass provides early spring grazing for wildlife and livestock. Its ability to recover rapidly following inundation by spring flooding makes it an important erosion control plant.

Adapted Varieties – There are two commercially available varieties, **Shoshone** and **Rio**. Shoshone has aggressive rhizomes and its recommended use is for forage, soil stabilization, or cover on wet or wet-saline-alkaline soils. Rio has reduced seed dormancy and vigorous rhizomes. Its intended use is for soil stabilization on channel, stream, river slopes, and restoration of roadside, riparian, and rangeland areas.

Wildrye, Blue

WILDRYE, BLUE

[*Elymus glaucus*; Native]

Introduction – Blue wildrye is a caespitose, self-fertilizing species that is native to North America. Natural stands of blue wildrye are often found on burned-over forest lands. Its spikes are erect to somewhat nodding and leaf blades are flat and usually lax. Because it is highly self-fertile, genetic purity is relatively easy to maintain within ecotypes.

Adaptation – Blue wildrye is widely distributed in the western U.S., most commonly found in forested areas from the western sea coast to the high elevations in the Rocky Mountains. This species is tolerant of shade, and is particularly noted for its compatibility with woody plants.

Uses – It is valued as a grass cover in wind breaks, woodlots, and in shrub plantings. In these environments, blue wildrye reduces weeds with minimal competition to the seedling trees.

Adapted Varieties – There are no commercially available plant materials of blue wildrye. When considering wildland collected material, the coastal ecotypes are considered best adapted for general use and those from the interior are more promising as self-seeding cover crops.

WILDRYE, MAMMOTH

[*Leymus racemosus*; Introduced]

Introduction – Mammoth wildrye is a long-lived, drought tolerant, cool-season, sod-forming grass from the former USSR. Used for inland dune and highway stabilization in the Pacific Northwest, this coarse stemmed, tall growing species is unpalatable to livestock. However, in wildlife plantings it is utilized

Wildrye, Mammoth

as cover and provides nesting sites for upland game birds.

Adaptation – Mammoth wildrye is adapted to inland sand dunes, deep sands, and dredge spoils, where it will stop sand movement and provide permanent cover. It requires at least 7 in of rainfall annually. It prefers neutral to slightly alkaline soils with good drainage.

Limitations – Two years are required to grow plant plugs vigorous enough to transplant.

Uses – It is used for inland dune and highway stabilization. Because of its showy inflorescence, giant wildrye has been used as an ornamental.

Adapted Varieties – **Volga** mammoth wildrye is the only released variety. Volga is a tall, coarse, creeping, non-palatable wildrye used for sand dune and soil stabilization.

WILDRYE, RUSSIAN

[*Psathyrostachys juncea*; Introduced]

Introduction – Russian wildrye is a long-lived bunchgrass. Most of the forage produced is contained in the basal leaves that grow rapidly in spring and remain palatable throughout the summer and fall as long as soil moisture is available. In North America it has been successfully seeded most often on arid and semiarid rangelands of the Northern Great Plains and Intermountain Regions in areas receiving above 8 in of precipitation annually. It is adapted to heavy grazing. Once established, Russian wildrye competes effectively against undesirable plants within stands.

Adaptation – Russian wildrye is best adapted to the highly fertile loam and clay soils of the Intermountain Region; however, acceptable stands can be obtained on a wide range of soil types. Forage production and stand persistence decline on soils of low fertility. Russian wildrye is exceptionally tolerant of cold and drought. Its resistance to drought exceeds that of crested wheatgrass; however it is more difficult to establish. Within the Intermountain Region, Russian wildrye is adapted to sagebrush, mountain-brush, and pinyon-juniper sites. It is moderately tolerant of saline and alkaline soils and is particularly useful on soils too alkaline for crested wheatgrass and too dry for tall wheatgrass.

Limitations – Relatively slow seedling growth and development is the most serious limitation in obtaining acceptable stands of Russian wildrye. Stands are often difficult to obtain, particularly under severe soil water stress and where seeds have been planted too deep. Due to the poor seedling vigor, initial grazing should be restricted to at least the year after establishment when stands have reached maturity and set seed. Russian wildrye seeds tend to shatter soon after maturity, which is a major concern in commercial seed production. Strong winds or heavy rains during seed ripening can essentially decimate a seed crop. To prevent losses due to shattering, direct combining is generally not recommended. It does not tolerate spring flooding and is generally not well adapted to moist cool areas in the Intermountain Region.

Plant nutrient needs – Applications of nitrogen fertilizer at 50 to 100 lbs/acre/year has improved the long-term productivity of Russian wildrye, particularly on dry sites. If the application of nitrogen fertilizer is not feasible on dry sites, planting on wider spaced

Wildrye, Russian

rows (2 to 3 feet apart) can overcome the nitrogen deficiency and soil water depletion.

Hay and Pasture Management – Russian wildrye is not well suited to hay production. Due to the predominance of basal leaves, Russian wildrye is best adapted as a pasture grass in dry areas. As a cool-season grass, Russian wildrye initiates growth early in the season and although it may be less palatable than crested wheatgrass in spring, its basal leaves retain their green color and forage quality later in the grazing season than most temperate range grasses. Due to the excellent curing qualities of Russian wildrye, it can extend the grazing season during the fall and winter. It is tolerant of grazing and regrows quickly after grazing. It is recommended that Russian wildrye be grazed lightly in spring, and stock-piled for late summer, fall, and winter grazing when other grasses are less productive and of lower quality. If Russian wildrye is being grown for a seed crop, residues should be removed after harvest to maintain good seed yields. Light grazing should begin as soon after seed harvest as possible or residues be removed by baling. Forage yields have increased in stands of Russian wildrye when it is seeded with a legume. Legumes should be seeded in alternate rows or cross-seeded rows to decrease the competition from Russian wildrye plants. The optimum row spacing for seed production of Russian wildrye is 40 in, and 24 in for forage production. Recommended planting depth should be no deeper than 1/4 to 1/2 in (very sensitive to deeper placement).

Adapted Varieties – **Vinall,** an earlier variety, has poor seedling vigor, **Swift** is selected for seedling vigor and **Cabree** is selected for seedling vigor and reduced seed shattering. **Bozoisky-Select** has increased seedling vigor and forage production. The variety **Mankota** is selected for improved seedling emergence, increased forage yield, and seed yield. In planting Russian wildrye in the Intermountain Region, Bozoisky-Select and Mankota should be the varieties of choice.

CHARACTERISTICS OF GRASSLIKE SPECIES (Rushes, Sedges)

BULRUSH, ALKALI

[*Scirpus maritimus*; Native]

Introduction – Alkali bulrush is a perennial, rhizomatous wetland plant found at low to mid elevations in marshes, transient wet spots, pond margins, and backwater areas. It frequently forms large dense stands on alkaline and saline sites throughout the midwest and western U.S.

Adaptation – Alkali bulrush inhabits soils ranging from fine clay to sandy with a pH of up to 9.0. It survives periods of flooding, up to 3 ft, throughout the year. Its rhizomes are most aggressive when water tables are within 3 to 4 in of the surface. Alkali bulrush is recognized as a short-lived pioneering species that will be replaced with more permanent vegetation.

Limitations – Due to poor seed and seedling characteristics, direct seeding of alkali bulrush usually results in marginal stands. However, acceptable stands have been achieved by planting vegetative plugs combined with fluctuating water levels throughout the year. Livestock and big game rarely utilize this species as a forage due to its low palatability.

Uses – Alkali bulrush is used for erosion control, constructed wetlands, wildlife cover, and increased plant diversity. As a pioneering species, it reduces wind and wave erosion on exposed soils. Planting includes removing up to 1 ft of soil surface in a 3 ft area and placing the vegetative plug in the area.

Adapted Varieties – There are four released germplasm selections: **Bear Lake** (collected in Bear Lake County, Idaho), **Fort Boise** (collected in Canyon County, Idaho), **Stillwater** (collected in Churchill County, Nevada), and **Bear River** (collected in Box Elder County, Utah).

BULRUSH, HARDSTEM

[*Scirpus acutus*; Native]

Introduction – Hardstem bulrush is a rhizomatous, perennial wetland species that is found at low to mid elevations, below 7,500 ft, in marshes and along lake and reservoir shorelines. It is widespread throughout North America, but occurs most frequently in the West.

Adaptation – Hardstem bulrush inhabits areas of standing water ranging from 4 in to more than 8 ft. However, when exposed to extended periods of deep water, hardstem bulrush stands are reduced. Hardstem bulrush tolerates alkaline, saline, and brackish soils where it spreads by rhizomes. Spread can exceed 1 ft per growing season. Hardstem bulrush can also tolerate periods of drought and will resprout after fire.

Limitations – Due to poor seed and seedling characteristics, direct seeding of hardstem bulrush results in marginal stands. However, acceptable stands have been achieved by planting vegetative plugs combined with fluctuating water levels throughout the year. Fluctuating water levels increase rhizome development during establishment.

Uses – Livestock use hardstem bulrush as a winter forage under heavy snow. Stands of hardstem bulrush are valued by waterfowl for feed and nesting. Other uses include plant materials for constructed wetland, erosion control, and increasing biodiversity in wetland and riparian communities.

Adapted Varieties – Released germplasm selections include: **Camas** (collected in Jefferson County, Idaho), **Hagerman** (collected in Gooding County, Idaho), **Ogden Bay** (collected in Weber County, Utah), and **Stillwater** (collected in Churchill County, Nevada).

CATTAIL, COMMON

[*Typha latifolia*; Native]

Introduction – Common cattail is a tall, stout, rhizomatous perennial grasslike species that is found in large monotypic stands in water right-of-ways and drainage areas.

Adaptation – Common cattail is adapted to a wide array of soils ranging from gravelly to clay. However, it will not persist on heavy clay soils. It is often found in association with hardstem bulrush in marshes and along pond edges where it can become invasive. It is adapted to season-long

Cattail, Common

saturated soils or sites with standing or slow moving water up to 12 in deep. It will tolerate long periods of flooding or drought and is tolerant of saline soils.

Limitations – Propagation is generally by transplanting vegetative sprigs. Where adapted, common cattail can be very invasive to the exclusion of other species.

Uses – Common cattail provides cover and an abundant food source for waterfowl and muskrats.

RUSH, BALTIC
[*Juncus balticus*; Native]

Introduction – Baltic rush is a rhizomatous, perennial wetland species found throughout the Intermountain Region. Its ability to fix atmospheric nitrogen makes it an important component in wetland plant communities.

Adaptation – Baltic rush is found at low to mid elevations and occasionally in subalpine and alpine sites in wet depressions, swales, moist meadows, sloughs, and around springs. Many of these sites experience spring flooding followed by dropping watertable and periods of drought. Adapted soils range from silt to clay loams to coarse substrates, and peat. Baltic rush can persist on soils that are acidic to neutral and alkaline to sodic.

Limitations – Due to small seed and poor seedling characteristics, direct seeding of Baltic rush results in poor stands. However, acceptable stands have been achieved by planting vegetative plugs. Fluctuating water levels increase rhizome development during establishment.

Uses – Baltic rush provides cover and food for waterfowl, songbirds, and small mammals. It is not utilized by cattle as a forage. However, if heavily grazed this grasslike species tends to increase, making it an excellent plant for sites subject to heavy trampling and erosion.

Adapted Varieties – Released germplasm selections include: **Sterling** (collected in Bingham County, Idaho), **Roswell** (collected in Canyon County, Idaho), **Stillwater** (collected in Churchill County, Nevada), and **Railroad Valley** (collected in Nye County, Nevada).

Rush, Baltic

SEDGE, BEAKED
[*Carex rostrata*; Native]

Introduction – Beaked sedge is a medium sized rhizomatous perennial grasslike plant that occurs in large dense stands. It is adapted to moderately acidic and alkaline soils, where it is often used to create overhanging banks on streams.

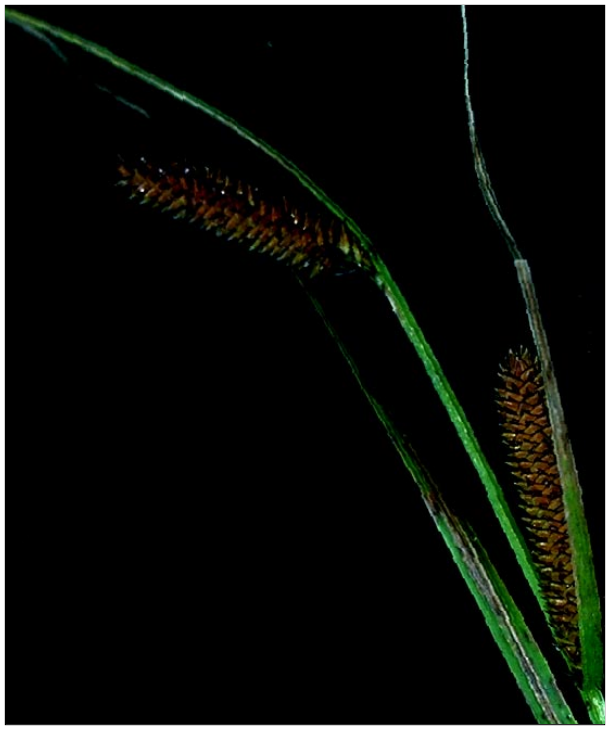
Adaptation – Beaked sedge inhabits elevations from 5,000 to 10,000 ft on soils that are saturated and standing water is 15 to 30 in deep throughout the year.

Limitations – Acceptable stands of beaked sedge have been achieved by planting vegetative sprigs from either greenhouse grown or wildland collected populations. Beaked sedge can take several years to establish a uniform stand.

Uses – Beaked sedge provides food and nesting habitat for waterfowl, upland game birds, and small mammals. Big game and other grazing wildlife utilize beaked sedge during the early part of the growing season.

SEDGE, NEBRASKA
[*Carex nebrascensis*; Native]

Introduction – Nebraska sedge is a rhizomatous perennial wetland grasslike plant that grows in low valleys to mid elevations. It forms dense stands and is often the dominant member of the wetland community throughout the western portions of the Midwest and western United States.



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Sedge, Nebraska

Adaptation – Nebraska sedge is adapted to moist meadows, marshes, swamps, ditches, seeps, stockwater pond areas, low to moderate gradient streams, riparian wetland, and lake shores where it can persist under water for up to 3 months. It also tolerates moderate to high alkaline soils. Once established, Nebraska sedge can tolerate periods of drought.

Limitations – Acceptable stands of Nebraska sedge have been achieved by planting vegetative sprigs. Direct seeding usually results in poor stands. During establishment, the water table should rarely drop below the root zone.

Uses – Nebraska sedge is a valuable forage species used by big game and livestock. It has moderate to good palatability early in the season, but becomes tough as it matures. It cures well and often becomes the preferred grazing species as other upland grasses go dormant. It provides cover for nesting waterfowl, seeds for small mammals and birds, and shoots are grazed by muskrats and geese. Conservation uses include: erosion control, constructed wetland, wildlife cover, and increasing biodiversity in wetland and riparian communities.

Adapted Varieties – Released germplasm selections include: **Sterling** (collected in Bingham County, Idaho), **Centennial** (collected in Camas County, Idaho), **Modoc** (collected in Modoc County, California), and **Ruby Lake** (collected in Elko County, Nevada).

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Sedge, Water

SEDGE, WATER

[*Carex aquatilis*; Native]

Introduction – Water sedge is a moderately rhizomatous grasslike perennial that grows in large stands at elevations from 5,000 to 10,000 ft.

Adaptation – Water sedge is adapted to moist soils (loams to silts) where it inhabits ponds, stream edges, marshes, and wet meadows. At lower elevations, water sedge will persist on gravelly/sandy soils. Water sedge has moderate tolerance for acidic, saline, and alkaline soils.

Limitations – After establishment, water sedge spreads slowly into surrounding areas.

Uses – Upland game birds, water fowl, and other birds harvest the seed for food. Wildlife and livestock utilize water sedge when more palatable forages are absent.

SPIKERUSH, CREEPING

[*Eleocharis palustris*; Native]

Introduction – Creeping spikerush is a strongly rhizomatous grasslike perennial wetland species that grows from low to mid elevations, distributed from the west coast of the U.S., east to the upper peninsula of Michigan and south to Louisiana.

Adaptation – Creeping spikerush inhabits wet meadows, irrigation ditches, springs, seepage areas, freshwater marshes, rivers, and lake shores. It is a pioneering species that establishes quickly in mud flats as water recedes. It can tolerate soils that are flooded up to 3 ft deep, throughout the growing season and saturated in the fall. It is best adapted to fine textured soils that are neutral, but will tolerate soils that are alkaline or saline. Creeping spikerush spreads rapidly by rhizomes and infrequently by seed. It is also capable of fixing atmospheric nitrogen, making it an important component in wetland communities.

Limitations – Planting vegetative sprigs from greenhouse or wildland collections is the best way to establish creeping spikerush. Vegetative sprigs should be placed 14 to 18 in apart. Open spaces will close within one growing season. To maximize stand establishment, water should fluctuate occasionally down to saturated conditions (without standing water) throughout the growing season.

Uses – Creeping spikerush has moderately high protein content in the spring and good digestibility. The upper portions are grazed by livestock and big game. It is used for erosion control, constructed wetland, wildlife cover, and soil stabilization.

Adapted Varieties – **Mud Lake** (collected in Jefferson County, Idaho), **C J Strike** (collected in Owyhee County, Idaho), **Malheur** (collected in Harney County, Oregon), and **Ruby Lake** (collected in Elko County, Nevada).

Spikerush, Creeping

THREESQUARE, COMMON

[*Scirpus pungens*; Native]

Introduction – Common threesquare is a rhizomatous grass-like perennial wetland species found at low to mid elevations in backwater areas of streams, ponds, reservoirs, and lake fringes. It occurs throughout the continental United States.

Adaptation – Common threesquare is adapted to soils that range from fine silty clay to sandy loam that frequently experiences 2 to 4 in of standing water. It is frequently associated with Nebraska sedge, creeping spikerush, and Baltic rush. It will tolerate alkaline and saline soils. Pure stands are not common.

Limitations – Due to poor seed germination, direct seeding of common threesquare results in poor stands. However, acceptable stands have been achieved by planting vegetative plugs. Fluctuating water levels increase rhizome development during establishment. Because of poor palatability, common threesquare is rarely grazed by livestock or big game.

Uses – Common threesquare is used for erosion control, constructed wetlands, and wildlife feed and cover.

Adapted Varieties – There are four released germplasm selections: **Market Lake** (collected in Jefferson County, Idaho), **Fort Boise** (collected in Canyon County, Idaho), **Malheur** (collected in Harney County, Oregon), and **Wayne Kirch** (collected in Nye County, Nevada).

CHARACTERISTICS OF FORBS AND LEGUMES

ALFALFA

[*Medicago sativa*; Introduced]

Introduction – Due to alfalfa's forage quality and palatability, it is often referred to as the queen of forages. Because of its ability to fix nitrogen, alfalfa improves soil fertility, competes with weeds, and is used extensively in crop rotations.

Adaptation – Alfalfa is adapted to a wide range of climatic and soil conditions. It can survive the cold of Alaska and the hot summers of California and Arizona. It is best adapted to deep well-drained soils under irrigation or in dryland situations where the annual precipitation is 12 in or more. It does not persist under heavy grazing on rangelands unless a recovery period is allowed. Newly selected varieties are currently available for rangeland and pasture utilization that

Alfalfa

have increased tolerance to grazing. Alfalfa has fair salt and alkalinity tolerance. Winter hardiness, disease, and insect resistance varies with cultivars and care should be taken to ensure that a winter hardy variety is planted.

Limitations – Alfalfa is sensitive to soil acidity and production is limited at pH levels less than 6.0. Forage production is reduced if alfalfa is subjected to periods of flooding for more than 2 weeks. Water logged or poorly drained soils severely limit production and increase the potential for disease. Alfalfa is sensitive to carbohydrate depletion in the roots and grazing should be managed to minimize loss of root reserves.

Plant Nutrient Needs – In alfalfa plantings, phosphorous and potassium are usually limiting and should be applied based on a soil analysis. The addition of phosphorous also increases alfalfa's tolerance to close grazing or haying management and decreases winter injury. Potassium increases the number of nodules present, which improves the rate of nitrogen fixation.

Hay and Pasture Management – Pasture grazing of alfalfa should be avoided when soil moisture is high lessening crown damage. Grazing rotations should be long enough to provide adequate regrowth, usually 30 to 35 days. Bloating can be a problem when grazing alfalfa; however, planting grass in a mix with alfalfa (75% grass and 25% alfalfa) will greatly reduce the risk of bloat. When used in a pasture, alfalfa should not be grazed below 3 to 6 in during spring and summer. Regrowth to 8 to12 in should be permitted prior to fall grazing. Removal of the top growth following a killing frost will allow utilization without reducing winter survival. If a pasture is continually grazed, varieties with creeping roots withstand grazing more effectively. Recommended planting depth is 1/4 to 1/2 in deep. Plant 1 lb per acre in pasture mixes and 10 to15 lbs per acre for hay. Caution should be taken when spring seeding to assure that new seedlings are not damaged by late killing frosts.

Adapted Varieties – Alfalfa varieties are being changed and improved continually, making it difficult to recommend specific varieties. Consult your county extension agent or seed supplier for information on alfalfa varieties adapted to specific areas.

ASTER, BLUELEAF

[*Aster glaucodes*; Native]

Introduction –- Blueleaf aster is a perennial native forb.

Adaptation – Blueleaf aster is well adapted to sites ranging from the upper sagebrush-grass communities to subalpine zones where it is found on exposed or depleted rangeland sites. It greens-up earlier in the spring compared to other forbs, making it a species with high animal preference and palatability.

Uses – Blueleaf aster has strong rhizomes making it a good species for stabilization of disturbed and erodible sites and for use in areas of considerable livestock or big game trampling. It should be surface seeded on disturbed soils or drilled to a depth of 1/2 in. Fall seeding is preferred.

BALSAMROOT, ARROWLEAF

[*Balsamorhiza sagittata*; Native]

Introduction–- Arrowleaf balsamroot is a long lived native perennial forb that grows to 2 ft tall and produces flowers that resemble sunflowers. Vigorous stands of arrowleaf balsamroot are an indicator of good grazing management on rangelands.

Balsamroot, Arrowleaf

Adaptation – Arrowleaf balsamroot is adapted to well drained soils on southerly facing slopes and open ridges on semiarid rangelands. This plant is drought tolerant requiring only 12 in of precipitation to persist, but it is better adapted to rangelands with higher precipitation.

Limitations – Arrowleaf balsamroot may take 5 to 7 years to become fully established. The foliage of arrowleaf balsamroot becomes dry and tough during the latter portions of summer at which time it is not utilized by wildlife and livestock. It will survive brief periods of soil saturation but is intolerant of high water tables. Seedlings of arrowleaf balsamroot develop very slowly and seed quality and production is generally low.

Uses – Arrowleaf balsamroot is preferred by browsing animals and will withstand heavy use by livestock and wildlife. New spring growth is readily utilized by livestock and wildlife. The yellow flowers are preferred by sheep and deer. Arrowleaf balsamroot recovers quickly from grazing, trampling, and fire. Recommended seeding depth is 1/3 in.

BURNET, SMALL

[*Sanquisorba minor*; Introduced]

Introduction – Small burnet is a hardy, long-lived, non-leguminous forb. Plants reach heights of 6 to 25 in depending on the amount of annual precipitation.

Adaptation – Small burnet is adapted to well drained soils that range from moderately basic to weakly acidic. It inhabits elevations ranging from 1,000 to

Burnet, Small

6,000 ft in areas that receive 14 to 25 in of annual precipitation. It will establish in low rainfall areas, but will not persist. Small burnet is known to provide high quality forage for livestock and wildlife throughout the growing season. It remains green throughout the growing season and into the winter until covered by snow. Small burnet is compatible with most non-aggressive species in mixtures.

Limitations – Small burnet does not tolerate shade, poorly drained soils, or soils that have a high water table or experience flooding. Seedling vigor is fair but plants are slow to establish. Small burnet is not drought tolerant and can be grazed out because it remains green later in the growing season. It is recommended that grazing of small burnet be deferred until the second season.

Adapted Varieties – **Delar** small burnet is the only commercially available variety. It was selected for good seed and forage production, cold tolerance, and palatability for wildlife and livestock. Delar's intended use is for erosion control, livestock and wildlife forage, and rangeland improvements. It is recommended that Delar be planted no deeper than 1/4 to 1/2 in.

CLOVER, ALSIKE

[*Trifolium hybridum*; Introduced]

Introduction – Alsike clover is a short lived perennial legume that produces abundant forage on fertile soils. It is adapted to low, wet areas on a wide range of soil types, except sand, and prefers heavy soils.

Adaptation – Alsike clover can be planted alone but produces best when planted with other legumes or grasses. It will tolerate soils that are completely waterlogged and will withstand spring flooding up to 6 weeks. Alsike clover will tolerate more alkalinity than most other clovers. It is easy to establish with minimal land preparation. Of the legumes, it is the most tolerant of cold and frost heaving. Damage from insects, disease and depletion of root carbohydrates are

uncommon, giving alsike clover's good winter hardiness.

Limitations – Alsike clover does not tolerate shade. When planting alsike clover in a pasture, use low growing companion species. It is intolerant of drought and high temperatures. Alsike clover is not long-lived and after 3 to 5 years stands begin to decline and overseeding may be necessary.

Plant Nutrient Needs – On most soils alsike clover responds well to applications of phosphate and potassium. Increased rates of nitrogen reduce alsike clover stands by increasing the grass component.

Hay and Pasture Management – Alsike clover has high moisture content and may require more time for drying when cut for hay. It is seldom grown alone, but produces good yields in mixtures with grass. When grazing or haying, cutting below 2 in will reduce the stand of alsike clover in subsequent years. Under hay management, one or two crops are harvested per season with the spring harvest accounting for the majority of the forage. Regrowth after haying/grazing is good. Alsike clover has a tendency to dominate the stand and decrease the grass component in the first few years, but declines rapidly after that. Bloat is a potential problem equal to that of red clover or alfalfa. As with all small seeded legumes, care should be taken to ensure seed is not planted more than 1/4 inch deep.

Adapted Varieties – Most of the seed available commercially is common alsike clover.

CLOVER, RED

[*Trifolium pratense*; Introduced]

Introduction – Red clover is the most widely grown of all clovers. It is a short lived perennial legume, that is used for hay, pasture and soil improvement. Red clover is adapted to a wide range of climatic conditions, soil types, fertility levels, and management practices.

Adaptation – Red clovers are categorized in two types, medium and mammoth types. The medium type is a short-lived biennial and produces two or three crops a season. The mammoth type is a late flowering clover that normally produces one crop per year. Red clover is best adapted where summer temperatures are moderately cool to warm and where moisture is sufficient throughout the growing season. In the Intermountain Region it requires irrigation to produce a crop. Red clover is best adapted to well-drained loamy soils with a pH of 6.0 or higher. It will tolerate medium to fine textured soils. It also tolerates shade, and is compatible with other species in mixtures.

Limitations – Due to its short-lived nature, red clover stands typically decline after 2 to 3 years. Double-cut varieties remain productive for only 1 or, at most, 2 years when grown under favorable conditions. Although red clover has a low tolerance to flooding and water logging, it is more tolerant of poorly drained soils than alfalfa and sweet clover and it can survive up to 2 weeks of spring flooding. Red clover is intolerant of saline soils and extended periods of drought. It is susceptible to snow mold.

Plant Nutrient Needs – Red clover prefers soils high in phosphorus. As a general rule, minor elements are usually adequate in most soils. Red clover requires more phosphorous and potassium than most pasture grasses and levels should be adjusted according to soil tests.

Hay and Pasture Management – Rotational rather than continuous grazing will lengthen the stand life of red clover. The inclusion of grass in clover pastures is desirable to control soil erosion and cattle are less likely to bloat. Initially red clover tends to dominate mixes; however, after 2 to 3 years the red clover component begins to decline. The bloat hazard with red clover is almost as great as with alfalfa. After one crop of hay, the single cutting varieties regrow well and provide palatable fall grazing. Red clover pastures should not be grazed shorter than 3 in. Because it is a short lived perennial, the second year's production is usually greater than that of the first or third year. The recommended planting depth for red clover seed is 1/4 in.

Adapted Varieties are **Kenland, Dollard**, **Redman**, and **Reddy**.

CLOVER, STRAWBERRY

[*Trifolium fragiferum*; Introduced]

Introduction – Strawberry clover is a perennial legume that is similar to white clover. The flower heads are pink and resemble strawberries.

Adaptation – Strawberry clover is adapted to wet, saline, or alkaline soils. It is used in pastures where white clover has a difficult time persisting. Though well adapted to a wide variety of soils, strawberry clover requires supplemental irrigation. It does well under irrigation where drainage is a limiting factor and it can tolerate flooding for several weeks at a time. Strawberry clover is more salt tolerant than any of the clovers normally used in the Intermountain Region.

Limitations – Strawberry clover is not adapted to dryland conditions.

Plant Nutrient Needs – Strawberry clover responds well to applications of phosphorous when limiting.

Hay and Pasture Management – Grazing should be light until the pasture is well developed, at which time it can be grazed all season. Strawberry clover is a spreading type clover. Planting depth should not exceed 1/4 in.

Adapted Variety – **Salina** is a recommended variety.

CLOVER, WHITE

[*Trifolium repens*; Introduced]

Introduction – White clover is a low growing long-lived perennial legume that spreads rapidly from stolons. It is used predominantly in pastures with grasses and is adapted to sites with good soils and adequate moisture. There are three types of white clover: ladino or large white, white Dutch often referred to as intermediate or common white clover, and wild white clover, which is a low growing white clover. The ladino type is much taller than the other two types. White clover can tolerate close grazing, but produces best if allowed adequate time to recover.

Adaptation – Because of its shallow root system, white clover requires supplemental irrigation and is not drought tolerant. White clover forage remains closer to the ground than other legumes because leaves and stems develop from stolons which spread along the soil surface.

Limitations – White clover is less winter hearty than red clover and will not survive in areas where snow cover is inadequate. It has a low tolerance for prolonged flooding and does not do well on poorly drained or waterlogged soils. Pure stands of white clover are usually not planted because of their prostrate growth, low yields and high risk of causing bloat. Due to its nitrogen fixing potential and forage quality, white clover makes an excellent component in mixed pastures.

Plant Nutrient Needs – White clover is responsive to applications of phosphorous and potassium when limiting.

Hay and Pasture Management – All three types of white clover are high in forage quality, however, bloat is a concern when grazing white clover. Of the three types, ladino is the most productive and is best suited for forage production. Grazing intensity should be managed to protect the other species in the mixes. Due to its more upright structure, ladino is the only white clover that is used for hay production. When harvested for hay it should be part of a grass mix and harvested early to eliminate shading. White clover's contribution to total forage yield in a mixed stand is relatively small, but its overall contribution to forage quality and as a source of nitrogen makes it an excellent legume for mixed pastures. When planting white clover, seed should be planted no deeper than1/4 in.

Adapted Varieties – The adapted varieties are large white **Ladino**, Intermediate or Dutch **Grassland HUIA**, and small white **New York**.

FLAX, BLUE

[*Linum perenne*; Native]

Introduction – Blue flax is a blue-flowered, short-lived perennial forb that ranges from 12 to 36 inches in height.

Adaptation – Blue flax grows best on sites receiving 10 to 18 in of annual precipitation that are open and sunny on well drained soils. However, it will establish and persist on disturbed, droughty sites at elevations between 1,000 and 8,000 ft. It is utilized by wildlife and livestock throughout the season. Blue flax establishes well and spreads from seed.

Limitations – Blue flax is intolerant of soils that have high water tables, poor drainage or are subject to flooding. It has limited shade tolerance and does best on open sites. Blue flax generally does not flower until the second growing season.

Uses – Forage value of blue flax is fair when utilized by wildlife and livestock. Blue flax is most often used as a beautification plant and to control erosion on reclamation and highway plantings. It is also used in many wildlife plantings. Blue flax can be seeded as shallow as 1/8 in.

Adapted Varieties: Wildland collected seed is available. Appar Lewis flax is an introduced cultivar that is commercially available.

Flax, Blue

GLOBEMALLOW

[*Sphaeralcea coccinea* and *S. murroana;* Native]

Introduction – Globemallow is a perennial forb ranging from bunch type to creeping rhizomes with a large taproot. Flowers are pink, orange, or red and bloom from May to July based on available moisture and may bloom again in summer following precipitation.

Adaptation – Globemallow is found on dry sites, foothill areas that have sandy or rocky soils, open flats, and roadsides. Its deep rhizome allows globemallow to survive such disturbances as disking or fire. After disturbances, globemallow frequently becomes a natural colonizer. Globemallow should only be considered for use in areas that receive 8 or more inches of annual precipitation.

Limitations – A hard seed coat often prevents germination of globemallow seeds. The forage value of scarlet globemallow is acceptable.

Uses – Once germinated, globemallow establishes well on disturbed sites making it a valuable species for reclamation purposes. Browsing animals utilize the forage better than grazing animals. It is also used for landscape plantings on roadways, recreation areas where it adds species diversity in low precipitation areas. Seed placement of scarlet globemallow should not exceed 1/4 in.

Globemallow

Adapted Varieties: Germplasm releases include the spreading type **Scarlet** (ARS-2936) globemallow which is recommended as a forb component in seed mixtures on arid and semiarid sites. An additional release is **Munroe** globemallow that is an upright bunch type. Wildland collected seed is also available commercially.

GOLDENEYE, SHOWY

[*Viguiera multiflora;* Native]

Introduction – Showy goldeneye is an attractive native perennial forb that is prevalent throughout the Intermountain West. The flowers are sunflower-like and grow on single stalks.

Adaptation – Showy goldeneye is adapted to soils that range from heavy clays to gravel on open rocky slopes in sagebrush-grass, pinyon-juniper, mountain brush, aspen, spruce-fir, and subalpine communities. It is adapted to elevations that range from 3,500 to 11,000 ft. Showy goldeneye establishes rapidly on disturbed sites that receive 16 to 20 in of annual precipitation where it competes well with annuals and perennials.

Limitations – When seeded on disturbed sites showy goldeneye may become the dominant species. It is not shade tolerant and requires direct sunlight.

Uses – Showy goldeneye has high aesthetic value and is often planted on cabin sites and around campgrounds. It is utilized by deer, elk, and sheep as a forage plant. Planting depth should not exceed 1/4 in.

MILKVETCH, CICER

[*Astragalus cicer;* Introduced]

Introduction – Cicer milkvetch is a long lived perennial that does not cause bloat in grazing animals. Growth is upright when plants are young. As plants mature the stems have a tendency to bend over or lodge. Cicer milkvetch is a rhizomatous legume and seeds need to be inoculated with the proper rhizobium bacteria for successful nitrogen fixation. It is a heavy seed and forage producer with forage quality similar to that of alfalfa.

Adaptation – Cicer milkvetch is well adapted to soils with high to medium moisture holding capacity. It is not tolerant of flooding, but will withstand high water tables. Drought tolerance is fairly good, but yields will be reduced when moisture is limited. Cicer milkvetch is quite tolerant of cold temperatures and is less susceptible to frost heaving than alfalfa. Once established, cicer milkvetch is aggressive and produces well throughout the season. Cicer milkvetch should be used on dryland sites that receive at least 16 inches of

Milkvetch, Cicer

annual precipitation in order for it to establish and persist.

Limitations – Cicer milkvetch may require at least 2 years to become established. Because of this, seedbed preparation, seed placement, and weed control are important. Cicer milkvetch usually starts growing later in the year than other legumes such as alfalfa.

Plant Nutrients – Cicer milkvetch responds to applications of phosphorous and potassium fertilizers. Fertilizer amounts should be based on soil tests.

Hay and Pasture Management – Cicer milkvetch is easily harvested for hay, but does not yield with alfalfa. It is later maturing than other legumes and its forage quality does not decline until later in the growing season. It is very tolerant of grazing and compatible with many pasture grasses. Regrowth is slow requiring a longer period between grazing events. It is recommended that cicer milkvetch be planted 1/4 to 1/2 in deep.

Adapted Varieties – Recommended varieties include **Lutana**, and **Monarch**.

PARSNIP, COW

[*Heracleum lanatum*; Native]

Introduction – Cow parsnip is a large perennial forb with a single stem that grows 3 to 10 ft high. When mature, cow parsnip has a pungent odor.

Adaptation – In the Intermountain West, cow parsnip is found in aspen, spruce-fir, and subalpine areas in meadows with rich loamy soils. It grows best on well drained soils, but has been reported to establish and persist on clay to gravelly soils. In addition, it can be found inhabiting grasslands, wet meadows, and stream terraces. Cow parsnip prefers shaded sites.

Limitations – Cow parsnip is sensitive to grazing, particularly on rangelands, requiring an adequate rest period between grazing events. In order to ensure adequate stands of cow parsnip, allow stands to naturally reseed themselves once every few years.

Uses – Cow parsnip is highly palatable to livestock and big game. It is also used as an ornamental around recreational sites such as summer homes and campgrounds. Cow parsnip has also been used as a reclamation forb in riparian areas. Suggested planting depth for cow parsnip is 1/2 in.

PENSTEMON, ALPINE

[*Penstemon venustus*; Native]

Introduction – Alpine penstemon is a cool-season, native perennial forb with showy lavender to purple flowers that bloom in mid-summer through early fall. It was originally collected near Dworshak Reservoir on the Clearwater River in Idaho.

Adaptation – Alpine penstemon is adapted to rangelands of the western United States that range in elevations from 1,000 to 6,000 ft with annual rainfall between 20 and 35 in. It can be found on soils ranging from shallow rocky to well drained loam. Alpine penstemon is noted for its winter hardiness, seed production, and wide range of adaptability.

Limitations – Alpine penstemon is susceptible to soilborne fusarium and rhizoctinia root rot on poorly drained soils.

Uses – Alpine penstemon is used in revegetation plantings to control erosion and increase biodiversity and beautification. The seed of alpine penstemon can be late fall or early winter drilled or broadcast and covered to a depth of 1/8 to 1/4 in.

Adapted Varieties: Alpine Penstemon – collected near Clearwater. Seed is available through the Idaho and Utah Crop Improvement Associations and Soil Conservation Districts in Idaho, Utah, and Nevada.

PENSTEMON, FIRECRACKER

[*Penstemon eatonii*; Native]

Introduction –- Firecracker penstemon is a cool-season, native perennial forb with bright red tubular flowers that bloom from mid-summer through early fall. It was originally collected near Richfield, Utah.

Adaptation – Firecracker penstemon is adapted to sagebrush-juniper zones at 3,300 to 8,000 ft elevation in 10 to 16 in rainfall areas. It can be found on soils ranging from shallow rocky to well drained loam. Firecracker penstemon grows in association with sagebrush, globemallow, and Indian ricegrass. Firecracker penstemon is noted for its winter hardiness, seed production, and wide range of adaptability.

Limitations – Firecracker penstemon is susceptible to soil-borne fusarium and rhizoctinia root rot on poorly drained soils.

Uses – Firecracker penstemon is used in revegetation plantings to control erosion and increase biodiversity and beautification. The seed of firecracker penstemon can be late fall or early winter drilled or broadcast and covered to a depth of 1/8 to 1/4 in.

Adapted Varieties: Firecracker penstemon – collected near Richfield UT. Seed is available through the Idaho and Utah Crop Improvement Associations and Soil Conservation Districts in Idaho, Utah, and Nevada.

PENSTEMON, PALMER

[*Penstemon palmeri*; Native]

Introduction – Palmer penstemon is a short lived perennial, native forb. It is a semi-evergreen plant with a thick, fibrous taproot. The flowers are pink to lavender pink and bloom in late spring to early summer. The semi-evergreen nature of Palmer penstemon allows the leaves to stay green throughout the year.

Adaptation – It is adapted to a wide range of soils from rocky to clayey at elevations of 3,500 to 6,000 ft. Palmer penstemon persists best with 10 to 16 in of annual moisture. Palmer penstemon does well on exposed and disturbed sites with well drained sandy, gravelly soil where it is considered a pioneering species. Palmer penstemon is very drought and cold tolerant.

Limitations – The stand life of Palmer penstemon is between 5 to 7 years with flowering delayed until the second year. It is also susceptible to root diseases.

Uses – Palmer penstemon is readily grazed by wildlife and livestock and is used primarily for winter forage, erosion control, highway plantings, and as an ornamental. Recommended planting depth is 1/8 in.

Adapted Varieties: Cedar is the only released cultivar of Palmer penstemon.

Penstemon, Palmer

PENSTEMON, ROCKY MOUNTAIN

[*Penstemon strictus*; Native]

Introduction – Rocky Mountain penstemon is a perennial semi-evergreen native forb. The flowers of Rocky Mountain penstemon are a bright blue to purple and bloom from mid May to the latter part of June.

Adaptation – Rocky Mountain penstemon is found in upper pinyon-juniper, mountain big sagebrush, mountain brush, and on open areas in aspen and coniferous forests. Rocky Mountain penstemon is well adapted to soils that range from rocky to sandy loam in regions that receive 15 to 20 in of annual precipitation. It is adapted to elevations ranging from 6,000 to 10,000 ft. As with most penstemons, Rocky Mountain penstemon has good cold tolerance.

Limitations – It is recommended that Rocky Mountain penstemon be planted in mixtures rather than alone. Flowering is delayed until the second growing season.

Uses – Rocky mountain penstemon can be grazed by livestock and wildlife and has some utility as an

ornamental in the horticulture trade. It is widely used for stabilization on disturbed, depleted, and eroded sites. Suggested planting depth is 1/8 in.

Adapted Varieties – **Bandera** is the only variety available.

SAGEWORT, LOUISIANA

[*Artemisia ludoviciana*; Native]

Introduction – Louisiana sagewort is a long lived, fast growing native perennial forb that ranges in height from 12 to 40 in.

Adaptation – Louisiana sagewort occurs in all plant communities from sagebrush through subalpine zones. Plants can be found on dry open sites in grassland, shrub land, and forested areas. These sites range in elevation from 3,000 to 10,000 ft. It is adapted to many soil types, from heavy clays to more sandy conditions. Louisiana sagewort is considered a pioneer species that rapidly establishes on disturbed sites. Once established it can serve as a nurse plant to slower establishing grasses. Louisiana sagewort is drought and cold tolerant. Louisiana sagewort spreads rapidly and can be used for erosion control on roadsides, etc. Within these plantings, it does not out-compete slower growing species.

Limitation – Germination of Louisiana sagewort seed is low (30 to 40%), and plants often require 3 years to set the first seed crop under rangeland conditions.

Use – Louisiana sagewort has limited seasonal value as a forage for livestock and wildlife. With the exception of deer, forage value of Louisiana sagewort is fair to poor. When grazed, it is best utilized as a late fall and winter forage. Due to its aggressive rhizome, Louisiana sagewort is an excellent stabilization species that offers good cover and soil retention. Recommended planted depth is 1/8 in.

Adapted Varieties – **Summit** is the recommended variety.

SAINFOIN

[*Onobrychis viciifolia*; Introduced]

Introduction – Sainfoin is a cool season, non-bloating legume adapted to deep soils of medium texture that are well drained. It is less productive than alfalfa and is intolerant of wet soils, frequent irrigation, or high water tables. Sainfoin can be used for hay or pasture where irrigation or annual precipitation exceeds 13 in annually.

Adaptation – Sainfoin is more drought and cold tolerant than alfalfa and it grows well under the same conditions. It survives in dry areas but yields are greatly reduced. Sainfoin begins growth early in spring and is tolerant of early frost.

Limitations – Sainfoin does not tolerate frequent defoliation. When used for pasture or hay it should be allowed to regrow to early bloom before harvesting a second crop. Sainfoin is not tolerant of saline soils. Establishment is relatively rapid but seedlings lack competitiveness so competition from weeds or other plants should be reduced as much as possible.

Plant Nutrient Needs – In the absence of nitrogen fixing bacteria, sainfoin does not fix adequate amounts of nitrogen. Increased production can be obtained by adding nitrogen fertilizer.

Hay and Pasture Management – When harvested for hay it is best to take one crop of sainfoin when it is between half and full bloom. Sainfoin retains its lower leaves longer than alfalfa and stems remain more succulent as the plant matures, thus it maintains quality longer into the growing season. The advantages of sainfoin pasture include excellent quality, good palatability, and animal performance without the danger of bloat. It is adapted for use in dryland pastures and does well when mixed with dryland bunch type grasses such as Russian wildrye and crested wheatgrass. It is compatible in mixes with meadow brome and orchardgrass, but

Sainfoin

is generally shorter lived than alfalfa. Regrowth following a hay crop can be grazed, but care should be taken to graze sainfoin before it reaches full bloom. Sainfoin persistence increases with moderate grazing intensities, whereas continuous close grazing will result in stand reductions. It is recommended that sainfoin seeds be planted between 1/2 and 3/4 in deep.

Adapted Varieties – **Eske**, **Remont**, and **Renumex** are commercially available varieties.

SWEET ANISE

[*Osmorhiza occidentalis*; Native]

Introduction–- Sweet anise is an erect perennial forb that grows up to 4 ft tall and is thought to be the most important range plant of its genus.

Adaptation – Sweet anise is found at elevations up to 10,000 ft in the Intermountain Region. It prefers rich, well-drained soils in aspen stands, openings in ponderosa pine and Douglas fir forests, and open brushy slopes and ridges. It is rarely found in pure stands. Because of its deep taproot, sweet anise withstands trampling and if allowed to reseed itself will persist and even increase over time.

Limitations – Sweet anise is a poor seed producer.

Uses – Sweet anise is quite palatable to wildlife and livestock where most of the above ground forage is utilized. Sweet anise remains green and palatable throughout the grazing season provided adequate moisture is available. Recommended planting depth is 1/4 in.

SWEETVETCH, UTAH

[*Hedysarum boreale*; Native]

Introduction – Utah sweetvetch is a cool-season perennial legume that is native to the foothills and upland areas of the Intermountain Region.

Adaptation – Utah sweetvetch is recommended for use on rangelands and upland wildlife habitat areas. It grows well in areas receiving 10 to 18 in of annual precipitation. Utah sweetvetch is adapted to well drained rocky, gravelly, sandy, and clayey loam soils. Its long taproot makes it well adapted to rangeland sites throughout the Intermountain Region.

Limitations – Utah sweetvetch should not be grazed during the establishment period or serious damage can occur.

Uses – Utah sweetvetch is recommended for rangeland reseedings and grazing. Suggested planting depth ranges from 1/8 to 3/4 in.

Adapted Varieties: Timp is the only cultivar of Utah sweetvetch that is commercially available.

Sweetvetch, Utah

TREFOIL, BIRDSFOOT

[*Lotus corniculatus*; Introduced]

Introduction – Birdsfoot trefoil is a perennial legume used for pasture and hay. There are two types; empire and common or European. The empire type is semi-erect, fine stemmed, and flowers 10 to 14 days later than the European. European types have earlier spring growth and more rapid seedling recovery and growth. The empire type is the most winter hardy and is commonly grown in the Intermountain Region.

Adaptation – Birdsfoot trefoil is adapted to a wide range of soil types from clays to sandy loams that can be droughty, infertile, acidic, and mildly saline or alkaline. Birdsfoot trefoil is more resistant to water logged soils than alfalfa and is not susceptible to *phytothora* root rot. Although it tolerates poor soil conditions, it is most productive when grown on moderate to well drained soils.

Limitations – Birdsfoot trefoil is not winter hardy and where snow cover is lacking severe winter injury can result. Birdsfoot trefoils is short lived (2-4 years), making reseeding or production of new shoots from established plants necessary. Seedlings are smaller than alfalfa and slower to establish. It takes 2 years for birdsfoot trefoil plants to become established. If grazed during the establishment period, it should be grazed lightly only after the first year. Birdsfoot trefoil is intolerant of competition from other plants, especially tall varieties that produce shade. It is important

Trefoil, Birdsfoot

Yarrow, Western

that birdsfoot trefoil be inoculated with the correct bacteria for proper nitrogen fixation.

Plant Nutrient Needs – Adequate amounts of phosphorous promote vigorous seedling growth and increase the chance of a successful seeding. Dry matter production of birdsfoot trefoil generally increases with increased availability of phosphorous. Birdsfoot trefoil responds well to both phosphorous and potassium on deficient soils.

Hay and Pasture Management – Because it does not cause bloat, birdsfoot trefoil is a popular choice as a pasture forb. It has a nutritional value similar to alfalfa. Although pure stands provide the best quality forage, companion grasses contribute to higher forage yields by utilizing the nitrogen fixed by birdsfoot trefoil. Because carbohydrate reserves are low during the growing season, birdsfoot trefoil can be grazed frequently, but it should not be completely defoliated. Palatability is high so proper livestock management is essential to prevent over grazing. European cultivars with erect growth have been developed for hay production, but prostrate type cultivars persist better when harvested more often. When harvested for hay, birdsfoot trefoil usually yields only 50%-80% of alfalfa. If growing birdsfoot trefoil for hay on land that is suitable for alfalfa production, significant yield reductions will be noticed compared to alfalfa. For this reason it is recommended that birdsfoot trefoil be produced on land that is unsuitable for alfalfa production such as poorly drained soil or those soils that are acidic. Birdsfoot trefoil should be planted 1/4 to 1/2 in deep.

Adapted Varieties – Adapted varieties are **Empire** for low growing types and **Maitland** for the more upright growth type.

YARROW, WESTERN

[*Achillea millefolium* L. var. *occidentalis* DC.; Native]

Introduction – Western yarrow is one of the most widely distributed herbaceous species in the western United States and is treated by some as a perennial weed. Its presence has been used as an indicator of overgrazing on high summer ranges.

Adaptation – Western yarrow is adapted to a wide variety of habitats ranging from aspens and open forests to sagebrush zones. It avoids dense shade and is comparatively drought-resistant and flourishes in sandy and gravelly loam soils.

Limitations – In areas of natural plant disturbance, western yarrow invades readily and increases over time.

Hay and Pasture Management – On rangelands, western yarrow is lightly utilized by all classes of livestock throughout the growing season. Flower heads of western yarrow provide acceptable forage for sheep in Nevada, New Mexico, Utah, and Arizona.

CHARACTERISTICS OF WOODY PLANTS (Shrubs, Willows, Trees)

ALDER, RED
[*Alnus rubra;* Native]

Introduction – Red alder is a rapidly growing tree that reaches heights of 80 ft. Its bark is thin, smooth, often appearing white mottled due to crutose lichens. Roots fix nitrogen and leaves are deciduous, shiny dark green above, and lighter below with rusty pubescence along veins on the underside, and double serrated.

Adaptation – Generally adapted to areas with slightly moist to wet soils at lower elevations.

Propagation – Ripe seed is generally harvested in September and October and air dried to prevent molding. Seed can be stored for short term by refrigeration, but long term storage to insure seed viability for up to 5 years requires controlled atmospheres where moisture does not exceed 10% and seed is placed in moisture proof containers at 8 to 10 degrees F. Fresh seed should be surface seeded in fall with adequate water and applications of low nitrogen and high phosphorus fertilizer to enhance germination and growth. Seedlings are transplanted at 1 to 2 years old. Dormant unrooted hardwood cuttings are rare; however, small seedlings can be collected under mature trees and potted in containers for eventual reestablishment in riparian zones.

ALDER, SITKA
[*Alnus viridis;* Native]

Introduction– Sitka alder is a multiple stemmed shrub up to 10 ft tall with smooth bark that becomes reddish brown to grayish-green with aging. The stems are three sided and leaves are alternate, deciduous, and shiny green. It is perhaps more fittingly referred to as thin leaf alder because of its thin textured leaves. It is one of the most palatable of the native alders, classed as fair to good sheep browse in some parts of its range.

Adaptation –Sitka alder grows in moist montane woods, wet slopes, and streambanks at mid to lower elevations where soils are coarse textured. It is distributed from the borders of the Arctic Circle in Alaska to Alberta, California, and Colorado.

Propagation – Seed collected in fall from trees at least 4 to 7 years of age should germinate when surface seeded. Stored seeds require a moist prechilling period of 1 to 3 months at 37 degrees F. Seedlings are ready to transplant at 1 to 2 years of age into a well drained media with frequent watering and ample sunlight. Propagation by dormant unrooted hardwood cuttings is generally not successful.

ASPEN, QUAKING
[*Populus tremuloides;* Native]

Introduction – Quaking aspen is a small to medium tree growing to heights of 50 to 80 feet and forming dense colonies or clones. It is widely distributed from Alaska to Mexico and from the Pacific Coast to western Texas, Colorado, Nebraska and Manitoba. It is perhaps the best-known tree of the western mountains where it is a characteristic feature of the landscape. Western aspen is generally rated as fair to good forage for sheep, cattle, elk, and deer. Newly developing shoots are very susceptible to heavy animal use which often retards or prevents aspen reproduction.

Adaptation – In the Intermountain Region, quaking aspen ranges from 6,000 to11,000 ft elevation, and is best adapted to rich, moist, loamy soils, but it also occurs in wet soils and on dry, gravelly hillsides.

Propagation – Quaking aspen seed can be collected from May to mid June and is susceptible to viability loss requiring a special storage treatment to retain viable seed for extended periods. Seed is most effectively planted in spring on water-saturated soils. Successful propagation by dormant unrooted hardwood cuttings is rare.

BIRCH, WATER (BLACK)
[*Betula occidentalis;* Native]

Introduction – Black water birch is a small tree or large shrub that grows to heights of 30 ft and is frequently found in crowded dense thickets. Its bark is thin and smooth, with horizontal pores that are almost black on young trees and turn reddish-brown with age. Branches are slender, upright, and covered with numerous glands. Leaves are alternate and deciduous.

Adaptation – Black water birch is most commonly found along rivers, streams, springs, and moist locations at mid elevations on a variety of gravelly and cobbly to medium textured soils.

Propagation – Seed should be sown in late summer to fall or prechilled for 21 days at 68 to 86 degrees F and planted in spring. Seed should be pressed into the soil or lightly covered with soil. Sunlight becomes a very important factor contributing to successful propaga-

tion. Seedlings may be transplanted when they are 1 to 2 years old. The use of unrooted hardwood cuttings for field propagation is rarely successful.

BITTERBRUSH, ANTELOPE

[*Purshia tridentata*; Native]

Introduction – Antelope bitterbrush is a shrub that varies in form, from prostrate plants that are 2 to 6 ft tall to erect types that reach heights of 15 ft. Its leaves are three lobed or toothed at the tip. It is commonly found between elevations of 3,500 and 11,500 ft.

Adaptation – Antelope bitterbrush normally occurs in well-drained, sandy, gravelly, or rocky soils throughout the upper sagebrush, pinyon-juniper, mountain brush, ponderosa pine, and lodgepole pine zones. Seedlings are vigorous and compete well when seeded with shrubs. It grows rapidly and furnishes considerable forage.

Bitterbrush, Antelope

Limitations – Antelope bitterbrush persists under severe grazing pressure, but is very prone to fire damage.

Uses – Upright growth forms of antelope bitterbrush are heavily browsed and provide nutritious forage for wildlife and livestock. The protein content ranges between 10 and 15%. On some winter ranges, it furnishes the bulk feed for cattle and sheep and it is the major source of deer browse. It is considered one of the principal species in wildlife and range seedings.

Adapted Varieties – **Lassen** antelope bitterbrush is a large upright variety suited to neutral and granitic soils. Other germplasm selections include **Fountain Green** and **Maybell**. In addition, source identified seed for various regions is also available.

BITTERBRUSH, DESERT

[*Purshia glandulosa*; Native]

Introduction – Desert bitterbrush differs from antelope bitterbrush in that it is shorter in stature and evergreen rather than deciduous.

Adaptation – Desert bitterbrush is most prevalent in pinyon-juniper, blackbrush, and big sagebrush communities. It is more restricted in its range of adaptation than antelope bitterbrush and is usually confined to warmer southern regions of the Intermountain Region. It can establish and persist on soils of low fertility where it is more tolerant of heat and drought than antelope bitterbrush.

Uses – Desert bitterbrush is an important winter forage with good quality. It is utilized mainly on winter ranges by mule deer and sheep. Cattle and elk moderately graze desert bitterbrush. It has been used in reseeding reclamation projects as a soil stabilizer. Seeding should be made in well prepared seedbeds.

BOXELDER

[*Acer negundo*; Native]

Introduction – Boxelder is a small to medium tree that grows up to 65 ft tall and often has an irregular shape.

Adaptation – Boxelder is commonly found in lowland sites along streams, rivers, ponds, or flooded flats on a variety of soils and is tolerant of prolonged flooding.

Propagation – Seed requires both a pretreatment and a moist prechilling period to break dormancy. Northern sources have a shorter cold stratification requirement than southern sources. Pretreatment involves 2 weeks of soaking in cold water or a physical rupturing or removal of the pericarp prior to cold stratification. Recommendations vary from 21 days at 68 degrees F in sand or peat to 2 to 3 months at 40 degrees F. Seedlings may be transplanted at 1 to 2 years of age. Dormant unrooted hardwood cuttings are rarely planted successfully.

BUFFALOBERRY, SILVER

[*Shepherdia argentea*; Native]

Introduction – Silver buffaloberry is also known as reberry or bullberry. It is a spreading thorny shrub occasionally forming thickets up to 16 ft tall. The bark is dull gray, thin, and smooth when young, becoming somewhat ridged and shredding when older. Stems and leaves are covered with dense, silver-white scales. It is seldom browsed by domestic livestock or game animals; however, along the Green and Sevier rivers in

Utah, silver buffaloberry is lightly used by cattle and sheep.

Adaptation – Silver buffaloberry is adapted to moist hillsides, along streams, and in bottomlands at elevations from 3,500 to 7,500 ft from Saskatchewan and Alberta to Kansas, New Mexico, south central Utah, and Nevada. It is tolerant of some flooding, but is intolerant of prolonged flooding and permanent high water tables.

Propagation – Hard seed coats and embryo dormancy inhibit germination and requires 20 to 30 minutes of acid scarification followed by 60 to 90 days of cold stratification at 68 to 86 degrees F before planting. Seeds should not be planted deeper than 1/4 inch.

Adapted Selections – Sakakawea is the only released cultivar.

CEANOTHUS, MARTIN

[*Ceanothus martinii*; Native]

Introduction – Martin ceanothus is an important native forb of the Intermountain West, where it is often referred to as small chaparral shrub.

Adaptation – It occurs in pinyon-juniper, ponderosa pine, and aspen zones on soils ranging from well-drained, medium-textured to rocky-shallow.

Limitations – Martin ceanothus will tolerate soils that range from mildly acid to mildly basic. However, it prefers non-saline soils. It is moderately shade tolerant with fair drought tolerance. It can be overgrazed if not managed properly.

Uses – Martin ceanothus produces high quality forage that is utilized by big game and livestock when other forage is limited. It is recommended for use in wildlife and range revegetation mixtures in sagebrush, mountain brush, and juniper-pinyon zones. Due to its spreading habit, fire tolerance, and flowers, Martin ceanothus is used as a component of seed mixtures used on disturbed sites and roadsides. It should be seeded with other species on a firm seedbed to a depth of 1/3 inch in the fall.

CHOKECHERRY

[*Prunus virginiana*; Native]

Introduction–- Common chokecherry is a native perennial woody-shrub. This deciduous shrub ranges in height from 5 to 25 ft. It is often associated with willow, aspen, alder, ponderosa pine, and mountain brome.

Adaptation – Chokecherry is adapted to silty or sandy soils with good depth, fertility, and drainage. It does not tolerate poor drainage, prolonged spring flooding or high water tables. It inhabits foothills and mountain canyons, and occurs along stream banks between 2,000 and 9,000 ft in areas that receive 12 to 30 in of annual precipitation.

Limitations – Chokecherry is a poisonous plant that contains toxic quantities of hydrocyanic acid in its leaves and twigs. It is poisonous to all classes of livestock, but presents little concern when other acceptable sources of forage are added to the diet. Toxicity is more acute after a drought or freeze and when animals are grazing on new twigs and leaves.

Uses – Chokecherry provides fair forage, good watershed protection, wildlife habitat, and species diversity. Although, deer, elk, moose and bighorn sheep graze it year round, it is more intensely grazed in spring and fall. It is more heavily browsed by sheep than cattle. Chokecherry is utilized by deer on numerous winter ranges throughout the Intermountain Region. Even though it is deciduous, it retains relatively high nutrient levels throughout the fall and winter. It has aggressive roots and suckers that sprout after fire and it is moderately tolerant of grazing. Fall seeding is required and seeding depth should not exceed 1/2 in.

CINQUEFOIL, SHRUBBY

[*Pentaphylloides floribunda*; Native]

Introduction – Shrubby cinquefoil is a small shrub generally 10 to 30 in in height that is widely distributed in the Northern Hemisphere. It is sometimes called bush or shrub cinquefoil and it is also locally known as buckbrush, hardhack, or yellow rose.

Adaptation – Shrubby cinquefoil generally inhabits areas that are moist early in the season, but tend to become dry later in the growing season. Moisture is a limiting factor in its distribution, which extends from the upper ponderosa pine belt to above the timberline. It is characteristic of open timber exposures, especially moist subalpine meadows and springs. Soils vary from clay loams to sandy loams and are fairly well developed with neutral to slightly acid pH. Bitter leaves make it less palatable for utilization by domestic livestock, deer, and elk.

Propagation – Seed generally matures from July to September. If seed is properly dried and stored at 34 to 41 degrees F, it retains viability for up to 5 years. Seed will generally germinate without a pre-chill treatment and seedlings should be transplanted at 1 to 2 years of age. Dormant unrooted hardwood cuttings are rarely planted successfully.

CLIFFROSE
[*Cowania stansburiana*; Native]

Introduction – Cliffrose is a long lived, leafy evergreen shrub that ranges from 3 to 12 ft in height. Under favorable growing conditions, it can reach up to 25 ft. It occurs across most of the Intermountain Region at altitudes ranging from 4,000 to 8,000 ft.

Adaptation – Cliffrose is adapted to pinyon-juniper sites, salt-desert shrub, big sagebrush, and black sagebrush zones that receive from 8 to 18 in of annual precipitation. It is found on south and east exposures throughout the mountain brush zones where it is adapted to cliffs with shallow rocky soils high in limestone. In addition, it will persist on granitic, volcanic, and igneous formations.

Limitations – Small seedlings can be suppressed by annuals, such as cheatgrass. However, once seedlings become well established, they are extremely persistent under drought and competition. Branches of the shrub are brittle and under abusive grazing are liable to be broken or severely damaged, particularly by cattle.

Uses – Cliffrose is utilized lightly in spring and summer by most foraging animals, where grazing actually stimulates growth. Cliffrose is an important winter forage species for wildlife and livestock. It is usually less palatable than antelope bitterbrush.

Cliffrose

COTTONWOOD, BLACK
[*Populus trichocarpa*; Native]

Introduction – Black cottonwood is a tall tree with a narrow, rounded, open to pointed crown. It grows up to 160 ft in height and has trunk diameters from 2 to 5 ft.

Adaptation – Black cottonwood is common to the northern areas of the Intermountain Region, at elevations between 3,000 and 5,000 ft on coarse flooded soils. It frequently grows in association with whiplash and yellow willow.

Propagation – The species roots easily along the entire stem, especially when smooth bark sections are used in comparison to rough, older material.

COTTONWOOD, FREMONT
[*Populus fremontii*; Native]

Introduction – Fremont cottonwood is a medium to tall tree with a broad, open crown that reaches 50 to 100 ft with trunk diameters between 1 and 4 ft.

Adaptation – Fremont cottonwood is distributed throughout southern portions of the Intermountain Region at elevations between 2,000 and 6,000 ft where it prefers gravel to sandy-saline soils that flood periodically. It grows in association with coyote willow.

Propagation – Fremont cottonwood roots with moderate ease from hardwood cuttings.

COTTONWOOD, NARROWLEAF
[*Populus angustifolia*; Native]

Introduction – Narrowleaf cottonwood is a medium-sized tree reaching heights of 60 ft with a narrow, rounded crown, and trunks between 1 to 2 ft in diameter. It is a common species throughout the Intermountain Region at elevations ranging from 4,000 to 7,000 ft.

Adaptation – Narrowleaf cottonwood is often associated with redosier dogwood and alder where it is adapted to wetter sites with coarse, cobbly soils that flood frequently.

Propagation – Narrowleaf cottonwood roots easily from hardwood cuttings.

CURRANT, GOLDEN

[*Ribes aureum*; Native]

Introduction – Golden currant is a perennial, fast growing, moderately spreading, shrub that reaches heights of 3 to 10 ft and occurs at elevations from 3,000 to 6,500 ft. It grows in several forms and produces considerable foliage. It is best suited to areas receiving 15 to 20 in of annual precipitation.

Adaptation – Golden currant is widely adapted throughout the Intermountain Region where it grows along waterways and wet meadows. It grows in close association with big sagebrush, and juniper-pinyon in the mountain brush zones. It has low soil fertility requirements and is an excellent species for erosion control in moist areas along streams, meadows, and wind-breaks.

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Currant, Golden

Uses – Golden currant is moderately palatable to deer and sheep, but receives limited utilization by cattle and horses. It is, however, utilized by birds and small mammals as a wildlife habitat species. Golden currant is used in recreational plantings and soil stabilization seedings.

EPHEDRA, GREEN

[*Ephedra viridis*; Native]

Introduction – Green ephedra, also known as Mormon tea, is a long-lived native perennial shrub. It is widely distributed throughout the Intermountain Region at elevations ranging from 4,000 to 8,000 ft. It grows 8 to 40 in in height on sites that receive 10 to 14 in of annual precipitation. It was typically used as a beverage and medicine plant for Native Americans and early western pioneers.

Adaptation – Green ephedra is adapted to well drained shallow to medium soils on rocky slopes and southern salty valleys of the higher creosotebush deserts, desert grasslands, big sagebrush, northern desert shrub, pinyon-juniper, and mountain-brush zones. It will tolerate soils that are calcareous and moderately alkaline or saline. Green ephedra has low nutrient requirements.

Uses – Livestock and wildlife use this species, which provides green browse year-round. However, it is used more heavily on winter ranges than during the summer where it provides a source of energy and protein. It is commonly used to rehabilitate disturbed roadsides, erodible soils, depleted rangelands, mine dumps, and overused recreation sites. Nevada ephedra (*E. nevadensis*) is a desert species that is more tolerant of soil salinity and drought. It has potential as a forage and in stabilizing drier valley sites. Seed should be covered 1/4 to 1/2 inch deep on a well prepared, firm seedbed.

HOPSAGE, SPINY

[*Grayia spinosa*; Native]

Introduction – Spiny hopsage is a long-lived summer deciduous, spiny shrub 10 to 15 in in height that is widely distributed throughout most of the salt desert ranges of the Intermountain Region. It occurs at elevations from 4,000 to 5,500 ft.

Adaptation – Spiny hopsage persists on a wide range of soils from alkaline, limestone to gravelly soils. It prefers heavy textured soils on mesas and flats. It is found in association with salt desert species or intermixed with big and Wyoming sagebrush and pinyon-juniper communities.

Limitations – Prominent spines may cause some injury to wildlife and livestock. Due to the spines, spiny hopsage is relatively tolerant of grazing, but when overgrazed in spring and early summer it is often replaced by less palatable species such as low rabbit-brush.

Uses – Spiny hosage is regarded as one of the most palatable of the salt-desert shrubs. Reports suggest that spiny hopsage is browsed in spring and summer with limited value in late fall and winter. The deciduous fruits are eaten by wildlife after falling to the ground. Spiny hopsage should be fall planted no deeper than 1/4 inch in a weed-free seedbed. Seedlings are susceptible to weed competition, particularly from cheatgrass.

HAWTHORN, BLACK

[*Crataegus douglasii;* Native]

Introduction – At maturity black hawthorne becomes a small tree up to 33 ft tall with stems that produce 1 in thorns.

Adaptation – The hawthorns are adapted to drier areas of riparian zones on clay to sandy loam soils at low to mid elevations. These sites frequently have water tables within 40 in of the soil surface in spring or during high runoff years. This species is tolerant of semi-prolonged flooding.

Propagation – Seed ripens in late July through August, and can be air dried and stored for 2 to 3 years at 41 degrees F. Propagation by seed requires pretreatment with acid for 0.5 to 3.0 hours followed by moist prechilling at 41 degrees F for 84 to 112 days. Following pretreatments, germination of 50 to 80% is common. Seed may be fall sown after pretreatment or held in cold storage after scarification until the following spring. Seeds should be planted at depths no greater than 1/4 in. Seedlings should be transplanted before the second growing season. Seed may be fall sown directly without pretreatment; however, it may be 2 or more years before germination occurs. Field propagation by planting dormant unrooted hardwood cuttings is rarely successful.

Uses – The hawthorns are used as wildlife/riparian corridor species in wildlife plantings.

KOCHIA, FORAGE

[*Kochia prostrata;* Introduced]

Introduction – Forage kochia was introduced from southern Eurasia and is a long-lived (10-15 years.) semi-evergreen half shrub that reaches heights of 1 to 3 ft at maturity. It is often associated with grass and shrub seedings and is seeded on semiarid locations in the western United States as forage, reclamation and fire break plant. This shrub develops a fibrous root system with a large deep tap root that may extend to a depth of 16 feet. It does not tolerate flooding or soils with a high water table and is best adapted to arid areas receiving 6 to 16 in of precipitation. It is known to grow on saline sites where reduction in yield have not been observed at salt concentrations as high as an electrical conductivity (E.C.) of 17.0. Yields of alfalfa in comparison are reduced by 50% at salt concentrations of 12 mmoh/cm.

Adaptation – It is adapted to the pinyon-juniper, basin big sagebrush, Wyoming big sagebrush, greasewood, and shadscale zones. It can persist on disturbed harsh soils with high salt and extreme drought. Forage kochia is one of the most drought tolerant species and will establish at lower precipitation zones than almost any other plant materials available. It is winter hardy withstanding temperature extremes from -25 to 104 degrees F. Forage kochia has been successfully established on a wide range of soils including fine to coarse, shallow to deep, gravelly to stony and saline to alkaline. Recent findings indicate that it grows best on heavy-textured basic soils. However, it is not well adapted to neutral and acidic soils. In annual communities such as halogeton or cheatgrass, forage kochia competes with annuals by reducing their dominance, density, forage, and seed production. It is not highly invasive and does not spread aggressively into healthy perennial plant communities. Forage kochia is generally planted in mixes to enhance diversity with other shrubs, forbs and grasses and is seldom recommended for a single species seeding except for green-stripping to control fires.

Limitations – Seed viability in perennial forage kochia is generally limited to one year but can be extended under proper conditions. Forage kochia is often confused with the weedy annual kochia. Morphologically they are very different. To properly store forage kochia seed it should be reduced to 7% or less moisture, placed in sealed containers and stored at 36 to 50 degrees F. Under these conditions, seed may retain up to 55% germination after 3 years.

Uses – Forage kochia has been promoted as a year-round grazing forage for livestock and wildlife, and can withstand up to 70% utilization. Forage kochia should not be grazed to less than 2 in. Heavy or continuous overuse, especially in the spring, can impact the following year's regrowth. Kochia provides a valuable source of protein and carotene for grazing animals during late fall and winter seasons when many ranges are deficient in nutritional feed. In its native origin forage kochia is an important component of the plant composition where it is moderately to heavily grazed by cattle, sheep, goats, and horses and is often selectively grazed as a preferred plant in mixes. It is mowed and hayed for winter feed on the steppes of Kazakhstan where it comprises 1% to 20% of the total biomass. It is often used for prevention of soil erosion from flooding and to stabilize blowout areas in basins and sand dunes. Kochia has been successfully used in single species greenstrip plantings to reduce the spread of wildfires. It will ignite when surrounded by sufficient quantities of annuals, such as cheatgrass. However, unlike many shrubs it will resprout and grow after burning. Perhaps its greatest potential use is demonstrated in its ability to readily establish on harsh droughty sites with extreme competition, while suppressing and eliminating the invasion of annual weeds such as cheatgrass, halogeton, and Russian thistle. When seeding use current year's

Kochia, Forage

seed if possible. Incorrectly stored seed can experience a severe reduction in viability after 5 to 7 months. Direct seeding on rangelands is best accomplished in fall or winter by broadcasting on top of disturbed or undisturbed soil. If weedy annuals are dominant, a burn prior to seeding will greatly enhance a planting success. It is critical that drilled seed is not placed deeper than 1/16 of an inch.

Adapted Varieties – **Immigrant** is the only released variety of perennial forage kochia.

MAHOGANY, MOUNTAIN (curleaf and true) [*Cercocarpus ledifolius* and *C. montanus*; Native]

Introduction – Curlleaf mountain mahogany is an evergreen shrub or small tree that reaches a height of up to 23 ft. True mountain mahogany is a deciduous shrub generally less than 10 ft tall. Mountain mahogany inhabits dry, rocky slopes at mountain elevations between 4,000 and 10,000 ft that receive 16 to 24 in of annual precipitation.

Adaptation – Both species commonly grow on rocky, mountainous habitats in shallow soils and slickrock clay soils. They also are found in more moist fertile soils of canyon bottoms. Both are commonly adapted to hilly or mountainous habitat where they grow in association with oak, juniper, ceanothus, pinyon-juniper, and pine.

Limitations – Mountain mahogany has low seedling vigor and slow initial rates of growth. Subsequently it is difficult to establish and vulnerable to herbaceous competition and damage by browsing animals. However, after established, it grows rapidly if not browsed.

Uses – Crude protein content in both species is between 7 and 15%. Mountain mahogany is excellent forage for cattle, sheep, and deer. True mountain mahogany is palatable year-round to wildlife and livestock. However, constant utilization can cause plant damage. Curleaf mahogany is mainly browsed in winter by deer and antelope and withstands moderate use with little damage. Browsing in both species stimulates health and vigor, whereas undisturbed stands may become aged, decadent, less palatable, stagnated, and out of reach from most browsing animals.

Adapted Varieties – **Montane** is a widely adapted variety of true mountain mahogany.

ROSE, WOOD'S [*Rosa woodsii*; Native]

Introduction – Wood's rose is a long-lived perennial shrub that grows from 2 to 6 ft in height. It is found throughout the Intermountain Region at elevations from 4,500 to 9,000 ft, where annual precipitation is 14 to 20 inches. It prefers semi-wet well drained sites along streams, seeps and fence lines. If conditions are optimum it forms a nearly impenetrable hedge along mountain streams.

Adaptation –This species is common on well-drained loamy to sandy-gravelly soils on plains, mountain foothills, and mountain sites. It favors moist, well-drained soils present in riparian ecosystems. It tolerates moderately acid to weakly basic soils, and non-saline soils in open communities with reduced competition. It is an aggressive pioneer species in abandoned fields, disturbed sites, gullies, land cuts, and fills. Extensive rhizomes and persistence on harsh sites make it a good seeding option for erosion control along streambanks, seeps, fire rehabilitation, and road cuts. Seed can be drilled or broadcast no deeper than 3/4 in. Fall seeding is required.

Uses – Foliage is moderately palatable and preferred by livestock and big game in spring when leaves are tender. It provides good cover and food for birds and small mammals that readily use the dry fruits during fall and winter.

SAGEBRUSH, BIG [*Artemisia tridentata*; Native]

Introduction–- Big sagebrush has four subspecies: basin, Wyoming, mountain, and spicate. Big sagebrush has a wide distribution throughout the Intermountain Region ranging from 3,500 to 10,500 ft elevation in areas receiving 12 to 35 in of annual precipitation. It is a landscape dominating shrub ranging in height from 2.5 to 15 ft.

Adaptation – Big sagebrush is a species that grows in a variety of soils on arid plains, valleys, and foothills to mountain slopes. It is frequently associated with such shrubs as shadscale, saltbush, rubber rabbitbrush, low

Sagebrush, Big

rabbitbrush, fourwing saltbush, spiny hopsage, spiny horsebrush, winterfat, broom snakeweed, antelope bitterbrush, snowberry, and serviceberry. Seed should be surface seeded on disturbed seedbeds not deeper than 1/8 inch. Seed properly stored in sealed containers at low temperature and humidity will remain viable 2 years after harvest. The palatability of different populations of this shrub to mule deer, sheep, and other animals varies widely. Some of the subspecies provide nutritious forage high in protein for wintering livestock and big game, while others have little palatability and become invasive on former grasslands which have been depleted by overuse.

Limitations – Under continued overgrazing big sagebrush becomes the dominant species in many grass and mixed grass-shrub ranges. These near monoculture stands of big sagebrush require thinning or elimination to increase the grass component.

Uses – Palatable forms of big sagebrush are widely used in projects for wildlife improvement projects. Plants can spread by natural seeding and furnish good forage quality. The short forms of big sagebrush provide feed and cover for sagegrouse and some species provide forage for sheep and cattle.

Adapted Varieties – **Hobble Creek** is a robust, palatable form of mountain big sagebrush adapted to areas receiving more than 14 in of precipitation and deep soil. **Gordon Creek** is a release of Wyoming big sagebrush adapted to 10 to 14 in of annual precipitation.

SAGEBRUSH, BLACK

[*Artemisia nova*; Native]

Introduction – Black sagebrush is a spreading shrub that usually reaches a height of 6 to 20 inches, but occasionally may reach heights of 30 inches. It is important on low elevation winter ranges of the southern Intermountain Region. It is most commonly found at elevations between 3,000 and 6,500 ft on dry slopes, rocky foothills, ridges, and desert mountains that receive from 8 to 20 in of annual precipitation.

Adaptation – Black sagebrush grows in dry, stony, shallow soils, often over a caliche layer, that are often calcareous. It is normally associated with big sagebrush, shadscale, bluebunch wheatgrass, Indian ricegrass, bottlebrush squirreltail, needle and threadgrass, and pinyon-juniper.

Limitations – A decrease in black sage is a good indicator that range conditions are on a downward trend.

Uses – Individual populations of black sagebrush differ in their palatability to wildlife and livestock. In general, black sagebrush is considered excellent winter forage for sheep, antelope, and deer. Its nutritive quality approaches that of big sagebrush, and crude protein during winter ranges from 5 to 7%. It is an aggressive natural spreader from seed and can be easily established by broadcast seeding.

Adapted Germplasm – Pine Valley Ridge is the only release.

SALTBUSH, FOURWING

[*Atriplex canescens*; Native]

Introduction–- Fourwing saltbush is a long-lived perennial upright shrub from 1 to 6 ft tall depending on site conditions and genotype. It is one of the most valuable shrubs in the Intermountain Region where summers are typically hot and dry and winters are normally cold. It is found at elevations from 3,000 to 6,000 feet, on sites that receive 8 to 15 in of annual precipitation.

Adaptation – Fourwing saltbush grows in a wide variety of soil types from valley bottoms and plains to mountainous areas. It is well suited to deep, well drained sandy soil, sand dunes, gravelly mesas, and grassy uplands. It will persist on heavy clay alkaline flats with reduced stands and yields. It is frequently intermixed with numerous shrub and grass species. It grows in association with bottlebrush squirreltail, Indian ricegrass, bluebunch and crested wheatgrasses, rabbitbrush, big sagebrush, shadscale, pinyon-juniper, and greasewood. The presence of fourwing saltbush often enhances the growth of grasses that benefit from the presence of nitrogen and other minerals that concentrate under the fourwing saltbush canopy.

Limitations – When grown in selenium rich soils, fourwing saltbush can accumulate high concentrations, creating a hazard if heavily grazed. This usually does not become a problem if other acceptable sources of feed are available.


Saltbush, Fourwing

Uses – Fourwing saltbush is one of the most valuable forage shrubs on arid rangelands where it is adapted, because of its abundance, accessibility, palatability, size, evergreen habit, nutritive value, rate of growth, and large volume of foliage. Its leaves, stems, and utricles provide browse in all seasons. It withstands heavy winter browsing with new growth being stimulated by grazing. However, excessive spring and early summer grazing may cause severe damage. It provides excellent winter feed for deer and has good palatability for antelope and sheep, and fair for cattle. It is one of the most important shrubs in the rehabilitation of depleted rangelands and in soil stabilization projects. Seed can be covered to 3/8 in depths. Seed sources should not be moved and seeded in colder climates, but can be moved and seeded in warmer climates.

Adapted Varieties – **Rincon** is a productive southern strain best adapted to the big sagebrush, pinyon-juniper, and more mesic portions of the salt desert shrub zones.

SALTBUSH, GARDNER
[*Atriplex gardneri*; Native]

Introduction–- Gardner saltbush is a low growing perennial shrub, that is widespread throughout the salt desert shrublands occurring at 3,000 to 6,000 ft elevation and in areas receiving 6 to 12 in of annual precipitation. It is usually found on heavy textured soils on drier sites than big sagebrush and fourwing saltbush.

Adaptation – In comparison with many salt desert shrubs this species establishes and grows rapidly on heavy textured and basic soils where few other species exist. It is also found on sites where poor percolation and infrequent flooding occur.

Limitations – Gardner saltbush is sensitive to over grazing and many sites previously occupied by Gardner saltbush historically have been degraded by heavy use.

Uses – It produces excellent forage at all seasons. Wildlife and livestock graze the shrub, however, proper management is critical to stand persistence. Seeds should be fall planted at a depth of 1/4 to 3/4 in. It is best to seed this shrub in separate rows from fast growing herbaceous material.

SERVICEBERRY, SASKATOON
[*Amelanchier alnifolia*; Native]

Introduction – Saskatoon serviceberry is a long-lived erect deciduous shrub 3 to 15 ft tall. It is found throughout the Intermountain Region at elevations from 4,500 to 7,000 ft on sites receiving 16 to 30 in of moisture.

Adaptation – Saskatoon serviceberry generally occurs on mountain slopes in the pinyon-juniper and mountain sagebrush zones. It is most productive on sloping moist habitats within or just below the mixed conifers where it often grows in association with other shrubs such as manzanita, Gambel oak, and pinyon-juniper.

Limitations – Seedlings and young plants grow slowly and can be suppressed by more aggressive grasses and broadleaf herbs. It has a tendency to decrease when browsed by sheep and increase when grazed by cattle.

Uses – This species is a valuable browse plant due to its fair-to-high palatability and ready availability to livestock and big game. It is browsed by cattle, after mid-summer when the more palatable grasses and forbs have been grazed or have dried up. Wildlife use it in the fall and winter. Moderate use tends to promote plant growth and vigor, and it resprouts well after burning.

SHADSCALE
[*Atriplex confertifolia*; Native]

Introduction – Shadscale, commonly known as spiny saltbush or saltsage, is a medium to short lived, spiny shrub that is often found in dense clumps typically 1 to 3 ft high. It is usually found on dry and often salty basin valleys and hillsides in the Intermountain Region at elevations ranging from 4,000 to 7,000 ft that receive 6 to 10 in of annual precipitation.

Adaptation – Shadscale is common, but not restricted to alkaline and saline flats in arid desert valleys where it grows in association with sagebrush, rabbitbrush, pinyon-juniper, desert shrub, creosotebush, winterfat, and semi-desert bunchgrasses.

Limitations – Thick spines develop as twigs at maturity and restrict its use by animals. Shadscale can be difficult to establish. Seed dormancy is its greatest limitation.

Shadscale

Uses – Its importance is largely attributed to high production, palatability, nutritional value and an evergreen habit. Even though it is less palatable than some of its associated counterparts such as black sagebrush and grasses, its frequent occurrence makes it a very important source of forage. Shadscale is often eaten during the early spring before spines mature; however, extensive spring grazing can cause deterioration of mature plants and seriously reduce the recruitment of new seedlings. It is an important winter feed for livestock and wildlife. Its ability to thrive on harsh sites under poor soil conditions make it an excellent seeding alternative for range reclamation and stabilization. Fall plantings are recommended.

SNOWBERRY, COMMON

[*Symphoricarpus albus*; Native]

Introduction – Common snowberry is a perennial low spreading native shrub 1 to 3 ft in height. It occurs on hilly, well drained areas at elevations from 4,800 to 10,000 ft. Effective annual precipitation should be between 15 and 25 in.

Adaptation – Mountain snowberry occurs throughout the aspen-conifer forests, maple and other mountain brush communities on mountain loam and shale sites. It is commonly associated with ponderosa pine, fir, aspen, mountain big sagebrush, and chokecherry. This species is persistent under heavy grazing, burning and other major impacts. It is able to persist on harsh sites as well as more productive soils. Seeds are not easily collected, consequently costs are high. In addition, the seed has high seed dormancy problems.

Uses – It is occasionally used by mule deer and becomes an acceptable browse for sheep in late summer. Cattle utilize it to a lesser degree, but enjoy the berries during the autumn season. If seeded in mixtures it should be planted in separate rows or spots away from more rapid growing herbs.

SUMAC, SKUNKBUSH

[*Rhus trilobata*; Native]

Introduction – Skunkbush sumac is a perennial shrub 2 to 7 ft tall that has a wide area of distribution throughout most of the Intermountain Region. It inhabits dry, rocky hillsides, at elevations from 3,500 to 8,000 ft in areas that receive 10 to 20 in of annual precipitation.

Adaptation – This shrub can be found on soils of most textures. It is common along hot, drier riparian areas, shallow rocky foothills, and in well-drained soils. Sumac skunkbush is best adapted to coarse-textured disturbed soils in open communities. It inhabits the ponderosa pine and other open coniferous timber stands, as well as oakbrush. It has moderate drought tolerance and good fire and grazing tolerance.

Uses – In some areas it is considered a valuable source of forage for livestock and wildlife (fruits used by birds), while in most circumstances it has poor palatability and is utilized only when other more favorable forage is not available. Under heavy grazing it tends to be an increaser rather than a decreaser. It demonstrates good potential as a low maintenance species for erosion control in revegetation efforts, or roadside plantings in disturbed areas. It can be transplanted or direct seeded in the fall at a depth of 1/4 to 1/2 in. Seed may require scarification or moist prechilling. Seed dormancy is a problem.

Adapted Varieties – **Bighorn** is an adapted variety that transplants extremely well.

SYRINGA (MOCKORANGE)

[*Philadelphus lewisii*; Native]

Introduction – Mockorange is a loosely branched medium to tall shrub reaching between 3 and 10 ft tall at maturity. Mockorange is commonly referred to as syringa and has been adopted as the State Flower of Idaho. It is a shrub of the foothills and low mountains and extends to about 8,000 ft elevation on slopes of northern and eastern exposures. It is not usually considered a palatable plant by domestic livestock, but is moderately utilized by deer and elk especially on winter ranges.

Adaptation – Mockorange grows on a variety of sites, but prefers canyon bottoms or in other moist, moderately shaded or open areas. It grows more commonly in foothills and montane zones in ponderosa pine and Douglas fir forests, and in dry, rocky, moist streamside areas. Adaptable soils vary from deep, rich loams to dry, rocky or gravelly loams on open hillsides.

Propagation – Fruits are collected in late summer and processed by gently crushing the dried capsules and

then using wind from a clipper or similar device to separate the seed from the chaff. Stratify seed by chilling for 8 weeks at 41 degrees F prior to sowing or fall planting. Field propagation by dormant unrooted hardwood cuttings is moderately successful, especially if adequate and constant moisture is available.

WILLOW, ARROYO

[*Salix lasiolepis*; Native]

Introduction – Arroyo willow is a shrub or tree from 12 to 30 ft in height.

Adaptation – Arroyo willow is found at low elevations and is common to the southern portion of the Intermountain Region. It grows in association with Fremont cottonwood and prefers coarse, rocky soils.

Propagation – Arroyo willow has a moderate growth rate and due to erratic rooting is difficult to successfully propagate.

WILLOW, BARRENGROUND

[*Salix brachycarpa*; Native]

Introduction – Barrenground willow is a small rounded compact shrub that grows up to 3 ft in height. It occurs at elevations from 4,500 to 9,000 ft.

Adaptation – It is found on a wide range of sites and soils. It requires wetter sites at lower elevations than at higher elevations and is capable of tolerating saline soil conditions.

Propagation – It has a slow to moderate growth habit. It demonstrates moderate to good rooting with roots developing along the entire stem.

WILLOW, BEBB

[*Salix bebbiana*; Native]

Introduction – Bebb willow is a shrub to small tree, 10 to 30 ft in height with main stems up to 8 in in diameter. It is distributed between elevations of 3,300 to 7,900 ft.

Adaptation – Bebb willow is rarely observed as the dominant species and is usually identified with aspen and black cottonwood. At low elevations, it grows in moist soils while at higher elevations it adapts to coarser, well drained soils. It is effectively used in riparian plantings.

Propagation – Bebb willow is difficult to propagate and tends to have a low growth rate.

WILLOW, BOOTH

[*Salix boothii*; Native]

Introduction–- Booth willow is a multiple branched shrub with a rounded top which generally reaches 6 to 10 ft in height. It is the most common willow found between 4,500 and 8,000 ft elevation.

Adaptation – Booth willow is frequently associated with the Geyer and Drummond willow. It often occurs on wet, coarse soils, but is also adapted to fine-textured soil. Booth willow is commonly found on riparian sites.

Propagation – Booth willow roots effectively from hardwood cuttings and maintains a good growth rate.

WILLOW, COYOTE

[*Salix exigua*; Native]

Introduction – Coyote willow, also known as sandbar willow, is a shrub from 3 to 15 ft in height that forms a thicket with numerous slender stems.

Adaptation – Coyote willow is a common species found in riparian habitats from elevations of 2,000 to 7,000 ft. It is commonly associated with cottonwood, whiplash and yellow willow, and grows on moist soils, from gravel to silt. Coyote willow spreads vegetatively as shoots that develop from spreading roots.

Propagation – It grows very rapidly, roots freely from cuttings, and is one of the easiest riparian species to propagate.

WILLOW, DRUMMOND

[*Salix drummondiana*; Native]

Introduction–- Drummond willow is a shrub with an open growth from 6 to 12 ft in height.

Adaptation – Drummond willow is found throughout the Intermountain Region between 4,500 and 9,000 ft, but is especially abundant at higher elevations in riparian areas. Associated species include Engelmann spruce and subalpine fir on coarse textured soils that are moist and well aerated.

Propagation – Drummond willow has a moderate growth rate and roots along the entire stem.

WILLOW, GEYER

[*Salix geyeriana*; Native]

Introduction – Geyer willow reaches 10 to 15 ft with numerous straight branches that rise from a tight basal cluster.

Adaptation – Geyer willow is distributed throughout the Intermountain Region from 4,000 to 8,000 ft elevation, and is most commonly found along drainage sides. It is usually found growing with booth willow which occupies wetter riparian zones while the geyer willow is more adapted to associated drier sites. Geyer willow prefers deep, fine textured soils.

Propagation – Geyer willow is relatively easy to propagate. It roots along the entire stem and has a good growth rate.

WILLOW, LEMMON

[*Salix lemmonii*; Native]

Introduction – Lemmon willow is a shrub with numerous, slender, crooked stems reaching heights of 3 to 10 ft.

Adaptation – Lemmon willow is found between 4,000 and 8,000 ft in the northern part of the Intermountain Region. It tends to occupy drier portions of the riparian community. It prefers well drained, coarse soil, and grows at higher elevations than geyer willow.

Propagation – Even though lemmon willow roots along the entire stem, it is only a fair rooting plant with a slow to moderate growth rate.

Willow, Lemmon

WILLOW, PACIFIC

[*Salix lasiandra*; Native]

Introduction – Pacific willow, also know as whiplash willow, is a tree with several main stems and a dense green crown that reaches heights of 50 ft. Stems are often 4 to 12 in in diameter.

Adaptation – Pacific willow is distributed in the Intermountain Region between 2,000 and 6,500 ft where is grows in close association with black cottonwood and yellow willow and is highly adapted to moist sandy to gravelly soils.

Propagation – It has a medium growth rate and is easy to propagate stems that are 2 to 4 years old, whereas older stems root more slowly.

WILLOW, PEACHLEAF

[*Salix amygdaloides*; Native]

Introduction–- Peachleaf willow is a tree that reaches heights of 90 ft with trunks 3 ft in diameter. However, it is not uncommon to find smaller trees occurring in clumps that have 1 1/2 to 2 ft diameter trunks.

Adaptation – Peachleaf willow occurs throughout the Intermountain Region at elevations ranging from 4,000 to 6,000 ft. It commonly grows with cottonwoods and coyote willow and is adapted to riparian loamy soils that are saturated seasonally.

Propagation – Peachleaf willow tends to have a slow growth rate, but has good rooting ability with rooting up and down the entire stem. It is important to use smooth rather than deep furrowed bark sections.

WILLOW, PLANELEAF

[*Salix planifolia*; Native]

Introduction – Planeleaf willow is a very low growing compact rounded shrub that reaches 3 to 4 ft in height.

Adaptation – Planeleaf willow is found throughout the Intermountain Region at upper mid elevations (7,000 ft). It grows in association with wolf willow at higher elevations and booth willow at lower areas. Capable of growing in continually saturated riparian, high organic soils.

Propagation – Planeleaf willow roots along the entire stem and possesses fair rooting attributes, but has slow growth potential.

WILLOW, SCOULER

[*Salix scouleriana*; Native]

Introduction – Scouler willow is a large to small multi-stemmed tree that is 20 to 35 ft in height. Stems are often 4 to 8 in in diameter.

Adaptation – Scouler willow has a wide distribution throughout the Intermountain Region at elevations ranging from 4,000 to 8,000 ft. It often grows with bebb willow. At higher elevations it occupies drier slopes and becomes the only willow adapted to dryer upland areas.

Propagation – Scouler willow has a very slow rate of growth and is relatively difficult to propagate. It is important to use a rooting hormone when starting roots from cuttings.

WILLOW, WOLF

[*Salix wolfii*; Native]

Introduction – Wolf willow is a low growing rounded shrub, that is rarely over 2 ft in height.

Adaptation – Wolf willow's distribution ranges from 6,500 to 9,000 ft elevation where it is in association with geyer and lemmon willows on wetter areas at mid elevations and occupies drier sites at higher elevations. It is adapted to sandy, well drained and aerated soils.

Propagation – Wolf willow has a very slow growth rate. It roots along the entire stem, but rooting is erratic and treatment with a rooting hormone is absolutely necessary.

WILLOW, YELLOW

[*Salix lutea*; Native]

Introduction – Yellow willow is a rounded shrub which occasionally becomes a multi-stemmed tree up to 20 ft in height.

Adaptation – Yellow willow has a wide distribution ranging in elevation from 2,000 to 4,500 ft. Associated species include coyote and Pacific willow. It is found on sites that vary from coarse cobble along streams to moist terraces with deep, fine textured soils.

Propagation – Yellow willow has good growth rate. Propagation is relatively easy from hardwood cuttings that root along the entire stem.

WINTERFAT

[*Ceratoides lanata*; Native]

Introduction – Winterfat is a perennial erect or spreading subshrub with wide variation in stature, from dwarf forms less than 8 in in height to larger forms as tall as 4 ft. It is widely distributed throughout the Intermountain Region at elevations from 3,000 to 7,000 ft. where annual precipitation is 7 to 12 in. It is known to many as "white sage," however, it is classified as a closer relative to the saltbushes. The name "winterfat" denotes its value on winter ranges where it furnishes an abundance of palatable and nutritious forage for sheep and cattle.

Adaptation – It is abundant on lower foothills, plains, and valleys with dry subalkaline soils. However, the upright forms are also intermixed with basin big sagebrush, pinyon-juniper, and ponderosa pine. It is usually mixed with saltbushes, semidesert bunchgrasses, rabbitbrush, sagebrush, and greasewood, and on higher range sites with wheatgrasses and blue grama as the only shrub.

Limitations – Even though it is relatively tolerant to grazing, overgrazing, especially during spring and summer, has greatly reduced and even eliminated winterfat on many areas.

Uses – Winterfat is a nutritious winter browse for livestock and big game. Sheep, cattle, antelope, elk, deer, and rabbits utilize it. It is planted as an ornamental along roadsides and on recreation areas on arid lands. It demonstrates high potential for reclamation efforts on neutral to moderately alkaline soils in cold desert ranges under managed utilization. During the winter dormant season, use of up to 50% of topgrowth has occurred without adverse effects to plant health, providing areas are rested from grazing in 1 of 3 years. Plants are much less susceptible to damage if grazing occurs in winter as opposed to spring and summer. Winterfat seed is viable for relatively short periods of time without special treatment.

Adapted Varieties – **Hatch** is adapted to areas receiving 9 to 14 in of precipitation on salt desert shrubland and pinyon-juniper areas. It is a woody variety that grows rapidly. Hatch may be seeded or transplanted. However, young seedlings are generally vulnerable to spring frosts.

Appendix B. Common Names with Their Scientific Names and Common Synonyms Used Throughout the Planting Guide

Common Name used in Planting Guide	Latin Name used in Planting Guide	NRCS-Data Latin Name	Traditional Latin Name when Different
GRASSES			
Bluegrass, Big	*Poa ampla*	*Poa secunda*	
Bluegrass, Canada	*Poa compressa*	*Poa compressa*	
Bluegrass, Sandberg	*Poa sandbergii*	*Poa secunda*	
Brome, Meadow	*Bromus riparius*	*Bromus biebersteinii*	
Brome, Mountain	*Bromus carinatus*	*Bromus marginatus*	
Brome, Smooth	*Bromus inermis*	*Bromus inermis*	
Canarygrass, Reed	*Phalaris arundinacea*	*halaris arundinacea*	
Dropseed, Sand	*Sporobolus cryptandrus*	*Sporobolus cryptandrus*	
Fescue, Creeping Red	*Festuca rubra*	*Festuca rubra*	
Fescue, Hard	*Festuca ovina var. duriuscu*	*Festuca trachyphylia*	
Fescus, Sheep	*Festuca ovina*	*Festuca ovina*	
Fescue, Tall	*Festuca arundinacea*	*Lolium arundinaceum*	
Foxtail, Creeping	*Alopecurus arundinaceus*	*Alopecurus arundinaceus*	
Needle & Threadgrass	*Stipa comata*	*Hesperotipa comata*	
Needlegrass, Letterman	*Stipa lettermainii*	*Achnatherum lettermanii*	
Needlegrass, Green	*Stipa viridula*	*Nassella viridula*	
Needlegrass, Thurbers	*Stipa thurberiana*	*Achnatherum thurberianum*	
Orchardgrass	*Dactylis glomerata*	*Dactylis glomerata*	
Ricegrass, Indian	*Oryzopsis hymenoides*	*Achnatherum hymenoides*	
Ryegrass, Perennial	*Lolium perenne*	*Lolium perenne*	
Sacaton, Alkali	*Sporobolus airoides*	*Sporobolus airoides*	
Squirreltail, Bottlebrush	*Elymus elymoides*	*Elymus elymoides*	*Sitanion hystrix*
Timothy	*Phleum pratense*	*Phleum pratense*	
Wheatgrass, Bluebunch	*Pseudoroegneria spicata*	*Pseudoroegneria spicat*	*Agropyron spicata*
Wheatgrass, Crested	*Agropyron cristatum and A. A. desertorum*	*Agropyron cristatum and A. desertorum*	
Wheatgrass, Intermediate	*Thinopyrum intermedium*	*Thinopyrum intermedium*	*Agropyron intermedium*
Wheatgrass, NewHy	*Elymus hoffmannii*	*Elymus hoffmannii*	
Wheatgrass, Siberian	*Agropyron fragile*	*Agropyron fragile*	*Agropyron sibericum*
Wheatgrass, Slender	*Elymus trachycaulus*	*Elymus trachycaulus*	*Agropyron trachycaulum*
Wheatgrass, Snake River	*Elymus wawawaiensis*	*Elymus wawawaiensis*	*Agropyron spicatum*
Wheatgrass, Streambank	*Elymus lanceolatus*	*Elymus lanceolatus*	*Agropyron riparium*
Wheatgrass, Tall	*Thinopyrum ponticum*	*Thinopyrum ponticum*	*Agropyron elongatum*
Wheatgrass, Thickspike	*Elymus lanceolatus*	*Elymus macrourus*	*Agropyron dasystachyum*
Wheatgrass, Western	*Pascopyrum smithii*	*Pascopyrum smithii*	*Agropyron smithii*
Wildrye, Altai	*Leymus angustus*	*Leymus angustus*	*Elymus angustus*
Wildrye, Basin	*Leymus cinereus*	*Leymus cinereus*	*Elymus cinereus*
Wildrye, Beardless	*Leymus triticoides*	*Leymus triticoides*	*Elymus triticoides*
Wildrye, Blue	*Elymus glaucus*	*Elymus glaucus*	
Wildrye, Mammoth	*Leymus racemosus*	*Leymus racemosus*	*Elymus giganteus*
Wildrye, Russian	*Psathyrostachys juncea*	*Psathyrostachys juncea*	*Elymus juncea*
GRASSLIKE SPECIES			
Bulrush, Alkali	*Scirpus maritimus*	*Schoenoplectus maritimus*	
Bulrush, Hardstem	*Scirpus acutus*	*Schoenoplectus acutus*	
Cattail, Common	*Typha latifolia*	*Typha latifolia*	
Rush, Baltic	*Juncus balticus*	*Juncus balticus*	
Sedge, Beaked	*Carex rostrata*	*Carex rostrata*	
Sedge, Nebraska	*Carex nebrascensis*	*Carex nebrascensis*	

Common Name used in Planting Guide	Latin Name used in Planting Guide	NRCS-Data Latin Name	Traditional Latin Name when different
Sedge, Water	*Carex aquatilis*	*Carex aquatilis*	
Spikerush, Creeping	*Eleocharis palustris*	*Eleocharis palustris*	
Threesquare, Comon	*Scirpus pungens*	*Schoenoplectus pungens*	
FORB AND LEGUMES			
Alfalfa	*Medicago sativa*	*Medicago sativa*	
Aster, Blueleaf	*Aster glaucodes*		
Arrowleaf, Balsamroot	*Balsamorhiza sagittata*	*Balsamorhiza sagittata*	
Burnet, Small	*Sanquisorba minor*	*Sanquisorba minor*	
Clover, Alsike	*Trifolium hybridum*	*Trifolium hybridum*	
Clover, Red	*Trifolium pratense*	*Trifolium pratense*	
Clover, Strawberry	*Trifolium fragiferum*	*Trifolium fragiferum*	
Clover, White	*Trifolium repens*	*Trifolium repens*	
Flax, Blue	*Linum perenne*	*Linum perenne*	
Globemallow, Scarlet	*Sphaeralcea coccinea*	*Sphaeralcea coccinea*	
Goldeneye, Showy	*Viguiera multiflora*	*Heliomeris multiflora*	
Milkvetch, Cicer	*Astragalus cicer*	*Astragalus cicer*	
Parsnip, Cow	*Heracleum lanatum*	*Heracleum maximum*	
Penstemon, Alpine	*Penstemon venustus*	*Penstemon venustus*	
Penstemon, Firecracker	*Penstemon eatonii*	*Penstemon eatonii*	
Penstemon, Palmer	*Penstemon palmeri*	*Penstemon palmeri*	
Penstemon, Rocky Mountain	*Penstemon strictus*	*Penstemon strictus*	
Sagewort, Louisiana	*Artemisia ludoviciana*		
Sainfoin	*Onobrychis viciifolia*	*Onobrychis viciifolia*	
Sweet Anise	*Osmorhiza occidentalis*	*Osmorhiza occidentalis*	
Sweetvetch, Utah	*Hedysarum boreale*	*Hedysarum boreale*	
Trefoil, Birdsfoot	*Lotus corniculatus*		
Yarrow, Western	*Achillea millefolium*	*Achillea millefolium*	
WOODY PLANTS			
Alder, Red	*Alnus rubra*	*Alnus rubra*	
Alder, Sitka	*Alnus viridis*	*Alnus viridis ssp. sinuata*	
Aspen, Quaking	*Populus tremuloides*	*Populus tremuloides*	
Birch, Water	*Betula occidentalis*	*Betula occidentalis*	
Bitterbrush, Antelope	*Purshia tridentata*	*Purshia tridentata*	
Bitterbrush, Desert	*Purshia glandulosa*	*Purshia glandulosa*	
Boxelder	*Acer negundo*	*Acer negundo*	
Buffaloberry, Silver	*Shepherdia argentea*	*Shepherdia argentea*	
Ceanothys, Martin's	*Ceanothus martinii*	*Ceanothus martinii*	
Chokecherry	*Prunus virginiana*	*Prunus virginiana*	
Cinquefoil, Shrubby	*Pentaphylloides floribunda*	*Dasiphora floribunda*	
Stansbury, Cliffrose	*Cowania stansburiana*	*Purshia stansburiana*	
Cottonwood, Black	*Populus trichocarpa*	*Populus balsamifera*	
Cottonwood, Fremont	*Populus fremontii*	*Populus fremontii*	
Cottonwood, Narrowleaf	*Populus angustifolia*	*Populus angustifolia*	
Currant, Golden	*Ribes aureum*	*Ribes aureum*	
Ephedra, Green	*Ephedra viridis*	*Ephedra viridis*	
Hopsage, Spiny	*Grayia spinosa*	*Grayia spinosa*	
Hawthorn, Black	*Crataegus douglasii*	*Crataegus douglasii*	
Kochia, Forage	*Kochia prostrata*	*Kochia prostrata*	
Mahogany, True Mountain	*Cercocarpus montanus*	*Cercocarpus montanus*	
Mahogany, Curleaf Mountain	*Cercocarpus ledifolius*	*Cercocarpus ledifolius*	

Common Name used in Planting Guide	Latin Name used in Planting Guide	NRCS-Data Latin Name	Traditional Latin Name when different
Rose, Wood's	*Rosa woodsii*	*Rosa woodsii*	
Sagebrush, Big	*Artemisia tridentata*	*Artemisia tridentata*	
Sagebrush, Black	*Artemisia nova*	*Artemisia nova*	
Saltbush, Fourwing	*Atriplex canescens*	*Atriplex canescens*	
Saltbush, Gardner	*Atriplex gardneri*	*Atriplex gardneri*	
Serviceberry, Saskatoon	*Amelanchier alnifolia*	*Amelanchier alnifolia*	
Shadscale	*Atriplex confertifolia*	*Atriplex confertifolia*	
Snowberry, Common	*Symphoricarpos albus*	*Symphoricarpos albus*	
Sumac, Skunkbush	*Rhus trilobata*	*Rhus trilobata*	
Syringa (Lewis) Mock Orange	*Philadelphus lewisii*	*Philadelphus lewisii*	
Willow, Arroyo	*Salix lasiolepis*	*Salix lasiolepis*	
Willow, Barrenground	*Salix niphoclada*	*Salix niphoclada*	
Willow, Bebb	*Salix bebbiana*	*Salix bebbiana*	
Willow, Booth	*Salix boothii*	*Salix boothii*	
Willow, Coyote (Narrowleaf)	*Salix exigua*		
Willow, Drummond	*Salix drummondiana*	*Salix drummondiana*	
Willow, Geyer	*Salix geyeriana*	*Salix geyeriana*	
Willow, Lemmon	*Salix lemmonii*	*Salix lemmonii*	
Willow, Pacific	*Salix lucida*	*Salix lucida*	
Willow, Peachleaf	*Salix amygdaloides*	*Salix amygdaloides*	
Willow, Planeleaf (Diamondleaf)	*Salix planifolia*		
Willow, Scouler	*Salix scouleriana*	*Salix scouleriana*	
Willow, Wolf	*Salix wolfii*	*Salix wolfii*	
Willow, Yellow	*Salix lutea*	*Salix lutea*	
Winterfat	*Ceratoides lanata*	*Krascheninnikovia lanata*