TECHNICAL NOTES

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SEED PRODUCTION STANDARDS FOR CONSERVATION PLANTS IN THE INTERMOUNTAIN WEST

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SEED PRODUCTION OF CONSERVATION PLANTS IS A SPECIALTY ENTERPRISE

Seed production of conservation grasses, forbs and shrubs offers an opportunity for a few dedicated producers to develop a highly profitable enterprise over time.

Grass, forb and shrub seed production is a long-term endeavor that requires a minimum of two years before the first seed crop is harvested and any financial return is realized. Marketing may delay positive cash flow for additional years after harvest, even assuming good seed yields.

Seed of conservation plants, unlike cereal crops such as wheat, barley, and oats, has no real dollar value until sold to a seed distributor or to the final user for hay, pasture, range, soil protection or wildlife habitat plantings. Individuals considering seed production as a farm enterprise should produce varieties that are in demand and also have a marketing strategy or production contract in place when the seed field is established.

Conservation plants are specialty crops that require specific management and cultural practices to ensure success. The following guidelines will help individuals to establish a successful seed production enterprise. Valuable information can also be obtained by visiting successful seed producers, seed dealers, Plant Materials Centers, and Research and Extension Centers. Take time to visit with several sources for information before making final seed production decisions.

SEED CERTIFICATION

The purpose of seed certification is to ensure that high quality seed is distributed to seed growers and users. Certification ensures seed genetic identity with a known pedigree and high germination and purity standards. This is accomplished through use of Foundation (Generation 1) or Registered (Generation 2) seed, isolation of seed production fields, field inspection, and seed testing-analysis by state certified seed laboratories under the jurisdiction of the state seed certification agency.

Seed producers should seriously consider the production of Certified seed. Certified seed is more readily marketable, especially if the seed producer is not well known. USDA-Natural Resources Conservation Service - Plant Materials Centers (PMCs), Agricultural Research Service (ARS) and others produce Foundation seed. Foundation seed is available to individuals through Crop Improvement Associations. Individuals in can purchase Aberdeen PMC Foundation seed through the University of Idaho Foundation Seed Program or through the Utah Crop

Improvement Association. Registered and Certified seed is available through local seed dealers and producers.

Foundation seed must be planted to qualify for production of Registered seed. Foundation or Registered seed must be planted to qualify for Certified production. Certified seed cannot be used to produce any other class of Certified seed. Certified seed can only produce common or uncertified seed.

Producers of Certified seed must comply with the rules of their state seed certification program, which is administered in Idaho and Utah by the Crop Improvement Associations and in Nevada by the State Department of Agriculture to grow Certified seed.

SPECIES SELECTION

Seed producers should consider only those species and varieties that are adapted to their area. It is also advisable to grow those varieties in greatest demand by land managers or the seed trade.

First time seed producers should select varieties that establish easily, have high seed yield potential, exhibit the least difficulty in maintaining row culture (bunchgrasses), and present the least difficulty in culture, establishment and management, seed harvesting, conditioning and storage.

SITE SELECTION

Seed production fields should be as weed free as possible, especially from noxious weeds such as wild oats, morning glory, Canada thistle, quackgrass, whitetop, etc. Each state has a noxious weed list and it is very important to be able to identify and control those weeds. Cheatgrass (downy brome) can be especially troublesome in seed production fields. If the field is not clean, do not plant. Many weeds can be controlled in conjunction with seed production but this should not be the primary objective in growing conservation plants seed.

Fields should be adapted to irrigation without ponding or excessive erosion. Soil erosion by water can be a serious problem when producing seed in wide row spacing on rolling land. Select a level to gently sloping site for growing varieties in wide rows or plant on the contour to reduce soil erosion between rows. Rills and gullying between rows can make harvesting very difficult. In addition, runoff water from spring snow melt or heavy rains can carry seed of other species from adjacent fields or field margins and from one seed production field to another, causing potentially serious cross species contamination. Locate seed production fields to avoid potential contamination by other species.

Seed production will be maximized if plantings are established on productive soil. Required isolation distances must be maintained between species of the same kind for production of all classes of Certified seed. In Idaho for example, a seed field for the production of Foundation, Registered or Certified seed must be isolated from any other strain or strains of the same species

in bloom at the same time. Eligibility requirements are in accordance with the state Crop Improvement Association given in the following table:

		Minimum Isolation Distance Required (feet)		
	Symbol	Foundation	Registered	Certified
All Cross-pollinated species	C	990	330	165.0
Strains at least 80% Apomictic*	A	165	33	16.5
Highly self fertile species	S	165	33	16.5

* Apomixis refers to a type of asexual production of seed as in Kentucky bluegrass.

In addition, Idaho grass seed fields must meet a specific cropping history to be eligible as shown below:

Past Cropping History - Field Eligibility

1. A field to be eligible for the production of Foundation seed must not have grown or been seeded to the same species during the previous five years.
2. A field to be eligible for the production of Registered seed must not have grown or been seeded to the same species during the previous two years.
3. A field to be eligible for the production of Certified seed must not have grown or have been seeded to the same species during the previous year, except for foundation, registered or certified seed of the same variety.

Always check the rules and requirements of certification for your state prior to field selection.

ESTABLISHMENT

Planting Dates

If fields are irrigated, planting in May or June produces the best stands for seed production of most grasses in the Intermountain Region. Studies conducted at the Aberdeen PMC have shown very appreciable differences between spring (May and June) planting versus late summer (August and September) planting. Spring planting dates consistently yield more seed in the first year after planting than late summer or early fall planting dates.

Planting some cool season grasses in late summer or early fall will often permit a seed harvest the following year. These species include crested wheatgrass, intermediate wheatgrass, pubescent wheatgrass, slender wheatgrass, and bromegrass. Russian wildrye will not produce seedheads the following year when planted in mid-summer through fall. Green needlegrass, western

wheatgrass, and basin wildrye are slow to establish and will not produce enough seedheads for a profitable harvest if planted in mid-summer through fall.

To obtain maximum seed production consistently, late summer or early fall planting is generally not advised. Fall planting dates run the risk of winterkill due to slow developing root systems that may be damaged by soil heaving from frost.

Dormant-season planting (generally late October – December) is recommended for varieties such as green needlegrass, beardless wildrye, Indian ricegrass, and penstemon species that possess natural seed dormancy. The cold temperature stratification of seed over winter is necessary in order for seed to germinate and establish a suitable stand. Dormant-season planting must be late enough in the fall so that seed does not germinate and emerge until conditions are more favorable for plant growth in the spring. Soil temperatures of less than 40 ° Fahrenheit is ideal for dormant planting.

Shrubs, such as fourwing saltbush and winterfat may be seeded in the dormant season or early spring. However, for seed production, the best success is by starting the plants in a greenhouse and transplanting to the seed production field.

Seeding Depth

Most grasses should be seeded at a depth of ¼ to ¾ inch (but no deeper than 1 inch) into a moist, firm, weed free seedbed. A firm seedbed and shallow depth of seeding will provide more uniform emergence of seedlings and stand establishment. A firm seedbed also holds moisture near the surface of the soil for most optimal seedling root growth. Indian ricegrass is an exception to the rule and in sandy soils must be planted at depths of 2 to 3 inches. Blue flax and fourwing saltbush, should be planted ¼ to ½ inch deep. Winterfat, sagebrush, penstemon species and forage kochia should be surface seeded and firmed or pressed into the soil surface.

Row Spacing

Grasses, forbs and shrubs tend to react differently to wide row spacing versus solid or narrow row spacing. Wide row spacing generally produces higher seed yields over a longer term compared to narrow row spacing. Row plantings require less seed per acre for desired stand establishment, and cultivation for weed control is possible when compared to a solid planting. Few herbicides are available and labeled for forage seed crops. Undesirable or off-type plants can be identified and rogued from the field easier and volunteer plants from shattered seed or tillering from rhizomes can be controlled more effectively when planted in rows.

Desired row spacing is dependent on equipment available, whether site is irrigated or dryland, and the plant being grown. Row spacing for grasses and forbs should not be less than twenty-four inches. Thirty-six inch row spacing is recommended and ideal for most species when irrigated or grown in a 16 inch plus precipitation zone. Seed fields grown in less than 16-inch mean annual precipitation zone (generally not recommended) should be established in 48-inch

rows. Shrubs must also be planted in wider row spacing. For example, winterfat should be planted in 5 feet rows (minimum) and antelope bitterbrush should be planted in 14 feet rows.

A single seeded row of grass will, within 1-2 years, tiller and spread out in the row. A mature row will occupy a space about ten inches wide. Grasses grown in rows will produce more seed if new tiller shoots are given room to grow as the stand ages.

Many forbs such as penstemon species can be grown in 16-18 inch rows if weed barrier material is used for weed control.

SEEDING RATES AND SEEDLING ESTABLISHMENT

A seeding rate of 25 to 30 pure live seeds (PLS) per lineal foot (2 to 2.5 seeds per inch) of row normally provides a solid, uniform row of plants for species that have less than 500,000 seeds per pound. Species with greater than 500,000 seeds per pound should be seeded at approximately 50 PLS per lineal foot (4 seeds per inch). A solid in-row stand assists with weed control. Seeding rates should always be based on pure live seed (PLS) basis. Table 1 provides seeding rate information for plant materials commonly grown in the Intermountain West

Seed of some species does not feed evenly through common grain drills and tends to bridge in drill boxes without seed agitators, resulting in an uneven seeding and skips. A carrier such as rice hulls or cracked corn may be required to permit even flow of seed (see Idaho Plant Materials Technical Note No. 7, Grass - Legume - Forb Seed Dilution with Rice Hulls).

Companion or nurse crops are not recommended when planting grass, forb and shrub species for seed production. Companion crops delay development of the stand and reduce seed yields.

Cultivate as soon as rows (seedlings) are visible and weeds begin to grow. Cultivate between rows and mow as often as necessary to reduce weed competition and weed seed production. Use caution when cultivating to ensure the row does not become ridged. Shallow cultivation, 1 to 2 inches deep and as close to the row as possible is recommended. Roto-tillers and rolling cultivators adjusted to move soil away from the seeded row do an excellent job of cultivation. If shovels or sweeps are used, a disc mounted next to the row adjusted to pull soil away from the grass seedlings is helpful. Row shields are also helpful to avoid covering seedlings.

Phosphorus fertilizer assists with rapid healthy root growth and future seed production. Soil test and if phosphorus is below 18 parts per million apply phosphorus and plow it down during seedbed preparation for a long-term supply. Phosphorus is immobile in the soil and must be incorporated into the soil to be available.

Other fertilization is generally not recommended during establishment. However, once the small amount of nutrients in the seed is depleted, the seedlings depend on soil nutrients for growth and development. If soil tests indicate low levels nitrogen and potassium, an application of ten to fifteen pounds of nitrogen and twenty to thirty pounds of potassium per acre may be applied prior to planting. Heavier rates may injure germinating seeds and promote weed production.

Fertilize for full seed production following the first year of establishment in early fall or use a split application in early fall and again in early spring on sandy or other soils where nutrient leaching may be a problem. Shallow side dressing is recommended to place nutrients in the crop root zone with minimal root injury. Broadcasting fertilizing results in feeding weeds in spaces between rows.

STAND MANAGEMENT FOR SEED PRODUCTION

Weed, disease and insect control, maintaining row culture, irrigation, after-harvest residue, and fertilization are the primary concerns for management of established seed production fields.

Cultivation

Cultivation, use of herbicides, and hand rogueing are the primary methods for controlling weeds, maintaining row culture, eliminating off type plants and species invading seed production fields. Mowing of other perennial species around waste areas, tree rows, drainage areas, and along roadsides bordering seed fields and maintaining a clean-tilled or mowed field border will be beneficial to prevent invasion of undesirable plants and to maintain genetic purity. Perennial grasses adjacent to seed fields should be mowed before flowering.

Cultivate as often as necessary to maintain a weed-free stand. A minimum of three to five cultivation or roto-tilling operations during the growing season are generally required to control annual grasses, broadleaf weeds, volunteer seedlings and spread from sod-forming grasses between the rows.

Cultivate shallow, usually no deeper than 1 to 1½ inches. Deep cultivation prunes the fibrous roots, reducing plant vigor and potential seed production. Begin cultivation in early spring, before growth begins, to suppress rhizomatous growth and early growing weeds between the rows. An additional cultivation may be required two to three weeks later. Cultivation is usually required following seed harvest. Cultivation is normally required after irrigation or adequate rainfall and when new seedlings develop between rows from seed shatter at harvest time.

Use care when cultivating to prevent soil ridging in the seed row. Ridged rows will make it difficult to harvest windrowed crops that lay between the rows. Row shields, slow travel speed and proper adjustment of tillage equipment should minimize soil ridging in the row.

Caution - Do not damage the green vegetative growth at the margins of seed rows in early spring or after regrowth begins in the fall when cultivating because potential seed production may be reduced. Most perennial grasses initiate vegetative tiller buds in the fall. These tiller buds develop into reproductive shoots in late winter or very early spring on newer shoots.

Tillage equipment may transport rhizomes of sod-forming grasses and tillers or live seeds between seed fields. Always clean tillage equipment thoroughly before moving to another field

planted to a different variety of the same grass or to a different species to avoid cross contamination of seed fields.

Weed, Disease and Insect Control

Herbicides may be required to control broadleaf weeds in seed production fields. Grass seed fields can be sprayed with labeled herbicides such as 2,4-D, MCPA, dicamba, bromoxynil or combinations of these herbicides. Seedling grasses should not be sprayed until at least the three-leaf stage on irrigated and five to six-leaf stage on dryland. Apply herbicides on established grass fields early, preferably before jointing, but before the boot stage of growth because seed yield may be reduced. Herbicide application during the boot stage will reduce seed yield significantly. Annual grassy weeds must be controlled prior to planting or with cultivation or roguing in established fields.

ALWAYS APPLY HERBICIDES ACCORDING TO LABEL INSTRUCTIONS

Hand roguing is essential in grass, forb and shrub seed production to maintain genetic purity and to ensure the production of high quality seed. Hand roguing is the removal of inferior, non-typical or off-type plants from the seed field. Removal of off-type plants and invading grasses should be completed before the plants begin to flower. Most grasses are easily identified after seedhead emergence.

Disease and insects sometimes become more prevalent and serious when a species is planted as a monoculture in a field. Fields should be inspected regularly to note any damage by insects or disease. Quick action should occur to identify and control problems. University and commercial pest and disease specialists can provide the latest information for insect and disease control. Often, a change in cultural practices such as preventing excessive irrigation and maintaining soil fertility will decrease disease problems.

Irrigation

Dryland seed production should generally not be attempted unless you have at least 16 inches of mean annual precipitation.

If seed of conservation plants are produced with irrigation, maintain the soil moisture holding capacity above fifty percent field capacity during the growth period. Adequate irrigation water should be applied before the flowering stage (boot stage) to maintain the crop until pollination is complete. Three or four irrigation applications (approximately 3 inches per application based on plant needs and soil moisture holding capacity) will generally produce a seed crop during most years. Irrigate in spring at or prior to the boot growth stage, just prior to the flowering growth stage, and after flowering, but no later than the soft dough stage. Do not irrigate during the flowering growth stage. Sprinkler irrigation or rainfall during flowering or pollination may reduce seed set, lowering the potential seed yield. A fourth irrigation is often required after

harvest and residue removal in mid September to germinate shattered seed from harvest, promote active fall regrowth and food storage in the plant.

Residue Management

Residue or straw should be removed following seed harvest to encourage future maximum seed yields. Removal is essential because large amounts of residue cannot be incorporated adequately into the soil by cultivation. Research indicates that residue removal reduces plant disease and pest potential and stimulates the production of larger and an increased number of tillers due to increased light penetration to the plant crown. Shading of plant crowns reduces regrowth causing reduced food storage and seedstalk development. Residue may be removed by baling for use as livestock feed or as mulch material for reclamation projects.

Burning residue following harvest is not generally recommended if an alternative method is available. Certain varieties such as basin wildrye and meadow brome can be severely damaged by burning too hot and too deep into the plant crown, affecting regrowth and plant recovery. Very early spring burning to remove prior fall regrowth has shown increased orchardgrass seed yields and production longevity. Any spring burning should be fast and before any plant green up begins to occur. Late fall burning limits the amount of snow-catch for moisture conservation and exposes the plant stand to cold winter temperatures. Perennials require some regrowth after harvest in order to build plant (carbohydrate) reserves before going into the winter period.

Fertilization

Fertilization of seed production fields is essential to maintain high yields of seed, especially following the first seed production year. Grass stands tend to become "sod bound" with age, becoming nitrogen deficient within one to two years following establishment. The grass stand is producing more roots than vegetative shoot growth. This condition is caused primarily by a lack of nitrogen, although phosphorus, potassium and other micro-nutrients such as sulfur may be lacking. A soil test will determine the level of each nutrient in the soil. If the soil test indicates some of these nutrients are low, the response to nitrogen fertilizer application alone may be reduced. Excess nitrogen will promote lodging, especially in tall grasses. Soil testing is recommended to ensure proper fertilization.

Typically, on productive soils, apply forty to sixty pounds per acre of available nitrogen after stand establishment. Following the first seed harvest, apply eighty to one hundred pounds per acre of available nitrogen for each subsequent crop. Side dressing or shanking in nutrients is recommended because less fertilizer is needed and it reduces weed growth between rows. Side-dress shallow enough to provide soil coverage without root injury.

Timing of fertilizer application is very important. Tiller buds, which determine the number of grass shoots the following year, are initiated in the fall. Seed production fields of cool-season

species should be fertilized in early fall following seed harvest and residue removal. On soils where leaching may be a problem, a split application of fertilizer in early fall and again early the following spring is desirable. The split application stimulates fall tiller bud development and maintains vigorous growth the following spring while limiting the potential loss of nitrogen.

HARVEST

The first step is to make sure there is sufficient seed to make a profitable harvest. Make a careful examination of many seedheads to see if they contain seed. Seed harvested in the hard dough stage usually has higher germination and greater longevity. Grasses do not mature uniformly so a compromise between maturity and seed shatter must be made when deciding to harvest. Generally, for grasses and forbs, when the tip of the seedhead begins to shatter on about half the field, the crop is ready to harvest. Most grasses and forbs do not hold their seed long after ripening. Table 1 provides information on recommended harvest methods, harvest dates and expected seed yields for conservation plants used in the Intermountain West.

Seed may be harvested by different methods but the two most common methods are direct combining and windrowing followed by combining. Direct combining involves less time and labor and the seed is more mature. Disadvantages of direct combining are:

- the seed has a higher moisture content and must be dried before storage
- the crop is left standing in the field to become more mature and is vulnerable to rain and wind
- threshing of seed is not as complete and more seed conditioning may be required

Windrowing allows for an earlier harvest. Seed is cured in the field to the safe moisture content (< 12% moisture) for storage and sometimes a higher purity product is obtained. There is less loss of seed from shattering if properly handled resulting in more seed produced than direct combining. Disadvantages of windrowing are:

- a pickup attachment is needed on the combine and some materials are difficult to lift out of the windrow
- light rain may wet the windrow to a condition too wet to thresh
- persistent showers will require turning the windrow to reduce incidence of mold and mildew and seed may shatter
- increased chance of picking up weeds and weed seed
- high winds can seriously disturb or blow windrows off the field

SEED CONDITIONING

A state-certified seed cleaning plant should clean seed for the most satisfactory results.

Harvested seed contains trash and potential contaminants that must be removed before seed analysis and sale. Seed quality can be improved by sizing and removing damaged seed. Seed conditioning is a complicated process requiring specialized equipment and is usually not

performed by the seed grower. Machines are available to separate seed based on length, width, thickness, shape, weight, specific weight and surface texture. Weed seed with physical characteristics similar to the crop seed are of greatest concern because removal of the weed seed will result in loss of good crop seed. A good weed control program in the field will help reduce this problem.

Remember grass, forb and shrub seed crops are specialty crops and require specific management techniques in order to ensure success.

THE GROWER WHO PRODUCES SEED INTENTIONALLY IS THE GROWER WHO PRODUCES GOOD QUALITY SEED CONSISTENTLY.

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Table 1.
Seed Production Guidelines for Conservation Plants Used in the Intermountain West

Common Name	PLS [1/] Seeding Rate	Harvest Method [2/]		Approximate [3/] Harvest date	Average Seed Yield	
		Direct	Windrow		Dryland	Irrigated
GRASSES	(lbs./ acre)				(lbs./ acre)	
Bluegrass, big	1.0*	#	X	early-July	350	900
Bluegrass, Kentucky	0.4*	#	X	mid-July	350	900
Bluegrass, Sandberg	0.8*	X	#	early-July	-	260
Brome, meadow	4.7	#	X	mid-July	200	550
Brome, mountain	5.0	#	X	mid-July	300	600
Brome smooth	3.5	#	X	mid-July	300	500
Canarygrass, reed	1.5*	X	#	late-June	150	450
Fescue, hard	1.4*	#	X	early-July	300	600
Fescue, sheep	1.1*	X	#	early-July	300	600
Fescue, tall	2.2	#	X	mid-August	200	400
Foxtail, creeping	0.9*	stripping	#	early-July	150	300
Needlegrass species	2.5	stripping	#	late-June	100	250
Orchardgrass	1.2	#	X	early-July	-	300
Ricegrass, Indian	3.5	X	#	late-July	100	200
Squirreltail, bottlebrush	2.4	#	X	mid-July	-	200
Timothy	0.6*	stripping	#	mid-July	-	500
Wheatgrass, beardless	3.5	#	X	mid-July	80	150
Wheatgrass, bluebunch & Snake River	3.2	#	X	late-July	80	170
Wheatgrass, crested	2.8	#	X	early-August	200	650
Wheatgrass, intermediate	4.9	#	X	late-August	250	500
Wheatgrass, pubescent	5.5	#	X	late-August	250	500
Wheatgrass, Siberian	2.7	X	#	late-August	200	450
Wheatgrass, slender	3.4	#	X	early-August	250	500
Wheatgrass, streambank	2.9	#	X	mid-July	100	400
Wheatgrass, tall	5.5	X	#	late-August	-	600
Wheatgrass, thickspike	3.3	#	X	mid-July	100	350
Wheatgrass, western	4.5	#	X	mid-August	80	200
Wildrye, basin	3.5	X	#	mid-August	150	350
Wildrye, beardless	2.5	#	X	early-August	-	150
Wildrye, Russian	3.2	X	#	early-August	150	500

Table 1 continued.
Seed Production Guidelines for Conservation Plants Used in the Intermountain West

Common Name	PLS [1/] Seeding Rate	Harvest Method [2/] Direct	Windrow	Approximate [3/] Harvest date	Average Seed Yield Dryland	Irrigated
FORBS	(lbs./ acre)				(lbs./ acre)	
Alfalfa	2.0	X	#	late-August	150	500
Burnet, small	10.4	X	#	late-August	200	550
Flax, blue	1.6	No	X	early-August	300	700
Milkvetch, cicer	3.3	#	hand	mid-September	150	500
Penstemon, alpine	0.7*	#	hand	early-September	-	200
Penstemon, firecracker	1.3	#	hand	early-September	-	200
Penstemon, Palmer	1.2	#	hand	early-September	-	200
Penstemon, Rocky Mountain	1.7	#	hand	October	-	200
Sainfoin	24.2	X	#	mid-August	200	1000
Yarrow, western	0.3	X	#	mid-September	-	150
SHRUBS						
Bitterbrush, antelope	hand plant	hand harvest		mid-August	200	-
Forage kochia	1.5	#	X	late-October	-	400
Sagebrush, basin-Mtn-Wyoming	0.3-(hand plant)	hand harvest		late-October	1000	-
Saltbush, fourwing	hand plant	hand harvest		mid-October	400	-
Winterfat	hand plant	hand harvest		early-October	300	-

[1/] Seeding rate based upon 30 pure live seeds per foot at 36 inch row spacing for species < 500,000 seeds per pound and 50 pure live seeds per foot at 36 inch spacing for species >500,000 seeds per pound. * Denotes species with > 500,000 seeds per pound. Multiply by 0.86 for 42-inch rows; by 1.2 for 30-inch rows; by 1.5 for 24-inch rows. Most shrubs should be transplanted with much wider row and in-row spacing than for grasses or forbs.

[2/] Harvest method: X, preferred; # satisfactory; depending on conditions and grower preference. Review plant guides for each variety for specific information.

[3/] Approximate harvest date at Aberdeen, Idaho. The exact date in a given year will depend on geographic location and environmental conditions.