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# Grass Seed Production Guide for Utah

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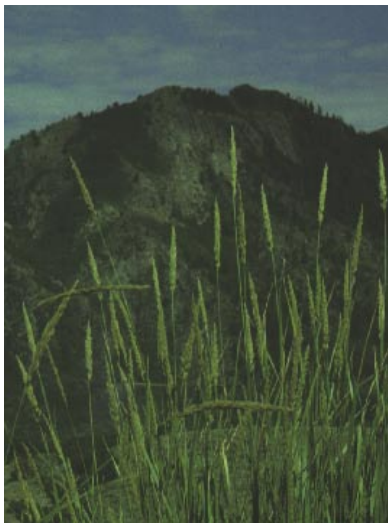

# Grass Seed Production Guide for Utah

*H. Horton, K. H. Asay, T. F. Glover, S. A. Young, B. A. Haws, S. A. Dewey, J. O. Evans*

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# Introduction

Certified seed of wheatgrass varieties was initiated in Utah in 1954. From then until 1963, approximately 100 acres per year of mainly wheatgrasses was produced for certified seed. During the 1970s and 1980s, certified seed production has increased dramatically. In 1989, certified wheatgrass seed was produced on nearly 2,000 acres. Production of non-certified seed has fluctuated over the years depending on needs for reseedings of government land (BLM and Forest Service), private rangeland improvements, and in the reclamation of disturbed areas such as mine spoils.

Interest in grass seed production in Utah has increased in recent years by the release of several new varieties. The USDA-Soil Conservation Service Plant Materials Centers have released several new varieties for special use in range and conservation seedings. The Forage and Range Research Unit of the USDA-ARS at Utah State University and the USDA-Forest Service Great Basin Experiment Station at Ephraim have been responsible for the development of several of the new grass species and varieties and other promising new varieties are in the release process. The Conservation Reserve Program which has been implemented with the passing of the 1985 Farm Bill has increased demand for these new species and varieties. Approximately 40 million acres was initially designated for the conservation program whereby erodible land was to be taken out of grain production for conservation purposes.

Certified grass seed acreage in Utah has surpassed alfalfa seed acreage and is now a major certified seed crop in the state. Much of this acreage is in new varieties of wheatgrasses. For example, 1,273 acres of the new crested wheatgrass variety “Hycrest” was established in Utah for certified seed production in 1989. This was more than any other species or variety. Producers have found that grass seed production offers a diversification alternative in small acreages to traditional small grain and alfalfa crops. Some have used the seed crop alternative with livestock systems to diversify production in the face of rather cyclical markets for farm produce. The market for grass seed also tends to be cyclical and is highly influenced by government policy action regarding conservation and rangeland seeding programs. The care and harvest requirements for seed crops are quite demanding as well, and farmers are in need of information regarding production requirements and the behavior of the market. This guideline provides general information on species and varieties available, cultural practices recommended, certification requirements, economics of production, and market for such grasses.

# Establishing a Grass Seed Production Field

## Time of Seeding

On non-irrigated areas, seedings should be made only when adequate moisture is present to ensure seedling establishment. In most Utah areas, this occurs in the early spring or late fall. Seedings should be made early enough in the spring to take advantage of cool weather and moist conditions. Fall seedings should be made late enough so that germination will be delayed until the following spring. Small seedlings exposed to winter desiccation, especially in areas where snow cover comes late and does not remain will usually experience high mortality.

There is much more flexibility in irrigated plantings. However, irrigated seedings should be made in early to mid spring before the onset of summer heat. Late summer seedings on irrigated land are acceptable in late August or early September as temperatures begin to moderate. It is important that plants have time to develop beyond the seedling stage before winter.

## Seedbed Preparation

The seedbed should be smooth, firm, moist, and free from competition. A firm seedbed is especially critical in order to provide a better opportunity for germinating seed to maintain contact with moist soil. If the field is not essentially free of weeds, particularly weedy annual and perennial grasses, **do not plant**. Weedy grasses are especially difficult to eliminate from a desired grass stand, or as seed during the seed cleaning process at harvest time. Increased seeding rate will seldom compensate for poor seedbed preparation.

## Seeding Depth

Perennial grasses have small seed and are particularly sensitive to excessive planting depths. Great care should be taken to ensure proper seed placement, which generally should not exceed 1/4 to 1/2 inch deep. Seeding at greater depths will usually result in severe seedling mortality. Seed should be planted deeper in light textured soils than in heavy textured soils.

## Row Spacing

Optimum spacing depends on the species, amount of water (irrigated or dryland), and the equipment available for cultivation. Dryland plantings require wider spacing than irrigated. Grass stands that are seeded in rows usually produce more seed and are easier to fertilize and cultivate. Row seedings also have more efficient access to sunlight, nutrients, and available water than solid-seeded stands. In addition, row plantings require a lower seeding rate and volunteer plants from shattered seed are easier to control. The latter becomes an important factor in certified or registered seed production.

## Planting Methods and Equipment

Contact between the soil and seed can be enhanced by rolling or cultipacking after planting or by using a planter equipped with packer wheels. Double-disk furrow openers with depth bands provide for more accurate seed placement. Corn planters with additional weight on the timing or packer wheels, appropriate seed plates, and depth bands on the disk openers are effective grass planters. Individual planting units can be positioned on the toolbars for various row spacings and they provide for accurate seed placement and compaction of soil around the seed.

## Irrigation

Irrigation not only improves the chances for successful establishment, but increases seed yield as well. It also provides flexibility in choice of planting date and species. Sprinkler or furrow irrigation methods are generally more suitable than flood irrigation for establishing grasses on most soil types. Irrigation of new seedings must be done with tender care. On heavy soils, crusting can severely impede seedling emergence, especially when a sprinkler irrigation system is used. To avoid crusting, keep the soil surface moist by frequent light irrigations until seedling emergence occurs. If soil crusting develops on dryland or areas with limited irrigation water, it is possible to use a roller for loosening soil surfaces, so seedlings can emerge. However, experience, timing, and choice of equipment is critical.

## Fertilization

A moderate to heavy application of nitrogen at planting time is not usually recommended because of its caustic effects on the seed and young seedlings. Nitrogen fertilizer also encourages rapid development of weeds. However, in relatively weed-free seedbeds, a band of fertilizer (approximately 10 to 15 lbs N per acre) placed below the seed, but not in contact with it, will enhance seedling vigor. Adequate amounts of phosphorus, potassium, and sulfur must be available for proper root development and optimum seed production of the mature stand. These are most easily applied and worked into the soil at planting time. Soil testing on seed production fields before planting is a very important factor associated with profitable economic returns.

## Weed Control

Weed control is an important management element in establishing a stand of grass for seed production. Other grasses and weeds that were in the designated seed field prior to establishing the stand should be controlled. Grassy weeds are the most difficult to control. In Utah, downy brome (cheatgrass), quackgrass, barnyard grass, foxtail, and other cultivated grasses and grains such as brome, fescue, and barley are problems in establishing grasses for production of certified seed. Quackgrass requires spot spraying or "wiping" with glyphosate (Roundup) so that seed contamination can be prevented.

For establishing a new stand, control weeds before planting. Roundup, 2,4-D or Paraquat can be applied to control emerging weed seedlings. Herbicides currently registered for application to grass seed crops for weed control include:

**Glyphosate (Roundup)**: Recommended for control of annual and perennial weeds before planting (0.25 to 4.0 lbs active ingredient per acre).

**Paraquat (Gramoxene Super)**: Use 0.625 lbs active ingredient per acre prior to (or on the day of planting) to control annual grasses and broadleaf weeds.

**Bromoxynil (Buctril)**: Apply 0.375 to 0.5 lbs active ingredient per acre to new grass planting before weeds exceed 2 inches in height. Recommended for control of annual broadleaf weeds.

**2,4-D (Various Brands)**: For control of annual broadleaf weeds, use 0.95 lbs active ingredient amine or 0.475 lbs active ingredient ester per acre when grass seedlings have five or more leaves.

**Dicamba (Banvel)**: Apply 0.25 to 0.50 lbs active ingredient per acre or in a mixture with 2,4-D to control broadleaf weeds after seedling grasses have developed 3 to 5 leaves.

In specialized seed production areas, such as the Willamette Valley in Oregon, the charcoal band method is often used to control weed competition in new seedings. The charcoal is placed in a band with the seed and deactivates the herbicide (usually diuron), which would otherwise harm or kill the developing grass seedlings. The herbicide is not deactivated in areas between bands and it remains effective for 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 bulletin 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 not legal nor recommended.

# Management of the Established Grass Seed Production Field

## Irrigation

Furrow irrigation by gravity flow is the best method for irrigating seed production fields. Sprinkler irrigation is also effective but may result in higher incidence of disease and lodging problems. For optimum seed production, it is important to irrigate often enough to promote uninterrupted plant growth. Frequency of irrigation will vary according to soil conditions, climate, rainfall, and species used. Range grasses such as crested and intermediate wheatgrass require substantially less water than more humid grasses such as orchardgrass and smooth bromegrass. In general, grass seed crops do not require as much moisture as most field crops; however, timing of water application is critical. Moisture must be sufficient during pollination and the seed-filling period. If soil moisture is low during these periods, the results may be poor pollination, inadequate seed development, and reduced seed yield. Because irrigation or heavy rain during peak pollination is often detrimental, it is best to irrigate just prior to pollination. Sprinkler irrigation should not be used during and immediately after pollination. If furrow irrigation is used, it is beneficial to apply water after pollination during the grain-fill period.

## Fertilization

Fertilization of seed production fields, particularly with nitrogen, is essential to maintain high seed yields and to prevent stands from becoming sodbound. Fall, or fall/early spring split applications of nitrogen have given the best results for seed production. Late spring applications cause excessive vegetative growth which leads to lodging problems and decreased seed yields. Sixty to 80 lbs of nitrogen applied annually is sufficient for most cool-season grass seed crops in Utah. Periodic soil testing is essential to ensure requirements for other mineral elements are met and to prevent excessive buildup of nitrogen.

After several years, productivity declines even under moderate fertilization. These long-term stands can be rejuvenated by ripping or close cultivation to disturb root systems. This practice applies particularly to rhizomatous species that have a tendency to become sodbound.

## Fall Management

Crop residue should be removed soon after harvest and before fall regrowth to reduce buildup of disease and insects. This can be done by mowing for hay, moderate grazing by livestock, or burning. If row seedings are used and the aftermath is not too heavy, it can be shredded with a rotary mower and incorporated into the soil with cultivation. Regrowth should be promoted in the early fall by irrigation (if soil moisture is lacking) and fertilization. Tillers that develop in the fall will ultimately produce seed heads the following spring, whereas inadequate fall tillering will result in poor seed head development and low yields. Moreover, energy reserves produced by the fall regrowth are essential for winter survival of perennial grasses.

## Weed Control on Established Grass Stands

Weed control on established stands is essential in order to comply with seed certification requirements. Previous crop and weed control management will determine the degree of weed control in subsequent grass seed production. General control measures have been recommended to control weeds in the established stand. This often includes spot spraying after seed crop harvest to control field bindweed (or morning glory), Canada thistle, and other perennials. Herbicides approved for use in established grass seed crops include:

**Bromoxynil (Buctril)**: This herbicide should be applied at the rate of 0.5 to 2.0 lbs active ingredient per acre for the control of annual broadleaf weeds. It may be tank mixed with MCPA, 2,4-D or Banvel. (See caution statement on Banvel below.)

**2,4-D (Various Brands)**: For control of annual and perennial broadleaf weeds, apply 0.95 to 1.9 lbs active ingredient amine or 0.475 to 0.713 lbs active ingredient ester per acre to grass that has tillered. Application can be made up to the early boot stage. This herbicide may also be applied in the fall.

**Dicamba (Banvel)**: For control of annual and perennial broadleaf weeds, apply 0.25 to 1.0 lbs active ingredient per acre after the grass has become established, but before jointing.

**CAUTION:** Use of Dicamba on established stands during seed production is not recommended because of its possible detrimental effects on seed yield and seed quality. To minimize potential yield losses, it is recommended that Dicamba be used primarily for spot-treatment applications. Research at the Meeker, Colorado Plant Materials Center and experience of growers in Colorado and Utah has shown that Banvel can reduce seed production and germination potential of crested wheatgrass.

## Insect Control

Very little is known regarding the nature and extent of damage caused by insects on grass seed production. It is known that a number of insects infest grass stands around the state as well as in other forage and seed producing areas in the Pacific Northwest and the Great Plains. In Utah, thrips appear to be the dominant insect pest in grass seed fields. Thrips are small, winged or wingless, narrow insects about 1/16 inch long. Some species of thrips can cause the foliage of grass to turn whitish or rusty colored, and can damage developing florets or grass flowers. Part or all of the seed head turns white and the condition often is referred to as “silver top.” The most effective control time is not yet known, but an application of 1 lb of active ingredient malathion per acre prior to flowering has been successful. More than one application may be needed depending on the insect population and weather conditions. A major advantage of malathion is that no interval is required between the last application and harvest. One-half pound of diazinon per

acre can be applied, but the interval between application and harvest has been set at 7 days.

Other insects also damage grass seed crops in Utah. These include the meadow plant bug, grasshoppers, aphids, some mites, and the black grass bug. Malathion application is useful in controlling aphids, the black grass bug, and grasshoppers. Approximately 1 lb or 8 fluid ounces of liquid active ingredient should be applied per acre. The meadow plant bug is best controlled with 0.5 lb of diazinon or 0.33 to 0.5 lb per acre of dimethoate; however, 21 days is required between the last application and harvest when diazinon is used and the grass stand should not be grazed or used as a feed for livestock if dimethoate is used.

The meadow plant bug also produces the "silver top" effect in grasses. Adults are dirty yellow and dark brown in color, and are narrow and about 3/8 inch long with either short or long wings. This population of bugs produces a rank odor. They suck plant juices and reduce seed yields by extracting the nutrients used for seed production. Grasshoppers feed on seed heads and prevent the seed from reaching full maturity. The black grass bug, also a sucking insect, leaves a residue on the seed. Mites and aphids suck the plant nutrients and destroy the developing seed head and associated seed. Parathion is presently the best control of mites if applied at about 0.5 lb per acre. At least 15 days are required between the time of application and harvest.

It is essential that labels on bags or bottles of insecticide are read and understood to comply with safety requirements and the proper application of the pesticide. Additional caution should be exercised to avoid drift of insecticide into pastures and hay fields or areas where bees or other beneficial insects are located.

# Harvesting Grass Seed

## Time of Harvest

One of the most important decisions in grass seed production is determining when to harvest. The appropriate time varies depending on the grass species, weather, and method of harvest. Seedheads of a grass variety do not emerge or mature at the same time. This leads to considerable variation in degree of maturity among seedheads of a typical grass variety. Approximately 30 days is required for the seed to advance from the flowering stage to maturity. Hot, dry weather reduces the time for required for ripening, while cool, moist conditions delay ripening. For some grasses under hot, dry weather conditions, it may take only 3 to 4 days for seed to advance from the medium dough stage to maturity. It is important, therefore, to inspect the field frequently. In general, grass should be swathed when seed is beginning to shatter at the top of the head.

Meadow foxtail, green needlegrass, Russian wildrye, and other wildrye species shatter readily and must be harvested within one or two days of the recommended stage to avoid significant loss of seed. The wheatgrasses and smooth brome are less susceptible to shattering.

## Harvest Method

Swathing followed by combining is the most commonly accepted practice for harvesting grass seed. Direct combining is often used to harvest grasses with uniform seed maturity, short-growing grasses, or grasses which are difficult to pick up from a windrow. Swathing allows for earlier harvesting, which reduces shattering. Because seed, stems, etc. can then be dried in the swath, combining is easier and the seed from the combine has a lower moisture content. The moisture content of the seed is often low enough to store without additional drying. The

disadvantages include increased labor and harvesting costs.

The common grain combine is usually suitable for harvesting seed of forage grasses. The combine should be thoroughly cleaned, particularly if more than one variety or species is to be harvested. Some adjustments are necessary before harvesting grass seed. For light, chaffy seed, all air intakes should be shut off. This may require that the fan housing be sealed or the fan deactivated. Other grasses require a small amount of air. The sieves and chaffers need to be removed from the cleaning shoe except for the upper chaffer. The chaffer should be opened wide enough for seed to drop through and allow most straw to ride out of the combine. Chaffy grass seed requires a wider cylinder concave spacing than heavier seed. The cylinder should be run only as fast as required to dislodge all ripe seed. A concave spacing of about 1/4 inch and a cylinder speed from 900 to 1000 RPM are generally adequate. If the cleaning shoe has a tailing rake or adjustable tailer, cover the shoe completely to prevent material from returning to the cylinder. When direct combining is done, the cutting height should be adjusted to cut as little green foliage as possible.

### Seed Storage

Grass seed at 10 to 12% moisture is considered safe for storage in bulk. If the seed is to be stored in bags, then a range of 12 to 15% moisture is usually safe. A cool and dry environment for storage is best for maintaining good seed germination. There are two general rules of thumb for proper storage of the seed. First, seed life is generally doubled for every decline in air temperature of 10 degrees Fahrenheit. Second, the numerical sum of air temperature and relative humidity (in percentage terms) should not exceed 100. For example, if the air temperature is 80 degrees, then the relative humidity in storage should not exceed 20%.

## Seed Certification

A seed grower should be familiar with the various aspects of varietal identity, genetic purity, seed quality, and proper labeling. Certified seed generally has better market potential, especially for newer varieties. Some public and proprietary varieties are registered under Title 5 of the Plant Variety Protection Act, which means they must be produced as certified seed. Certified seed by definition has known varietal identity, high genetic purity, high germinating ability, and minimum amounts of other crop seed, weed seed, and inert matter.

There are four classes of seed recognized by seed certification agencies. **BREEDER SEED** is very limited in amount and is directly produced or controlled by the originating plant breeder. **FOUNDATION SEED** (White tag) is produced from Breeder seed and is available from state Foundation seed organizations or a company which controls the variety. **REGISTERED SEED** (Purple tag) is the progeny of Foundation seed. **Registered seed (or Foundation seed of varieties for which the breeder designates there is no Registered class) must be planted to produce the Certified seed class.** CERTIFIED SEED is the class commonly sold to those establishing grass stands for forage and reclamation.

### The Application and Certification Process

In Utah, certification is a service performed by the Utah Crop Improvement Association (UCIA) in cooperation with the Utah Agricultural Experiment Station and the Division of Plant

Industry of the Utah Department of Agriculture.

Anyone may apply to grow certified seed, but the UCIA must be contacted before planting. Only varieties approved by an official seed certification agency are eligible for certification in Utah.

Application forms and copies of the seed certification standards may be obtained by contacting: Utah Crop Improvement Assn., Utah State University, Logan, UT 84322-4855; Phone: (801) 750-2082.

After planting, fields should be rouged to remove other varieties and off-types. Weeds (particularly noxious or restricted) must be controlled. Seed fields will be inspected at least once before harvest by a UCIA representative. Seed identity and freedom from contamination must be maintained during harvest and storage. Conditioning facilities are inspected and a sample of the cleaned seed is submitted to an approved seed laboratory for analysis. If the seed sample meets the certified seed analysis standards, certification is completed by proper labeling. **Only seed produced in accordance with the regulations of the UCIA and labeled with an official tag or bulk certificate can be represented as Utah Certified Seed.**

## Labeling Seed Properly

Utah seed law states that seed (whether certified or non-certified) cannot be legally sold without an **ANALYSIS** label which lists the seed laboratory test results. In Utah, a separate **CERTIFICATION** tag indicates the kind (common name of the species), variety, and certification number and/or lot number.

The analysis information and net weight of the packaged seed may be identified on either the bag, an attached tag, or both. Information on the analysis tag includes the state of origin, seller's name and address, and variety and kind. (If the seed is not certified, the variety does not need to be stated.) Also included are the proportions of pure seed, inert matter, weed seed, and other crop seed, which must all add up to 100%. In non-certified grass seed, weed seed can total up to 1.0% of the net weight except that seeds of weedy *Bromus* species may increase the percentage up to 2.0%. Presence of restricted noxious weed seeds (not to exceed 27 per lb) must be indicated on the label.

Total germination (sum of the seeds actually sprouted plus dormant seed) is also listed on the analysis label. The notation (TZ) following the germination percentage indicates that a staining technique utilizing tetrazolium chloride was used to give a quick evaluation of the viability of the seed. This treatment can substitute for the actual germination test. A germination test date must also be listed, and must be updated with results of another test every 18 months.

**If seed is certified**, seed lots must meet or exceed certain minimum requirements for germination that vary for each species. Standards for contamination by seeds of other varieties and other crops must not be exceeded, and the maximum proportion of weed seed allowed is 0.3%. In special cases, seed lots which do not meet normal certification standards, based on factors other than varietal identity and genetic purity may be labeled with the word SUBSTANDARD on the certification tag along with the particular factor, upon which such labeling is based, e.g., “Excessive Inert Matter.”

Many grass seed lots are sold on a pure live seed (pls) basis. The pls is calculated by multiplying the percent purity by the percent total germination (i.e., 80% purity (.8) X 85% germ. (.85) = .68 or 68% pls).

## Major Grass Species Considered for

## BROMGRASS, MEADOW

*(Bromus biebersteinii)*

**Establishment**

**Seeding Rate** 25-30 pure live seeds per linear foot of drill row.
**Seeding Depth** 1/4-1/2 inch.
**Row Spacing** 24 inches under irrigation.
**Time of Seeding**
Spring - March-April
Late Summer - Late Aug.-Mid Sept., if irrigation is available.
Late Fall - After Nov. 1. Objective is to delay germination until Spring.
**Weed Control** Clipping, hand-rouging, light rate of 2,4-D after the five leaf stage (consider an additional follow-up application if needed), or bromoxynil according to label directions.
**Fertilization** If irrigated, apply phosphorus according to soil tests to include enough for several years. Very little nitrogen should be applied until seedlings are established at which time apply 30 to 50 lbs N per acre.
**Irrigation** Apply adequate moisture for germination and establishment, then bring soil profile to field capacity. Seed production of Meadow Brome is not recommended under dryland.

**Management of Stand**

**Weed Control** Clipping, hand-rouging, 2,4-D, or bromoxynil according to the label and cultivation.
**Fertilization** Split application of nitrogen each year recommended. Under Irrigation, apply 30-50 lbs N per acre in the early fall and 30-40 lbs N per acre in the early spring.
**Irrigation** Fertilize and irrigate soon after seed harvest. For optimum production, do not stress plants for moisture, especially during regrowth and tillering in the Fall, late boot stage, and pollination.

**Seed Harvest**

**Time of Harvest** Early to Mid-July
**Method of Harvest**
Direct Combining - Acceptable when mature, when seed begins to shatter at top of head
Windrowing - Recommended
Stage - Hard dough
Approximate Drying Time in Windrow - 5-7 days
Special Problems
Shattering - No
Lodging - No

**Seed Cleaning**

**Drying** If crop is windrowed, not necessary
**Debearding** No

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## BROMEGRASS, SMOOTH
*(Bromus inermis)*

**Establishment**

**Seeding Rate** 30-35 pure live seeds per linear foot of drill row.
**Seeding Depth** 1/4-1/2 inch.
**Row Spacing** Irrigated 30-36 inches.
**Time of seeding**
Spring - March-April
Late Summer - Late Aug.-mid Sept. if irrigation is available.
Late Fall - After Nov. 1. Objective is to delay germination until the following Spring.
**Weed Control** Clipping, hand-rouging, light rate of 2,4-D after the five leaf stage (consider an additional follow-up application if needed), or bromoxynil according to label directions.
**Fertilization** Apply phosphorus according to field tests to include enough for several years supply. Very little nitrogen should be applied until seedlings are established at which time apply 30 to 50 lbs N per acre under irrigation.
**Irrigation** Apply adequate moisture for germination and establishment; the soil profile should then be brought to field capacity. Seed production of smooth brome is not recommended under dryland.

**Management of Stand**

**Weed Control** Clipping, hand-rouging, 2,4-D, or bromoxynil according to the label and cultivation.
**Fertilization** If possible make a split application of nitrogen each year. Under irrigation apply 30-50 N lbs per acre in the early Fall and 30-40 lbs N per acre in the early Spring.
**Irrigation** Fertilize and irrigate soon after seed harvest. For optimum production, do not stress plants for moisture, especially during regrowth and tillering in the Fall, late boot stage, and pollination.

**Seed Harvest**

**Time of Harvest** Early to mid-July

**Method of Harvest**
Direct Combining - Acceptable when mature, when seed begins to shatter at top of head.
Windrowing - Recommended
Stage - Hard dough
Approximate drying time in windrow - 5-7 days.
Special Problems

Shattering - No
Lodging - Can be a problem with heavy applications of nitrogen. Split fertilizer applications will minimize the problem.

**Seed Cleaning**

**Drying** Usually not necessary if crop is windrowed.
**Debearding** No

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## FESCUE, TALL

*(Festuca arundinacea)*

**Establishment**

**Seeding Rate** 25-30 pure live seeds per linear foot of drill row.
**Seeding Depth** 1/4-1/2 inch
**Row Spacing** 24-30 inches with irrigation.
**Time of Seeding**
Spring - March-April
Late Summer - Late August-mid September with irrigation.
Late Fall - After November 1. Objective is to delay germination until the following Spring.
**Weed Control** Clipping, hand-rouging, light rate of 2,4-D after the five leaf stage (consider an additional follow-up application if needed), or bromoxynil according to label directions.
**Fertilization** With irrigation, apply phosphorus according to field tests to include enough for several years supply. Very little nitrogen should be applied until seedlings are established at which time apply 30-50 lbs N per acre.
**Irrigation** Apply adequate moisture for germination and establishment. The soil profile should then be brought to field capacity. Seed production of tall fescue is not recommended under dryland.

**Management of Stand**

**Weed Control** Clipping, hand-rouging, 2,4-D, or bromoxynil according to the label and cultivation.
**Fertilization** If possible make a split application of nitrogen each year. Under irrigation, apply 30-50 lbs N per acre in the early Fall and 30-40 N lbs per acre in the early Spring.
**Irrigation** Fertilize and irrigate soon after seed harvest. For optimum production, do not stress plants for moisture, especially during regrowth and tillering in the Fall, late boot stage, and pollination.

**Seed Harvest**

**Time of Harvest** Mid to late July
**Method of Harvest**
Direct Combining - Acceptable at maturity, when seed begins to shatter at top of head.
Windrowing - Recommended
Stage - Hard dough

Approximate Drying Time in Windrow - 4-6 days

Special Problems

Shattering - No

Lodging - Moderate under heavy fertilization and irrigation

**Seed Cleaning**

**Drying** Usually not necessary if crop is windrowed

**Debearding** No

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## FOXTAIL, CREEPING

*(Alopecurus arundinaceus)*

**Establishment**

**Seeding Rate** 30-35 pure live seeds per linear foot of drill row.

**Seeding Depth** 1/4-1/2 inch

**Row Spacing** Irrigated 36 inches

**Time of Seeding**

Spring - March-April

Late Summer - Late Aug.-mid Sep., if irrigation is available.

Late Fall - After November 1. Objective is to delay germination until the following Spring.

**Weed Control** Clipping, hand-rouging, light rate of 2,4-D after the five leaf stage (consider an additional follow-up application if needed), or bromoxynil according to label directions.

**Fertilization** If irrigated, apply phosphorus according to field needs for several years supply. Very little nitrogen should be applied until seedlings are established at which time apply 30-50 lbs N per acre under irrigation.

**Irrigation** Apply adequate moisture for germination and establishment, then soil profile should be brought to field capacity. Seed production of creeping foxtail is not recommended under dryland.

**Management of Stand**

**Weed Control** Clipping, hand-rouging, 2,4-D, or bromoxynil according to the label and cultivation.

**Fertilization** If possible, make a split application of nitrogen each year. Under irrigation, apply 30-50 lbs N per acre in the early Fall and 30-40 lbs N per acre in the early Spring.

**Irrigation** Fertilize and irrigate soon after seed harvest. For optimum production, do not stress plants for moisture, especially during regrowth and tillering in the Fall, late boot stage, and pollination.

**Seed Harvest**

**Time of Harvest** Late June to early July

**Method of Harvest**

Direct Combining - Not recommended

Stripping - Preferred

Windrowing - When seed stripper is not available
Stage - Seeds have turned black
Approximate drying time in windrow - 4-7 days
Special Problems
Shattering - Yes
Lodging - No

**Seed Cleaning**

**Drying** Yes, unless crop is windrowed
**Debearding** Yes

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## ORCHARDGRASS

*(Dactylis glomerata)*

**Establishment**

**Seeding Rate** 25-30 pure live seeds per linear foot of drill row.
**Seeding Depth** 1/4 to 1/2 inch.
**Row Spacing** Irrigated 24 to 30 inches
**Time of Seeding**
Spring - March-April
Late Summer - Late Aug.-mid Sep. if irrigation is available.
Late Fall - After November 1. After November 1. Objective is to delay germination until the following Spring.

**Weed Control** Clipping, hand-rouging, light rate of 2,4-D after the five leaf stage (consider an additional follow-up application if needed), or bromoxynil according to label directions.
**Fertilization** On irrigated fields, apply phosphorus according to field tests to include enough for several years supply. Very little nitrogen should be applied until seedlings are established, then apply 30-50 lbs per acre.
**Irrigation** Apply adequate moisture for germination and establishment after which the soil profile should be brought to field capacity. Seed production of orchardgrass is not recommended under dryland.

**Management of Stand**

**Weed Control** Clipping, hand-rouging, 2,4-D, or bromoxynil according to the label and cultivation.
**Fertilization** If possible make a split application of nitrogen each year. Under irrigation, apply 30-50 lbs N per acre in the early fall and 30-40 lbs N per acre in the early spring.
**Irrigation** Fertilize and irrigate soon after seed harvest. For optimum production, do not stress plants for moisture, especially during regrowth and tillering in the Fall, late boot stage, and pollination.

**Seed Harvest**

**Time of Harvest** Mid June to Early July.

**Method of Harvest**

Direct Combining - Not recommended

Windrowing - Preferred

Stage - Hard dough

Approximate drying time in windrows - 5-7

Special Problems

Shattering - Moderate

Lodging - Not usually

**Seed Cleaning**

**Drying** Usually not necessary when windrowed

**Debearding** No

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## RICEGRASS, INDIAN

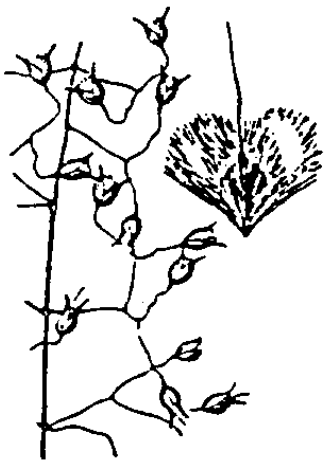
*(Oryzopsis hymenoides)*

**Establishment**

**Seeding Rate** 30-40 pure live seeds per linear foot of drill row.

**Seeding Depth** 1 1/2 inches to 2 inches

**Row Spacing** 24 inches under irrigation or high rainfall, 36 inches on dryland areas.



**Time of Seeding**

Late Fall - A dormant seeding (after November 1, before soil freezes) is preferred. Seed dormancy decreases after several years when seed is stored at room temperatures. Plantings are usually more effective with older seed. To ensure more successful seedings, store at room temperature for several years to reduce seed dormancy problems. Mechanically scarify seed if possible.

**Weed Control** Clipping, hand-rouging, light rate of 2,4-D after the five leaf stage (consider an additional follow-up application if needed), or bromoxynil according to label directions.

**Fertilization** On dryland and irrigated apply phosphorus according to field test to provide several years supply. Very little nitrogen should be applied until seedlings are established at which time apply 20-30 lbs N per acre dryland or 30-40 lbs N per acre irrigated.

**Irrigation** Apply adequate moisture for germination and establishment; the soil profile should be then be brought to field capacity.

**Management of Stand**

**Weed Control** Clipping, hand-rouging, 2,4-D, or bromoxynil according to the label and cultivation.

**Fertilization** If possible make a split application of nitrogen each year. For dryland, apply

20-30 lbs of N per acre in the early Fall and 20 lbs N per acre in the early Spring. For irrigated, apply 30 lbs N per acre in the early Fall and 20-30 lbs N per acre in the early Spring.

**Irrigation** Fertilize and irrigate soon after seed harvest. For optimum production, do not stress plants for moisture, especially during regrowth and tillering in the Fall, late boot stage, and pollination.

**Seed Harvest**

**Time of Harvest** Because of the indeterminate growth habit, seed matures from mid-June to mid-July. Harvest when later maturing seed begins to shatter.

**Method of Harvest**

Direct Combining - Recommended

Windrowing - Acceptable when mature

Stage - Hard dough

Approximate Drying Time in Windrow - 7 days

Special Problems

Shattering - Yes

Lodging - No

**Seed Cleaning**

**Drying** Depending on Moisture content, usually not required

**Debearding** Yes

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## WHEATGRASS, BLUEBUNCH

*(Pseudoroegneria spicata = Agropyron spicatum)*

**Establishment**

**Seeding Rate** 30-35 pure live seeds per linear foot of drill row.

**Seeding Depth** 1/4 to 1/2 inch.

**Row Spacing** 24 inches under irrigation or high rainfall, 36 inches in dryland areas.

**Time of Seeding**

Spring - March-April

Late Summer - Late August to mid September with irrigation.

Late Fall - After November 1. Objective is to delay germination until the following Spring.

**Weed Control** Clipping, hand-rouging, light rate of 2,4-D after the five leaf stage (consider an additional follow-up application if needed), or bromoxynil according to label directions.

**Fertilization** Dryland and irrigated apply phosphorus according to field tests to include enough for several years supply. Very little nitrogen should be applied until seedlings are established at which time apply 20-30 lbs N per acre.

**Irrigation** Apply adequate moisture for germination and establishment; soil profile

should then be brought to field capacity.

**Management of Stand**

**Weed Control** Clipping, hand-rouging, 2,4-D, of bromoxynil according to the label and cultivation.

**Fertilization** If possible make a split application of nitrogen each year. For dryland, apply 20-30 lbs N per acre in the early Fall and 20 lbs N per acre in the early Spring. For irrigated apply 30 lbs N per acre in the early Fall and 20-30 lbs N per acre in the early Spring.

**Irrigation** Fertilize and irrigate soon after seed harvest. For optimum production, do not stress plants for moisture, especially during regrowth and tillering in the Fall, late boot stage, and pollination.

**Seed Harvest**

**Time of Harvest** Mid-July

**Method of Harvest**

Direct combining - Acceptable when mature

Windrowing - Recommended

Stage - Hard dough

Approximate Drying Time in Windrow 4 days

Special Problems

Shattering - Moderate

Lodging - No

**Seed Cleaning**

**Drying** Usually not necessary. Check moisture content.

**Debearding** No

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## WHEATGRASS, CRESTED

*(Agropyron desertorum (Standard), A. cristatum (Fairway), A. fragile (Siberian), and A. desertorum X A. cristatum (Hycrest))*

**Establishment**

**Seeding Rate** 25-30 pure live seeds per linear foot of drill row.

**Seeding Depth** 1/4 to 1/2 inch

**Row Spacing** 30 inches under irrigation or high rainfall, 36 inches or more in dryland areas.

**Time of Seeding**

Spring - March-April

Late Summer - Late August to mid-September with irrigation.

Late Fall - After November 1. Objective is to delay germination until the following Spring.

**Weed Control** Clipping, hand-rouging, light rate of 2,4-D after the five leaf stage (consider an additional follow-up application if needed), or bromoxynil according to label directions.

**Fertilization** Dryland and irrigated apply phosphorus according to field tests to include enough for several years supply. Very little nitrogen should be applied until seedlings are established at which time apply 20-40 lbs N per acre dryland or 30-50 lbs N per acre irrigated.

**Irrigation** Apply adequate moisture for germination and establishment; the soil profile should then be brought to field capacity.

**Management of Stand**

**Weed Control** Clipping, hand-rouging, 2,4-D, or bromoxynil according to the label and cultivation.

**Fertilization** If possible make a split application of nitrogen each year. For dryland, apply 20-30 lbs N per acre in the early Fall and 20 lbs N per acre in the early Spring. For irrigated, apply 30-40 lbs N per acre in the early Fall and 20-30 lbs N per acre in the early Spring.

**Irrigation** Fertilize and irrigate soon after seed harvest. For optimum production, do not stress plants for moisture, especially during regrowth and tillering in the Fall, late boot stage, and pollination.

**Seed Harvest**

**Time of Harvest** Mid-July to August

**Method of Harvest**

Direct Combining - Acceptable when majority of seedheads begin to shatter at the top of the head.

Windrowing - Recommended

Stage - Hard dough

Approximate Drying Time in Windrow 5 to 7 days

Special Problems

Shattering - Moderate

Lodging - No

**Seed Cleaning**

**Drying** Usually not necessary if crop is windrowed

**Debearding** (scalping) Doubles can be broken up with a hammermill or a mechanical debearder.

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## WHEATGRASS, INTERMEDIATE AND PUBESCENT

*(Thinopyrum intermedium = Agropyron intermedium and A. tricophorum)*

**Establishment**

**Seeding Rate** 25-30 pure live seeds per linear foot of drill row.

**Seeding Depth** 1/2 inch

**Row Spacing** 36 inches irrigated or high rainfall, 36 inches or more for dryland areas.

**Time of Seeding**

Spring - March-April

Late Summer - Late August to mid-September with irrigation.

Late Fall - After November 1. Objective is to delay germination until the following Spring.

**Weed Control** Clipping, hand rouging, light rate of 2,4-D after the five leaf stage consider an additional follow-up application if needed), or bromoxynil according to label directions.

**Fertilization** Dryland and irrigated apply phosphorus according to field tests to include enough for several years supply. Very little nitrogen should be applied until seedlings are established at which time apply 20-40 lbs per acre dryland or 40-60 lbs per acre irrigated.

**Irrigation** Apply adequate moisture for germination and establishment; the soil profile should then be brought to field capacity.

**Management of Stand**

**Weed Control** Clipping, hand-rouging, 2,4-D, or bromoxynil according to the label and cultivation.

**Fertilization** If possible make a split application of nitrogen each year. For dryland apply 30-40 lbs N per acre in the early Fall and 20-30 lbs N per acre in the early Spring. For irrigated, apply 40-50 lbs N per acre in the early Fall and 30-40 lbs N per acre in the early Spring.

**Irrigation** Fertilize and irrigate soon after seed harvest. For optimum production, do not stress plants for moisture, especially during regrowth and tillering in the Fall, late boot stage, and pollination.

**Seed Harvest**

**Time of Harvest** Mid-July to August

**Method of Harvest**

Direct Combining - Acceptable at maturity

Windrowing - Recommended

Stage - Hard dough, but before shatter

Approximate Drying Time in Windrow - 3-5 days

Special Problems

Shattering - Usually not a problem

Lodging - Not usually, but possible with heavy fertilization.

**Seed Cleaning**

**Drying** Not necessary if combined at low moisture content.

**Debearding** No

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## WHEATGRASS, SLENDER

*(Elymus trachycaulus = Agropyron trachycaulum)*

**Establishment**

**Seeding Rate** 25-30 pure live seeds per linear foot of drill row.

**Seeding Depth** 1/4 to 1/2 inch

**Row Spacing** 24 inches under irrigation or high rainfall, 36 inches or more in dryland areas.

**Time of Seeding**

Spring - March-April

Late Summer - Late August-mid September under irrigation.
Late Fall - After November 1. Objective is to delay germination until the following Spring.

**Weed Control** Clipping, hand-rouging, light rate of 2,4-D after the five leaf stage (consider an additional follow-up application if needed), or bromoxynil according to label directions.

**Fertilization** On both dryland and irrigated apply phosphorus according to field tests to include enough for several years supply. Very little nitrogen should be applied until seedlings are established, then apply 20-40 lbs N per acre dryland or 30-50 lbs N per acre irrigated.

**Irrigation** Apply adequate moisture for germination and establishment; the soil profile should then be brought to field capacity.

**Management of Stand**

**Weed Control** Clipping, hand-rouging, 2,4-D, or bromoxynil according to the label and cultivation.

**Fertilization** If possible make a split application of nitrogen each year. For dryland apply 30 lbs N per acre in the early Fall and 20-30 lbs N per acre in the early Spring. For irrigated, apply 30-40 lbs N per acre in the early Fall and approximately 30 lbs N per acre in the early Spring.

**Irrigation** Fertilize and irrigate soon after seed harvest. For optimum production, do not stress plants for moisture, especially during regrowth and tillering in the Fall, late boot stage, and pollination.

**Seed Harvest**

**Time of Harvest** Mid-July to mid-August.

**Method of Harvest**

Direct Combining - Acceptable at maturity
Windrowing - Recommended
Stage - Hard dough
Approximate Drying Time in Windrow - 3-5 days
Special Problems
Shattering - Not usually
Lodging - No

**Seed Cleaning**

**Drying** Not usually, if harvested at maturity.

**Debearding** No

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## WHEATGRASS, TALL

*(Thinopyrum ponticum = Agropyron elongatum)*

**Establishment**

**Seeding Rate** 25-30 pure live seeds per linear foot of drill row.

**Seeding Depth** 1/2 to 1 inch

**Row Spacing** 30-36 inches under irrigation, 36 inches or more in dryland areas.

**Time of Seeding**

Spring - March-April
Late Summer - Late August to mid-September with irrigation
Late Fall - After November 1. Objective is to delay germination until the following Spring.

**Weed Control** Clipping, hand-rouging, light rate of 2,4-D after the five leaf stage (consider an additional follow-up application if needed), or bromoxynil according to label directions.

**Fertilization** On both dryland and irrigated apply enough phosphorus supply for several years. Very little nitrogen should be applied until seedlings are established, then apply 20-30 lbs N per acre dryland or 30-40 lbs N per acre irrigated.

**Irrigation** Apply adequate moisture for germination and establishment after which the soil profile should be brought to field capacity.

**Management of Stand**

**Weed Control** Clipping, hand-rouging, 2,4-D, or bromoxynil according to the label and cultivation.

**Fertilization** If possible make a split application of nitrogen each year. For dryland apply 30 lbs N per acre in the early Fall and 20 lbs N per acre in the early Spring. For irrigated apply 30-40 lbs N per acre in the early Fall and 30 lbs N per acre in the early Spring.

**Irrigation** Fertilize and irrigate soon after seed harvest. For optimum production, do not stress plants for moisture, especially during regrowth and tillering in the Fall, late boot stage, and pollination.

**Seed Harvest**

**Time of Harvest** Mid-Aug. to mid-Sept.

**Method of Harvest**

Direct Combining - Acceptable at maturity
Windrowing - Recommended
Stage - Hard dough
Approximate Drying Time in Windrow - 3-5 days
Special Problems
Shattering - No
Lodging - Possible

**Seed Cleaning**

**Drying** Not usually

**Debearding** No

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## WHEATGRASS, THICKSPIKE

*(Elymus lanceolatus = Agropyron dasystachyum)*

**Establishment**

**Seeding Rate** 30-35 pure live seeds per linear foot of drill row.

**Seeding Depth** 1/4 to 1/2 inch

**Row Spacing** 30 to 36 inches with irrigation, 36 inches for dryland areas.

**Time of Seeding**

Spring - March-April
Late Summer - Late August to mid-September under irrigation
Late Fall - After November 1. Objective is to delay germination until the following Spring.

**Weed Control** Clipping, hand-rouging, light rate of 2,4-D after the five leaf stage (consider an additional follow-up application if needed), or bromoxynil according to label directions.

**Fertilization** On both dryland and irrigated apply phosphorus according to field tests to include enough for several years supply. Very little nitrogen should be applied until seedlings are established at which time apply 20-40 lbs per acre dryland or 40-60 lbs per acre irrigated.

**Irrigation** Apply adequate moisture for germination and establishment; the soil profile should then be brought to field capacity.

**Management of Stand**

**Weed Control** Clipping, hand-rouging, 2,4-D, or bromoxynil according to the label and cultivation.

**Fertilization** If possible make a split application of nitrogen each year. For dryland, apply 20-30 lbs N per acre in the early Fall and 20 lbs N per acre in the early Spring. For irrigated, apply 30-40 lbs N per acre in the early Fall and 30 lbs per acre in the early Spring.

**Irrigation** Fertilize and irrigate soon after seed harvest. For optimum production, do not stress plants for moisture, especially during regrowth and tillering in the Fall, late boot stage, and pollination.

**Seed Harvest**

**Time of Harvest** Mid-July to Mid-August

**Method of Harvest**

Direct Combining - Acceptable at maturity
Windrowing - Recommended
Stage - Hard dough
Approximate Drying Time in Windrow - 2-4 days
Special Problems
Shattering - Not usually
Lodging - No problem for lower growing types, but possible in taller growing varieties.

**Seed Cleaning**

**Drying** Usually not necessary

**Debearding** A hammermill or debearder is useful for separating doubles.

## WHEATGRASS, WESTERN

*(Pascopyrum smithii = Agropyron smithii)*

**Establishment**

**Seeding Rate** 30 to 35 pure live seeds per linear foot of drill row.

**Seeding Depth** 1/4 to 1/2 inch

**Row Spacing** 36 inches under irrigation or high rain-fall, 36 inches or wider in dryland areas. Extremely rhizomatous, may require row ripping every 2nd or 3rd year to reduce sod binding.

**Time of Seeding**

Spring - March-April

Late Summer - Late August to mid-September with irrigation.

Late Fall - After November 1. Objective is to delay germination until the following Spring.

**Weed Control** Clipping, hand-rouging, light rate of 2,4-D after the five leaf stage (consider and additional follow-up application if needed), or bromoxynil according to label directions.

**Fertilization** On both dryland and irrigated apply phosphorus according to field tests to include enough for several years supply. Very little nitrogen should be applied until seedlings are established at which time apply 20-30 lbs N per acre dryland or 30-40 lbs N per acre irrigated.

**Irrigation** Apply adequate moisture for germination and establishment; soil profile should then be brought to field capacity.

**Management of Stand**

**Weed Control** Clipping, hand rouging, 2,4-D, or bromoxynil according to the label and cultivation.

**Fertilization** If possible make a split application of nitrogen each year. For dryland, apply 20-30 lbs N per acre in the early Fall and 20 lbs N per acre in the early Spring. For irrigated, apply 30-40 lbs N per acre in the early Fall and 30 lbs N per acre in the early Spring.

**Irrigation** Fertilize and irrigate soon after seed harvest. For optimum production, do not stress plants for moisture, especially during regrowth and tillering in the Fall, late boot stage, and pollination.

**Seed Harvest**

**Time of Harvest** August

**Method of Harvest**

Direct Combining - Acceptable when mature

Windrowing - Recommended

Stage - Hard dough

Approximate Drying Time in Windrow - 3 to 5 days

Special Problems

Shattering - Moderate

Lodging - Not usually

**Seed Cleaning**

**Drying** Usually not necessary

**Debearding** Use hammermill or debearder to break up doubles

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## WILDRYE, RUSSIAN

*(Psathyrostachys juncea = Elymus junceus)*

**Establishment**

**Seeding Rate** 30-35 pure live seeds per linear foot of drill row.

**Seeding Depth** 1/4 to 1/2 inch

**Row Spacing** 36 inches under irrigation or high rainfall, 36-48 inches in dryland areas.

**Time of Seeding**

Spring - March-April

Late Summer - Late August to mid-September with irrigation

Late Fall - After November 1. Objective is to delay germination until the following Spring.

**Weed Control** Clipping, hand-rouging, light rate of 2,4-D after the five leaf stage (consider an additional follow-up application if needed), or bromoxynil according to label directions.

**Fertilization** On both dryland and irrigated, apply phosphorus according to field tests to include enough for several years supply. Very little nitrogen should be applied until seedlings are established at which time apply 20-30 lbs N per acre dryland or 30-40 lbs N per acre irrigated.

**Irrigation** Apply adequate moisture for germination and establishment after which the soil profile should be brought to field capacity.

**Management of Stand**

**Weed Control** Clipping, hand-rouging, 2,4-D, or bromoxynil according to the label and cultivation.

**Fertilization** If possible make a split application of nitrogen each year. For dryland, apply 20-30 lbs N per acre in the early Fall and 20 lbs N per acre in the early Spring. For irrigated, apply 30-40 lbs N per acre in the early Fall and 30 lbs N per acre in the early Spring.

**Irrigation** Fertilize and irrigate soon after seed harvest. For optimum production, do not stress plants for moisture, especially during regrowth and tillering in the Fall, late boot stage, and pollination.

**Seed Harvest**

**Time of Harvest** Early to mid-July

**Method of Harvest**

Direct combining - Feasible but seed shatters very easily.

Windrowing - Recommended

Stage - Mid to hard dough

Approximate Drying Time in Windrow - 2-4 days

Special Problems

Shattering - Yes

Lodging - Yes, with fertilization and irrigation

**Seed Cleaning**

**Drying** Usually not necessary unless seed is combined at high moisture

**Debearding** No

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## WILDRYE, ALTAI

(*Leymus angustus*)

**Establishment**

**Seeding Rate** 30-35 pure live seeds per linear foot of drill row.

**Seeding Depth** 1/2 to 3/4 inch

**Row Spacing** 36-40 inches under irrigation, 40-48 inches on dryland areas.

**Time of Seeding**

Spring - March-April

Late Summer - Late August-mid September with irrigation.

Late Fall - After November 1. Objective is to delay germination until the following Spring.

**Weed Control** Clipping, hand-rouging, light rate of 2,4-D after the five leaf stage (consider an additional follow-up application if needed), or bromoxynil according to label directions.

**Fertilization** On both dryland and irrigated apply phosphorus according to field tests to include enough for several years supply. Very little nitrogen should be applied until seedlings are established at which time apply 20-30 lbs N per acre dryland or 30-40 lbs N per acre irrigated.

**Irrigation** Apply adequate moisture for germination and establishment after which the soil profile should be brought to field capacity.

**Management of Stand**

**Weed Control** Clipping, (clipping below 8 inches can cause plant mortality) hand rouging, 2,4-D, or bromoxynil according to the label and cultivation.

**Fertilization** If possible make a split application of nitrogen each year. For dryland, apply 30 lbs N per acre in the early Fall and 20 lbs N per acre in the early Spring. For irrigated, apply 30-40 lbs N per acre in the early Fall and 30 lbs N per acre in the early Spring.

**Irrigation** Fertilize and irrigate soon after seed harvest. For optimum production, do not stress plants for moisture, especially during regrowth and tillering in the Fall, late boot stage, and pollination.

**Seed Harvest**

**Time of Harvest** Mid-July to Mid-August

**Method of Harvest**

Direct Combining - Acceptable at maturity, large amounts of material make it difficult.

Windrowing - Recommended
Stage - Hard dough
Days in Windrow - 2-4
Special Problems
Shattering - Moderate
Lodging - Yes, especially under irrigation

**Seed Cleaning**

**Drying** Usually not necessary if crop is windrowed
**Debearding** No

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## WILDRYE, BASIN

*(Leymus cinereus)*

**Establishment**

**Seeding Rate** 30-40 pure live seeds per linear foot of drill row.
**Seeding Depth** 1/2 inch to 1 inch
**Row Spacing** 36-40 inches irrigated and 36-48 inches on dryland sites.
**Time of Seeding**
Spring - March-April
Late Summer - Late August to mid September with irrigation.
Late Fall - After November 1. Objective is to delay germination until the following Spring.
**Weed Control** Clipping, hand rouging, light rate of 2,4-D after the five leaf stages (consider an additional follow-up application if needed), or bromoxynil according to label direction.
**Fertilization** On both dryland and irrigated, apply phosphorus according to field tests to include enough for several years supply. Very little nitrogen should be applied until seedlings are established at which time apply 20-30 lbs N per acre dryland or 30-40 lbs N per acre irrigated.
**Irrigation** Apply adequate moisture for germination and establishment after which the soil profile should be brought to field capacity.

**Management of Stand**

**Weed Control** Clipping, hand-rouging, 2,4-D, or bromoxynil according to the label and cultivation.
**Fertilization** If possible make a split application of nitrogen each year. For dryland, apply 20-30 lbs N per acre in the early Fall and 20 lbs N per acre in the early Spring. For irrigated, apply 30-40 lbs N per acre in the early Fall and 30 lbs N per acre in the early Spring.
**Irrigation** Fertilize and irrigate soon after seed harvest. For optimum production, do not stress plants for moisture, especially during regrowth and tillering in the Fall, late boot stage, and pollination.

**Seed Harvest**

**Time of Harvest** Mid-July to mid August.

**Method of Harvest**

Direct Combining - Acceptable when mature. Must deal with large amounts of vegetative material.

Windrowing - Recommended

Stage - Hard dough

Approximate Drying Time in Windrow - 3-5 days

Special Problems

Shattering - Moderate

Lodging - Yes, especially with heavy applications of fertilizer.

**Seed Cleaning**

**Drying** Usually not necessary, if crop is windrowed.

**Debearding** No

## Economics of Grass Seed Production in Utah

A survey was conducted to compare the costs associated with establishing and maintaining grass stands for seed production in Utah with corresponding expenses in other competitive producing regions. Price information has been obtained for a period of approximately four growing and harvesting seasons. This information has been used to develop representative budgets for establishing and maintaining grasses for both irrigated and dryland production in Utah.

Budgets are developed for establishing the grass stand, and for operations associated with producing, cleaning, and marketing the seed crop.

Cost information is found in the budgets developed and given in Tables 1-4. The costs also include certification expenses, assuming certified seed is produced. The funds which accumulate interest include purchase costs, and all variable costs including labor costs.

To be economically viable, the cost of establishment of the grass stand must be recovered during the life of the stand. Therefore, a dual set of representative budgets is developed, with one representing the establishment budget and the other the annual seed production budget. The total cost of establishment is annualized and is included in the total cost of producing the seed.

Break-even prices (total costs including annualized establishment costs divided by the yield of clean seed) are then presented for both representative irrigated and dryland production conditions. Some seed in Utah is marketed and priced on a pure live seed (PLS) basis. Therefore, a break-even price is also derived for the average PLS standard of the grasses. The PLS percentage is calculated as percent pure seed times percent germination. The standard used in deriving the break-even prices uses a minimum 95 percent pure seed and an 80 percent minimum germination. This is representative of crested, intermediate, tall, and pubescent wheatgrasses, bluegrasses, and ricegrasses. Thickspike, bluebunch and western wheatgrasses in addition to orchardgrass, and the wildrye grasses generally have a slightly lower minimum pure seed standard. The bromegrasses and tall fescue would generally have a higher pure seed and percent germination standard. The break-even price would, of course, be lower for seed of higher PLS standard.

Under some dryland conditions it may take up to two years to establish the grass stand

before a seed crop could be harvested in the third year. This would increase the break-even price from the $1.32 per pound cleaned (or $1.74 for the PLS standard) to approximately $1.44 per pound cleaned (or $1.90 using the PLS standard) which is much higher than the break-even price under irrigated conditions.

**Table 1. Estimated Representative Establishment Costs for Irrigated Grass Used for Seed in Utah, 36 Inch Row Spacing, Per Acre Basis.**

| Item | Unit | Quantity | Price | | Total |
|---|---|---|---|---|---|
| Purchases: | | | | | |
| Nitrogen | lb | 50.00 | .22 | | 11.00 |
| Phosphate | lb | 18.00 | .18 | | 3.24 |
| Herbicide | oz | 40.00 | .18 | | 7.20 |
| Insecticide | oz | 16.00 | .15 | | 2.34 |
| Seed | lb | 5.00 | 1.75 | | 8.75 |
| Water | share | .80 | 13.00 | | 10.40 |
| Total Purchases | | | | | 42.93 |
| | **Costs** | | | | |
| | Times | Fixed | Var. | Labor | |
| Operation: | | | | | |
| Fertilizer appli. | | | | | 3.00 |
| herb/insect/ application | 3 | .76 | .32 | .26 | 2.50 |
| Plowing | 1 | 12.87 | 6.86 | 2.15 | 21.88 |
| Disking | 1 | 6.76 | 3.14 | .95 | 10.85 |
| Harrowing | 1 | 2.16 | 1.27 | .48 | 3.91 |
| Planting | 1 | 6.72 | 3.65 | 1.64 | 12.01 |
| Irrigation | 4 | 8.90 | .45 | .90 | 14.30 |
| Cultivation | 2 | 2.85 | 1.68 | .63 | 7.47 |
| Rouging | | | | | 7.00 |
| Total Operating Costs | | | | | 82.92 |
| Interest on variable costs and purchases (12% for 6 months) | | | | | 4.48 |
| Total Establishment Purchase, Operating and Interests Costs (42.93 + 82.92 + 4.48) | | | | | 130.33 |
| Capitalized Cost (9 year stand) | | | | | 24.48 |

There may be the possibility of grazing the grass stand or using the aftermath of the crop for grazing or feed. If 1.5 animal unit months (AUM's) could be obtained per acre at $8.50 per AUM, then the break-even price for production of irrigated grass seed would decline from $0.63 per pound (or $0.83 using the PLS standard) to $0.59 (or $0.78 for the PLS standard) per pound. For dryland grass seed production the break-even price would decrease from $1.32 per pound ($1.74 for the PLS standard) to $1.18 (or $1.55 for the PLS standard).

**Table 2. Annual Costs for Production of Irrigated Grass Seed in Utah, Per Acre Basis.**

| Item | Unit | Quantity | Price | | Total |
|---|---|---|---|---|---|
| Purchases: | | | | | |
| Nitrogen | lb | 60.00 | .22 | | 13.20 |
| Herbicide | oz | 32.00 | .10 | | 3.20 |
| Insecticide | oz | 16.00 | .15 | | 2.40 |
| Water | share | .80 | 13.00 | | 10.40 |
| Total Purchases | | | | | 29.20 |
| | **Costs** | | | | |
| | Times | Fixed | Var. | Labor | |
| Operation: | | | | | |
| Fertilizer appli. | 2 | | | | 5.00 |
| Herb/insect/ | 3 | .76 | .32 | .26 | 2.50 |
| appli. | 4 | 8.90 | .45 | .90 | 14.30 |
| Irrigation | 2 | 2.85 | 1.68 | .63 | 7.47 |
| Cultivation | | | | | 7.00 |
| Rouging | 1 | 13.59 | 2.07 | .55 | 16.21 |
| Windrowing | 1 | custom | | | 25.00 |
| Combining | 1 | | .15/cwt | | .75 |
| Hauling | | custom | .15/lb | | 75.00 |
| Cleaning | 1 | 1.88 | 2.65 | | 4.53 |
| Certification | | | | | |
| Total Operating Costs | | | | | 157.76 |
| Interest on variable costs and purchases (12% for 6 months) | | | | | 9.74 |
| Total Purchase, Operating and Interests Costs | | | | | 196.50 |
| Total Cost including Annualized Establishment Cost (24.45 + 29.20 + 157.76 + 9.54) | | | | | 220.95 |

**Break-even price for established crop (per pound cleaned) $0.63**
**Break-even price per pound, pure live seed standard 0.83**

**Table 3. Estimated Representative Establishment Costs for Dryland Grass, Used for Seed in Utah, Per Acre Basis.**

| Item | Unit | Quantity | Price | Total |
|---|---|---|---|---|
| Purchases: | | | | |
| Nitrogen | lb | 30.00 | .22 | 6.60 |
| Phosphate | lb | 18.00 | .18 | 3.24 |
| Herbicide | oz | 40.00 | .18 | 7.20 |
| Insecticide | oz | 16.00 | .15 | 2.34 |
| Seed | lb | 5.00 | 1.75 | 8.75 |
| Total Purchases | | | | 28.13 |

| | Costs | | | | |
|---|---|---|---|---|---|
| | Times | Fixed | Var. | Labor | |
| Operation: | | | | | |
| Fertilizer appli. | | | | | 3.00 |
| Herb/insect/ appli | 3 | .76 | .32 | .26 | 2.50 |
| Plowing | 1 | 4.03 | 3.29 | .71 | 8.03 |
| Disking | 1 | 4.03 | 3.29 | .71 | 8.03 |
| Harrowing | 1 | 1.29 | .76 | .48 | 2.53 |
| Planting | 1 | 3.45 | 2.89 | .50 | 6.84 |
| Cultivation | 2 | 2.85 | 1.68 | .63 | 7.47 |
| Rouging | | | | | 7.00 |
| Total Operating Costs | | | | | 45.40 |
| Interest on variable costs and purchases (12% for 6 months) | | | | | 3.43 |
| Total Establishment Purchase, Operating and Interests Costs (28.13 + 45.40 + 3.43) | | | | | 76.96 |
| Capitalized Cost (7 year stand) | | | | | 16.86 |

**Table 4. Annual Costs for Production of Dryland Grass Seed in Utah, Per Acre Basis.**

| Item | Unit | Quantity | Price | | Total |
|---|---|---|---|---|---|
| Purchases: | | | | | |
| Nitrogen | lb | 40.00 | .22 | | 8.80 |
| Herbicide | oz | 32.00 | .10 | | 3.20 |
| Insecticide | oz | 16.00 | .15 | | 2.40 |
| Total Purchases | | | | | 14.40 |
| | **Costs** | | | | |
| | Times | Fixed | Var. | Labor | |
| Operation: | | | | | |
| Fertilizer appli. | 2 | | | | 5.00 |
| Herb/insect/ | 3 | .76 | .32 | .26 | 2.50 |
| appli. | 2 | 2.85 | 1.68 | .63 | 7.47 |
| Cultivation | | | | | 7.00 |
| Rouging | 1 | 13.59 | 2.07 | .55 | 16.21 |
| Windrowing | 1 | custom | | | 22.00 |
| Combining | 1 | | .15/cwt | | .20 |
| Hauling | | custom | .5/lb | | 19.50 |
| Cleaning | 1 | 1.25 | 1.70 | | 2.95 |
| Certification | | | | | |
| Total Operating Costs | | | | | 82.83 |
| Interest on variable costs and purchases (12% for 6 months) | | | | | 4.73 |
| Total Cost including Annualized Establishment Cost (16.86 + 14.40 + 82.83 + 4.73) | | | | | 118.82 |

**Break-even price for established crop (per pound cleaned) $1.32**
**Break-even price per pound, pure live seed standard 1.74**

## Break-even Price Comparisons

Break-even prices for alternative yield of cleaned seed and number of years harvested are given in Tables 5 and 6. The break-even prices based on the PLS standard are given in parentheses below each bulk price. The important elements determining economic viability of grass seed production are pointed out in the tables. These are establishment of the stand, longevity of stand, and shrinkage involved in seed cleaning. If the seed is sold on a PLS basis, the pure live seed and germination are also very important.

Break-even prices for grass seed are not as favorable as break-even prices per pound of barley and wheat in Utah, which range from $0.06 to $0.09 per pound on a bulk basis and from $0.08 to $0.13 on a PLS basis. Break-even prices for wheatgrasses in Montana, North Dakota and South Dakota range from $0.48 to $1.14 per pound of cleaned seed (approximately $0.63 to

$1.50 on a PLS basis) under irrigated conditions, and from $1.02 to $2.60 per pound of cleaned seed (or $1.34 to $3.42 on a PLS basis) under dryland production conditions.

**Table 5. Break-even Price per Cleaned Pound of Seed and for the Pure Live Seed Standard (within parentheses) for Irrigated Grass Seed (in dollars).**

| Years Harvested | Pounds of Clean Seed per Acre 100 | 200 | 250 | 300 | 350 | 400 | 500 |
|---|---|---|---|---|---|---|---|
| 2 | 2.75 | 1.37 | 1.10 | .92 | .79 | .69 | .55 |
| | (3.62) | (1.80) | (1.45) | (1.21) | (1.04) | (.91) | (.72) |
| 4 | 2.40 | 1.20 | .96 | .80 | .69 | .60 | .48 |
| | (3.16) | (1.58) | (1.26) | (1.05) | (.91) | (.79) | (.63) |
| 6 | 2.29 | 1.14 | .91 | .76 | .65 | .57 | .46 |
| | (3.01) | (1.50) | (1.20) | (1.00) | (.86) | (.75) | (.61) |
| 8 | 2.23 | 1.12 | .89 | .74 | .64 | .56 | .45 |
| | (2.93) | (1.47) | (1.17) | (.97) | (.84) | (.74) | (.59) |
| 10 | 2.20 | 1.10 | .88 | .73 | .63 | .55 | .44 |
| | (2.89) | (1.45) | (1.16) | (.96) | (.83) | (.72) | (.58) |

**Table 6. Break-even Price per Cleaned Pound of Seed and for the Pure Live Seed Standard(within parentheses) for Dryland Grass Seed (in dollars).**

| Years Harvested | Pounds of Clean Seed Per Acre 50 | 100 | 125 | 150 |
|---|---|---|---|---|
| 2 | 2.95 | 1.48 | 1.18 | .98 |
| | (3.88) | (1.95) | (1.55) | (1.29) |
| 4 | 2.55 | 1.27 | 1.02 | .85 |
| | (3.36) | (1.67) | (1.34) | (1.12) |
| 6 | 2.41 | 1.21 | .97 | .81 |
| | (3.17) | (1.59) | (1.28) | (1.07) |
| 8 | 2.35 | 1.17 | .94 | .78 |
| | (3.09) | (1.54) | (1.24) | (1.03) |
| 10 | 2.31 | 1.16 | .92 | .77 |
| | (3.04) | (1.53) | (1.21) | (1.01) |

## Price Variations

Prices have varied considerably over the years. Seed prices for most rangeland grasses used for seeding both private and government rangelands during the 1950s, 1960s and for most of the 1970s ranged from $0.30 to $1.05 per pound depending on the species and the requirements of the seeding projects. The Conservation Reserve Program was initiated under the legislation of the 1985 Farm Bill. It caused prices to rise rapidly as demand increased sharply relative to supplies from Utah and the major producing areas of Montana, North Dakota, South Dakota, Nebraska, and Kansas. By 1987, prices for Ephriam Crested Wheatgrass were approximately $3.50 per pound to the grower for cleaned seed. Hycrest hybrid crested wheatgrass seed was up to $3.70 per pound, and Basin Wildrye, in short supply, climbed rapidly to $6.50 per pound. Currently, much of the land which was determined eligible for the Conservation Reserve Program has been seeded. Prices are currently much lower and are declining further. Prices for most grass seed now range from $0.30 to $2.40 per pound, with Western wheatgrass and the wildryes commanding the higher level of the price range.

## Characteristics of the Rangeland Grass Seed Market

Markets for rangeland grass seed are greatly influenced by rangeland seeding operations, particularly government seeding operations sponsored by the Bureau of Land Management and Forest Service. Marketing of grass seed is highly variable and depends on this demand. Unlike other agricultural commodities there is not always a ready buyer. Seed may have to be carried over from season to season. Installation of cleaning facilities on the farm may enable the producer to market the seed directly to the final user. However, this type of investment is risky given the cyclical nature of the market and the specialized demand for seed.

There are limited data which reflect the operations of the markets for the rangeland grasses. Some information on the demand and supply characteristics of the crested wheatgrass seed market was obtained by using U. S. Department of Agricultural data on prices and seed statistics over a period from 1962 - 1984. These data were used along with data on the number of range seedings derived from the Bureau of Land Management Public Land Statistics and cost indexes for producing rangeland grasses to estimate sup-ply/demand conditions. The demand elasticity at the mean of the price and quantity data was estimated to be -0.241 while the supply elasticity was estimated to be 0.174.

The interpretation of these elasticities provides a characterization of the price-quantity movements typical of the crested wheatgrass market as a representative market for the wildland grass seed markets. A demand elasticity of -0.241 suggests the demand for crested wheatgrass is relatively price inelastic, i.e., a 10 percent increase in price reduces quantity demanded by 2.4 percent. In general, an inelastic demand in the market means that price effects of shifts in the supply are greater than quantity changes. If supply becomes short, then price increases are greater than the quantity reductions, and revenue increases. The market conditions of the early Conservation Program years reflected this type of price behavior. The inelastic demand also suggests a very basic warning to producers. New supplies which are more than immediate market clearing supplies will bring about greater downward pressure on price relative to the increases in supply, hence revenues fall in this case. So the demand side of the market appears, at least from these estimates, to be rather delicate.

The supply elasticity of 0.174 suggests that a 10 percent increase in price induces a 1.74 percent increase in supply of seed.

Supply is even less responsive to price than is demand, which reflects the production conditions in producing seed as a result of the difficulty and time in establishing a stand of grass from which seed can be harvested. A supply elasticity which is more inelastic than the demand

elasticity tends to move the market in demand-supply cycles, hence price cycles are likely. The level of seeded acreage is highly influential on demand in the market. If seeded acreage on government land increases by 10 percent, then some 7,872 pounds of seed are needed. A 10 percent increase in seed production costs reduces supply approximately 12 percent.

There are two other markets which have not been developed by Utah producers and may have potential. First is the international market, particularly the North African market in arid regions where drought conditions persist.

Certain drought resistant species may find a new market opening in this area of the world. Of course, risk is encountered in the marketing effort, and it appears that growers would have to link their marketing efforts with brokers or international divisions of major seed firms. The second possible market is the tall fescue seed market. Some growers have been approached about the possibility of growing this species for Oregon seed firms. Oregon producers have been in this market for some time, but the market for this rather aggressive, hardy, cool season grass has been rather strong. It competes with Kentucky bluegrass in turf grass sales. The price of tall fescue is currently about $0.40 per pound, and the seed yield is much higher than yields for most wildland grasses. It is projected that under irrigated conditions that up to 1,000 pounds to the acre could be produced in Utah. The grass is drought resistant and is much more resilient than most other turf grasses. It can be grazed after the stand has been established and the first seed crop has been harvested. It should be noted that Western wheatgrass has a specialized use on government rangelands or in reclamation use. Also, the wildrye species have a more specialized use. The price of seed from these grasses is currently higher than more generally used grasses such as the wheatgrasses, but their demand is more specialized.

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