# Native Grass Seed Production Manual
## (including selected forbs)

This edition contains the supplemental section "Important Introduced Grasses of the Great Plains".


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## Purpose of this Manual

The purpose of this manual is to provide detailed information on seed production of native grasses indigenous to the northern Great Plains region of North America. It also includes seed production techniques for a selected number of native forbs as well as seed production information for several native grass species from the foothill and intermountain regions of western North America.

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## Table of Contents

# Introduction

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## Native Grasses

Native grasses are those that occurred naturally in North America at the time of European settlement. A number of grass species have been introduced into the Great Plains region from Europe and Asia. Several of these introduced grasses, such as smooth bromegrass, crested wheatgrass and Kentucky bluegrass, are often mistakenly referred to as "native". More accurately, these introduced species should be referred to as naturalized in that they are now widespread and naturally establish by seed. This manual will primarily focus on the native grasses found in the Great Plains region of North America.

The Great Plains region of North America is one of the largest grassland regions worldwide and extends from east of the Rocky Mountain foothills to the eastern deciduous forests. There is a west to east gradient of increasing precipitation and a north to south gradient of increasing temperature. The Great Plains are divided into four main ecological zones. These zones or prairie regions are usually described by the natural vegetation that occurred before European settlement. They include the tall grass prairie, the mixed grass prairie the short grass prairie, and the fescue prairie. The Great Plains region has also been called the heartland of the continent because of the fertile soils that resulted from thousands of years of grass growth. Consequently, much of the Great Plains is now devoted to agriculture and only a portion of the original native prairie grassland remains undisturbed.

The tall grass prairie, sometimes referred to as the true prairie, consists predominantly of the warm season grass species including big bluestem, switchgrass, little bluestem and Indiangrass. This type of prairie predominates in areas of higher precipitation. The tall grass prairie extends north south from Manitoba to central Texas and encompasses large areas of the states of South Dakota, Iowa, Nebraska, Missouri, Kansas, Oklahoma and Texas. Manitoba is the only western Canadian province that contains tall grass prairie and its range only extends approximately 30 to 60 miles (50 to 100 km) east and west of the Red River. In Canada, only 1 per cent of the tall grass prairie region has not been cultivated and remains in native vegetation.

The short grass prairie is dominated by shorter statured grasses such as blue grama and buffalograss. This prairie region encompasses much of the semiarid region east of the Rocky Mountains and extends north south from southern Alberta and Saskatchewan to western Texas. Some botanists argue that very little of the shortgrass prairie extends into Canada because of the absence of buffalograss, normally a dominant short grass species.

The mixed grass prairie, or transition grassland, covers the region that lies between the tall and short grass prairies and includes grass species found in both regions as well as a number of wheatgrass and needlegrass species. The mixed prairie is distinguished by intermediate precipitation and extends north south from the three prairie provinces to Kansas. In Canada, only 20 per cent of this region has never been used for crop production and contains naturally occurring native grasslands.

The fescue grassland or prairie is located in the foothills of the Rocky Mountains and on the northern edge of the mixed grass prairie region in Canada. The predominant native grass species in this region are the fescues and the oatgrasses. The fescue prairie is unique and not always included with the other three prairie regions.

It is important to remember that many other grass species, besides those listed above, are present in each of the four prairie regions within the Great Plains. Additionally, some grass species are not unique to any specific prairie region, but are found throughout the Great Plains in specific environments. For example, reed canarygrass is associated with wet, low-lying areas, whereas prairie sandreed is normally found on sandier soils. Even a primary tall grass species like big bluestem can be found in river valleys in the semiarid regions of the western Great Plains.

In North America native grasses have been grazed for thousands of years. Before European settlement it was estimated that over 100 million herbivores roamed the Great Plains including: 60 million buffalo, 40 million whitetail deer, 40 million pronghorn antelope and 10 million elk. Much of the land base in Canada and the U.S. that still contain native grasses is used for livestock grazing. Over the last 40 years there has been an increased interest in replanting native grasses for restoration, diversity and sustainability (National Parks, rangelands) and for conservation purposes, such as for wind and water erosion control. Several of these grass species have shown excellent forage yields and are being planted for pasture and hay production. During the last 20 years there has been a growing interest in planting native grasses along highway and pipeline right-of-ways, to reclaim strip mines and for wildlife habitat. In the future, one can expect to see more native grasses used in urban settings for esthetic reasons as well as for their low maintenance requirements.

## Why not plant more native grasses?

Many people have asked, "Why has it taken so long for native grasses to be considered for planting in the Great Plains?" During the late 1800's, many prairie farmers and ranchers realized the need for establishing pastures for their livestock. At the same time, a number of grass species were being introduced from Eurasia like smooth bromegrass and crested wheatgrass. These grasses and other introduced species were found to have good forage production potential, longevity and reasonable ease for seed production. Although some of the native grasses rival the introduced grasses in forage productivity, their most important evolutionary attribute was survival under the often harsh conditions (drought, cold, fire) on the Great Plains. Consequently, deep and extensive root systems were much more important than above ground growth.

Another reason that these native species did not become important for pasture establishment relates to seed production. Native grasses can best be described as conservative when it comes to seed production. Since these plants have evolved for long term survival, then it makes sense that they would put more energy into survival than into seed production. Consequently, native grasses have been traditionally characterized as low seed yielders, and in comparison, the successful introduced grasses showed higher seed yields. Interestingly, seed yields of most native grasses can be quite good when seed is grown under conditions of adequate moisture and fertility.

Even with good seed production, the seed still has to be harvested. A seed producer is cautious in growing a species that shows a high rate of seed shatter. Seed shatter is an important evolutionary advantage for many native grasses because it insures that the seed will be disseminated. Again, most introduced grasses have an advantage by being less prone to shatter. New seed harvesting equipment (e.g. seed strippers) have been and continue to be developed that allow seed harvest of native grasses without excessive shattering losses.

Seed quality is a comprehensive term often used to

describe a number of seed characteristics. This term refers to the common seed characteristics of germination and seed viability, but can also be used to describe characteristics like seed dormancy, rate of seedling emergence and seedling vigor. (Note: seedlot quality refers to the presence or absence of weed seeds or inert matter.) In other words, seed quality reflects the ability of a seed to germinate and develop into a healthy plant. Many native grasses are said to have poor seed quality, but in this context poor seed quality is only a limitation during initial establishment. Seed dormancy provides an advantage in allowing seed to survive in the soil over winter or for several years, until growth conditions are ideal. Seedling vigor is usually measured on above ground growth, but most native grasses spend much of their first growing season putting down deep root systems to insure long term survival, rather than expending energy on above ground vegetative growth. Potential seed quality limitations have become less of a concern in recent years with the advent of effective herbicides to control weed competition and the development of seeding equipment that controls seed placement and allows moisture conserving tillage practices such as minimum and zero tillage.

The reasons given for not planting more native grasses are many, but lower forage yields, lower seed yields, seed shattering and lower seed quality are commonly used to describe the disadvantages of native grasses in comparison to most introduced grasses. These disadvantages are true for many native species. It is easy to understand why native grasses currently make up only a portion of the billion dollar grass seed industry in North America. Native grasses have a long list of attributes, including superior longevity, low input requirements, ecological diversity, wildlife habitat and the advantage of thousands of years of adaptation to the Great Plains environment.

## Cool season vs. Warm season Grasses

Native grasses can be separated into cool and warm season grasses (Table 1). Cool season grasses are most productive in the spring and fall because of the cooler day and night temperatures, shorter day and typically higher soil moisture levels. Plant growth of cool season grasses is reduced during the summer. These grasses generally survive periods of high temperatures and low precipitation by entering a drought induced dormancy. When the high temperature, low moisture stress is over, growth resumes.

In contrast, warm season grasses are most productive during the warmer summer season, when day and night temperatures are warmer and daylengths are longer. These grasses also show more efficient dry matter production per unit of water than cool season grasses and have a more efficient photosynthetic pathway. In much of the Great Plains, especially the mixed grass prairie region, cool and warm season grasses have evolved together. From an ecosystem standpoint, the combination of grass types allows for plant growth throughout the growing season. Similarly, forage producers and ranchers can take advantage of a mixture of cool and warm season grasses to allow uniform forage production throughout the growing season.

Cool and warm season grasses also show differences in the way in which seedheads are formed and develop. In general, the growing point in grasses is initially contained within the leaf sheath of individual grass shoots or tillers. Under certain conditions this growing point develops into an immature seedhead, then as the shoot elongates, the seedhead emerges from within the sheath and the normal process of pollination and seed development occur. In most cool season grasses a period of short days and/or low temperatures in the fall or early spring are required for the growing point to develop into an immature seedhead. This phase is called the vernalization or induction period. Additionally, a grass shoot or tiller

has to reach a certain size before vernalization can begin. Therefore, the ability of cool season grasses to produce seedheads is dictated by the number of tillers which have been vernalized during the fall of the previous growing season. In a few cool season grasses, fall vernalization is not required for seedhead initiation the following year. Green needlegrass and timothy, an introduced species, fall into this category.

Warm season grasses generally do not require low temperatures for the development of seedheads, but most are short day plants adapted to specific latitudes. Therefore, specific daylengths are required to induce seedhead development. Warm season grasses moved north of their normal latitude may not switch from the vegetative to reproductive stage in time for seedhead production, pollination and seed development before the first killing frost.

Although a detailed understanding of vernalization and the seedhead development process is not required for successful seed production, it is essential that a seed producer understand the impact that environmental conditions and management can have on seed production. In other words, vernalization is important because for most cool season grasses, the upper limit of seed production is determined by the environmental conditions or management practices during the previous growing season.

In warm-season grasses, the daylength requirement for seedhead development means that latitude can have a great influence on the success or failure of seed production. Obviously, for both cool and warm season grasses, the environmental conditions and management during the growing season also have a large influence on final seed production.

## Native Grass Adaptation

One of the major benefits of native grasses is their adaptation to the extreme environmental conditions that are common to the Great Plains (Table 1). Some species have evolved to survive under specific environmental conditions, such as low or high moisture, high soil salinity or infertile soil conditions. Most native grasses have adapted to a wide range of environmental conditions. For example, blue grama is one of the most drought tolerant and one of the most cold tolerant grass species in North America and it also shows moderate salinity tolerance.

Although all grasses are adapted to specific environmental and geographic regions, native grasses are much more sensitive to changes in latitude and altitude than are introduced grasses. As a general rule, native grasses should not be grown outside of a geographic range of 200 miles (320 km) south or 300 miles (480 km) north of their point of origin. In addition, a change of approximately 1650 feet (500 m) in elevation will have the same effect on native grasses as a move of 300 miles (480 km) north. Movement of native grasses east or west will depend upon precipitation and elevation. A reduction in precipitation is generally a more critical factor for adaptation than an increase in precipitation.

Moving native grasses out of their normal area of adaptation will have several consequences. Moving them northward or increasing elevation will decrease their winter survival potential. Changes in latitude and elevation will also affect their ability to consistently produce a seed crop. Interestingly, native grasses generally show increased drymatter production when planted north of their normal range of adaptation, but this increase can quickly become irrelevant if winterkill occurs.

## Alternatives for Plant Release for Pedigreed (Certified) and Commercial Production

Most U.S. certified seed production utilizes the conventional certified seed

classification system for both native and introduced grasses (i.e. breeders, foundation, registered and certified). A new certification system has been adopted and is beginning to be used on many native ecotypes (e.g. source identified). Eventually, it will be used on selected and tested releases as they are made available to the public. The new certification classification allows production within four classes: source identified, selected, tested and cultivar. These four classes are now part of the seed certification system and native grass seed can be bought and sold with one of these four designations.

**Source Identified:** Seeds or plants from a naturally growing population occupying a known or defined geographic area. It has been through no selection or testing. Seeds for commercial sale may be collected directly from the wild stand or grown under cultivated conditions. This agronomically grown seed should be representative of the entire germplasm of the wild stand and have undergone no selection procedures. Source identified seed can be certified by the seed certifying agency of the source state.

**Selected:** Seeds or plants which have been through some testing and which show some desirable superior trait or show promise of performance when compared with other accessions at a common site. Their performance has not been proven. They have not been tested at multiple sites or for more than one generation. This means that they may not breed true and that the desirable characteristics may not show up in all of the offspring.

**Tested:** Seeds or plants which have been through additional testing on more than one generation which will include testing on multiple sites with replicated plots to verify performance and heritability of desirable traits. The material has proven genetic superiority or possesses distinctive traits for which heritability is stable. Complete area of adaptation may not be known.

**Cultivar:** This plant material has been through replicated testing at multiple sites over two or more generations. The material will be clearly distinguished by documented characteristics and when reproduced, it will retain these characteristics. This testing will prove and document the heritability of traits, the superiority and/or performance and the range of adaptation. The plant will have a demonstrated value for conservation or other use.

The traditional seed classification system in the U.S. only recognized the cultivar seed class for both native and introduced grasses and allowed the following seed increase generations: breeder, foundation, registered and certified. With the new classes the seed increase designations for the cultivar class remain the same, but for the source identified, selected and tested classes, the seed increase generations are simply designated as Generation 1 (G1), Generation 2 (G2), etc.

In Canada, native grasses have traditionally been sold as cultivars or just as common seed with only a species designation. The cultivar class is exactly the same as described above in the U.S. system. Sometimes seed companies and producers have also sold native grass seed based on its origin. This would be similar to the source identified class in the U.S., but in Canada this seed only bears an unofficial origin designation and is still sold officially as common seed. The traditional system in Canada is gradually changing and another seed class is entering the seed certification system. This class has been referred to as the ecovar class and is related to the U.S. selected or tested classes. In other words, some human directed selection has occurred, but much of the genetic diversity present in the original population has been maintained.

Whether planting native grasses for conservation purposes, reclamation, forage production or seed production, it is important to obtain as much information as

possible about the origin of the seed. Native grasses have many attributes, but a native grass species or population planted outside of its area of adaptation is a waste of money and may not persist or perform well. Although it is not always possible to obtain certified seed of some native grass species, seedlots with a certified tag carry a number of guarantees including: genetic integrity, source, germination and purity (the percentage of weed seeds, crop kinds and inert matter). Therefore, if available, buy certified seed.

Table 4, on page 38, contains a list of current native grass cultivars and their origins.

# General Principles of Native Grass Seed Production

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## The Need for Native Grass Seed Production Information

This manual was developed to provide seed production information on a number of native grass species and to provide this information in a format that can be easily referenced by both seed producers and companies. Some people have been concerned that overproduction of native grass seed may cause more problems than underproduction, but our approach is that if seed costs can be reduced while maintaining consistent supplies, then more people will be willing to try native grasses for everything from pastures to home lawns. Obviously, native grass seed production is not for everyone, but this manual provides a good reference for those who are willing to research current and future markets and to commit to the careful management requirements and risks that accompany native grass seed production.

There has been tremendous interest in planting native grasses for restoration, ecological and conservation purposes and along highway and pipeline right-of-ways, to reclaim strip mines and for wildlife habitat. Species like switchgrass and some of the wheatgrasses are currently being planted for pasture and hay production. The market for native grasses should only continue to grow as they are increasingly accepted as options for forage production and conservation plantings. New markets are also emerging due to an increased interest in native grasses for turfgrass and esthetic purposes. Thirty years ago, buffalograss mostly occurred in overgrazed native pastures across the west, but now it is found in lawns in some of the most exclusive subdivisions in the south central U.S.

There are several limitations to increased use of native grasses. Some of these limitations have solutions, but others like seed quality may be inherent within the plants themselves. One of the greatest hindrances to increased use of native grasses is poor seedling vigor and the high cost of seed. Some species are poor seed producers, but for many species there has never been a concerted effort to produce seed on a commercial scale. For example, in species like blue grama, companies have traditionally relied on seed harvest from native stands. Consequently, seed cost and availability depend on prevailing growing conditions (moisture, temperature, pests) and therefore can be quite variable.

## Site Selection

Success in the establishment and maintenance of grasses for seed production is closely correlated with soil type, slope, moisture regimes and other site factors. For consistently high production, choose the best land available and match the soil and site with the species to be grown. The best soils for growing native grass seed are well-drained sandy loams, loams, or silt loams, all of which allow for easy cultivation and the maintenance of optimal soil moisture conditions. Many native grass species will tolerate poorer soil conditions, but seed production potential may be somewhat limited. If the field is to meet seed certification standards, it must be isolated from other cultivars or native plants of the same species and it should not have produced a seed crop of the same species during the past two years.

## Site Preparation

Control measures to reduce or eliminate undesirable vegetation should be planned during site preparation and well in advance of seeding. It is essential to control competing vegetation before attempting to establish grasses.

Inadequate weed suppression leads to more grass seeding failures than any other single factor.

Fields that have not been tilled recently and contain quackgrass (couchgrass), smooth bromegrass, crested wheatgrass, Canada thistle, leafy spurge or other perennial weeds may require one or more years of intensive cultivation, herbicide treatment or both. If only tillage is used, numerous operations may be required. A final tillage just before the fall freeze has been effective in killing rhizomes of undesirable perennial grasses and weeds. Several tillage methods have been designed to keep plant residue on the soil surface to reduce runoff, evaporation and erosion. Selective herbicides are available and should be evaluated as alternatives to tillage.

## Seedbed Preparation

Final seedbed preparation typically involves both shallow tillage and packing to produce a finely granulated, yet firm seedbed. Packing is essential to insure good soil to seed contact, and with the exception of heavy clay soils, it is difficult to overpack a seedbed. A good rule of thumb is that a footprint will be no deeper than one quarter inch (0.6 cm) in an ideal seedbed. A firm seedbed facilitates the capillary movement of moisture to the seed and developing seedling. Allow the seedbed to set for a period of time following tillage and packing. Morning and evening dew will assist in settling the seedbed. Failure to provide a firm seedbed often results in non-uniform emergence and uneven stands which reduce seed production potential and encourage weed infestation.

One of the best ways to insure an ideal seedbed is to precede the seeding year by a season or partial season of summer fallow. Fallowing not only provides a firmly packed, finely granulated seedbed, but allows full recharge of the soil moisture profile, enhances nutrient availability, allows rapid soil warming in the spring and reduces weed problems. Summer fallowing is not recommended on light soils that are prone to wind erosion or on steep slopes subject to water erosion.

With the development of zero and reduced tillage seeding equipment, it is becoming more common to plant native grasses into a standing cereal stubble. A standing stubble makes an excellent seedbed for fall dormant planting of some cool season native grasses and spring planting of both cool and warm season species. A major cause of establishment failures with slow establishing native grasses is weed competition, especially annual weeds. Growing a cereal crop the previous year provides a good opportunity for weed control. Then planting native grasses the following spring with reduced or zero tillage, preceded by the application of a nonselective herbicide (e.g. glyphosate), usually results in excellent weed control. It is essential that surface residue be thinly and evenly distributed over the field to prevent uneven emergence of the small, nonvigorous grass seedlings.

## Seeding Date

Early spring is the most commonly recommended establishment date for the majority of cool and warm season native grasses (Table 2). In most regions of the northern Great Plains, cool season grasses should be planted before May 15, while warm season grasses are typically planted between mid-May and mid-June. There are some exceptions to these establishment guidelines. For example, prairie junegrass should be planted as soon as frost is out of the ground, from the latter part of April to the beginning of May, depending on geographic location.

Early spring planting dates are commonly recommended for most cool season grass species. The cool moist conditions in the spring are ideal for initial seed germination and also help to reduce emergence losses caused by rapid drying of the seedbed and soil crusting. Seeding delays for

any reason move the critical early plant developmental stages into the warmer part of the growing season. Although early spring planting is ideal, seeding may need to be delayed if there are concerns over potential weed problems which require a spring herbicide application or tillage operation.

Although the majority of cool season stands are established during the early spring, these grasses tend to be less restrictive in terms of recommended planting dates in comparison to warm-season grasses. Three different planting periods are generally recommended:

1) early spring before the middle of May,
2) early August to early September and
3) late October for dormant planting.

The most critical question to consider when deciding on a planting date follows: "Is there sufficient moisture for germination, emergence and seedling establishment?" Stands established during the late summer often have less weed problems, but soil moisture can be deficient at this time of year in much of the Great Plains. Producers with irrigation have the potential to supply water as needed, but even with irrigation, high temperature and windy conditions can quickly desiccate young seedlings.

Fall dormant seeding is a new concept for most traditional grass seed producers. The seed of a number of native grass species shows delayed germination (or dormant seed). The common method to break seed dormancy is to moisten the seed and then store at cool temperatures for several weeks (also called stratification). Fall dormant seeding uses the early spring period to naturally stratify the seed. Ideally, seeding occurs immediately before freezing or before the first heavy snow. The seed is frozen over the winter and is then subjected to cool, moist conditions during snow melt. Germination occurs later in the spring when soil temperatures are high enough. Green needlegrass is an example of a species that produces seed with high dormancy. Fall dormant seedings are not recommended for warm season grasses.

Although soil moisture is critical for grass seed establishment, soil temperatures must reach certain minimum levels. Cool season grasses will germinate when soil temperatures are as low as 39 to 45 degrees (4 to 7°C), but for warm season grasses soil temperatures must reach 50 to 56 degrees (10 to 13°C) before germination will occur.

## Seeding Rate

Seeding equipment is no longer a major restriction to grow native grasses. Equipment is now available which will deliver the seed at an accurate, uniform rate, place the seed at the proper depth and firm the soil around the seed. To provide a uniform row, 25 to 30 pure live seed per foot of row (60 to 100 seed per meter) are normally planted (Table 2). Although lower seeding rates are sometimes recommended, these seeding rates should provide good competition with weeds within the row and add a measure of insurance against external factors (climate, etc.) which may limit establishment success. It is essential that enough seed be planted to insure that the row is solid by the end of the second growing season. Since germination percentage for many native grass seedlots is below 80 per cent, seeding rates should always be based on a pure live seed basis (PLS).

Grasses with light, chaffy, and/or winged seed (e.g. blue grama, big bluestem, little bluestem and sideoats grama) may require a carrier to prevent bridging in the seedbox and to aid in seed flow through the drill. Cracked wheat, oat groats, heated millet (proso) or heated flax, all in a one to one weight/weight ratio, have been used as carriers. In seed drills where the seedbox does not

have an agitator, watch for settling of the heavier carrier. An agitator within the seed box is very useful to assist in seed flow when seeding many native grasses.

**Broadcast seeding:** Traditionally native grass seed producers have not used solid seeding, but in recent years some producers have been successful using this approach in native grass seed fields. When solid seeding, one should increase the seeding rate. Most importantly, it is essential to follow the seeder with a harrow or packer to push the seeds into the ground and to provide increased seed to soil contact. The greatest limitation for solid seeding is providing adequate weed control without cultivation given that the number of herbicides registered for use on native grasses is limited. (Note: More information regarding solid seeding is included in the section on row spacing.)

## Cover/Companion Crop

The use of cover or companion crops is generally not recommended for establishing native grasses. Competition by the companion crop for water, light and nutrients during the establishment year often results in uneven stands and lower seed yields during the early production years. Under ideal establishment conditions, some native grasses will produce a harvestable seed crop during the year after establishment. Anything that delays establishment, whether it is a companion crop or unfavorable weather conditions, often delays the production of a harvestable seed crop until the third year of the stand.

While companion crops tend to delay stand development they may be used under specific conditions. For example, in soils which have a tendency to crust, the emerging cover crop may assist the emerging native grass seedling in penetrating the soil surface. More commonly, cover crops are sometimes recommended on very light, sandy soil where blowing can be a problem. During early seedling establishment, cover crops can also provide shade, reducing soil baking and desiccation of the seedlings. Both flax and oats have been successfully used as cover crops at low rates (generally one third the normal seeding rate), but some producers have been successful with rates as low as 2 to 3 lb/acre (2.2 to 3.4 kg/ha) for flax, and oats at 4 to 6 lb/acre (4.5 to 6.7 kg/ha). Ideally, plant a cover crop in alternate rows (e.g. grass seed in every second row) or plant the cover crop perpendicular to the grass seed rows. If a cover crop is used, it is essential that it be a noncompetitive species and that the seeding rate is low.

To help decide whether a cover crop may be advantageous, then consider the following quote: "The best cover crop is a dead one." The disadvantage of a cover crop comes from competition for light, water and nutrients. If a native grass stand is planted into a standing dead cereal stubble, then the potential for blowing and moisture loss is reduced and there is no competition for water and nutrients. Another option is to mow off or harvest a cereal cover at the boot stage or to desiccate a flax or canola cover crop with a herbicide that does not damage the grass seedlings.

## Seeding Depth

Native grasses need to be shallow seeded. Increasing the seeding depth reduces the percent emergence. The recommended seeding depths range from one quarter to one inch (.63 to 2.5 cm). Native grasses evolved under a system where cultivation was rare. In the natural state, there was little opportunity for soil incorporation and the mechanisms of germination and emergence developed without this influence. Therefore, factors such as light play a key role in the germination of many native grass seeds. Shallow seeding becomes critical. It also allows leaf area to form quickly and prevents seed reserves from being exhausted as the seedling stretches for the soil surface. (Note: Soil to seed contact is still essential, so it is important that the seed be covered with a

shallow layer of soil.)

The range in seeding depths is influenced by soil type and structure. Germination and emergence in heavier soils is more difficult due to increase bulk density of the soil and therefore seeds should be planted in the one quarter to one-half inch (.63 to 1.25 cm) range. In lighter soils the seeding depth may increase to one inch (2.5 cm) with certain species to insure adequate soil moisture for germination, emergence, and establishment. A seeding depth of one inch (2.5 cm) or greater will lead to nonuniform emergence and may lead to difficulties in both establishment and weed control.

Seeding depth is also influenced by seed size, with smaller seeds planted shallower. For example, green needlegrass and western wheatgrass can both be seeded at a depth of one-half to one inch (1.25 to 2.5 cm), while blue grama and switchgrass are seeded shallower at one quarter to one-half inch (.625 to 1.25 cm).

The emergence mechanisms differ between the warm and cool season grasses, influencing the optimal seeding depth. The main emergence mechanism for cool season grasses is the elongating coleoptile. With this type of emergence the coleoptile node remains at the seeding depth and the adventitious roots develop from this node. The adventitious roots take over from the short lived primary root system when the seedling is from four to eight weeks of age. Cool season grasses are often easier to establish because it's more likely for the soil to remain moist close to the seed vs. closer to the soil surface. On light soils, deeper seeding is sometimes recommended so that the coleopile node remains in moist soil insuring adventitious root development.

The emergence mechanism of warm season grasses includes the elongation of a subcoleoptile internode which raises the coleoptile node close to the soil surface. Since adventitious root development takes place at the coleoptile node, warm season grasses are more vulnerable to the fluctuations in temperature and moisture which occur at the soil surface. Warm season grasses, like their cool season counterparts, need to develop an adventitious root system prior to the plant being considered established.

Blue grama seedling development has been studied extensively, mainly due to the problems typically encountering during stand establishment of this species. In order for adventitious root development in blue grama to take place the following soil conditions must be in place for two to four days; 96 per cent relative humidity, at least 59 degrees (15°C) soil temperature and light reaching the coleoptile node. Soil temperatures, especially with spring seeding dates, are generally not a problem. Relative humidity is dependent upon the moisture content of the soil and upon the above ground environmental factors. Although a minimum soil temperature is required for germination, as temperatures increase during the season it becomes more and more difficult to maintain the high soil moisture close to the surface required for adventitious root development in blue grama and other warm season native grasses.

## Row Spacing

The recommended row spacing for native grass seed production generally ranges from 30 to 48 inches (75 to 120 cm) under dry land conditions, and from 12 to 36 inches (30 to 90 cm) under irrigation and good moisture conditions (Table 2). Determining the ideal row spacing depends on a number of factors including:

1) the potential for inter-row cultivation
2) the grass growth type
3) irrigated or dryland production
4) planting equipment available.

Most native grasses will yield higher in wider rows, compared to narrow rows and solid stands.

In one study, green needlegrass seed yield increased by 90 lbs/acre (100 kg/ha) at 30 to

42 inches (75 to 105 cm) row spacings in comparison to a row spacing of 18 inches (45 cm). In another study, slender wheatgrass seed yield increased by 90 lbs/acre (100 kg/ha) when row spacing was increased from 12 to 36 inches (30 to 90 cm). Planting double rows 6 to 8 inches (15 to 20 cm) within the wide row 36 to 42 inches (90 to 105 cm) allows an increase in the total number of rows while still maintaining seed yields.

Additionally, if the grass being grown is pedigreed seed, then wider rows makes it easier to rogue offtypes, to remove volunteer plants and to control weeds with interrow cultivation.

**Broadcast seeding or narrow row (6 inch or 15 cm) seeding:** As mentioned in the seeding rate section, some producers have found that solid seeding can be a valid option for native grass seed production. Although seed yields and stand longevity may be reduced, solid stands or narrow rows are more economical to maintain since interrow cultivation is not required. It is essential that the seedbed be weed free at establishment, since weed control options are limited to mowing or herbicides with solid seeding. On the other hand, many native grasses are quite competitive once established and a solid stand provides more plant competition with weeds than a stand with wide rows. It is important to remember that solid or narrow row stands are only valid in areas of higher rainfall or under irrigation. Under dryer conditions, excessive plant competition for moisture may severely limit seed yields.

## Fertilization

**During Establishment:** Fertilization is often not required or recommended for native grass establishment. The macronutrients P, K, and S are essential for development of the root system, but generally are not required unless a soil test indicates low levels. Since phosphorus does not move well with the soil profile, one recommendation is to incorporate enough P to last for 3 years. Applications of nitrogen are not usually recommended because nitrogen often tends to benefit annual grass and broadleaf weeds more than the slower growing native perennials. Although the safest seed placed fertilizer is pure phosphorus (0-46-0), some producers like to add low nitrogen fertilizer mixtures (11-48-0 or 11-51-0) with the planted seed at the rate of 30 to 50 lbs/acre (34 to 56 kg/ha) of actual product. Sidedressing or deep banding is an option during the first cultivation when using interrow cultivation. Many new seed drills are designed to allow the application of fertilizer in side or deep bands, thereby preventing fertilizer to seed contact. Another option is to apply 20 to 30 lbs/acre (22 to 34 kg/ha) of nitrogen at the 2 to 3 leaf stage. Applying more than 10 lbs/acre (11 kg/ha) of actual N or K2O with the seed may cause injury to native grass seedlings.

**Established stands:** Typically nitrogen rates for established stands range from 30 to 50 lbs/acre (34 to 56 kg/ha) for dryland fields up to 60 to 100 lbs/acre (67 to 112 kg/ha) for irrigated fields. Excess N will promote lodging, especially in tall native grasses such as big bluestem and switchgrass. Fertilizer applied to established stands can be side or deep banded between rows, normally 4 to 6 inches (10 to 15 cm) off center to ensure that roots have access to the immobile or less mobile nutrients being added.

The primary season for nitrogen application for both cool and warm season grasses is in the late fall (soon before it freezes) or in the early spring. Many producers also apply a light fertilizer rate to cool season grasses immediately after harvest, since the late season tillers contain the floral primordia that must undergo vernalization for seedheads to develop the next spring. In warm season grasses, seedheads develop from spring tillers, so after harvest fertilizer is generally not necessary. If a seed stand is planted on a coarse textured soil where N leaching is possible, N fertilizer will be more

efficient if applications are equally split between the late fall and early spring.

## Weed Control

Weed control in native grasses can be difficult. Native grasses tend to be very poor competitors, at least at the seedling stage. Little information is available on native grass herbicide tolerance, and there are few herbicides currently registered for use on native grasses in western Canada or the U.S. The limited acreage of native grasses has meant that little emphasis has been placed on the evaluation of these grasses for herbicide tolerance. Thus, the selection of a relatively weed free field and the control of weeds in crop during the year prior to the establishment is essential to reduce potential weed problems throughout the life of the native grass stand. Use of certified seed will dramatically reducing the chances of planting weed seed with the native grass, thereby reducing the amount of competition within the row and further reduce the potential for future problems. For example, weeds such as green and yellow foxtail and pennycress are difficult to control in switchgrass fields. It is essential to select fields and seedlots that contain low levels (or none) of problem weeds. Practices such as zero tillage and low N fertility during early establishment will help suppress weed growth and competitiveness. Controlling perennial weeds in areas surrounding the seed field will also help reduce the weed pressure within the field.

The methods of weed control that are currently available to native grass seed producers are as follows: mechanical control, herbicides and roguing.

**Mechanical weed control**

Mechanical control usually invoives the use of cultivation equipment to uproot weeds. Various forms of interrow cultivation equipment are available including shovels, sweeps and rotary tillers. Interrow cultivation can take place as soon as the rows of the native grass are visible. Cultivation should not be any closer than one to one and a half inches (2.5 to 3.75 cm) to the row, so as not to disturb the native grass seedlings. Cultivators can be equipped with row shields to prevent covering the seedlings with soil. Care must be taken to ensure that the emerging tillers are not cut off or buried by soil.

Interrow cultivation is also a valuable weed control practice on established stands. Cultivation should be shallow, ideally one to two inches (2.5 to 5 cm) deep, as cultivating too deep may cut off the fibrous roots of the native grasses. Interrow cultivation should not leave soil ridges, as this can be problematic in the windrows during harvesting. Another benefit of interrow cultivation may be the restriction of rhizome growth in certain species, which helps to keep the seed production field from becoming sodbound.

Mowing is another form of mechanical weed control to use during the establishment year. Mowing is especially effective where annual weeds are a problem in a native grass seed production field. Annual weeds are killed when mowed at the proper stage of maturity and the perennial native grass seedlings not only survive, but clipping usually encourages them to tiller out. It is essential to wait until the annual weeds are at an early seedhead stage before mowing. If annual weeds are mowed too soon and the growing point remains below mowing height, they often stool out. In other words, they produce new tillers which grow close to the soil surface and can create even greater competition than before mowing. Mowing height is generally 4 to 6 inches (10 to 15 cm), but some weed species may require closer mowing to remove the developing seedhead or growing point.

**Herbicides for weed control**

Herbicide application in seedling fields can sometimes begin as early as the 1 to 2 leaf stage. Bromoxynil, a broadleaf herbicide, has been used in some

species at this early growth stage. Other broadleaf controls such as MCPA, 2,4-D and Dicamba should not be used until the 4 to 5 leaf stage or roughly 6 to 8 weeks after emergence. A delay in application can pose a problem because the efficiency of control decreases as the size of the weeds increase. Some producers like to spray a nonselective herbicide like Roundup (glyphosate) before or immediately after seeding, but timing is critical to allow control of rapid emerging weed species before the native grass seedlings emerge or are established.

Another method of enhancing weed control in seedling stands is to charcoal band with the seed. A preemergent herbicide is then applied prior to emergence. The charcoal band, approximately 3 inches (7.5 cm) wide, is applied directly over the seed. It absorbs and neutralizes subsequent herbicide applications, thereby protecting the developing seedling. This method is being used with some of the higher valued perennial grass seed crops grown in the northwestern U.S.

Atrazine, a germination inhibitor, can be used with many warm-season grasses like big bluestem and switchgrass. Dinoseb, a nonselective chemical that also controls early emerging grasses and weeds in warm season grasses, has also been successfully utilized. This chemical should be applied prior to the onset of growth in the spring as it will burn off any vegetation that it contacts, setting back the growth of the warm season grass. Roundup (glyphosate) has also been successfully used on warm season grasses, but it must be sprayed before the warm season plant has initiated growth or stand losses will occur. On established fields, application of most other herbicides is recommended during the vegetative period when the plant is rapidly growing, but before it has reached the boot stage.

Wicking or wiping with nonselective herbicides like Roundup (glyphosate) requires a height differential between the weeds and the grass crop in order to be effective. Therefore, wicking is effective on short statured grass species, and on the taller warm season grasses early in the season before they initiate active growth in the spring. For example, wicking quackgrass (couchgrass) out of warm season grass stands before they initiate active growth.

Registration of herbicides for use on native seed crops will not take place unless there is a concerted effort from producer groups to promote minor use registration. Trade names are used in this manual solely to provide specific information. Mention of a trade name does not constitute a guarantee or endorsement by any of the agencies or organizations listed in this manual. (Note: The products listed in this section or on the tables may not be registered on a particular grass species in your state or province.)

**Roguing for seed purity and weed control**

Roguing involves the physical removal of off-type plants of the same species, plants of different species and weeds from a seed production field. Roguing is the most labour intensive and time consuming method of weed control and may be accomplished by removing the plants either by hand or spot spraying the weeds with a nonselective herbicide. The removal of offtype plants and plants of other species is an important component in the production of pedigreed (certified) seed. Contamination of a pedigreed (certified) seed field by off-type plants results in the loss of genetic purity. Seed of other species or other cultivars in the harvested seed may result in the harvested seedlot being rejected for pedigreed (certified) status. Often there is zero tolerance for many weeds or even other crop kinds.

If the plants are rogued by hand, they should be removed from the field to reduce the possibility of contamination during harvest. Roguing of offtypes is usually left until the plants have

headed, but before pollination so that off-types are more easily identified. Chemical roguing may be accomplished using a nonselective herbicide to spray out individual weeds, other grass species, and off-type plants. Chemical roguing is best accomplished prior to heading because immature or nonviable seed will also lead to a downgrading of the seedlot. (Note: Wide row spacings will facilitate roguing by providing easier identification of undesirable plants and easier movement within the field.)

## Diseases and Insects on Native Grasses

Relatively little information is available on disease and insect damage of native grasses and is mainly in the form of observations from researchers in the field. The natural environment for most native grasses is in mixed stands. This reduces the chance of inoculum buildup which is necessary for severe disease and insect infestations. The planting of the native grasses in monoculture for seed production may actually encourage the development of disease and insect problems.

Stem and leaf rust are the only frequently referenced diseases of native grasses, with the exception of ergot. For example, prairie junegrass and prairie sandreed have been infested by stem rust (Puccinia graminis), while the switchgrass cultivar Cave-in-Rock has been infested by leaf rust. Ergot has been occasionally observed on western wheatgrass and basin wildrye.

Insects can become a problem in native grass seed production. Grasshoppers have been observed feeding on the above ground plant parts of prairie junegrass and young grass seedlings of any species are vulnerable to grasshopper damage. Elaters and moth larvae have also been detected feeding on the root system of prairie junegrass. A midge is known to infest big bluestem and indiangrass and can significantly reduce seed yields.

More research and field observation is needed in the area of diseases and insect pests of native grasses.

## Seed Harvest

Time of harvest for each grass species varies. The timing of harvest for native grasses also depends on their origin. Because of the short day photoperiod response of most native grasses, plant material brought from southern regions will flower later when moved northward. If native grasses are moved greater than 300 miles (480 km) north of their point of origin they often fail to produce mature seed before frost. Introduced cool season grasses do not react the same way (e.g. smooth bromegrass).

### Seed maturity

Seed maturity varies among grass species. Seedhead emergence occurs over a period of time lasting from a few days to several weeks, with the time from flowering (pollination) to the mature seed stage taking up to 30 days, dependent on the weather. Wet, cool weather increases the number of days to maturity and dry, hot weather decreases the time to maturity. Seedheads ripen indeterminately from the top down, and all grasses go though the same stages of maturity; milk, soft dough, medium dough, hard dough and vitreous or mature. Seed harvested at the milk or soft dough stages usually shrivel when cured and show poor germination. Seed harvested at the hard dough to mature seed stage generally have the highest germination and greatest longevity in storage. Swathing at the medium dough stage is sometimes recommended with shatterprone grass species, since the seed can continue to mature for several days in the swath, depending on temperature and humidity.

A major limiting factor for seed production of many native grasses is a tendency for seed to shatter before or during harvest. Most grasses do not hold seed long after maturity. For example,

reed canarygrass and green needlegrass may only retain mature seed for 5 or less days, whereas some grasses retain seed for 10 to 15 days following maturity. Timing of harvest is critical for grass species prone to shattering. Successful growers regularly inspect seed fields to determine when the greatest number of seedheads are ripe. Some compromise is often required in deciding when to harvest to prevent seed yield losses from immature seed on the one hand and from shattering on the other. Interestingly, there have been reports of improving germination in species that have a high percentage of dormant seeds (e.g. green needlegrass) by swathing at the milk stage of maturity. It is important to remember that there can be a fine line between viable seed that will germinate and shrivelled seed that is worthless. As alluded to earlier, germination of most grasses is decreased by harvesting too early.

**A few practical harvesting guidelines:**

1) Harvest when most of the seed is at the medium- to hard-dough stage or the mature seed stage. Thumbnail test: At the hard-dough stage firm thumbnail pressure will be required to produce an imprint on the kernel (caryopsis).

2) Since the seedheads of most native grasses ripen from the top downward, a stand is generally ready to harvest when the tips of the seedheads begin to shatter.

3) If seed shatters when striking the seedhead firmly against the palm, the grass seed stand is ready to combine. If seeds shatter when gently struck against the palm combining should proceed immediately.

4) Grasses which shatter readily or are quite mature should be harvested during the early morning hours when the relative humidity is generally higher.

**Swathing vs Direct combining:**

Since seed maturation continues for several days after cutting, a seed stand should be swathed at an earlier stage of maturity than if direct combined. For example, swathing is often recommended at the medium to hard dough stage, whereas direct combining is often recommended at the mature seed stage.

**Harvesting techniques**

Three harvest options are available for native grass seed growers; direct combine, swathing then combining, or stripping the seed from the seedhead.

**Direct combining** has the advantage that the necessary equipment is already available on many farms. It is the method of choice for shortstatured grasses, since their small swaths are often difficult to pick up. The seed is harvested mature, but because there is often a range of maturity within a grass seed field, some some postharvest seed drying may be required. This operation requires less actual harvest time, in comparison to swathing and then combining. The major problem with direct combining is that the crop is left longer in the field (10 to 14 days longer), increasing the risk of crop loss due to inclement weather and/or seed shatter. Also, seed yields are usually lower than swathing due to the indeterminate ripening pattern of most grasses.

**Swathing followed by combining** is the most common method of grass seed harvest. It is a more rapid field operation because the foliage is cured prior to combining. The major problem associated with swathing is retrieving the swath from the field. This occurs especially when there are small swaths with a short, sparse stubble or swaths which have been rained on and have become imbedded in the stubble. Seed quality also declines when the swath has been rained on. Fortunately, there are now many excellent pickup attachments on the market for combines.

**Stripper headers** provide a new harvesting option. While these headers are costly, they are good for grasses which do not have uniform maturity and for those with light and fluffy seeds or that

have long awns or seed pubescence. The header works by stripping mature seed from the seedhead, leaving immature seed still attached. Therefore, the harvest operation can be repeated one or more times, resulting in a higher yield potential. This method is not good for all grasses. To be most efficient grass seedheads should be concentrated at a uniform height. This method is recommended for grasses such as big bluestem, little bluestem, indiangrass, sideoats grama, blue grama and green needlegrass. It is not recommended for the wheatgrasses and wildryes because of their tendency for excessive shattering. Swathing reduces the risk of shatter loss in these grasses.

As alluded to in the above paragraphs, timing of harvest is very dependent on the harvest method. Swathing can begin when the seed is in the medium to hard dough stage, whereas direct combining requires seed in the hard dough to mature seed stage. Grasses with high shatter potential should be swathed. The decision to either direct combine or swath will also depend on the amount of biomass produced. For example, switchgrass may be direct combined in dry years when vegetative growth is reduced, but swathed followed by combining in other years.

Harvest should take place when the humidity is low and temperature high, to ensure separation of the seed from the head and reduce the need for postharvest drying. However, these conditions also cause the greatest amount of seed shattering. Seed should be threshed at 20 to 30 per cent moisture. Combines need to be properly adjusted and carefully monitored to prevent physical damage to the seed or the loss of seed out the back. There is usually a delicate compromise between cylinder speed and concave setting to completely thresh out seed without damage when using traditional combines.

## Residue Management and Renovation

Following harvest, residue should be removed to both reduce disease pressure from stubble-borne diseases and to prevent shading of the crowns. Shading of the crown reduces tiller initiation and ultimately tiller numbers.

Both cool and warm season native grasses require periodic renovation in order to maintain optimum vigor. Burning, grazing and haying are all prescribed renovation methods to rejuvenate most native grasses. Burning is considered the natural method for rejuvenating both cool and warm season native grasses, since these species evolved on the Great Plains and were subjected to frequent fires. Burning is also extremely effective in completely removing crop residue. Grazing and haying are also effective, as long as the amount of residue (stubble, straw and chaff) is dramatically reduced.

For most cool season grasses, the ideal time to renovate is immediately after harvest. This is especially true when burning is used as a renovation method for several reasons. Some cool season grasses start to regrow soon after cutting and burning can damage the young tillers or it may be impossible to burn with high moisture vegetative growth present. Most cool season grasses require a 6 to 8 weeks regrowth period after harvest for the tillers to vernalize during the late fall before freezing. Without an adequate regrowth period, seed production the following season will be poor. Burning in the early spring (before regrowth) is an option for some cool season grasses, if weather conditions permit, but care must be taken to prevent damage to the overwintered tillers or seedhead production will be severely reduced.

Warm season grasses mature later than cool season grasses and should not be burned, mowed, clipped or grazed until after fall freeze up or early in the spring. The traditional practice is to renovate warm season grasses using an early spring burn (mid-April to mid-May). Vernalization

is not required for seedhead production, therefore burning will not adversely affect seed yield. In fact, in more northern locations, burning warm-season grasses is often delayed until later in May. The best regrowth response following burning occurs when the new warm season grass leaves are one to one and a half inches (2.5 to 4 cm ) tall.

Another renovation option includes chemical gapping. Blue grama, on a range site, had 100 per cent increase in seed yield using chemical gapping where 12 inch (30 cm) strips were chemically removed, allowing room for new tiller initiation and growth from the remaining 6 inch (15 cm) rows.

## Processing Native Grass Seed

Grass seed from the field contains various contaminants such as weed seeds, other crop seeds as well as inert material such as stems, leaves and immature and broken seed. Depending on the method of harvest used, inert material can make up over 50 per cent of the bulk material received from the field. Impurities are separated from the grass seed based on physical properties such as size, weight, surface texture and shape. Of greatest concern is weed seeds with physical characteristics similar to the desired grass seeds. Therefore, the grass seed cleaning process must begin in the field. Every effort must be made to keep the field as weed free as possible. Good cultural and management practices such as spray programs, crop rotation, interrow cultivation and roguing can minimize many serious weed and contaminant problems.

### Seed cleaners and separators

Many types of seed cleaning machines use the physical properties of seed and these machines can be used either singly or in combination. The choice of machines used and their arrangement in a processing line depends primarily on the seed being cleaned, the quantity of weed seeds and other contaminants in the mixture, and the purity requirements that must be met. Following are brief descriptions of machines commonly used in a seed cleaning plant.

**The Air-Screen Cleaner** is the basic machine in a seed cleaning plant. It makes seed separations mainly on the basis of three physical properties: size, shape and density. There are many makes, sizes and models of airscreen cleaners ranging from the small, one fan, single screen machine to the large, multiple fan, six or eight screen machine. Screens are manufactured with many sizes and shapes of openings. The typical airscreen cleaner now found in a seed cleaning plant is a four screen machine located beneath a seed hopper. Seed flows by gravity from the hopper into a feeder that meters the seed mixture into an airstream, which removes the light chaffy material so that the remaining seed can be uniformly distributed over the top screens. The top screen scalps or removes large material, the second screen grades or sizes the seed, the third screen scalps the seed more closely and the fourth screen performs a final grading. This finely graded seed is then passed through an airstream, which drops the plump, heavy seed, but lifts and blows out light seed and chaff.

**The Horizontal Screen Cylinder** sizes products by width or thickness and is similar to a grader. Material introduced to the rotating cylinder either passes through the perforations or is discharged from the tail end.

**Indent Disc and Indent Cylinder Separators** clears with seeds that have been size graded by width and thickness can be further separated on the basis of length differences. Length separators are of two general types – the indent disk and the indent cylinder – both use the principle of lifting short seeds from a mixture with an indentation which is too shallow to accommodate long seeds. The disc separator consists of a series of indented discs which revolve

together on a horizontal shaft. As the discs revolve, the recessed pockets in the disks lift out the short seeds and reject the longer seeds. Indent cylinders use centrifugal force and length differences to lift material and make a length sizing separation. The indent cylinder consists of a rotating, horizontal cylinder and a movable, horizontal serrating trough. Seed is passed through the rotating cylinder, short seed is lifted from the seed mixture by indentations on the inside of the cylinder and dropped into an adjustable trough.

**Specific Gravity Separator** classifies material according to density or specific gravity. Particles of the same size, but different densities and particles of different size and same densities can be separated. The mixture to be separated is metered at a uniform rate to the back of the deck. The slant of the deck and its oscillating motion move the seed over the deck. Air forced through the porous deck causes the material to stratify in layers of different densities. Heavy material is moved uphill and light material downhill. Movable splitters divide the material into different density fractions.

**Air Separators** divide materials according to their terminal velocities. Air velocity through the machine can be adjusted by regulating the fan air intake. All products with a terminal velocity less than the air velocity will be lifted. Materials with the same terminal velocity as the air will float and objects with a higher terminal velocity will fall against the airflow. With adequate control of airflow and feed rate, many precise separations can be made.

**Velvet Roll Separator** is a special seed cleaning machine that divides material by differences in surface texture and shape. It consists primarily of pairs of velvet covered rollers placed side by side in contact with one another and set at an angle. The rolls rotate outwardly in opposite directions and have an adjustable shield above them. A seed mixture to be separated is fed onto the rolls at the upper end so that seed travels down the incline formed by the rolls. Rough coated seeds, sharp pointed seeds and broken seeds catch in the velvet and are thrown against the shield, which deflects them back to the roll. They bounce back and forth until they are worked over the roll and out of the mixture. Smooth coated seeds spin and work their way down the incline and are discharged.

**Seed precleaning**

Many seed lots are conditioned or precleaned before they enter the seed cleaning line. The major machines used are scalpers, debearders, hammermills and huller scarifiers.

**Scalping** is a rough cleaning operation, usually performed at high capacity that screens off foreign material larger than the crop seed. The scalped material typically contains stems, green leaves, weed seeds, insects, and trash. Removing this large bulk of waste early will reduce later handling and storage and improve cleaning efficiency. Also, removal of trash and high moisture green material will lower drying costs and permit safer storage. There are many types and sizes available. The most common is a simple two screen machine which will remove large stems and leaves quickly and also provide for removal of inert material by basic air separation. For the greatest benefits from a scalper, it should be the first equipment used when seed comes in from the field.

**Seed conditioning**

Many seed lots can be cleaned directly after scalping, while others may require further conditioning. In some cases, a lot may contain unthreshed seed in the form of pods, heads, clusters or doubles. Also many native grasses have hulls, awns, beards, and/or pubescence. To minimize seed loss, unthreshed units must be broken down to single seeds, and awns should be removed for proper separation in the cleaning process.

**The debearder** consists of a horizontal beater assembly that rotates inside a steel drum. The beater is made up of a shaft with projecting arms which are pitched to move the seed through the drum. Stationary posts, adjustable for clearance with the arms, protrude inward from the drum to prevent the seed from turning with the beater. This machine causes a vigorous rubbing of seeds, pods, heads and doubles against the arms, posts and each other. The time that seeds remain in the unit is varied by regulating a weighted discharge gate. The severity of action is controlled by exposure time, beater speed and clearance between beater arms and posts. Another type of debearder utilizes a cylinder made of exchangeable wire mesh and sets of beaters and brushes. An auger system moves the seed to the cylinder. The paddles and brush are pitched to move the seed through the cylinder. Debearding is accomplished by the action of the seed rubbing together and against the inside of the wire mesh cylinder.

**The hammermill** uses many finger-like hammers rotating inside a section of perforated metal cylinder. Seeds processed in the mill are subjected to vigorous beating or rolling action between the hammers and perforated screen which removes appendages and forces the seed through the screen holes. Results will depend on hammer speed, size of screen openings, feed rate and crop condition. Too large a screen will cause an excess amount of inert material and high percentage of awns not removed. Too small a screen will cause excess damage to the seed, decrease capacity and increase the length of the operation. If the speed is too fast, the seed may be mutilated or cracked. If the speed is too slow, the awns may not be completely removed.

**Hullers and Scarifiers** are used after scalping and sometimes debearding when many kinds of seeds can be cleaned without further conditioning. However, certain legumes and grasses may require hulling, scarifying or both. Hulling is the removal of an outer coat or husk to improve the seeds cleaning characteristics or its planting qualities. With the husk removed, the seed is more readily handled in both cleaning and planting equipment, and in some cases, husks are impermeable to water and thus prevent germination. In scarification, the seed coat itself is scratched or ruptured. Hullers and scarifiers usually abrade the seeds between two rubber faced surfaces or against roughened surfaces like sandpaper or carborundum. Some kinds of seed lose viability quickly after being hulled or scarified, therefore this should be delayed until shortly before planting time.

**Seed storage**

The stage of maturity at harvest will ultimately affect both seed viability and longevity. Seed which is too wet for immediate storage can be slowly dried with warm air 100 degrees (38°C), bringing the moisture down to 15 per cent before storage. Care must be taken not to use hot air greater than 108 degrees (42°C) to dry the seed. Doing so will cause reduced viability and potentially result in death of the seed. To maintain viability, native grass seed should be stored in bulk conditions at 10 to 12 per cent moisture andin bags at 12 to 15 per cent moisture. Some grasses, such as green needlegrass, big bluestem, little bluestem and indiangrass, possess a prolonged seed dormancy period. Others, like sideoats grama, have a brief dormancy period. Seeds with a long dormancy period, may require a period in storage of 14 to 18 months in order to completely break dormancy. When environmental conditions are not controlled during storage, these native grasses will reach their maximum germination 2 to 3 years following harvest and maintain a high level of viability for 3 to 6 years.

Ideally, seed should be stored under carefully controlled environmental conditions in order to maintain viability over long periods. To maintain existing viability, seed has to be stored under cool and low relative

humidity conditions. The rule of thumb is that the sum of the air temperature and relative humidity should be less than 100 in order to provide a suitable long-term storage environment.

## Future Potential

Much of the current market for native grass seed is through contract seed production or bulk purchase by end users, such as wildlife organizations, mining companies and highway departments. Most of the remainder is through the sale of smaller quantities of seed to the general public for small scale plantings and even for ornamental purposes. The price of seed is dependent upon the species. Factors affecting the price of seed are the ease of production and the demand for the seed.

Table 4 lists the available cultivars for the native grass species described in this manual and that are presently available in the northern Great Plains. The area of origin is recorded where available. The production of common seed (seed harvested from natural sites or seed produced from noncultivar sources) is still prevalent for most species.

In general, the quality of native grass seed has been below the standards set for introduced forage grasses. The adoption of the pedigree (certified) seed production system for native grass seed is being encouraged in both the U.S. and Canada and will have the effect of increasing seed quality. Increasing quality of native seed should also increase the ease of establishment and possibly increase demand.

The greening of the general public has led to an increased demand for native plant material. The reclamation of marginal agricultural lands has become more prevalent as sustainability of the agricultural land base has increased in importance. These factors should help to provide a steady market demand for native grass seed.

Market opportunities for expansion of the native grass seed industry need to be explored. Increasing the use of native grasses in mainstream agriculture (e.g. pastures and rangelands) would increase the demand for seed. Recent investigations into the use of native grasses for energy production may also increase demand for some of the native warm season grasses.

Expanding the native grass seed market into the urban market may increase seed demand. Native grasses for turf plantings are being evaluated by many turfgrass breeding companies and at several research institutions. Both warm and cool season grasses are being investigated for their performance under low turf maintenance conditions, as well as for their seed production potential.

At present, the native grass seed production industry is relatively small. The quantity of seed that is required to meet the North American demand for some native grass species can be produced by a single producer on limited acreage. Many current producers have entered the industry through their own interest in preserving native materials and habitats. The growth of the industry will depend upon an increase in the demand for seed and the willingness of the present producers to share their knowledge, much of which has been independently acquired. The amount of research that will be focused in the area of native grass seed production will depend largely upon funding from the native grass seed industry. A coordinated effort must be made to link producers, extension agents,and researchers in order to accumulate, organize and disseminate any available information as well as to identify areas of priority for future research.

# References


Barnes, R.F., Miller, D.A., and Nelson, C.J. (ed.) 1995. Forages, volume 1: An introduction to grassland agriculture. Iowa State University Press. Ames, Iowa.

Boe, A. 1988. Biological aspects of seed production in big bluestem. Northern Plains Grass Seed Symposium. Pierre, South Dakota. pp. (2)37-43.

Bultsma, P.M. and Haas, R.J. 1989. Grass varieties for North Dakota. Circular R-794. NDSU Extension Service, North Dakota State University, Fargo, North Dakota.

Canadian Seed Growers Association. Regulations and Procedures for Pedigreed Crop Production. Circular 6-88. Ottawa, Canada.

Dodds, D., Meyer, D., Carter, J., and Haas, R. 1987. Grass seed production in North Dakota. Circular R-917. Cooperative Extension Service, North Dakota State University, Fargo, North Dakota.

Duebbert, H.F., Jacobson, E.T., Higgins, K.,F., and Podoll, E. B. 1981. Establishment of seeded grasslands for wildlife habitat in the prairie pothole region. United States Department of the Interior, Fish and Wildlife Service. Special Scientific Report, Wildlife No. 234. Washington, D.C.

Haas, R.J. 1988. Development of grass varieties in the northern Great Plains. Northern Plains Grass Seed Symposium. Pierre, South Dakota. pp. (1)1-23.

Haas, R.J., Sediviec, K.K., and Tober, D.A. 1994. Grass varieties for North Dakota. Circular R-794. Cooperative Extension Service, North Dakota State University, Fargo, North Dakota.

Holzworth, L.K. 1988. Grass seed production: Roses or thistles. Northern Plains Grass Seed Symposium. Pierre, South Dakota. pp. (2)11-19.

Holzworth, L.K., Wiesner, L.E., and H.F. Bowman. Revised 1990. Grass and Legume Seed Production in Montana and Wyoming. Special Report No. 12. Montana and Wyoming Soil Conservation Districts.

Jacobson, E.T. 1988. Handling and storage of grass seed to maintain quality. Northern Plains Grass Seed Symposium, Pierre, South Dakota. pp. (5)3-16.

Jacobson, E.T., Tober, D.A., Haas, R.J., and Darris, D.C. 1984. The performance of selected cultivars of warm- season grasses in the northern prairie and plains states. Proceedings of the Ninth North American Prairie Conference. Chapter 8: Prairie Restoration, pp. 215-221.

Kruger, G. 1994. Seed production of native grasses. Presentation to the Native Plants of Saskatchewan, A workshop on uses and importance. September 21-22, Saskatchewan Forage Council, Saskatoon, Saskatchewan.

Loeppky, H. 1994. Native grass herbicide tolerance report on the URMULE project. Agriculture Canada, Melfort Research Station, Melfort, Saskatchewan.

Looman, J. 1978. Biological flora of the Canadian prairie provinces. V. Koeleria gracilis Pers. Can. J. Plant Sci. 58:459-466.

Looman, J. 1982. Prairie Grasses: Identified and described by vegetative characters. Agriculture Canada pub. 1413. Research Station, Swift Current, Saskatchewan.

Lyseng, R. 1993. Native Prairie Plants. Ducks Unlimited Canada, Oak Hammock Marsh Conservation Centre, Oak Hammock Marsh, Manitoba.

Moser, L.E. and Newman, P.R. 1988. Grass seedling development. Northern Plains Grass Seed Symposium. Pierre, South Dakota. pp. (1)37-48.

Prairie Habitats. 1995. Native Prairie Wildflowers and Grasses Catalog. Argyle, Manitoba.

Saskatchewan Agriculture and Food. Field Guide: Identification of common range plants of southern Saskatchewan.

Stock Seed Farms. 1995. Prairiegrass and Wildflower Catalog. 28008 Mill Rd., Murdock, Nebraska, 68407-2350.

Tober, D.A. 1988. Methods and timing of grass seed harvest. Northern Plains Grass Seed Symposium. Pierre, South Dakota. pp. (4)1-10.

Tober, D.A. and Chamrad, A.D. 1992. Warm-season grasses in the Northern Great Plains. Rangelands 14(4): 227-230.

Trottier, G.C. 1992. A Landowner Guide: Conservation of Canadian Prairie Grasslands. Environment Canada.

Twidwell, E.K., Beutler, M.K., and Kephart, K.D. Grass Seed Production; Guidelines. Circular C 244. Agricultural Experimental Station, South Dakota State University. Brookings, South Dakota.

USDA-NRCS Plant Materials Center. 1992/93 Activity Report. Bismarck, North Dakota.

USDA-NRCS Plant Materials Center. 1992/93 Technical Report. Part 1 of 2, Grasses, Forbs, and Legumes. Bismarck, North Dakota.

# Economics of Native Grass Seed Production

# Economics of Native Grass Seed Production

Seed production of perennial grasses can provide a profitable alternative to traditional grain and oilseed crops. Equipment and management requirements are different and production costs are often higher than with many annual crops. One advantage is that a grass species can be selected that will not conflict with the harvest of other crops. Periods of peak labor requirements are often different than with traditional annual crops. Seed production of these grasses may also provide a good fit for a soil improving crop rotation.

## Cost Return Data

Cost and returns for producing grass seed crops can be estimated using the following guidelines. Each grower will have a different situation and can enter his or her own cost return figures. Planting, cultivating, harvesting and other preparations for grass seed production require more time than comparable operations for other crops. The establishment year costs will vary according to an individual's preferred management practices, but may be prorated over the life of the stand, usually three or four seed crops. The crop can be established with an intensive seedbed preparation for an entire growing season or seeded into grain stubble. The differences in cost of establishment between these two methods is substantial. The following guidelines are based on an intensive seedbed preparation.

### Estimated Production Expenses for Critana Northern (Thickspike) Wheatgrass.

| Establishment-Year Costs/Acre | Average Total Production Costs (1995)[1] | Your Expenses |
|---|---|---|
| | dollars (US) | |
| Seedbed Preparation<br>Plow, Disc, Harrow and Level Pack | $50 | |
| Seed – Foundation at 5 lb/acre (5.6 kg/ha) at $5/lb. | 25 | |
| Seeding | 14 | |
| Irrigation (flood) – 5 times at $5/time = $25 (labor only) | 25 | |
| Cultivation – 3 at $5 = $15 | 15 | |
| Herbicide – 1 application (chemical, labor, equipment) | 12 | |
| Roguing – 1st year at 2 hours/acre | 25 | |
| Water Cost – $17.50/acre | 17.50 | |
| Ditch and Structure Maintenance | 4 | |
| Taxes | 5 | |
| Total Cost of Establishment | $192.50 | |
| **Prorated costs over a four year stand life = $48.12 per year** | | |

[1]Cost Assumptions: Individual production records for 1995 and custom rates for farm-ranch operations in Wyoming for 1992 and 1993.

## Estimated Production Expenses (continued).

| Annual Costs per Acre (Production year) | Average Production Costs | Your Expenses |
|---|---|---|
| | dollars (US) | |
| Fertilizer - 150 lbs/acre (168 kg/ha) at $0.28/lb | $42 | |
| Applying Fertilizer (side dress) | 3.50 | |
| Cultivation - 3 at $5 | 15 | |
| Herbicide | 19 | |
| Roguing (contract) | 25 | |
| Irrigation (flood) - 6 times at $5 (labor only) | 30 | |
| Water Cost/acre | 17.50 | |
| Ditch and Structure Maintenance | 4 | |
| Taxes | 5 | |
| Windrowing | 18 | |
| Combining | 24 | |
| Certification[1] | 5.50 | |
| Total Annual Costs[2] | $208.50 | |

[1]Additional certification costs include: Membership fee of $25 per year plus a $10 application fee for each variety.

[2]Additional costs of drying, handling, storing, cleaning and bagging need to be added to this total if they apply. Seed processing (scalping, cleaning, debearding) can be a significant portion of cost, especially when processor is not experienced with the species and transportation to and from the processor is included.

## Expected Income

1. Expected yield _____lb/acre.
2. Expected price per lb.
   Wholesale _____price/lb.
   Retail _____price/lb.
3. Aftermath and straw value $ _____.
4. Expected gross income $_____.
5. Total annual costs $ _____.
6. NET RETURN PER ACRE (line 4 minus line 5) $_____.

# Quick Reference Tables

# Table 1. General description of native grass species: Growth type and adaptation

| **Common name** (*Scientific name*) | Warm or Cool season | Growth type | Adaptation |
|---|---|---|---|
| **Alpine bluegrass** (*Poa alpina*) | Cool | Sod forming; short | Tolerant to droughty and acidic soils; alpine species |
| **Basin (Giant) wildrye** (*Leymus cinereus*; formerly *Elyus cinereus*) | Cool | Bunchgrass; tall | Tolerant to droughty, saline and alkaline soils |
| **Beardless wheatgrass** (*Pseudroegneria spicata* subsp. *inermis*; formerly *Agropyron inerme*) | Cool | Bunchgrass; medium to tall | Tolerant to droughty and alkaline soils |
| **Beardless wildrye** (*Leymus triticoides*) | Cool | Sod forming; medium to tall | Tolerant to saline and alkaline soils and poor drainage |
| **Big bluestem** (*Andropogon gerardii*) | Warm | Bunchgrass; tall; short rhizomes | Requires high moisture, well drained and highly fertile soils |
| **Bluebunch wheatgrass** (*Pseudoroegneria spicata* subsp. *spicata*; formerly *Agropyron Spicatum*) | Cool | Bunchgrass; medium to tall | Tolerant to droughty and slightly saline soils |
| **Blue grama** (*Bouteloua gracilis*) | Warm | Bunchgrass; short | Extremely tolerant to drought; tolerant to low fertility soils |
| **California brome** (*Bromus carinatus*) | Cool | Bunchgrass; med-tall; short-lived | West coast species |
| **Canada wildrye** (*Elymus canadensis*) | Cool | Bunchgrass; medium to tall; short-lived | Requires moderate to well drained soils |
| **Canby bluegrass** (*Poa canby*) | Cool | Bunchgrass; short | Tolerant to droughty, alkaline and saline soils |
| **Early bluegrass or Muttongrass** (*Poa fendleriana* or *cusickii*) | Cool | Bunchgrass; short | Tolerant to drought |
| **Green needlegrass** (*Nassella viridula* formerly *Stipa viridula*) | Cool | Bunchgrass; short | Tolerant to droughty and moderately saline-alkali soils; adapted to a wide range of soil types |
| **Idaho or Bluebunch fescue** (*Festuca idahoensis*) | Cool | Bunchgrass; short | Tolerant to droughty and alkaline soils |
| **Indiangrass** (*Sorghastrum nutans*) | Warm | Sod-forming; tall | Requires high moisture, well drained and fertile soils |
| **Indian ricegrass** (*Oryzopsis hymenoides*) | Cool | Bunchgrass; medium to tall | Tolerant to droughty and infertile soils |
| **Junegrass** (*Koeleria macrantha* or *cristata*) | Cool | Bunchgrass; short | Tolerant to droughty and alkaline soils |

Table 1. continued

| **Common name** (*Scientific name*) | Warm or Cool season | Growth type | Adaptation |
|---|---|---|---|
| **Little bluestem** (*Schizachyrium scoparium*) | Warm | Bunchgrass; medium to tall | Tolerant to droughty and infertile soils |
| **Mountain rough fescue** (*Festuca campestris*) | Cool | Bunchgrass; medium to tall; short rhizomes | Alpine species |
| **Needle-and-thread grass** (*Stipa comata*) | Cool | Bunchgrass; medium to tall | Extremely tolerant to droughty and infertile soils |
| **Nodding brome** (*Bromus anomalus*) | Cool | Bunchgrass; medium to tall | Requires moderate moisture |
| **Northern or Thickspike wheatgrass** (*Elymus lanceolatus*; formerly *Agropyron dasystachyum*) | Cool | Sod-forming; medium to tall | Tolerant to drought; good flooding tolerance; adapted to wide range of soils |
| **Nuttall's alkali grass** (*Puccinellia nuttalliana*) | Cool | Bunchgrass; medium to short | Tolerant to saline and alkaline soils, tolerant to flood prone, poorly drained soils |
| **Prairie cordgrass** (*Spartina pectinata*) | Warm | Sod-forming; tall | Tolerant to flood prone, poorly drained soils |
| **Prairie sandreed** (*Calamovilfa longifolia*) | Warm | Sod-forming; tall | Tolerant to droughty, sandy soils |
| **Reed canarygrass** (*Phalaris arundinacea*) | Cool | Sod-forming; tall | Extremely tolerant to flooding and poorly drained soils |
| **Sand bluestem** (*Andropogon hallii*) | Warm | Sod-forming; tall | Tolerant to droughty, sandy soils |
| **Sedges** (*Carex spp.*) | Cool | Sod-forming; short to med-tall | Wide range of adaptation depending on species |
| **Side-oats grama** (*Bouteloua curtipendula*) | Warm | Sod-forming; short rhizomes; med-tall | Tolerant to droughty and infertile soils |
| **Slender wheatgrass** (*Elymus trachycaulus* subsp. *trachycaulus*; formerly *Agropyron tracycaulum*) | Cool | Bunchgrass; med-tall; short lived | Tolerant to high salinity; moderate tolerance to both drought and flooding |
| **Streambank wheatgrass** (*Elymus lanceolatus* ssp. *lanceolatus*; formerly *Agropyron riparium*) | Cool | Sod-forming; medium to short | Good tolerance to drought and flooding |
| **Switchgrass** (*Panicum virgatum*) | Warm | Sod-forming; tall | Requires high moisture; moderate tolerance to flooding |
| **Tufted hairgrass** (*Deschampsia caespitosa*) | Cool | Sod-forming; medium to short | Tolerant to saline, alkaline and acidic soils |
| **Western wheatgrass** (*Pascopyrum smithii*; formerly *Agropyron smithii*) | Cool | Sod-forming; medium to tall | Tolerant to drought; moderate tolerance to flooding and salinity |

# Table 2. Establishment recommendations for seed production of native grass species

| Common name | Seed weight | | Seeding date[1] | Row spacing[2] Dryland and Irrigated | Average seeding rate[3] (based on 24" or 60cm row spacing) | | Average stand life[4] |
|---|---|---|---|---|---|---|---|
| | seeds/lb | seeds/kg | | inches(cm) | lbs/acre | kg/ha | years |
| **Alpine bluegrass** | 1,000,000 | 2,200,000 | Spring | 12 and 24 (30-60) | 1.0 | 1.1 | 4 |
| **Basin (Giant) wildrye** | 130,000 | 286,000 | Dormant, Spring | 30 and 48 (75-120) | 4.5 | 5.0 | 5 - 7 |
| **Beardless wheatgrass** | 160,000 | 352,000 | Spring, Fall | 24 and 36 )60-90) | 4.1 | 4.6 | 4 |
| **Beardless wildrye** | 175,000 | 385,000 | Dormant | 24 and 36 (60-90) | 3.7 | 4.2 | 5 |
| **Big bluestem** | 165,000 | 364,000 | Late Spring | 30 and 42 (75-105) | 4.1 | 4.6 | 10 - 15 |
| **Bluebunch wheatgrass** | 140,000 | 308,000 | Spring, Fall | 24 and 36 (60-90) | 4.6 | 5.2 | 4 |
| **Blue grama** | 775,000 | 1,709,000 | Late Spring | 30 and 42 (75-105) | 1.0 | 1.1 | 10 - 15 |
| **California brome** | 103,700 | 228,000 | Spring | 30 and 36 (75-90) | 5.3 | 5.9 | 1 - 4 |
| **Canada wildrye** | 115,000 | 254,000 | Spring, Fall, Dormant | 30 and 42 (75-105) | 5.7 | 6.4 | 3 - 5 |
| **Canby bluegrass** | 925,000 | 2,035,000 | Spring | 24 and 36 (60-90) | 2.0 | 2.2 | 7 - 8 |
| **Early bluegrass (Muttongrass)** | 890,000 | 1,958,000 | Spring | 30 and 36 (75-90) | 2.0 | 2.2 | 8 |
| **Green needlegrass** | 168,000 | 370,000 | Spring, Fall, Dormant | 30 and 36 (75-90) | 3.6 | 4.0 | 5 - 10 |
| **Idaho or Bluebunch fescue** | 380,000 | 836,000 | Spring | 24 and 36 (60-90) | 2.0 | 2.2 | 3 |
| **Indiangrass** | 175,000 | 386,000 | Late Spring | 30 and 42 (75-105) | 3.7 | 4.1 | 10 -15 |
| **Indian ricegrass** | 159,000 | 350,000 | Dormant | 24 and 36 (60-90) | 4.1 | 4.6 | 5 |
| **Junegrass** | 2,315,000 | 5,090,000 | Spring | 24 and 36 (60-90) | 1.0 | 1.1 | 4 - 5 |

[1]**Seeding date: Spring** – Spring seeding should take place as early as possible after risk of sever frost; **Late Spring** – Late Spring seeding is required for warm season grasses after risk of frost and it is warm enough to plant corn, late May or early June; **Fall** – Fall seeding is typically mid- to late-August depending on location, must have irrigation or sufficient soil moisture, it is essential to allow enough seedling growth for winter survival; **Dorm** – Dormant seeding should occur as close to freeze up as possible so that seed can "lie dormant" over winter for spring germination. Most cool season grasses can be planted late summer (if sufficient moisture) or dormant seeded. Dormant seeding is not recommended for warm-season grasses.

[2]**Row spacing:** Irrigated row spacings should also be used in higher rainfall areas; narrow row spacings are sometimes used without interrow cultivation, but seed yields and stand longevity can be reduced.

[3]**Average seeding rates** are based on a 24 inch (60 cm) row spacing. Multiply x 2 for 12 inch (30 cm) rows; by 0.875 for 30" (75cm) rows; by 0.75 for 36 inch (90 cm) rows.

[4]**Depends on local environmental conditions** including: rainfall, evaportranspiration, winter temperatures, summer temperatures, snow cover and other environmental factors.

Table 2. continued

| Common name | Seed weight | | Seeding date[1] | Row spacing[2] Dryland and Irrigated | Average seeding rate[3] (based on 24" or 60cm row spacing) | | Average stand life[4] |
|---|---|---|---|---|---|---|---|
| | seeds/lb | seeds/kg | | inches(cm) | lbs/acre | kg/ha | years |
| **Little bluestem** | 260,000 | 573,000 | Late Spring | 30 and 42 (75-105) | 2.5 | 2.8 | 10 - 15 |
| **Mountain rough fescue** | 215,000 | 473,000 | Spring | 24 and 48 (60-120) | 2.5 | 2.8 | 5 - 6 |
| **Needle-and-thread grass** | 115,000 | 253,000 | Spring, Fall, Dormant | 30 and 42 (75-120) | 5.7 | 6.4 | 3 - 4 |
| **Nodding brome** | 168,000 | 369,600 | Spring | 24 and 36 (60-90) | 2.6 | 2.9 | 4 |
| **Northern or thickspike wheatgrass** | 145,000 | 319,000 | Spring, Fall, Dormant | 24 and 36 (60-90) | 4.5 | 5.0 | 4 - 5 |
| **Nuttall's alkali grass** | 1,000,000 | 2,640,000 | Spring | 24 and 36 (60-90) | 1.0 | 1.1 | 4 |
| **Prairie cordgrass** | 165,000 | 364,000 | Late Spring | 72 (180) Irrigated | 1.3 | 1.5 | – |
| **Prairie sandreed** | 274,000 | 603,000 | Spring | 24 and 36 (60-90) | 2.4 | 2.7 | 5 - 10 |
| **Reed canarygrass** | 227,200 | 500,500 | Spring | 30 and 36 (75-90) | 3.0 | 3.4 | 10 - 15 |
| **Sand bluestem** | 113,000 | 249,000 | Late Spring | 30 and 42 (75-105) | 5.8 | 6.5 | 10 - 15 |
| **Sedges** | >1,000,000 | >2,200,000 | — | — | — | — | — |
| **Side-oats grama** | 191,000 | 421,000 | Late Spring | 30 and 42 (75-105) | 3.5 | 3.9 | 10 - 15 |
| **Slender wheatgrass** | 160,000 | 352,000 | Spring, Fall | 24 and 36 (60-90) | 4.1 | 4.6 | 3 - 4 |
| **Streambank wheatgrass** | 152,000 | 334,000 | Spring, Fall, Dormant | 30 and 36 (75-90) | 4.3 | 4.8 | 4 - 5 |
| **Switchgrass** | 389,000 | 857,000 | Late Spring, Dormant | 30 and 42 (75-105) | 1.7 | 1.9 | 10 - 15 |
| **Tufted hairgrass** | 2,500,000 | 5,500,000 | Spring, Fall, Dormant | 30 and 36 (75-90) | 1.0 | 1.1 | 8 |
| **Western wheatgrass** | 114,000 | 251,000 | Dormant, Spring, Fall | 30 and 36 (75-90) | 5.7 | 6.4 | 3 - 5 |

[1]**Seeding date: Spring** – Spring seeding should take place as early as possible after risk of sever frost; **Late Spring** – Late Spring seeding is required for warm season grasses after risk of frost and it is warm enough to plant corn, late May or early June; **Fall** – Fall seeding is typically mid- to late-August depending on location, must have irrigation or sufficient soil moisture, it is essential to allow enough seedling growth for winter survival; **Dorm** – Dormant seeding should occur as close to freeze up as possible so that seed can "lie dormant" over winter for spring germination. Most cool season grasses can be planted late summer (if sufficient moisture) or dormant seeded. Dormant seeding is not recommended for warm-season grasses.

[2]**Row spacing:** Irrigated row spacings should also be used in higher rainfall areas; narrow row spacings are sometimes used without interrow cultivation, but seed yields and stand longevity can be reduced.

[3]**Average seeding rates** are based on a 24 inch (60 cm) row spacing. Multiply x 2 for 12 inch (30 cm) rows; by 0.875 for 30" (75cm) rows; by 0.75 for 36 inch (90 cm) rows.

[4]**Depends on local environmental conditions** including: rainfall, evaportranspiration, winter temperatures, summer temperatures, snow cover and other environmental factors.

# Table 3. Seed production and harvest characteristics of native grass species

| Common name | Preferred method | Average harvest date | Seed maturity stage | Lodging potential | Shatter potential | Ease of production | Irrigated yield (ave) | Dryland yield (ave) |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | lbs/acre (kg/ha) | lbs/acre (kg/ha) |
| **Alpine bluegrass** | SW*, DC | mid-June | hard dough to mature | Low | Low | — | 150 (168) | — |
| **Basin (Giant) wildrye** | SW*, DC | early-Aug | hard dough to mature | Low | Moderate | easy | 350 (392) | 175 (196) |
| **Beardless wheatgrass** | SW*, DC | mid-July | hard dough to mature | Low | High | easy | 150 (168) | 100 (112) |
| **Beardless wildrye** | SW* | mid-Aug | hard dough to mature | High | Low | medium | 150 (168) | — |
| **Big bluestem** | DC*, SW, ST | mid-Sept | med to hard dough | Moderate | Moderate | medium | 200 (224) | 100 (112) |
| **Bluebunch wheatgrass** | SW*, DC | mid-July | hard dough to mature | Low | High | medium | 350 (392) | 250 (280) |
| **Blue grama** | DC*, SW, ST | mid-Sept | hard dough to mature | Low | Low | medium | 150 (168) | 75 (84) |
| **California brome** | DC*, SW | July | hard dough to mature | Low | Low | — | — | 250 (280) |
| **Canada wildrye** | SW*, DC | mid-Aug | hard dough | Moderate | Moderate | easy | 700 (784) | 250 (280) |
| **Canby bluegrass** | SW* | late-June | hard dough | Low | Low | — | — | 150 (168) |
| **Early bluegrass (Muttongrass)** | DC* | early-June | mature | Low | High | — | 33 (39) | — |
| **Green needlegrass** | ST*, SW | early-June | hard dough to mature | Low | High | medium | 250 (280) | 100 (112) |
| **Idaho or Bluebunch fescue** | SW*, DC | early-July | hard dough | Low | Moderate | — | 300 (336) | 100 (112) |
| **Indiangrass** | ST*, SW, DC | early-Sept | med to hard dough | Moderate | High | medium | 175 (196) | 100 (112) |
| **Indian ricegrass** | DC*, SW | late-July | hard dough | Low | Moderate | difficult | 300 (336) | 150 (168) |
| **Junegrass** | SW*, DC | late-July | hard dough to mature | Low | Low | difficult | 150 (168) | 75 (84) |

[1]**Harvest method:** SW – swathing; DC - direct combining; ST - seed stripper. An (*) indicates the preferred harvest method, but depending on conditions and individual species other methods are possible. See individual species guidelines for more details.

[2]**Average harvest date:** The dates listed came from several locations (primarily Bismarck, ND and Bridger, MT) and should only be used as a reference. Obviously, the exact date in a given year will depend on geographic location and environmental conditions. For more information on harvest dates, see guidelines for individual species.

[3]**Seed maturity stage:** Swathing usually occurs at an earlier stage of maturity than direct combining, since the seed continues to mature during the dry down period. When more than one stage of maturity is listed, the earlier stage should be adhered to for swathing.

[4]**Ease of production –** This recommendation should only be used as a reference. Actual ease or difficulty of seed production depends on many factors.

[5]**Seed yield –** The listed average yields should only be used as a relative guide to compare species. Since this is only a relative average, actual seed yields will cover a range of higher and lower values. See individual species guidelines for more detailed seed yield information.

Table 3. continued

| Common name | Preferred method | Average harvest date | Seed maturity stage | Lodging potential | Shatter potential | Ease of production | Irrigated yield (ave) | Dryland yield (ave) |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | lbs/acre (kg/ha) | lbs/acre (kg/ha) |
| **Little bluestem** | ST*, DC | mid-Sept | hard dough to mature | Low | Moderate | difficult | 150 (168) | 100 (112) |
| **Mountain rough fescue** | DC* | early-July | hard dough to mature | Low | High | — | 75 (84) | — |
| **Needle-and-thread grass** | ST*, SW | early-July | hard dough to mature | Low | High | difficult | 150 (168) | 100 (112) |
| **Nodding brome** | DC* | mid-Aug | hard dough to mature | Moderate | Moderate | — | 250 (280) | — |
| **Northern or thickspike wheatgrass** | SW*, DC | late-July | hard dough | High | Low | difficult | 350 (391) | 100 (112) |
| **Nuttall's alkali grass** | SW*, DC | mid-July | hard dough to mature | Low | Moderate | — | 300 (336) | — |
| **Prairie cordgrass** | DC*, SW | mid-Oct | medium to hard dough | Low | Moderate | medium | 100 (112) | — |
| **Prairie sandreed** | DC*, SW | late-Sept | med dough to mature | Low | High | difficult | 250 (280) | 100 (112) |
| **Reed canarygrass** | DC*, SW | late-June | mature seed | Moderate | High | difficult | — | 140 (157) |
| **Sand bluestem** | DC*, ST | late-Sept | hard dough to mature | Low | Moderate | difficult | 150 (168) | 75 (84) |
| **Sedges** | ST* | mid-Sept | mature | Low | Moderate | — | — | — |
| **Side-oats grama** | DC*, ST, SW | late-Aug | med dough to mature | Low | Low | easy | 250 (280) | 100 (112) |
| **Slender wheatgrass** | SW*, DC | late-July | hard dough to mature | Low | Low | easy | 500 (560) | 300 (336) |
| **Streambank wheatgrass** | SW*, DC | early-Aug | hard dough to mature | Low | Low | difficult | 300 (336) | 100 (112) |
| **Switchgrass** | DC*, SW | late-Aug | med to hard dough | Low | Moderate | easy | 400 (448) | 200 (224) |
| **Tufted hairgrass** | DC* | early-July | mature | Low | High | — | 40 (45) | — |
| **Western wheatgrass** | SW*, DC | early-Aug | hard dough | High | Low | difficult | 200 (224) | 100 (112) |

[1]**Harvest method:** SW – swathing; DC - direct combining; ST - seed stripper. An (*) indicates the preferred harvest method, but depending on conditions and individual species other methods are possible. See individual species guidelines for more details.

[2]**Average harvest date:** The dates listed came from several locations (primarily Bismarck, ND and Bridger, MT) and should only be used as a reference. Obviously, the exact date in a given year will depend on geographic location and environmental conditions. For more information on harvest dates, see guidelines for individual species.

[3]**Seed maturity stage:** Swathing usually occurs at an earlier stage of maturity than direct combining, since the seed continues to mature during the dry down period. When more than one stage of maturity is listed, the earlier stage should be adhered to for swathing.

[4]**Ease of production –** This recommendation should only be used as a reference. Actual ease or difficulty of seed production depends on many factors.

[5]**Seed yield –** The listed average yields should only be used as a relative guide to compare species. Since this is only a relative average, actual seed yields will cover a range of higher and lower values. See individual species guidelines for more detailed seed yield information.

Table 4. List of currently available cultivars in North America for the native grass species described in this manual.

| Common name | Cultivar | Origin | Source of Foundation Seed[1] |
|---|---|---|---|
| Alpine bluegrass | Greuning | France | AKDNR PMC |
| Basin (Giant) wildrye | Magnar | Saskatchewan, Canada | ID PMC |
| | Trailhead | Musselshell County, Montana | MT AES |
| Beardless wheatgrass | Whitmar | Whitman County, Washington | MT AES |
| Beardless wildrye | Shoshone | Riverton, Wyoming | MT AEC |
| Big bluestem | Bison | Oliver County, North Dakota | ND PMC |
| | Bonilla | Beadle County, South Dakota | ND PMC |
| | Champ | Nebraska | NE AES |
| | Kaw | Riley County, Kansas | KS PMC |
| | Niagara | Erie County, New York | NY PMC |
| | Pawnee | Pawnee County, Nebraska | NE AES |
| | Rountree | Monona County, Iowa | MO PMC |
| Bluebunch wheatgrass | Goldar | Asotin, Washington | ID PMC |
| | Secar | Lewston, Idaho | WA AES |
| Blue grama | Alma | Southwest USA composite | NM PMC |
| | Hachita | Hachita Mountain, New Mexico | NM PMC |
| | Lovington | Lea County, New Mexico | NM PMC |
| | Bad River | Haakon County, South Dakota | ND PMC |
| California brome | Cucamonga | Cucamonga, California | CA PMC |
| Canada wildrye | Mandan | Morton County, North Dakota | ND PMC |
| Canby bluegrass | Canbar | Southeastern Washington | WA PMC |
| Early bluegrass (Muttongrass) | — | — | — |
| Green needlegrass | Lodorm | Burleigh County, North Dakota | ND AES |
| Idaho (Bluebunch) fescue | — | — | — |
| Indiangrass | Holt | Holt County, Nebraska | NE AES |
| | Llano | Elida, New Mexico | NM PMC |
| | Lometa | Lometa, Texas | TX PMC |
| | Osage | Kansas, Oklahoma | KS AES |
| | Oto | Nebraska, Kansas | NE AES |
| | Rumsey | Jefferson County, Illinois | MO PMC |
| | Tomahawk | North and South Dakota | ND PMC |
| Indian ricegrass | Nezpar | Whitebird, Idaho | ID PMC |
| | Paloma | Pueblo, Colorado | NM PMC |
| | Rimrock | Yellowstone County, Montana | MT AES |
| Junegrass | — | — | — |
| Little bluestem | Aldous | Flinthills, Kansas | KS AES |
| | Blaze | Western Kansas and Nebraska | NE AES |
| | Camper | Kansas, Nebraska | NE AES |
| | Cimarron | Kansas, Oklahoma | KS PMC |
| | Badlands | North and South Dakota | ND PMC |
| Mountain rough fescue | — | — | — |
| Needle and thread grass | — | — | — |
| Nodding brome | — | — | — |

[1]See directory for addresses and phone numbers for Foundation Seed Sources.

| Common name | Cultivar | Origin | Source of Foundation Seed[1] |
|---|---|---|---|
| Northern wheatgrass (Thickspike) | Bannock | Idaho, Oregon, Washington | ID PMC |
| | Critana | Hill County, Montana | MT AES |
| | Elbee | Canada | AC AB |
| | Schwendimar | The Dalles, Oregon | WA PMC |
| Nuttall's alkali grass | — | — | — |
| Prairie cordgrass | — | — | — |
| Prairie sandreed | Bowman | Bowman, North Dakota | ND PMC |
| | Goshen | Goshen County, Wyoming | MT AES |
| | Pronghorn | Nebraska | NE AES |
| Reed canarygrass | Ioreed[2] | composite from Iowa | MO PMC |
| Sand bluestem | Elida | Elida, New Mexico | NM PMC |
| | Garden | Garden County, Nebraska | KS PMC |
| | Goldstrike | Nebraska, Oklahoma | NE AES |
| | Woodward | Woodward County, Oklahoma; Curry County, New Mexico | OK AES |
| Sedges | — | — | — |
| Side-oats grama | Butte | Holt and Platte Counties, Nebraska | NE AES |
| | El Reno | Canadian County, Oklahoma | KS PMC |
| | Haskell | Haskell County, Texas | TX PMC |
| | Killdeer | Dunn County, North Dakota | — |
| | Niner | Socorro County, New Mexico | NM PMC |
| | Pierre | Stanley County, South Dakota | ND PMC |
| | Premier | Mexico | TX AES |
| | Trailway | Holt County, Nebraska | NE AES |
| | Vaughn | Guadalupe County, New Mexico | NM AES |
| Slender wheatgrass | Adanac | Saskatchewan, Canada | AC SK |
| | Primar | Beebe, Montana | WA PMC |
| | San Luis | Rio Grande, Colorado | UC EPC |
| | Pryor | Clarks Fork River, Montana | MT AES |
| | Revenue | Canada | AC SK |
| Streambank wheatgrass | Sodar | Washington, Oregon | ID PMC |
| Switchgrass | Alamo | Frio River, Texas | TX PMC |
| | Blackwell | Blackwell, Oklahoma | KS PMC |
| | Cave-in-Rock | Southern Illinois | MO PMC |
| | Dacotah | Morton County, North Dakota | ND PMC |
| | Forestburg | Sanborn County, South Dakota | ND PMC |
| | Kanlow | Wetumka, Oklahoma | KS AES |
| | Nebraska 28 | Holt County, Nebraska | NE AES |
| | Pathfinder | Nebraska, Kansas | NE AES |
| | Shelter | Pleasants County, West Virginia | NY PMC |
| | Summer | Nebraska City, Nebraska | SD AES |
| | Sunburst | Union County, South Dakota | SD AES |
| | Trailblazer | Nebraska, Kansas | NE AES |
| Tufted hairgrass | Peru Creek | Summit County, Colorado | UC EPC |
| Western wheatgrass | Ariba | Kit Carson County, Colorado | NM PMC |
| | Barton | Barton County, Kansas | KS PMC |
| | Flintlock | Kansas and Nebraska | NE AES |
| | Rodan | Morton County, North Dakota | ND PMC |
| | Rosana | Rosebud County, Montana | MT AES |
| | Walsh | Canada | AC AB |

[1]See directory for addresses and phone numbers for Foundation Seed Sources.

[2]There are a number of Reed canarygrass cultivars in North America, but were developed in large part from introduced plant material including: Castor, Flare, Frontier, Grove, Palaton, Rise, Rival, Vantage and Venture.

# Seed Production Guidelines: Individual Species

# Native Grasses

## Alpine bluegrass (*Poa alpina*)

SEED WEIGHT: 1,000,000/lb. (2,200,000/kg)

SEEDING RATE: (Pure live seed)
50 seeds per linear foot of row.
170 seeds per meter of row.

1 lb/acre (1.1 kg/ha) for 24" (60 cm) rows.
Multiply x 2.0 for 12" (30 cm) rows or x 0.75 for 36" (90 cm) rows.

ROW SPACING: 12" (30 cm) Irrigated or high rainfall areas.
24" (60 cm) Dryland areas.
(**Note:** Narrower row spacings are sometimes used without interrow cultivation, but seed yields and stand longevity can be reduced).

PLANTING DATE: Early spring

WEED CONTROL:

**During Establishment:** If possible, plant in a field where weeds have been controlled by summer fallow or a broad spectrum herbicide during the previous 1 to 2 years. Wait until 3 to 5 leaf stage before applying herbicides at lower rates; clipping or bromoxynil according to label directions.

**Established Stand:** Bromoxynil, MCPA, 2,4-D, dicamba and/or cultivation and hand roguing.
(**Note**: These products may not be registered on this grass species in your state or province).

FERTILIZATION:

**During Establishment:** Dryland and irrigated – apply phosphorus according to forage production rate and enough for 3 years. No nitrogen until seedlings are established or drill 50 lbs/acre (56 kg/ha) of 11-48-0 with seed. After seedlings are established, apply 30 lbs/acre (34 kg/ha) of nitrogen for dryland and 60 to 80 lbs/acre (67 to 90 kg/ha) of nitrogen for irrigated. On dryland fallow the year before seeding.

**Established Stand:** Apply nitrogen each year: Dryland, 30 lbs/acre (34 kg/ha); Irrigated, 60 to 80 lbs/acre (67 to 90 kg/ha); P2O5, 30 lbs/acre (34 kg/ha) or to soil test recommendation.

IRRIGATION:

**During Establishment:** Apply enough water to get the stand established. Keep surface moist to avoid crusting. Bring soil moisture up to field capacity in early September.

**Established Stand:** Irrigate after harvest to promote vegetative production. Bring moisture level up to field capacity by early September. Irrigate in spring through the boot stage if rainfall does not provide sufficient moisture for continued plant growth (soil moisture should be above 50 per cent field capacity). Do not irrigate during flowering (pollination), but good soil moisture is essential during the early phase of seed development. Do not irrigate during seed ripening.
(**Note:** Never allow plants to be moisture stressed while floral primordia immature seedheads are forming).

HARVEST:

**Range of harvest dates at Bridger, MT:** Early to mid-June.
**Lodging:** None
**Shattering:** Retains seed well
**Stripping:** No

## Alpine bluegrass continued

**Direct Combine:** Preferred

| | |
|---|---|
| Stage: | Mature seed. |
| Ground speed: | Dependent on stand, seed quantity and size of harvesting equipment. Adequate rate of feed and speed to ensure machine is operating at full capacity without overloading the cylinder and sieves. |

**Swathing/Windrowing:** Preferred

| | |
|---|---|
| Stage: | Hard dough. |
| Ground speed: | As described for direct combining. |
| Days in Windrow: | 5 to 7 days. |

**Combine Settings:**

| | |
|---|---|
| Air flow setting: | No more than 5 per cent filled seed going out back of combine. |
| Cylinder speed: | Fast enough to thresh seed and not crack caryopsis or kernel. |
| Cylinder spacing: | Closed enough to thresh seeds, but limited breakage of stems and seeds. |

**Average Dockage of Harvested Seed:** 25 per cent; Actually depends on type of sieve and settings (Peterson Sieve recommended).

PRECLEANING TREATMENT/STORAGE:

**Drying:** Usually not necessary (not to exceed 104° F or 40° C). Not necessary.
Direct Combined: Dry thoroughly if sample trashy.

**Safe Storage Moisture Content:**
Bins: 12 per cent
Sacks: 15 per cent

PROCESSING:

**Debearding:** Yes

| | |
|---|---|
| Barley debearder: | Enough to remove basal hairs. |
| Hammer mill: | Preferred method, enough to remove basal hairs. |

**Scalping:** Not required.

**Final cleaning:**
Top screen: 9/64" (0.36 cm).
Bottom screen: 7/64" (0.28 cm).

SEED YIELD:

**Irrigated:** Average, 150 lbs/acre (168 kg/ha).
**Dryland:** Not recommended.

POSTHARVEST MANAGEMENT:

**During Establishment:** See information on fertilization and irrigating.
**Established Stand:** See information on fertilization and irrigating. Clip to short stubble height immediately after harvest.

EXPECTED PRODUCTIVE STAND LIFE: 4 years

# Basin (Giant) wildrye (*Leymus cinereus* [Scribn. & Merr.] A. Love; formerly *Elymus cinereus*)

SEED WEIGHT: 130,000/lb. (286,000/kg)

SEEDING RATE: (Pure live seed)
25 seeds per linear foot of row.
85 seeds per meter of row.

4.5 lb/acre (5 kg/ha) for 24" (60 cm) rows.
Multiply x 2.0 for 12" (30 cm) rows or x 0.75 for 36" (90 cm) rows.

ROW SPACING: 30" (75 cm) Irrigated or high rainfall areas.
48" (120 cm) Dryland areas.
(**Note:** Narrower row spacings are sometimes used without interrow cultivation, but seed yields and stand longevity can be reduced).

PLANTING DATE: Dormant fall seeded just prior to freeze up or late spring.

WEED CONTROL:

**During Establishment:** If possible, plant in a field where weeds have been controlled by summer fallow or a broad spectrum herbicide during the previous 1 to 2 years. Wait until 3 to 5 leaf stage before applying herbicides at lower rates; clipping or bromoxynil according to label directions.

**Established Stand:** Bromoxynil, 2,4-D, dicamba and/or cultivation and hand roguing.
(**Note:** These products may not be registered on this grass species in your state or province).

FERTILIZATION:

**During Establishment:** Dryland and irrigated – apply phosphorus according to forage production rate and enough for 3 years. No nitrogen until seedlings are established or drill 50 lbs/acre (56kg/ha) of 11-48-0 with seed. After seedlings are established, apply 30 lbs/acre (34 kg/ha) of nitrogen for dryland and 60 to 80 lbs/acre (67 to 90 kg/ha) of nitrogen for irrigated. On dryland, fallow the year before seeding.

**Established Stand:** Apply nitrogen each year – dryland, 30 lbs/acre (34 kg/ha); Irrigated, 60 to 80 lbs/acre (67 to 90 kg/ha).

IRRIGATION:

**During Establishment:** Apply enough water to get the stand established. Keep surface moist to avoid crusting. Bring soil moisture up to field capacity in early September.

**Established Stand:** Irrigate after harvest to promote vegetative production. Bring moisture level up to field capacity by early September. Irrigate in spring through the boot stage if rainfall does not provide sufficient moisture for continued plant growth (soil moisture should be above 50 per cent field capacity). Do not irrigate during flowering (pollination), but good soil moisture is essential during the early phase of seed development. Do not irrigate during seed ripening.
(**Note:** Never allow plants to be moisture stressed while floral primordia or immature seedheads are forming).

HARVEST:

**Range of harvest dates at Bridger, MT:** Late July to mid-August.
**Lodging:** No
**Shattering:** Moderate
**Stripping:** No

## Basin (Giant) wildrye continued

**Direct Combine:** Satisfactory

| | |
|---|---|
| Stage: | Hard dough. |
| Ground speed: | Dependent on stand, seed quantity and size of harvesting equipment. Adequate rate of feed and speed to ensure machine is operating at full capacity without overloading the cylinder and sieves. |

**Swathing/Windrowing:** Preferred

| | |
|---|---|
| Stage: | Hard dough |
| Ground speed: | As described for direct combining. |
| Days in Windrow: | 7 to 10 days. |

**Combine Settings:**

| | |
|---|---|
| Air flow setting: | No more than 5 per cent filled seed going out back of combine. |
| Cylinder speed: | Fast enough to thresh seed and not to crack caryopsis or kernels. |
| Cylinder spacing: | Closed enough to thresh seeds, but limited breakage of stems and seeds. |

**Average Dockage of Harvested Seed:** 20 per cent; Actually depends on type of sieve and settings (Peterson Sieve recommended).

**Other harvest recommendations:** Swath and direct combine at 30" (75 cm) stubble height. Watch for stem buildup in upper sieve.

PRECLEANING TREATMENT/STORAGE:

**Drying:** Yes (not to exceed 104° F or 40° C).

| | |
|---|---|
| Swathed: | Often not necessary. |
| Direct Combined: | Requires drying because of green leaf material with seed. |

**Safe Storage Moisture Content:**

Bins: 12 per cent

Sacks: 15 per cent

PROCESSING:

**Debearding:** No

**Scalping:** Direct combining may require some scalping of leaf material.

| | |
|---|---|
| Top screen: | 12/64" (.47 cm) |

**Final cleaning:**

| | |
|---|---|
| Top screen: | 11/64" (0.43 cm) followed by 1/14" x 1/2" (0.18 x 1.25 cm) slotted. |
| Bottom screen: | 6 x 22 mesh. |

SEED YIELD:

**Irrigated:** Average, 350 lbs/acre (392 kg/ha).

**Dryland:** Average, 150 lbs/acre 168 kg/ha).

Range, 150 to 200 lbs/acre (168 to 224 kg/ha).

POSTHARVEST MANAGEMENT:

**During Establishment:** See information on fertilizing and irrigation.

**Established Stand:** See information on fertilizing and irrigation; Reswath to 4" (10 cm) stubble height immediately after combining and remove aftermath.

EXPECTED PRODUCTIVE STAND LIFE: 5 to 7 years

# Beardless wheatgrass *(Pseudoroegneria spicata* subsp. *inermis* [Scribn. & Smith] A. Love; formerly *Agropyron inerme)*

SEED WEIGHT: 160,000/lb. (352,000/kg)

SEEDING RATE: (Pure live seed)
25 to 30 seeds per linear foot of row.
82 to 100 seeds per meter of row.

4.1 lbs/acre (4.6 kg/ha) for 24" (60 cm) rows.
Multiply x 2.0 for 12" (30 cm) rows or x 0.75 for 36" (90 cm) rows.

ROW SPACING: 24" (60 cm) Irrigated or high rainfall areas.
36" (90 cm) Dryland areas.
(**Note:** Narrower row spacings are sometimes used without interrow cultivation, but seed yields and stand longevity can be reduced).

PLANTING DATE: Early spring; late summer by mid-August possible with irrigation.

WEED CONTROL:

**During Establishment:** If possible, plant in a field where weeds have been controlled by summer fallow or a broad spectrum herbicide during the previous 1 to 2 years. Wait until 3 to 5 leaf stage before applying herbicides at lower rates; clipping or bromoxynil according to label directions.

**Established Stand:** Bromoxynil, 2,4-D, dicamba and/or cultivation and hand roguing.
(**Note:** These products may not be registered on this grass species in your state or province).

FERTILIZATION:

**During Establishment:** Dryland and irrigated – apply phosphorus according to forage production rate and enough for 3 years. No nitrogen until seedlings are established or drill 50 lbs/acre (56 kg/ha) of 11-48-0 with seed. After seedlings are established, apply 30 lbs/acre (34 kg/ha) of nitrogen for dryland and 60 to 80 lbs/acre (67 to 89 kg/ha) of nitrogen for irrigated. On dryland, fallow the year before seeding.

**Established Stand:** Apply nitrogen each fall – dryland, 30 lbs/acre (34 kg/ha); irrigated, 60 to 80 lbs/acre (67 to 90 kg/ha).

IRRIGATION:

**During Establishment:** Apply enough water to get the stand established. Keep surface moist to avoid crusting. Bring soil moisture up to field capacity in early September.

**Established Stand:** Irrigate after harvest to promote vegetative production. Bring moisture level up to field capacity by early September. Irrigate in spring through the boot stage if rainfall does not provide sufficient moisture for continued plant growth (soil moisture should be above 50 per cent field capacity). Do not irrigate during flowering (pollination), but good soil moisture is essential during the early phase of seed development. Do not irrigate during seed ripening.
(**Note:** Never allow plants to be moisture stressed while floral primordia or immature seedheads are forming).

HARVEST:

**Average date at Bridger, MT:** Mid-July (Range of harvest dates: Mid to late July)
**Lodging:** No
**Shattering:** Yes
**Stripping:** N/A
**Direct Combine:** Satisfactory
Stage: Mature seed stage.

Ground speed: Dependent on stand, seed quantity and size of harvesting equipment. Adequate rate of feed and speed to ensure machine is operating at full capacity without overloading the cylinder and sieves.

**Swathing/Windrowing:** Preferred

Stage: Hard dough.

Ground speed: As described for direct combining.

**Days in Windrow:** 4 days.

**Combine Settings:**

Air flow setting: No more than 5 per cent filled seed going out back of combine.

Cylinder speed: Fast enough to thresh seeds and not crack caryopsis or kernels.

Cylinder spacing: Closed enough to thresh seed, but limited breakage of stems and seeds.

**Average Dockage of Harvested Seed:** 30 per cent; Actually depends on type of sieve and settings (Peterson Sieve recommended).

PRECLEANING TREATMENT/STORAGE:

**Drying:** Usually not necessary (not to exceed 104° F or 40° C).

Swathed: Usually not necessary.

Direct Combined: May require some drying dependent on trash.

**Safe Storage Moisture Content:**

Bins: 12 per cent

Sacks: 15 per cent

PROCESSING:

**Debearding:** No

**Scalping:** No

**Final cleaning:**

Top screen: 12/64" (0.47 cm).

Bottom screen: 6 x 24 mesh.

Fan speed: Set so that less than 5 per cent filled seed is blown out with chaff.

SEED YIELD:

**Irrigated:** Average, 100 to 200 lbs/acre (112 to 224 kg/ha).

**Dryland:** Average, 100 or less (112 or less kg/ha).

POST-HARVEST MANAGEMENT:

**During Establishment:** See information on fertilizing and irrigating.

**Established Stand:** See information on fertilizing and irrigating. Graze lightly or cut for hay in late fall after a killing frost.

EXPECTED PRODUCTIVE STAND LIFE: 4 years

# Beardless wildrye *(Leymus triticoides* [Buckley] Pilger; formerly *Elymus triticoides)*

SEED WEIGHT: 175,000/lb. (385,000/kg)

SEEDING RATE: (Pure live seed)
25 to 30 seeds per linear foot of row.
82 to 100 seeds per meter of row.

3.7 lbs/acre (4.2 kg/ha) for 24" (60 cm) rows.
Multiply x 2.0 for 12" (30 cm) rows or x 0.75 for 36" (90 cm) rows.

ROW SPACING: 24" (60 cm) Irrigated or high rainfall areas.
36" (90 cm) Dryland areas.
(**Note:** Narrower row spacings are sometimes used without interrow cultivation, but seed yields and stand longevity can be reduced).

PLANTING DATE: Fall dormant just prior to freeze up.

WEED CONTROL:

**During Establishment:** If possible, plant in a field where weeds have been controlled by summer fallow or a broad spectrum herbicide during the previous 1 to 2 years. Wait until 3 to 5 leaf stage before applying herbicides at lower rates; clipping or bromoxynil according to label directions.

**Established Stand:** Bromoxynil, metribuzin (Sencor), 2,4-D, dicamba and/or cultivation and hand roguing. (**Note:** These products may not be registered on this grass species in your state or province).

FERTILIZATION:

**During Establishment:** Apply phosphorus according to forage production rate and enough for 3 years. No nitrogen until seedlings are established or drill 50 lbs/acre (56 kg/ha) of 11-48-0 with seed. After seedlings are established, apply 60 to 80 lbs/acre (67 to 90 kg/ha) of nitrogen per acre.

**Established Stand:** Apply nitrogen each fall at a rate of 60 to 100 lbs/acre (67 to 112 kg/ha).

IRRIGATION:

**During Establishment:** Apply enough water to get the stand established. Keep surface moist to avoid crusting. Bring soil moisture up to field capacity in early September.

**Established Stand:** Irrigate after harvest to promote vegetative production. Bring moisture level up to field capacity by early September. Irrigate in spring through the boot stage if rainfall does not provide sufficient moisture for continued plant growth (soil moisture should be above 50 per cent field capacity). Do not irrigate during flowering (pollination), but good soil moisture is essential during the early phase of seed development. Do not irrigate during seed ripening.
(**Note:** Never allow plants to be moisture stressed while floral primordia or immature seedheads are forming).

HARVEST:

**Range of harvest dates at Bridger, MT:** Early to late August.
**Lodging:** Yes
**Shattering:** No
**Stripping:** N/A
**Direct Combine:** Satisfactory

| | |
|---|---|
| Stage: | Mature seed stage. |
| Ground speed: | Dependent on stand, seed quantity and size of harvesting equipment. Adequate rate of feed and speed to ensure machine is operating at full capacity without overloading the cylinder and sieves. |

**Swathing/Windrowing:** Preferred

| | |
|---|---|
| Stage: | Hard dough. |

## Beardless wildrye continued

Ground speed: As described for direct combining.
Days in Windrow: 7 to 10 days

**Combine Settings:**

Air flow setting: No more than 5 per cent filled seed going out back of combine.
Cylinder speed: Fast enough to thresh seeds and not crack caryopsis or kernels.
Cylinder spacing: Closed enough to thresh seeds, but limited breakage of stems and seeds.

**Average Dockage of Harvested Seed:** 10 per cent; Actually depends on type of sieve and settings (Peterson Sieve recommended).

**Other harvest recommendations:** Retains seed very well, can postpone harvesting if necessary.

PRECLEANING TREATMENT/STORAGE:

**Drying:** Usually not necessary (not to exceed 104° F or 40° C).

**Safe Storage Moisture Content:**

Bins: 12 per cent
Sacks: 15 per cent

PROCESSING:

**Debearding:** No

**Scalping:** No

**Final cleaning:**

Top screen: 9/64" (0.35 cm) followed by 1/14" x 1/2" (0.18 x 1.25 cm) slotted.
Bottom screen: 6 x 22 mesh.

SEED YIELD:

**Irrigated:** Average, 100 to 200 lbs/acre (112 to 224 kg/ha).

**Dryland:** N/A

POSTHARVEST MANAGEMENT:

**During Establishment:** See information on fertilizing and irrigating.

**Established Stand:** See information on fertilizing and irrigating. Graze lightly or cut for hay in late fall after a killing frost.

EXPECTED PRODUCTIVE STAND LIFE: 5 years

# Big bluestem (*Andropogon gerardii* Vitman)

SEED WEIGHT: 165,000/lb. (364,000/kg)
190,000/lb. (419,000/kg) - Debearded

SEEDING RATE: (Pure live seed)
30 seeds per linear foot of row.
98 seeds per meter of row.

4.1 lbs/acre (4.6 kg/ha) for 24" (60 cm) rows.
Multiply x 2.0 for 12" (30 cm) rows or x 0.75 for 36" (90 cm) rows.

ROW SPACING: 24 to 36" (60 to 90 cm) Irrigated or high rainfall areas.
36 to 45" (90 to 114 cm) Dryland areas.
(**Note:** Narrower row spacings are sometimes used without interrow cultivation, but seed yields and stand longevity can be reduced).

PLANTING DATE: Late spring (May) to early summer (June).

WEED CONTROL:

**During Establishment:** If possible, plant in a field where weeds have been controlled by summer fallow or a broad spectrum herbicide during the previous 1 to 2 years. Wait until 3 to 5 leaf stage before applying herbicides at lower rates; clipping, cultivation, bromoxynil, 2,4-D and/or atrazine.

**Established Stand:** Atrazine and/or hand roguing and cultivation.
(**Note:** These products may not be registered on this grass species in your state or province).

FERTILIZATION:

**During Establishment:** Not recommended.

**Established Stand:** Apply nitrogen at 60 to 100 lbs/acre (67 to 112 kg/ha) in late spring. Apply phosphorus and potassium according to soil test recommendations.

IRRIGATION:

**During Establishment:** Apply enough water to get the stand established. Keep surface moist to avoid crusting. Bring soil moisture up to field capacity in early September.

**Established Stand:** Bring moisture level up to field capacity by early September. Irrigate in spring through the boot stage if rainfall does not provide sufficient moisture for continued plant growth (soil moisture should be above 50 per cent field capacity). Do not irrigate during flowering (pollination), but good soil moisture is essential during the early phase of seed development. Do not irrigate during seed ripening.
(**Note:** Never allow plants to be moisture stressed while floral primordia or immature seedheads are forming).

HARVEST:

**Range of harvest dates at Bismarck, ND:** September 15 to 30.

**Lodging:** Only occasionally.

**Shattering:** Moderate

**Stripping:** Satisfactory

| | |
|---|---|
| Stage: | Hard dough to mature seed. |
| Brush speed: | 600 to 900 rpm |

**Direct Combine:** Preferred

| | |
|---|---|
| Stage: | Medium to hard dough. |
| Ground speed: | Dependent on stand, seed quantity and size of harvesting equipment. Adequate rate of feed and speed to ensure machine is operating at full capacity without overloading the cylinder and sieves. |

## Big bluestem continued

**Swathing/Windrowing:** Satisfactory
- Stage: Soft/medium dough.
- Ground speed: As described for direct combining.

**Days in Windrow:** 3 to 5 days.

**Combine Settings:**
- Air flow setting: Low to completely closed.
- Cylinder speed: 800 to 1,000 rpm.
- Cylinder spacing: 1/8 to 1/2" (0.31 - 0.63 cm).

**Average Dockage of Harvested Seed:** 20 to 40 per cent

**Other harvest recommendations:** Recommend direct combine with straw chopper.

PRECLEANING TREATMENT/STORAGE:

**Drying:** Often required (not to exceed 104° F or 40° C).
- Swathed: Usually not necessary.
- Direct Combined: Several days, depending on humidity.
- Stripped: Several days, depending on humidity.

**Safe Storage Moisture Content:**
- Bins: 12 per cent
- Sacks: 15 per cent

PROCESSING:

**Scalping:** Yes, Clipper 4 screen fanning mill.
- Top screens: No.1 = #12; No.2 = #11.
- Bottom screens: No.3 = #10; No.4 = #9 triangle, 3" (7.5 cm) open.
- Fan speed: 156 rpm
- Shake speed: 408 rpm

**Debearding:** Yes
- Debearder:
  - Speed: 218 rpm
  - Duration: 45 minutes

**Final cleaning:** Clipper 4 screen fanning mill.
- Top screens: No.1 = #12; No.2 = #11.
- Bottom screens: No.3 = #10; No.4 = #9 triangle, 3" (7.5 cm) open.
- Fan speed: 200 rpm
- Shake speed: 408 rpm

**Special processing equipment, techniques or other considerations:**
- Order of cleaning: 4 screen fanning mill; Debearder; 4 screen fanning mill.

SEED YIELD:

**Irrigated:** Average, 200 lbs/acre (224 kg/ha).
Range, 100 to 300 lbs/acre (112 to 336 kg/ha).

**Dryland:** Average, 100 lbs/acre (112 kg/ha).
Range, 50 to 200 lbs/acre (56 to 224 kg/ha).

POSTHARVEST MANAGEMENT:

**During Establishment:** See information on fertilizing and irrigating.

**Established Stand:** See information on fertilizing and irrigating. Rotary mow and roto-till or cultivate between rows in the fall or spring; or burn immediately after harvest or in spring before regrowth.

EXPECTED PRODUCTIVE STAND LIFE: 10 to 15 years

ADDITIONAL COMMENTS: A small, orange midge is known to infest big bluestem fields and can significantly reduce seed yields. The midge is found in individual florets.

# Bluebunch wheatgrass *(Pseudoroegneria spicata* subsp. *spicata* [Pursh] A. Love; formerly *Elytrigia spicatum*; formerly *Agropyron spicatum*)

SEED WEIGHT: 140,000/lb. (308,000/kg)

SEEDING RATE: (Pure live seed)
25 to 30 seeds per linear foot of row.
82 to 100 seeds per meter of row.

4.6 lbs/acre (5.2 kg/ha) for 24" (60 cm) rows.
Multiply x 2.0 for 12" (30 cm) rows or x 0.75 for 36" (90 cm) rows.

ROW SPACING: 24" (60 cm) Irrigated or high rainfall areas.
36" (90 cm) Dryland areas.
(**Note:** Narrower row spacings are sometimes used without interrow cultivation, but seed yields and stand longevity can be reduced).

PLANTING DATE: Early in spring or late summer by mid-August (with irrigation).

WEED CONTROL:

**During Establishment:** If possible, plant in a field where weeds have been controlled by summer fallow or a broad spectrum herbicide during the previous 1 to 2 years. Wait until 3 to 5 leaf stage before applying herbicides at lower rates; clipping or bromoxynil according to label directions.

**Established Stand:** Bromoxynil, 2,4-D, dicamba and/or cultivation and hand roguing.
(**Note:** These products may not be registered on this grass species in your state or province).

FERTILIZATION:

**During Establishment:** Dryland and irrigated – apply phosphorus according to forage production rate and enough for 3 years. No nitrogen until seedlings are established or drill 50 lbs/acre (56 kg/ha) of 11-48-0 with seed. After seedlings are established, apply 30 lbs/acre (34 kg/ha) of nitrogen for dryland and 60 to 80 lbs/acre (67 to 90 kg/ha) of nitrogen for irrigated. On dryland, fallow the year before seeding.

**Established Stand:** Apply nitrogen each fall – dryland, 30 lbs/acre (34 kg/ha); irrigated, 60 to 80 lbs/acre (67 to 90 kg/ha)

IRRIGATION:

**During Establishment:** Apply enough water to get the stand established. Keep surface moist to avoid crusting. Bring soil moisture up to field capacity in early September.

**Established Stand:** Irrigate after harvest to promote vegetative production. Bring moisture level up to field capacity by early September. Irrigate in spring through the boot stage if rainfall does not provide sufficient moisture for continued plant growth (soil moisture should be above 50 per cent field capacity). Do not irrigate during flowering (pollination), but good soil moisture is essential during the early phase of seed development. Do not irrigate during seed ripening.
(**Note:** Never allow plants to be moisture stressed while floral primordia or immature seedheads are forming).

HARVEST:

**Average date at Bridger, MT:** Mid-July.
**Lodging:** No
**Shattering:** Yes
**Stripping:** N/A
**Direct Combine:** Satisfactory.
Stage: Mature seed stage.

## Bluebunch wheatgrass continued

Ground speed: Dependent on stand, seed quantity and size of harvesting equipment. Adequate rate of feed and speed to ensure machine is operating at full capacity without overloading the cylinder and sieves.

**Swathing/Windrowing:** Preferred

Stage: Hard dough.

Ground speed: As described for direct combining.

**Days in Windrow:** 4 days.

**Combine Settings:**

Air flow setting: No more than 5 per cent filled seed going out back of combine.

Cylinder speed: Fast enough to thresh seeds and not crack caryopsis or kernels.

Cylinder spacing: Closed enough to do some debearding.

**Average Dockage of Harvested Seed:** 30 per cent; Actually depends on type of sieve and settings (Peterson Sieve recommended).

PRECLEANING TREATMENT/STORAGE:

**Drying:** Usually not necessary (not to exceed 104° F or 40° C).

Swathed: Usually not necessary.

Direct Combined: May require some drying depending on trash.

**Safe Storage Moisture Content:**

Bins: 12 per cent

Sacks: 15 per cent

PROCESSING:

**Debearding:** Yes

Barley debearder: Set to remove all awns without cracking caryopsis or kernels.

Hammer mill: Set to remove all awns without cracking caryopsis or kernels.

**Scalping:** No

**Final cleaning:**

Top screen: 12/64" (0.47 cm).

Bottom screen: 6 x 24 mesh.

Fan speed: Set so that less than 5 per cent filled seed is blown out with chaff.

SEED YIELD:

**Irrigated:** Average, 200 to 500 lbs/acre (224 to 560 kg/ha).

**Dryland:** Average, 100 to 400 lbs/acre (112 to 448 kg/ha).

POSTHARVEST MANAGEMENT:

**During Establishment:** See information on fertilizing and irrigating.

**Established Stand:** See information on fertilizing and irrigating. Graze lightly or cut for hay in late fall after a killing frost.

EXPECTED PRODUCTIVE STAND LIFE: 4 years

# Blue grama *(Bouteloua gracilis* [H.B.K.] Lag. ex Steud.)

SEED WEIGHT: 775,000/lb. (1,709,000/kg)

SEEDING RATE: (Pure live seed)
30 seeds per linear foot of row.
98 seeds per meter of row.

1 lb/acre (1.1 kg/ha) for 24 in. (60 cm) rows.
Multiply x 2.0 for 12" (30 cm) rows or x 0.75 for 36" (90 cm) rows.

ROW SPACING: 24 to 36" (60 to 90 cm) Irrigated or high rainfall areas.
36 - 48" (90 to 120cm) Dryland areas.
(**Note:** Narrower row spacings are sometimes used without interrow cultivation, but seed yields and stand longevity can be reduced).

PLANTING DATE: Late spring (May) to early summer (June).

WEED CONTROL:

**During Establishment:** If possible, plant in a field where weeds have been controlled by summer fallow or a broad spectrum herbicide during the previous 1 to 2 years. Wait until 3 to 5 leaf stage before applying herbicides at lower rates; clipping, cultivation, bromoxynil, 2,4-D. Do not use atrazine the year of establishment.

**Established Stand:** Atrazine, imazethapyr (Pursuit), 2,4-D and/or hand roguing and cultivation.
(**Note:** These products may not be registered on this grass species in your state or province).

FERTILIZATION:

**During Establishment:** Not recommended.

**Established Stand:** Apply nitrogen at 40 to 60 lbs/acre (44.8 to 67.2 kg/ha). Apply phosphorus and potassium according to soil test recommendations.

IRRIGATION:

**During Establishment:** Apply enough water to get the stand established. Keep surface moist to avoid crusting. Bring soil moisture up to field capacity in early September.

**Established Stand:** Bring moisture level up to field capacity by early September. Irrigate in spring through the boot stage if rainfall does not provide sufficient moisture for continued plant growth (soil moisture should be above 50 per cent field capacity). Do not irrigate during flowering (pollination), but good soil moisture is essential during the early phase of seed development. Do not irrigate during seed ripening.
(**Note:** Never allow plants to be moisture stressed while floral primordia or immature seedheads are forming).

HARVEST:

**Average date at Bismarck, ND:** September 15.

**Lodging:** None

**Shattering:** None

**Stripping:** Satisfactory

| | |
|---|---|
| Stage: | Hard dough to mature seed. |
| Brush speed: | 600 to 800 rpm |

**Direct Combine:** Preferred method.

| | |
|---|---|
| Stage: | Hard dough to mature seed. |
| Ground speed: | Dependent on stand, seed quantity and size of harvesting equipment. Adequate rate of feed and speed to ensure machine is operating at full capacity without overloading the cylinder and sieves. |

## Blue grama continued

**Swathing/Windrowing:** Satisfactory
- Stage: Medium to hard dough.
- Ground speed: As described for direct combining.

**Days in Windrow:** 2 to 4 days.

**Combine Settings:**
- Air flow setting: Closed
- Cylinder speed: 1200 rpm
- Cylinder spacing: 3/8 to 3/16" (0.94 to 0.47 cm).

**Average Dockage of Harvested Seed:** 30 per cent

PRECLEANING TREATMENT/STORAGE:

**Drying:** Often not necessary (not to exceed 104° F or 40° C).
- Swathed: No additional drying needed if allowed to dry in the field prior to harvest.
- Direct Combined: 3 to 5 days.
- Stripped: 1 to 2 days.

**Safe Storage Moisture Content:**
- Bins: 12 per cent
- Sacks: 15 per cent

PROCESSING:

**Debearding:** Yes
- Clipper debearder:
  - Speed: 290 rpm
  - Duration: 45 minute per batch.

**Scalping:** Clipper 4 screen fanning mill (top door removed).
- Top screens: No.1 = #12; No.2 = #11.
- Bottom screens: No.3 = #10; No.4 = #9 triangle, 3" (7.5 cm) open.
- Fan speed: 150 rpm
- Shake speed: 400 rpm

Seed which ran through the 4 screens were rerun at the following setting:

**Final cleaning:** Clipper 4 screen fanning mill (top door removed). Seed that runs through the 4 screens on the fanning mill.
- Top screens: No.1 = #12; No.2 = #11.
- Bottom screens: No.3 = #10; No.4 = #9 triangle, 1" (2.5 cm) open.
- Fan speed: 150 rpm
- Shake speed: 400 rpm

**Special processing equipment, techniques or other considerations:**
- Order of cleaning: Debearder, 4 screen fanning mill.

SEED YIELD:

**Irrigated:** Average, 150 lbs/acre (168 kg/ha).
Range, 100 to 300 lbs/acre (112 to 336 kg/ha).

**Dryland:** Average, 75 lbs/acre (84 kg/ha).
Range, 50 to 150 lbs/acre (56 to 168 kg/ha).

POSTHARVEST MANAGEMENT:

**During Establishment:** See information on fertilizing and irrigating.

**Established Stand:** See information on fertilizing and irrigating. Rotary mow if necessary, rototill or cultivate between rows in fall or spring or burning on a regular basis.

EXPECTED PRODUCTIVE STAND LIFE: 10 to 15 years

ADDITIONAL COMMENTS: Seed fill varies considerably from year to year. Mature seed holds on well and harvest may be delayed until early fall if necessary.

# California brome (*Bromus carinatus* Hook. & Arn.)

SEED WEIGHT: 103,700/lb. (228,000/kg)

SEEDING RATE: (Pure live seed)
25 to 30 seeds per linear foot of row.
82 to 100 seeds per meter of row.

5.3 lbs/acre (5.9 kg/ha) for 24 in. (60 cm) rows.
Multiply x 2.0 for 12" (30 cm) rows, x 0.875 for 30" (75 cm) rows or x 0.75 for 36" (90 cm) rows.

ROW SPACING: 30" (75 cm) Irrigated or high rainfall areas.
36" (90 cm) Dryland areas.
(**Note:** Narrower row spacings are sometimes used without interrow cultivation, but seed yields and stand longevity can be reduced).

PLANTING DATE: Early spring.

WEED CONTROL:

**During Establishment:** If possible, plant in a field where weeds have been controlled by summer fallow or a broad spectrum herbicide during the previous 1 to 2 years. Wait until 3 to 5 leaf stage before applying herbicides at lower rates; Treat with 2,4-D, MCPA, bromoxynil and/or cultivation and clipping.

**Established Stand:** Treat with 2,4-D, MCPP, Buctril and/or cultivation and hand roguing.
(**Note:** These products may not be registered on this grass species in your state or province).

FERTILIZATION:

**During Establishment:** Not recommended often added fertilizer only encourages weed growth.

**Established Stand:** 250 lbs/acre (280 kg/ha) 16-20-0 as a perennial. No fertilizer if grown as an annual.

IRRIGATION:

**During Establishment:** Apply enough water to get the stand established. Keep surface moist to avoid crusting. Bring soil moisture up to field capacity in the fall. In California, irrigate every 14 to 21 days during late spring and summer with 6 acre inches/irrigation.

**Established Stand:** In California, irrigate every 21 days during late spring to early summer (up to harvest) with 6 acre inches/irrigation. In the northern Great Plains, irrigate in spring through the boot stage if rainfall does not provide sufficient moisture for continued plant growth (soil moisture should be above 50 per cent field capacity). Do not irrigate during flowering (pollination), but good soil moisture is essential during the early phase of seed development. Do not irrigate during seed ripening.
(**Note:** Never allow plants to be moisture stressed while floral primdia or immature seedheads are forming. Irrigate after harvest to promote vegetative production. Bring moisture level up to field capacity by early September.)

HARVEST:

**Range of harvest dates at Lockeford, CA:** June to July depending on planting date.
**Lodging:** None to slight.
**Shattering:** None to slight.
**Stripping:** N/A
**Direct Combine:** Preferred

| | |
|---|---|
| Stage: | Hard dough to mature seed stage. |
| Ground speed: | 3 mph (4.9 km/h). |

## California brome continued

**Swathing/Windrowing:** Only satisfactory.
Stage: Hard dough.
**Combine Settings:**
Air flow setting: Slow
Cylinder speed: 600 rpm
Cylinder spacing: Small grain.
**Average Dockage of Harvested Seed:** 55 per cent

PRECLEANING TREATMENT/STORAGE:
**Drying:** Usually not required (not to exceed 104° F or 40° C).
Swathed: Not required.
Direct Combined: May be required if trashy.
**Safe Storage Moisture Content:**
Bins: 12 per cent
Sacks: 15 per cent

PROCESSING:
**Debearding:** Yes
Hammer mill:
Speed: 800 rpm - hammer once.
Screen: 1/4" (0.63 cm).
**Scalping:** Yes
Top screen: 1/12" x 1/2" (0.21 x 1.25 cm)
Middle screen: 1/16" x 1/4" (0.16 x 0.63 cm)
Bottom screen: 1/20" (0.13 cm)
Fan speed: 400 rpm
Air flow: 40 to 50 per cent
**Final cleaning:**
Top screen: 1/12" (0.21 cm)
Middle screen: #7
Bottom screen: Blank
Fan speed: 400 rpm
Air flow: 40 to 50 per cent

SEED YIELD:
**Irrigated:** Average
**Dryland:** Average, 250 lbs/acre (280 kg/ha).

POSTHARVEST MANAGEMENT:
**During Establishment:** See information on fertilizing and irrigating.
**Established Stand:** See information on fertilizing and irrigating. Remove residue following harvest.

EXPECTED PRODUCTIVE STAND LIFE: 1 to 4 years

# Canada wildrye (*Elymus canadensis* L.)

SEED WEIGHT: 115,000/lb. (254,000/kg)

SEEDING RATE: (Pure live seed)
30 seeds per linear foot of row.
98 seeds per meter of row.

5.7 lb/acre (6.4 kg/ha) for 24 in. (60 cm) rows.
Multiply x 2.0 for 12" (30 cm) rows or x 0.75 for 36" (90 cm) rows.

ROW SPACING: 24 to 36" (60 to 90 cm) Irrigated or high rainfall areas.
36 to 48" (90 to 120cm) Dryland areas.
(**Note:** Narrower row spacings are sometimes used without interrow cultivation, but seed yields and stand longevity can be reduced).

PLANTING DATE: Spring (April to May), late summer (August to September) or dormant seeding (November to March).

WEED CONTROL:

**During Establishment:** If possible, plant in a field where weeds have been controlled by summer fallow or a broad spectrum herbicide during the previous 1 to 2 years. Wait until 3 to 5 leaf stage before applying herbicides at lower rates; clipping, cultivation, bromoxynil, 2,4-D.

**Established Stand:** 2,4-D and/or hand roguing and cultivation.
(**Note:** These products may not be registered on this grass species in your state or province).

FERTILIZATION:

**During Establishment:** Not recommended.

**Established Stand:** Apply nitrogen at 40 to 60 lbs/acre (45 to 67 kg/ha). Apply phosphorus and potassium according to soil test recommendations.

IRRIGATION:

**During Establishment:** Apply enough water to get the stand established. Keep surface moist to avoid crusting. Bring soil moisture up to field capacity in early September.

**Established Stand:** Irrigate after harvest to promote vegetative production. Bring moisture level up to field capacity by early September. Irrigate in spring through the boot stage if rainfall does not provide sufficient moisture for continued plant growth (soil moisture should be above 50 per cent field capacity). Do not irrigate during flowering (pollination), but good soil moisture is essential during the early phase of seed development. Do not irrigate during seed ripening.
(**Note:** Never allow plants to be moisture stressed while floral primordia or immature seedheads are forming).

HARVEST:

**Average date at Bismarck, ND:** August 15.
**Lodging:** May be a problem.
**Shattering:** Some
**Stripping:** N/A
**Direct Combine:** Satisfactory

| | |
|---|---|
| Stage: | Hard dough. |
| Ground speed: | Dependent on stand, seed quantity and size of harvesting equipment. Adequate rate of feed and speed to ensure machine is operating at full capacity without overloading the cylinder and sieves. |

**Swathing/Windrowing:** Preferred method.

| | |
|---|---|
| Stage: | Hard dough |
| Ground speed: | As described for direct combining. |

## Canada wildrye continued

**Days in Windrow:** 2 days.
**Combine Settings:**
Air flow setting: Low
Cylinder speed: 1000 to 1200 rpm
Cylinder spacing: 3/8" (0.94 cm).
**Average Dockage of Harvested Seed:** 30 to 40 per cent
**Other harvest recommendations:** Swathing and drying in windrow before combining works best.

PRECLEANING TREATMENT/STORAGE:
**Drying:** May be required (not to exceed 104° F or 40° C).
Swathed: Usually not necessary.
Direct Combined: Seed needs to be dried for several days.
**Safe Storage Moisture Content:**
Bins: 12 per cent
Sacks: 15 per cent

PROCESSING:
**Debearding:**
Clipper debearder:
Speed: 225 rpm
Duration: 10 minutes
Other equipment: Indent cylinder cleaner.
**Scalping:** Clipper 4 screen fanning mill; top door 4" (10 cm) open.
Top screens: No.1 = 1/13 x 1/2" (0.20 x 1.27 cm); No.2 = 1/14 x 1/2" (0.18 x 1.27 cm).
Bottom screens: No.3 = 1/14 x 1/4" (0.18 x 0.63 cm); No.4 = #9 triangle, 3" (7.5 cm) open.
Fan speed: 250 rpm
Shake speed: 380 rpm
Comments: Light seed and small seed should be run back through with less air.
**Final cleaning:** Clipper 4 screen fanning mill, top door 4" (10 cm) open.
Top screens: No.1 = 1/13 x 1/2" (0.20 x 0.63 cm); No.2 = 1/14 x 1/2" (0.18 x 0.63 cm).
Bottom screens: No.3 = 1/14 x 1/4" (.071 x .25 cm); #4 = 9 triangle, 1" (2.5 cm) open.
Fan speed: 220 rpm
Shake speed: 380 rpm
Comments: Clean seed from No. 4 was run through 2 disc cleaner (V discs 4 1/2).
**Special processing equipment, techniques or other considerations:**
Order of cleaning: Debearder, 4 screen fanning mill, 2 disc indent cleaner.

SEED YIELD:
**Irrigated:** Average, 700 lbs/acre (784 kg/ha).
Range, 400 to 1100 lbs/acre (448 to 1232 kg/ha).
**Dryland:** Average, 250 lbs/acre (280 kg/ha).
Range, 150 to 300 lbs/acre (168 to 336 kg/ha).

POSTHARVEST MANAGEMENT:
**During Establishment:** See information on fertilization and irrigating.
**Established Stand:** Rotary mow and rototill or cultivate between rows in the fall or spring.

EXPECTED PRODUCTIVE STAND LIFE: 3 to 5 years

# Canby bluegrass (*Poa canbyi* [Scribn.] Piper)

SEED WEIGHT: 925,000/lb. (203,500/kg)

SEEDING RATE: (Pure live seed)
60 to 80 seeds per linear foot of row.
200 to 260 seeds per meter of row.

2 lbs/acre (2.2 kg/ha) for 24" (60 cm) rows.
Multiply x 2.0 for 12" (30 cm) rows or x 0.75 for 36" (90 cm) rows.

ROW SPACING: 24" (60 cm) Irrigated or high rainfall areas.
36" (90 cm) Dryland areas.
(**Note:** Narrower row spacings are sometimes used without interrow cultivation, but seed yields and stand longevity can be reduced).

PLANTING DATE: Mid to late April (Pullman, WA)

WEED CONTROL:

**During Establishment:** If possible, plant in a field where weeds have been controlled by summer fallow or a broad spectrum herbicide during the previous 1 to 2 years. Wait until 3 to 5 leaf stage before applying herbicides at lower rates; Bromoxynil, MCPA Amine after tillering, clipping and/or between row cultivation.

**Established Stand:** MCPA Amine (may be mixed w/4oz/acre of dicamba) and/or cultivation and handroguing.
(**Note:** These products may not be registered on this grass species in your state or province).

FERTILIZATION:

**During Establishment:** Not recommended.

**Established Stand:** 60 lbs/acre (67.2 kg/ha) nitrogen, fall applied.

IRRIGATION: None.

**During Establishment:** Apply enough water to get the stand established. Keep surface moist to avoid crusting. Bring soil moisture up to field capacity in early September.

**Established Stand:** Irrigate in spring through the boot stage if rainfall does not provide sufficient moisture for continued plant growth (soil moisture should be above 50 per cent field capacity). Do not irrigate during flowering (pollination), but good soil moisture is essential during the early phase of seed development. Do not irrigate during seed ripening.
(**Note:** Never allow plants to be moisture stressed while floral primordia or immature seedheads are forming. Irrigate after harvest to promote vegetative production. Bring moisture level up to field capacity by early September).

HARVEST:

**Average date at Pullman, WA:** June 25.
**Lodging:** No
**Shattering:** 5 per cent by hard dough stage.
**Stripping:** N/A
**Direct Combine:** Not recommended.
**Swathing/Windrowing:** Preferred

| | |
|---|---|
| Stage: | Hard dough |
| Ground speed: | Dependent on stand, seed quantity and size of harvesting equipment. Adequate rate of feed and speed to ensure machine is operating at full capacity without overloading the cylinder and sieves. |
| **Days in Windrow:** | 5 to 7 days. |

## Canby bluegrass continued

**Combine Settings:**

| | |
|---|---|
| Air flow setting: | 325 to 400 with fan openings 1/2 blocked. |
| Cylinder speed: | 1000 rpm |
| Cylinder spacing: | 1 to 1/2" (2.5 to 3.75 cm). |

**Average Dockage of Harvested Seed:** 40 to 55 per cent clean seed.

PRECLEANING TREATMENT/STORAGE:

**Drying:** Not required (not to exceed 104° F or 40° C).

**Safe Storage Moisture Content:**

Bins: 12 per cent

Sacks: 15 per cent

PROCESSING:

**Debearding:** Yes

| | |
|---|---|
| Hammer mill: | 6/64 screen |
| Speed: | 580 rpm |

**Scalping:** Yes

| | |
|---|---|
| Top screen: | #6 |
| Bottom screen: | Blank |
| Shake speed: | 420 to 440 rpm |

**Final cleaning:**

| | |
|---|---|
| Top screen: | 1/12" (0.21 cm). |
| Middle screen: | 3/64" x 5/16" (0.12 x 0.79 cm). |
| Bottom screen: | 6 x 40 |
| Fan speed: | 110 rpm |
| Shake speed: | 400 rpm |

**Special processing equipment, techniques or other considerations:**

Debearding or hammermilling can cause problems with lint. Use of hammer mill should be reserved for problem seedlots.

SEED YIELD:

**Irrigated:** Average

**Dryland:** Average, 150 lbs/acre (168 kg/ha) clean seed.
Range, 80 to 220 lbs/acre (89 to 246 kg/ha).

POSTHARVEST MANAGEMENT:

**During Establishment:** See information on irrigating and fertilizing. No harvest during establishment year.

**Established Stand:** See information on irrigating and fertilizing. Bale and remove residue. Control weeds as needed. Fall fertilize.

EXPECTED PRODUCTIVE STAND LIFE: 7 to 8 years.

ADDITIONAL COMMENTS: Fall moisture essential for seed yield following year.

# Early bluegrass or Muttongrass (*Poa fendleriana* [Steud.] Vasey or *cusickii*)

SEED WEIGHT: 890,000/lb. (1,958,000/kg)

SEEDING RATE: (Pure live seed)
36 seeds per linear foot of row.
120 seeds per meter of row.

0.9 lb/acre (1.0 kg/ha) for 24 in. (60 cm) rows.
Multiply x 2.0 for 12" (30 cm) rows or x 0.75 for 36" (90 cm) rows.

ROW SPACING: 24 to 36" (60 to 90 cm) Irrigated or high rainfall areas.
36" (90 cm) Dryland areas.
(**Note:** Narrower row spacings are sometimes used without interrow cultivation, but seed yields and stand longevity can be reduced).

PLANTING DATE: Early spring.

WEED CONTROL:

**During Establishment:** If possible, plant in a field where weeds have been controlled by summer fallow or a broad spectrum herbicide during the previous 1 to 2 years. Wait until 3 to 5 leaf stage before applying herbicides at lower rates; May require 2 years for stand to develop. Weed control is difficult for first 2 years and may require hand weeding/roguing.

**Established Stand:** Several broadleaf herbicides can be used for broadleaf weeds and hand weed for grasses. (**Note:** These products may not be registered on this grass species in your state or province).

FERTILIZATION:

**During Establishment:** Apply phosphorus according to soil test recommendation. Needs 30 lbs/acre (34 kg/ha) of available nitrogen based on soil test.

**Established Stand:** Determine soil fertility level. Needs approximately 45 lbs/acre (50 kg/ha) of available nitrogen.

IRRIGATION:

**During Establishment:** Apply enough water to get the stand established. Keep surface moist to avoid crusting. Bring soil moisture up to field capacity in early September.

**Established Stand:** Usually no more than one early spring irrigation.Irrigate in spring through the boot stage if rainfall does not provide sufficient moisture for continued plant growth (soil moisture should be above 50 per cent field capacity). Do not irrigate during flowering (pollination), but good soil moisture is essential during the early phase of seed development. Do not irrigate during seed ripening.
(**Note:** Never allow plants to be moisture stressed while floral primdia or immaturmature seedheads are forming. Irrigate after harvest to promote vegetative production. Bring moisture level up to field capacity by early September).

HARVEST:

**Average date at Meeker, CO:** June 1.
Range of harvest dates: May 25 to June 25.
**Lodging:** No
**Shattering:** Can be a problem.
**Stripping:** N/A
**Swathing:** N/A
**Direct Combine:** Preferred
Stage: At 10 per cent shatter.
Ground speed: Maintain even flow of material.

## Early bluegrass or Muttongrass continued

**Combine Settings:**

| | |
|---|---|
| Air flow setting: | Low |
| Cylinder speed: | 800 rpm |
| Cylinder spacing: | Close |

**Average Dockage of Harvested Seed:** N/A

PRECLEANING TREATMENT/STORAGE:

**Drying:** Yes (not to exceed 104° F or 40° C).
Direct Combined: Requires drying for several days.

**Safe Storage Moisture Content:**
Bins: Approx. 10 per cent.
Sacks: Approx. 10 per cent.

PROCESSING:

**Debearding:** Usually not needed.
Hammer mill: Sometimes helpful; only light (350 to 450 rpm) to break up intact heads.

**Scalping:** Usually not required.

**Final cleaning:**

| | |
|---|---|
| Top screen: | #6 |
| Bottom screen: | 1/25" (0.10 cm) |

SEED YIELD:

**Irrigated:**
Average,35 lbs/acre (39 kg/ha) clean seed.
Range, 25 to 75 lbs/acre (28 to 84 kg/ha) clean seed.

**Dryland:**
Average, No experience.
Range,

POSTHARVEST MANAGEMENT:

**During Establishment:** See information on fertilizing and irrigating.
**Established Stand:** See information on fertilizing, irrigation and weed control.

EXPECTED PRODUCTIVE STAND LIFE: Approximately 8 years.

ADDITIONAL COMMENTS: Our experience indicates considerable difference in seed production from year to year. For optimum harvest, only a short window of opportunity exists.

# Green needlegrass (*Nassella viridula* [Trin.] Barkworth; formerly *Stipa viridula*)

SEED WEIGHT: 168,000/lb. (370,000/kg)

SEEDING RATE: (Pure live seed)
25 to 30 seeds per linear foot of row.
82 to 100 seeds per meter of row.

3.6 lb/acre (4 kg/ha) for 24" (60 cm) rows.
Multiply x 2.0 for 12" (30 cm) rows or x 0.75 for 36" (90 cm) rows.

ROW SPACING: 30 to 36" (75 to 90 cm) Irrigated or high rainfall areas.
36" (90 cm) Dryland areas.
(**Note:** Narrower row spacings are sometimes used without interrow cultivation, but seed yields and stand longevity can be reduced).

PLANTING DATE: Spring, late summer, or dormant fall seeded just prior to freeze up.

WEED CONTROL:

**During Establishment:** If possible, plant in a field where weeds have been controlled by summer fallow or a broad spectrum herbicide during the previous 1 to 2 years. Wait until 3 to 5 leaf stage before applying herbicides at lower rates; clipping or bromoxynil according to label directions.

**Established Stand:** Bromoxynil, 2,4-D, dicamba and/or cultivation and hand roguing.
(**Note:** These products may not be registered on this grass species in your state or province).

FERTILIZATION:

**During Establishment:** Dryland and irrigated – apply phosphorus according to forage production rate and enough for 3 years. No nitrogen until seedlings are established or drill 50 lbs/acre (56 kg/ha) of 11-48-0 with seed. After seedlings are established, apply 30 lbs/acre (34 kg/ha) of nitrogen for dryland and 60 to 80 lbs/acre (67 to 90 kg/ha) of nitrogen for irrigated. On dryland, fallow the year before seeding.

**Established Stand:** Apply nitrogen each year – dryland, 30 lbs/acre (34 kg/ha); irrigated, 60 to 80 lbs/acre (67 to 90 kg/ha).

IRRIGATION:

**During Establishment:** Apply enough water to get the stand established. Keep surface moist to avoid crusting. Bring soil moisture up to field capacity in early September.

**Established Stand:** Irrigate after harvest to promote vegetative production. Bring moisture level up to field capacity by early September. Irrigate in spring through the boot stage if rainfall does not provide sufficient moisture for continued plant growth (soil moisture should be above 50 per cent field capacity). Do not irrigate during flowering (pollination), but good soil moisture is essential during the early phase of seed development. Do not irrigate during seed ripening.
(**Note:** Never allow plants to be moisture stressed while floral primordia or immature seedheads are forming).

HARVEST:

**Average date at Bridger, MT:** Late June to early July.
Range of harvest dates: June 20 to July 10 (Bridger, MT and Bismarck, ND).

**Lodging:** No

**Shattering:** Yes, High.

**Stripping:** Preferred

Stage: When majority of seedheads are black or at first sign of shattering at top on inflorescence.

## Green needlegrass continued

Brush speed: Varies by number of seedheads, excessive rpm dislodges immature seeds. Approx. 800 rpm.

Ground speed: Thicker the stand, slower the ground speed. Thinner the stand, faster ground speed.

**Direct Combine:** Not recommended.

**Swathing/Windrowing:** Satisfactory

Stage: Hard dough.

Ground speed: Dependent on stand, seed quantity and size of harvesting equipment. Adequate rate of feed and speed to ensure machine is operating at full capacity without overloading the cylinder and sieves.

**Days in Windrow:** 7 to 10 days

**Combine Settings:**

Air flow setting: Low, no more than 5 per cent filled seed going out back of combine.

Cylinder speed: 900 to 1200 rpm; Fast enough to thresh seeds and not to crack caryopsis or kernels.

Cylinder spacing: 3/8" (0.94 cm) or Closed enough to thresh seeds, but limited breakage of stems and seeds.

**Average Dockage of Harvested Seed:** 30 to 60 per cent; actually depends on the type of sieve and settings (Peterson Sieve recommended). Stripping is about 20 per cent.

**Other harvest recommendations:** Field may be stripped several times since seed ripens unevenly.

PRECLEANING TREATMENT/STORAGE:

**Drying:** Yes (not to exceed 104° F or 40° C).

Swathed: Usually not necessary.

Direct Combined: May require some drying if trashy.

**Stripped:** Yes - Needs to be dried several days before bagging.

**Safe Storage Moisture Content:**

Bins: 12 per cent

Sacks: 15 per cent

PROCESSING:

**Debearding:** Yes

Barley debearder:Set to remove all awns without cracking caryopsis or kernels.

Hammer mill: Set to remove all awns without cracking caryopsis or kernels.

Speed: Slow

Duration: Approx. 20 minutes.

Details: 1/4" (0.63 cm) screen; slow speed; full rate of feed; second run 1/8" (0.31 cm) screen.

**Scalping:** Not always necessary; If required: Clipper 4 screen fanning mill with top door open 4" (10 cm).

Top screens: #12 and #11.

Bottom screens: #10 and #9 triangle, 3" (7.5 cm) open.

Fan speed: 250 rpm

Shake speed: 400 rpm

**Final cleaning:** Yes - Clipper 4 screen fanning mill with top door open 4" (10 cm).

Top screens: Option 1: 12/64" (0.47 cm).
Option 2: #11 and 1/16 x 1/4" (0.16 x 0.63 cm), 1/4 open.

Bottom screens: Option 1: 9/64" (0.31 cm).
Option 2: #8 and 1/15" (0.17 cm).

Fan speed: Set so that less than 5 per cent filled seed is blown out with chaff, approx. 275 rpm.

Shake speed: Approx. 400 rpm.

## Green needlegrass continued

**Special processing equipment, techniques or other considerations:**

**Order of cleaning:** Hammermill, 4 screen fanning mill, hammer mill, 4 screen fanning mill.

SEED YIELD:

**Irrigated:** Average, 250 lbs/acre (280 kg/ha) or less.
Range, 100 to 700 lbs/acre (112 to 784 kg/ha).

**Dryland:** Average, 100 lbs/acre (112 kg/ha) or less.
Range, 50 to 150 lbs/acre (56 to 168 kg/ha).

POSTHARVEST MANAGEMENT:

**During Establishment:** See information on fertilizing and irrigating.

**Established Stand:** See information on fertilizing and irrigating. Graze or cut for hay in late fall after a killing frost. If cut for hay, cut stubble short. Some producers burn immediately after harvest or before growth in spring.

EXPECTED PRODUCTIVE STAND LIFE: 5 to 10 years

ADDITIONAL COMMENTS: Ripe seed shatters readily.

# Idaho or Bluebunch fescue (*Festuca idahoensis Elmer*)

SEED WEIGHT: 380,000/lb. (836,000/kg)

SEEDING RATE: (Pure live seed)
30 seeds per linear foot of row.
100 seeds per meter of row.

2 lbs/acre (2.2 kg/ha) for 24" (60 cm) rows.
Multiply x 2.0 for 12" (30 cm) rows or x 0.75 for 36" (90 cm) rows.

ROW SPACING: 24" (60 cm) Irrigated or high rainfall areas.
36" (90 cm) Dryland areas.
(**Note:** Narrower row spacings are sometimes used without interrow cultivation, but seed yields and stand longevity can be reduced).

PLANTING DATE: Early spring.

WEED CONTROL:

**During Establishment:** If possible, plant in a field where weeds have been controlled by summer fallow or a broad spectrum herbicide during the previous 1 to 2 years. Wait until 3 to 5 leaf stage before applying herbicides at lower rates; clipping or bromoxynil according to label directions.

**Established Stand:** Bromoxynil, 2,4-D, dicamba and/or cultivation and hand roguing.
(**Note:** These products may not be registered on this grass species in your state or province).

FERTILIZATION:

**During Establishment:** Dryland and irrigated – apply phosphorus according to forage production rate and enough for 3 years. No nitrogen until seedlings are established or drill 50 lbs/acre (56 kg/ha) of 11-48-0 with seed. After seedlings are established, apply 30 lbs/acre (34 kg/ha) of nitrogen for dryland and 60 to 80 lbs/acre (67 to 90 kg/ha) of nitrogen for irrigated. On dryland, fallow the year before seeding.

**Established Stand:** Apply nitrogen each year – dryland, 30 lbs/acre (34 kg/ha); irrigated, 60 to 80 lbs/acre (67 to 90 kg/ha).

IRRIGATION:

**During Establishment:** Apply enough water to get the stand established. Keep surface moist to avoid crusting. Bring soil moisture up to field capacity in early September.

**Established Stand:** Irrigate after harvest to promote vegetative production. Bring moisture level up to field capacity by early September. Irrigate in spring through the boot stage if rainfall does not provide sufficient moisture for continued plant growth (soil moisture should be above 50 per cent field capacity). Do not irrigate during flowering (pollination), but good soil moisture is essential during the early phase of seed development. Do not irrigate during seed ripening.
(**Note:** Never allow plants to be moisture stressed while floral primordia or immature seedheads are forming).

HARVEST:

**Range of harvest dates at Bridger, MT:** Early to mid-July.
**Lodging:** No
**Shattering:** Moderate to heavy.
**Stripping:** No
**Direct Combine:** Satisfactory

| | |
|---|---|
| Stage: | Hard dough. |
| Ground speed: | Dependent on stand, seed quantity and size of harvesting equipment. Adequate rate of feed and speed to ensure machine is operating at full capacity without overloading the cylinder and sieves. |

## Idaho or Bluebunch fescue continued

**Swathing/Windrowing:** Preferred
- Stage: Hard dough.
- Ground speed: As described for direct combining.

**Days in Windrow:** 5 to 7 days.

**Combine Settings:**
- Air flow setting: No more than 5 per cent filled seed going out back of combine.
- Cylinder speed: Fast enough to thresh seed and not to crack caryopsis or kernels.
- Cylinder spacing: Closed enough to thresh seeds, but limited breakage of stems and seeds.

**Average Dockage of Harvested Seed:** 15 per cent; Actually depends on type of sieve and settings (Peterson Sieve recommended).

PRECLEANING TREATMENT/STORAGE:

**Drying:** Usually not necessary (not to exceed 104° F or 40° C).
- Swathed: Not necessary.
- Direct Combined: May require some drying if trashy.

**Safe Storage Moisture Content:**
- Bins: 12 per cent
- Sacks: 15 per cent

PROCESSING:

Debearding: Yes, to remove short awns and separate doubles.
- Barley debearder: Set to remove all awns without cracking caryopsis or kernels.
- Hammer mill: Set to remove all awns without cracking caryopsis or kernels.

Scalping: No

Final cleaning:
- Top screen: 10/64" (0.39 cm).
- Bottom screen: 8/64" (0.31 cm).

SEED YIELD:

**Irrigated:** Average, 300 lbs/acre (336 kg/ha).

**Dryland:** Average, 100 lbs/acre (112 kg/ha).

POSTHARVEST MANAGEMENT:

**During Establishment:** See information on fertilizing and irrigating.

**Established Stand:** See information on fertilizing and irrigating. Graze or cut in late fall after a killing frost. If cut for hay, cut stubble short.

EXPECTED PRODUCTIVE STAND LIFE: 5 years (may not produce harvestable quantity until third growing season).

# Indiangrass (*Sorghastrum nutans* [L.] Nash)

SEED WEIGHT: 175,000/lb. (386,000/kg)

SEEDING RATE: (Pure live seed)
30 seeds per linear foot of row.
98 seeds per meter of row.

3.7 lb/acre (4.1 kg/ha) for 24". (60 cm) rows.
Multiply x 2.0 for 12" (30 cm) rows or x 0.75 for 36" (90 cm) rows.

ROW SPACING: 24 to 36" (60 to 90 cm) Irrigated or high rainfall areas.
36 to 48" (90 to 120 cm) Dryland areas.
(**Note:** Narrower row spacings are sometimes used without interrow cultivation, but seed yields and stand longevity can be reduced).

PLANTING DATE: Late spring (May) to early summer (June).

WEED CONTROL:

**During Establishment:** If possible, plant in a field where weeds have been controlled by summer fallow or a broad spectrum herbicide during the previous 1 to 2 years. Wait until 3 to 5 leaf stage before applying herbicides at lower rates; 2,4-D, bromoxynil and/or clipping and cultivation. Do not use atrazine the establishment year.

**Established Stand:** Atrazine, 2,4-D and hand roguing.
(**Note:** These products may not be registered on this grass species in your state or province).

FERTILIZATION:

**During Establishment:** Not recommended.

**Established Stand:** Apply nitrogen at 60 to 100 lbs/acre (67 to 112 kg/ha) in late spring. Apply phosphorus and potassium according to soil test recommendations.

IRRIGATION:

**During Establishment:** Apply enough water to get the stand established. Keep surface moist to avoid crusting. Bring soil moisture up to field capacity in early September.

**Established Stand:** Bring moisture level up to field capacity by early September. Irrigate in spring through the boot stage if rainfall does not provide sufficient moisture for continued plant growth (soil moisture should be above 50 per cent field capacity). Do not irrigate during flowering (pollination), but good soil moisture is essential during the early phase of seed development. Do not irrigate during seed ripening.
(**Note:** Never allow plants to be moisture stressed while floral primordia or immature seedheads are forming).

HARVEST:

**Range of harvest dates at Bismarck, ND:** August 30 to September 15.

**Lodging:** Generally No.

**Shattering:** Yes, High.

**Stripping:** Preferred method.

| | |
|---|---|
| Stage: | Hard dough |
| Brush speed: | 600 to 800 rpm |

**Direct Combine:** Satisfactory

| | |
|---|---|
| Stage: | Medium to hard dough. |
| Ground speed: | Dependent on stand, seed quantity and size of harvesting equipment. ensure machine is operating at full capacity without overloading the cylinder and sieves. |

## Indiangrass continued

**Swathing/Windrowing:** Satisfactory
- Stage: Soft to medium dough.
- Ground speed: As described for direct combining.

**Days in Windrow:** 2 to 4 days.

**Combine Settings:**
- Air flow setting: Low
- Cylinder speed: 800 to 1100 rpm
- Cylinder spacing: 3/8 to 1/8" (0.95 to 0.31 cm).

**Average Dockage of Harvested Seed:** 40 per cent

**Other harvest recommendations:** Seed ripens unevenly, so combining is not recommended.

PRECLEANING TREATMENT/STORAGE:

**Drying**: May be required (not to exceed 104° F or 40° C).
- Swathed: Usually not required.
- Direct Combined: Needs 2 to 4 days to dry.
- Stripped: Needs 1 to 2 days to dry.

**Safe Storage Moisture Content:**
- Bins: 12 per cent
- Sacks: 15 per cent

PROCESSING:

**Debearding:**
- Debearder:
  - Speed: 300 rpm
  - Duration: 40 minutes.

**Scalping:** N/A

**Final cleaning:**
- Top screens: No.1 = 11; No.2 = 1/16 x 1/4" (0.16 x 0.63).
- Bottom screens: No.3 = #8; No.4 = 1/15" (0.17 cm), 2" (5 cm) open.
- Fan speed: 200 rpm
- Shake speed: 425 rpm

**Special processing equipment, techniques or other considerations:**
- Order of cleaning: Debearder, 4 screen fanning mill.

SEED YIELD:

**Irrigated:** Average, 175 lbs/acre (196 kg/ha).
Range, 100 to 300 lbs/acre (112 to 336 kg/ha).

**Dryland:** Average, 100 lbs/acre (112 kg/ha).
Range, 50 to 200 lbs/acre (56 to 224 kg/ha).

POSTHARVEST MANAGEMENT:

**During Establishment:** See information on fertilization and irrigating.

**Established Stand:** Rotary mow, rototill and cultivate between rows in fall or spring or burning on a regular basis.

EXPECTED PRODUCTIVE STAND LIFE: 10 to 15 years

ADDITIONAL COMMENTS: Seed shatters readily when ripe.

# Indian ricegrass (*Oryzopsis hymenoides* [Roem. & Schult.] Ricker)

SEED WEIGHT: 159,000/lb. (350,000/kg)

SEEDING RATE: (Pure live seed)
25 to 30 seeds per linear foot of row.
82 to 100 seeds per meter of row.

4.1 lb/acre (4.6 kg/ha) for 24" (60 cm) rows.
Multiply x 2.0 for 12" (30 cm) rows or x 0.75 for 36" (90 cm) rows.

ROW SPACING: 24" (60 cm) Irrigated or high rainfall areas.
36" (90 cm) Dryland areas.
(**Note:** Narrower row spacings are sometimes used without interrow cultivation, but seed yields and stand longevity can be reduced).

PLANTING DATE: Dormant seeding just prior to freeze up.

WEED CONTROL:

**During Establishment:** If possible, plant in a field where weeds have been controlled by summer fallow or a broad spectrum herbicide during the previous 1 to 2 years. Wait until 3 to 5 leaf stage before applying herbicides at lower rates; clipping or bromoxynil according to label directions.

**Established Stand:** Bromoxynil, 2,4-D, dicamba and/or cultivation and hand roguing.
(**Note:** These products may not be registered on this grass species in your state or province).

FERTILIZATION:

**During Establishment:** Dryland and irrigated – apply phosphorus according to forage production rate and enough for 3 years. No nitrogen until seedlings are established or drill 50 lbs/acre (56 kg/ha) of 11-48-0 with seed. After seedlings are established, apply 30 lbs/acre (34 kg/ha) of nitrogen for dryland and 60 to 80 lbs/acre (67 to 90 kg/ha) of nitrogen for irrigated. On dryland, fallow the year before seeding.

**Established Stand:** Apply nitrogen each fall – dryland, 30 lbs/acre (34 kg/ha); Irrigated, 60 to 80 lbs/acre (67 to 90 kg/ha).

IRRIGATION:

**During Establishment:** Apply enough water to get the stand established. Keep surface moist to avoid crusting. Bring soil moisture up to field capacity in early September.

**Established Stand:** Irrigate after harvest to promote vegetative production. Bring moisture level up to field capacity by early September. Irrigate in spring through the boot stage if rainfall does not provide sufficient moisture for continued plant growth (soil moisture should be above 50 per cent field capacity). Do not irrigate during flowering (pollination), but good soil moisture is essential during the early phase of seed development. Do not irrigate during seed ripening.
(**Note:** Never allow plants to be moisture stressed while floral primordia or immature seedheads are forming).

HARVEST:

**Average date at Bridger, MT:** Late July.
Range of harvest dates: Early July to early August.
**Lodging:** Low
**Shattering:** Medium to high.
**Stripping:** N/A
**Direct Combine:** Preferred
Stage: Hard dough

## Indian Ricegrass continued

Ground speed: Dependent on stand, seed quantity and size of harvesting equipment. Adequate rate of feed and speed to ensure machine is operating at full capacity without overloading the cylinder and sieves.

**Swathing/Windrowing:** Satisfactory
- Stage: Hard dough.
- Ground speed: As described for direct combining.

**Days in Windrow:** 7 to 10 days.

**Combine Settings:**
- Air flow setting: No more than 5 per cent filled seed going out back of combine.
- Cylinder speed: Fast enough to thresh seeds and not to crack caryopsis or kernel.
- Cylinder spacing: Closed enough to thresh seeds, but limited breakage of stems and seeds.

**Average Dockage of Harvested Seed:** 50 per cent

PRECLEANING TREATMENT/STORAGE:

**Drying:** Usually not necessary (not to exceed 104° F or 40° C).
- Swathed: Usually not necessary.
- Direct Combined: May require some drying if trashy.

**Safe Storage Moisture Content:**
- Bins: 12 per cent
- Sacks: 15 per cent

PROCESSING:

**Debearding:** Yes
- Barley debearder: Set to remove callus hair without cracking caryopsis or kernels.
- Hammer mill: Set to remove callus hair without cracking caryopsis or kernels.

**Scalping:** No

**Final cleaning:**
- Top screens: 8/64" (0.31 cm) and then 7/64" (0.27 cm).
- Bottom screen: 1/19" (0.13 cm).

SEED YIELD:

**Irrigated:** Average, 300 lbs/acre (336 kg/ha).

**Dryland:** Range, 100 to 200 lbs/acre (112 to 224 kg/ha).

POSTHARVEST MANAGEMENT:

**During Establishment:** See information on fertilizing and irrigating.

**Established Stand:** See information on fertilizing and irrigating. Graze lightly or cut for hay in late fall after a killing frost.

EXPECTED PRODUCTIVE STAND LIFE: 5 years.

# Junegrass (*Koeleria macrantha* [Ledeb.] Schultes; formerly *K. cristata*)

SEED WEIGHT: 2,315,000/lb. (5,090,000/kg)

SEEDING RATE: (Pure live seed)
40 seeds per linear foot of row.
130 seeds per meter of row.

1 lb/acre (1.1 kg/ha) for 24" (60 cm) rows.
Multiply x 2.0 for 12" (30 cm) rows or x 0.75 for 36" (90 cm) rows.

ROW SPACING: 24" (60 cm) Irrigated or high rainfall areas.
36" (90 cm) Dryland areas.
(**Note:** Narrower row spacings are sometimes used without interrow cultivation, but seed yields and stand longevity can be reduced).

PLANTING DATE: Early Spring.

WEED CONTROL:

**During Establishment:** If possible, plant in a field where weeds have been controlled by summer fallow or a broad spectrum herbicide during the previous 1 to 2 years. Wait until 3 to 5 leaf stage before applying herbicides at lower rates; clipping or bromoxynil according to label directions.
(**Note:** Junegrass is very nonvigorous and slow growing as a seedling and is therefore extremely vulnerable to mechanical (wheel traffic, even foot traffic) and chemical damage.

**Established Stand:** Bromoxynil, 2,4-D, dicamba and/or cultivation and hand roguing.
(**Note:** These products may not be registered on this grass species in your state or province).

FERTILIZATION:

**During Establishment:** Dryland and irrigated – apply phosphorus according to forage production rate and enough for 3 years. No nitrogen until seedlings are established. A low nitrogen fertilizer (e.g. - 11-48-0) could be drilled with seed, but be very cautious to avoid burning seedling. After seedlings are established, apply 30 lbs/acre (34 kg/ha) of nitrogen for dryland and 60 to 80 lbs/acre (67 to 90 kg/ha) of nitrogen for irrigated. Plants may not be fully established until the third year. On dryland, fallow the year before seeding.

**Established Stand:** Apply nitrogen each year – dryland, 30 lbs/acre (34 kg/ha); irrigated, 60 to 80 lbs/acre (67 to 90 kg/ha).

IRRIGATION:

**During Establishment:** Apply enough water to get the stand established. Keep surface moist to avoid crusting. Bring soil moisture up to field capacity in early September.

**Established Stand:** Irrigate after harvest to promote vegetative production. Bring moisture level up to field capacity by early September. Irrigate in spring through the boot stage if rainfall does not provide sufficient moisture for continued plant growth (soil moisture should be above 50 per cent field capacity). Do not irrigate during flowering (pollination), but good soil moisture is essential during the early phase of seed development. Do not irrigate during seed ripening.
(**Note:** Never allow plants to be moisture stressed while floral primordia or immature seedheads are forming).

HARVEST:

**Range of harvest dates at Bridger, MT:** Mid to late-July.
**Lodging:** No
**Shattering:** No
**Stripping:** No
**Direct Combine:** Satisfactory

## Junegrass continued

Stage: Mature seed.
Ground speed: Dependent on stand, seed quantity and size of harvesting equipment. Adequate rate of feed and speed to ensure machine is operating at full capacity without overloading the cylinder and sieves.

**Swathing/Windrowing:** Preferred
Stage: Hard dough.
Ground speed: As described for direct combining.

**Days in Windrow:** 5 to 7 days.

**Combine Settings:**
Air flow setting: No more than 5 per cent filled seed going out back of combine.
Cylinder speed: Fast enough to thresh and not crack caryopsis or kernels.
Cylinder spacing: Closed enough to thresh seeds, but limited breakage of stems and seeds.

**Average Dockage of Harvested Seed:** 40 per cent; Actually depends on type of sieve and settings (Peterson Sieve recommended).

PRECLEANING TREATMENT/STORAGE:

**Drying:** Usually not required (not to exceed 104° F or 40° C).
Swathed: No drying required.
Direct Combined: May require some drying if trashy.

**Safe Storage Moisture Content:**
Bins: 12 per cent
Sacks: 15 per cent

PROCESSING:

**Debearding:** No
**Scalping:** No
**Final cleaning:**
Top screen: 8/64" (0.31 cm).
Bottom screen: 7/64" (0.27 cm).

SEED YIELD:

**Irrigated:** Average, 150 lbs/acre (168 kg/ha).
**Dryland:** Average, 75 lbs/acre (84 kg/ha).

POSTHARVEST MANAGEMENT:

**During Establishment:** See information on fertilizing and irrigating.
**Established Stand:** See information on fertilizing and irrigating. Graze or cut for hay in late fall after a killing frost. If cut for hay, cut stubble short.

EXPECTED PRODUCTIVE STAND LIFE: 4 to 5 years

# Little bluestem (*Schizachyrium scoparium* [Michx.] Nash)

SEED WEIGHT: 260,000/lb. (573,000/kg)

SEEDING RATE: (Pure live seed)
30 seeds per linear foot of row.
98 seeds per meter of row.

2.5 lb/acre (2.8 kg/ha) for 24" (60 cm) rows.
Multiply x 2.0 for 12" (30 cm) rows or x 0.75 for 36" (90 cm) rows.

ROW SPACING: 24 to 36" (60 to 90 cm) Irrigated or high rainfall areas.
36 to 48" (90 to 120cm) Dryland areas.
(**Note:** Narrower row spacings are sometimes used without interrow cultivation, but seed yields and stand longevity can be reduced).

PLANTING DATE: Late spring (May) to early summer (June).

WEED CONTROL:

**During Establishment:** If possible, plant in a field where weeds have been controlled by summer fallow or a broad spectrum herbicide during the previous 1 to 2 years. Wait until 3 to 5 leaf stage before applying herbicides at lower rates (Bromoxynil, 2,4-D, clipping and cultivation). Do not use atrazine in the year of establishment.

**Established Stand:** Atrazine (may cause leaf tip burn), imazethapyr (Pursuit), 2,4-D and/or hand roguing and cultivation.
(**Note:** These products may not be registered on this grass species in your state or province).

FERTILIZATION:

**During Establishment:** Not recommended.

**Established Stand:** Apply nitrogen at 40 to 60 lbs/acre (44.8 to 67.2 kg/ha). Apply phosphorus and potassium according to soil test recommendations.

IRRIGATION:

**During Establishment:** Apply enough water to get the stand established. Keep surface moist to avoid crusting. Bring soil moisture up to field capacity in early September.

**Established Stand:** Bring moisture level up to field capacity by early September. Irrigate in spring through the boot stage if rainfall does not provide sufficient moisture for continued plant growth (soil moisture should be above 50 per cent field capacity). Do not irrigate during flowering (pollination), but good soil moisture is essential during the early phase of seed development. Do not irrigate during seed ripening. (**Note:** Never allow plants to be moisture stressed while floral primordia or immature seedheads are forming).

HARVEST:

**Range of harvest dates at Bismarck, ND:** September 10 to 30.

**Lodging:** No

**Shattering:** Slight to moderate.

**Stripping:** Preferred

| | |
|---|---|
| Stage: | Hard dough to mature seed. |
| Brush speed: | 600 to 800 rpm |

**Direct Combine:** Marginally satisfactory.

| | |
|---|---|
| Stage: | Medium to hard dough. |
| Ground speed: | Dependent on stand, seed quantity and size of harvesting equipment. Adequate rate of feed and speed to ensure machine is operating at full capacity without overloading the cylinder and sieves. |

## Little bluestem continued

**Swathing/Windrowing:** N/A
**Combine Settings:** N/A
**Average Dockage of Harvested Seed:** 60 per cent
**Other harvest recommendations:** The seed is best stripped when most of the seed is fully mature and in the full-fluff stage, although some shattering will have occurred by this time.

PRECLEANING TREATMENT/STORAGE:

**Drying:** May be necessary (not to exceed 104° F or 40° C).
Stripped: 1 to 2 days drying time.
**Safe Storage Moisture Content:**
Bins: 12 per cent
Sacks: 15 per cent

PROCESSING:

**Debearding:** Yes
Clipper debearder: 200 rpm for 45 to 60 minutes.
Hammer mill: 3/16" (0.48 cm) screen.
Speed: 550 rpm
Duration: Continuous flow.
**Scalping:** Clipper 4 screen fanning mill; top door 7" (17.5 cm) open.
Top screens: No.1 = #12; No.2 = #10.
Bottom screens: No.3 = #8; No.4 = #9 triangle, 3" (7.5 cm) open.
Fan speed: 150 rpm
Shake speed: 400 rpm
**Final cleaning:**
Top screens: No.1 = #12; No.2 = #10.
Bottom screens: No.3 = #8; No.4 = #9 triangle, 3" (7.5 cm) open.
Fan speed: 160 rpm
Shake speed: 400 rpm
**Special processing equipment, techniques or other considerations:**
Order of cleaning: Clipper debearder, 4 screen fanning mill, hammermill, 4 screen fanning mill.

SEED YIELD:

**Irrigated:** Average, 150 lbs/acre (168 kg/ha).
Range, 100 to 300 lbs/acre (112 to 336 kg/ha).
**Dryland:** Average, 100 lbs/acre (112 kg/ha).
Range, 75 to 150 lbs/acre (84 to 168 kg/ha).

POSTHARVEST MANAGEMENT:

**During Establishment:** See information on fertilization and irrigating.
**Established Stand:** Rotary mow, rototill or cultivate between rows in the fall or spring; or burning on a regular basis in early spring.

EXPECTED PRODUCTIVE STAND LIFE: 10 to 15 years

# Mountain rough fescue (*Festuca campestris*)

SEED WEIGHT: 215,000/lb. (473,000/kg)

SEEDING RATE: (Pure live seed)
25 seeds per linear foot of row.
85 seeds per meter of row.

2.5 lbs/acre (2.8 kg/ha) for 24" (60 cm) rows.
Multiply x 2.0 for 12" (30 cm) rows, x 0.875 for 30" (75 cm) rows and x 0.5 for 48" (120 cm) rows.

ROW SPACING: 24 to 30" (75 cm) Irrigated or high rainfall areas.
48" (120 cm) Dryland areas.
(**Note:** Narrower row spacings are sometimes used without interrow cultivation, but seed yields and stand longevity can be reduced).

PLANTING DATE: Early spring.

WEED CONTROL:

**During Establishment:** If possible, plant in a field where weeds have been controlled by summer fallow or a broad spectrum herbicide during the previous 1 to 2 years. Wait until 3 to 5 leaf stage before applying herbicides at lower rates; clipping or bromoxynil according to label directions.

**Established Stand:** Bromoxynil, 2,4-D, dicamba and/or cultivation and hand roguing.
(**Note:** These products may not be registered on this grass species in your state or province).

FERTILIZATION:

**During Establishment:** Dryland and irrigated – apply phosphorus according to forage production rate and enough for 3 years. No nitrogen until seedlings are established or drill 50 lbs/acre (56 kg/ha) of 11-48-0 with seed. After seedlings are established, apply 30 lbs/acre (34 kg/ha) of nitrogen for dryland and 60 to 80 lbs/acre (67 to 90 kg/ha) of nitrogen for irrigated. On dryland, fallow the year before seeding.

**Established Stand:** Apply nitrogen each year – dryland, 30 lbs/acre (34 kg/ha); irrigated, 60 to 80 lbs/acre (67 to 90 kg/ha).

IRRIGATION:

**During Establishment:** Apply enough water to get the stand established. Keep surface moist to avoid crusting. Bring soil moisture up to field capacity in early September.

**Established Stand:** Irrigate after harvest to promote vegetative production. Bring moisture level up to field capacity by early September. Irrigate in spring through the boot stage if rainfall does not provide sufficient moisture for continued plant growth (soil moisture should be above 50 per cent field capacity). Do not irrigate during flowering (pollination), but good soil moisture is essential during the early phase of seed development. Do not irrigate during seed ripening.
(**Note:** Never allow plants to be moisture stressed while floral primordia or immature seedheads are forming).

HARVEST:

**Range of harvest dates at Bridger, MT:** Late June to mid-July.
**Lodging:** No
**Shattering:** Yes
**Stripping:** No
**Direct Combine:** Preferred
Stage: Hard dough to mature seed.

## Mountain rough fescue continued

Ground speed: Dependent on stand, seed quantity and size of harvesting equipment. Adequate rate of feed and speed to ensure machine is operating at full capacity without overloading the cylinder and sieves.

**Swathing/Windrowing:** No

**Combine Settings:**

Air flow setting: No more than 5 per cent filled seed going out back of combine.

Cylinder speed: Fast enough to thresh seed and not crack caryopsis or kernels.

Cylinder spacing: Closed enough to thresh seeds, but limited breakage of stems and seeds.

**Average Dockage of Harvested Seed:** 15 per cent

**Other harvest recommendations:** Elongated naked culms allow direct combining with little trash accumulation.

PRECLEANING TREATMENT/STORAGE:

**Drying:** Usually not required (not to exceed 104° F or 40° C).

Direct Combined: May be necessary if harvested in medium dough stage.

**Safe Storage Moisture Content:**

Bins: 12 per cent

Sacks: 15 per cent

PROCESSING:

**Debearding:** No

**Scalping:** No

**Final cleaning:**

Top screen: 12/64" (0.47 cm).

Bottom screen: 10/64" (0.39 cm).

**Special processing equipment, techniques or other considerations:**

Chaff and light seeds can be easily separated by regulation of fan speed.

SEED YIELD:

**Irrigated:** Average, Highly variable – 50 to 100 lbs/acre (56 to 112 kg/ha).

**Dryland:** Not recommended

POSTHARVEST MANAGEMENT:

**During Establishment:** See information on fertilizing and irrigating.

**Established Stand:** See information on fertilizing and irrigating. Graze or cut for hay in late fall after a killing frost. If cut for hay, cut stubble short.

EXPECTED PRODUCTIVE STAND LIFE: 5 to 6 years (may only produce significant amount of seed 1 in 3 years).

# Needle and thread grass (*Stipa comata* Trin. & Rupr.)

SEED WEIGHT: 115,000/lb. (253,000/kg)

SEEDING RATE: (Pure live seed)
30 seeds per linear foot of row.
98 seeds per meter of row.

5.7 lb/acre (6.4 kg/ha) for 24" (60 cm) rows.
Multiply x 2.0 for 12" (30 cm) rows or x 0.75 for 36" (90 cm) rows and x 0.5 for 48" (120 cm) rows.

ROW SPACING: 24 to 36" (60 to 90 cm) Irrigated or high rainfall areas.
36 to 48" (90 to 120cm) Dryland areas.
(**Note:** Narrower row spacings are sometimes used without interrow cultivation, but seed yields and stand longevity can be reduced).

PLANTING DATE: Spring (April to May); late summer (August to September); dormant seeding is often preferred (November to March).

WEED CONTROL:

**During Establishment:** If possible, plant in a field where weeds have been controlled by summer fallow or a broad spectrum herbicide during the previous 1 to 2 years. Wait until 3 to 5 leaf stage before applying herbicides at lower rates; Bromoxynil, 2,4-D, clipping and cultivation.

**Established Stand:** 2,4-D, bromoxynil, dicamba and/or hand roguing and cultivation.
(**Note:** These products may not be registered on this grass species in your state or province).

FERTILIZATION:

**During Establishment:** Only apply phosphorus and potassium recommended by soil tests. Dryland and irrigated – apply phosphorus according to forage production rate and enough for 3 years. No nitrogen until seedlings are established. A low nitrogen fertilizer (i.e. - 11- 48-0) could be drilled with seed, but be very cautious to avoid burning seedling. If seedling are well established the first year, apply 30 lbs/acre (34 kg/ha) of nitrogen for dryland and 60 to 80 lbs/acre (67 to 90 kg/ha) of nitrogen for irrigated. On dryland, fallow the year before seeding.

**Established Stand:** Apply nitrogen each year – dryland, 30 lbs/acre (34 kg/ha); irrigated, 60 to 80 lbs/acre (67 to 90 kg/ha).

IRRIGATION:

**During Establishment:** Apply enough water to get the stand established. Keep surface moist to avoid crusting. Bring soil moisture up to field capacity in early September.

**Established Stand:** Irrigate after harvest to promote vegetative production. Bring moisture level up to field capacity by early September. Irrigate in spring through the boot stage if rainfall does not provide sufficient moisture for continued plant growth (soil moisture should be above 50 per cent field capacity). Do not irrigate during flowering (pollination), but good soil moisture is essential during the early phase of seed development. Do not irrigate during seed ripening.
(**Note:** Never allow plants to be moisture stressed while floral primordia or immature seedheads are forming).

HARVEST:

**Range of harvest dates at Bridger, MT:** Late June to early July.
**Lodging:** No
**Shattering:** Yes
**Stripping:** Preferred

## Needle and thread grass continued

Stage: Mature seed - repeat seed stripping one week later to capture indeterminate late maturing seed.
Brush speed: Varies by number of seed heads; excessive RPM will dislodge immature seeds.
Ground speed: The thicker the stand the slower the ground speed; the thinner the stand, the faster the ground speed.

**Direct Combine:** No

**Swathing/Windrowing:** Satisfactory. Swath to 24" (30 cm) stubble height to avoid excess trash.
Stage: Hard dough – seed turning brown.
Ground speed: Dependent on stand, seed quantity and size of harvesting equipment. Adequate rate of feed and speed to ensure machine is operating at full capacity without overloading the cylinder and sieves.

**Days in Windrow:** 10 to 14 days.

**Combine Settings:**
Air flow setting: No more than 5 per cent filled seed going out back of combine.
Cylinder speed: Fast enough to thresh seed and not crack caryopsis or kernels.
Cylinder spacing: Closed enough to thresh seeds, but limited breakage of stems and seeds.

**Average Dockage of Harvested Seed:** 50 to 70 per cent; Actually depends on type of sieve and settings (Peterson Sieve recommended).

PRECLEANING TREATMENT/STORAGE:

**Drying:** Required with stripping (not to exceed 104° F or 40° C).
Swathed: No
Stripped: Yes, several days required.

**Safe Storage Moisture Content:**
Bins: 12 per cent
Sacks: 15 per cent

PROCESSING:

**Debearding:** Yes
Barley debearder: May require multiple treatments.
Hammer mill: May require mulitple treatments.
(**Note:** Deawning becomes easier wiith lower seed moisture).

**Scalping:** Yes
Top screen: 14/64" (0.55 cm).

**Final cleaning:**
Top screen: 12/64" (0.47 cm).
Bottom screen: 10/64" (0.39 cm).

**Special processing equipment, techniques or other considerations:** Seed needs to be stored in plastic woven sacks – not cotton or burlap. Sharp seeds will become caught in cotton or burlap fabric. Awned should be removed as soon as possible after harvest or the will intertwine and become quite difficult to handle and separate.

SEED YIELD:

**Irrigated:** Average, 150 lbs/acre (168 kg/ha).
**Dryland:** Average, 100 lbs/acre (112 kg/ha).

POSTHARVEST MANAGEMENT:

**During Establishment:** See information on fertilizing and irrigating.
**Established Stand:** See information on fertilizing and irrigating. Graze or cut for hay in late fall after a killing frost. If cut for hay, cut stubble short.

EXPECTED PRODUCTIVE STAND LIFE: 3 to 4 years

# Nodding brome *(Bromus anomalus* Rupr.)

SEED WEIGHT: 168,000/lb. (369,600/kg)

SEEDING RATE: (Pure live seed)
36 seeds per linear foot of row.
120 seeds per meter of row.

4.7 lb/acre (5.2 kg/ha) for 24" (60 cm) rows.
Multiply x 2.0 for 12" (30 cm) rows or x 0.75 for 36" (90 cm) rows.

ROW SPACING: 24" Irrigated or high rainfall areas.
36" Dryland areas.
(**Note:** Narrower row spacings are sometimes used without interrow cultivation, but seed yields and stand longevity can be reduced).

PLANTING DATE: Early spring.

WEED CONTROL:

**During Establishment:** If possible, plant in a field where weeds have been controlled by summer fallow or a broad spectrum herbicide during the previous 1 to 2 years. Wait until 3 to 5 leaf stage before applying herbicides at lower rates; clipping or bromoxynil according to label directions.

**Established Stand:** Bromoxynil, 2,4-D, dicamba and/or cultivation and hand roguing.
(**Note:** These products may not be registered on this grass species in your state or province).

FERTILIZATION:

**During Establishment:** Dryland and irrigated – apply phosphorus according to forage production rate and enough for 3 years. No nitrogen until seedlings are established or drill 50 pounds of 11-48-0 per acre with seed. After seedlings are established, apply 30 lbs/acre (34 kg/ha) of nitrogen for dryland and 60 to 80 lbs/acre (67 to 90 gh/ha) of nitrogen for irrigated. On dryland, fallow the year before seeding.

**Established Stand:** Apply nitrogen each year – dryland, 30 lbs/acre (34 kg/ha); irrigated, 60 to 80 lbs/acre (67 to 90 kg/ha).

IRRIGATION:

**During Establishment:** Apply enough water to get the stand established. Keep surface moist to avoid crusting. Bring soil moisture up to field capacity in early September.

**Established Stand:** Irrigate in spring through the boot stage if rainfall does not provide sufficient moisture for continued plant growth (soil moisture should be above 50 per cent field capacity). Do not irrigate during flowering (pollination), but good soil moisture is essential during the early phase of seed development. Do not irrigate during seed ripening.
(**Note:** Never allow plants to be moisture stressed while floral primordia or immature seedheads are forming). Irrigate after harvest to promote vegetative production. Bring moisture level up to field capacity by early September).

HARVEST:

**Average date at Meeker, CO:** August 13.
Range of harvest dates: August 1 to 25.
**Lodging:** Could lodge if over fertilized.
**Shattering:** Can be a problem.
**Stripping:** N/A
**Direct Combine:**

| | |
|---|---|
| Stage: | 10 to 15 per cent mature seed. |
| Ground speed: | Uniform feed of material. |

## Nodding brome continued

**Swathing/Windrowing:** Not recommended.
**Combine Settings:**
Air flow setting: Low
Cylinder speed: 850 to 900 rpm
Cylinder spacing: Close
**Average Dockage of Harvested Seed:** N/A

PRECLEANING TREATMENT/STORAGE:
**Drying:** Yes (not to exceed 104° F or 40° C).
Swathed: Usually not necessary.
Direct Combined: May require some drying if trashy.
Stripped: Yes, needs to be dried several days before bagging.
**Safe Storage Moisture Content:**
Bins: 10 per cent
Sacks: 14 per cent

PROCESSING:
**Debearding:** Used for removing pubescents and splitting doubles.
**Scalping:** N/A
**Final cleaning:**
Top screen: #14
Bottom screen: #1/16 (0.16 cm)

SEED YIELD:
**Irrigated:** Average, 250 lbs/acre (280 kg/ha) clean seed.
Range, 150 to 450 lbs/acre (168 to 504 kg/ha).
**Dryland:** Average

POSTHARVEST MANAGEMENT:
**During Establishment:** See information on fertilizing and irrigating.
**Established Stand:** See information on irrigating and fertilizing.

EXPECTED PRODUCTIVE STAND LIFE: 4 years.

# Northern or Thickspike wheatgrass (*Elymus lanceolatus* [Scrib. & Smith] Gould; formerly *Elytrigia dasystachya*; formerly *Agropyron dasystachyum*)

SEED WEIGHT: 145,000/lb. (319,000/kg)

SEEDING RATE: (Pure live seed)
25 to 30 seeds per linear foot of row.
82 to 100 seeds per meter of row.

4.5 lbs/acre (5.0 kg/ha) for 24" (60 cm) rows.
Multiply x 2.0 for 12" (30 cm) rows or x 0.75 for 36" (90 cm) rows.

ROW SPACING: 24" (60 cm) Irrigated or high rainfall areas.
36" (90 cm) Dryland areas.
(**Note:** Narrower row spacings are sometimes used without interrow cultivation, but seed yields and stand longevity can be reduced).

PLANTING DATE: Early in spring; late summer by mid-August with irrigation. Alternative option: Dormant fall seeding just prior to freeze up.

WEED CONTROL:

**During Establishment:** If possible, plant in a field where weeds have been controlled by summer fallow or a broad spectrum herbicide during the previous 1 to 2 years. Wait until 3 to 5 leaf stage before applying herbicides at lower rates; clipping or bromoxynil according to label directions

**Established Stand:** Bromoxynil, metribuzin (Sencor), 2,4-D, dicamba and/or cultivation and hand roguing. (**Note:** These products may not be registered on this grass species in your state or province).

FERTILIZATION:

**During Establishment:** Dryland and irrigated – apply phosphorus to last 3 years and work into soil. When seeding, apply 55 lbs/acre (62 kg/ha) of 11-55-0 or 11-52-0 with seed. After seedlings are established, apply 30 lbs/acre (34 kg/ha) of nitrogen of dryland if seeding into stubble; none is needed if planted in summer fallow. Under irrigation, apply 60 to 80 lbs/acre (67 to 90 kg/ha) of nitrogen.

**Established Stand:** On dryland, apply at least 50 lbs/acre (56kg/ha) of nitrogen each year in late fall; under irrigation, 60 to 80 lbs/acre (67 to 90 kg/ha).

IRRIGATION:

**During Establishment:** Apply enough water to get the stand established. Keep surface moist to avoid crusting. Bring soil moisture up to field capacity in early September.

**Established Stand:** Irrigate after harvest to promote vegetative production. Bring moisture level up to field capacity by early September. Irrigate in spring through the boot stage if rainfall does not provide sufficient moisture for continued plant growth (soil moisture should be above 50 per cent field capacity). Do not irrigate during flowering (pollination), but good soil moisture is essential during the early phase of seed development. Do not irrigate during seed ripening.
(**Note:** Never allow plants to be moisture stressed while floral primordia or immature seedheads are forming).

HARVEST:

**Range of harvest dates Bridger, MT:** July to August.
**Lodging:** Yes
**Shattering:** No
**Stripping:** N/A
**Direct Combine:** Satisfactory
Stage: Hard dough

## Northern or Thickspike wheatgrass continued

Ground speed: Dependent on stand, seed quantity and size of harvesting equipment. Adequate rate of feed and speed to ensure machine is operating at full capacity without overloading the cylinder and sieves.

**Swathing/Windrowing:** Preferred

Stage: Hard dough

Ground speed: As described for direct combining.

**Days in Windrow:** 2 to 3 days.

**Combine Settings:**

Air flow setting: No more than 5 per cent filled seed going out back of combine.

Cylinder speed: Fast enough to thresh seeds and not to crack caryopsis or kernels.

Cylinder spacing: Closed enough to thresh seeds, but limited breakage of stems and seeds.

**Average Dockage of Harvested Seed:** 10 per cent; Actually depends on type of sieve and settings (Peterson Sieve recommended).

PRECLEANING TREATMENT/STORAGE:

**Drying:** Usually not necessary (not to exceed 104° F or 40° C).

Swathed: Usually not necessary

Direct Combined: May require some drying if trashy.

**Safe Storage Moisture Content:**

Bins: 12 per cent

Sacks: 15 per cent

PROCESSING:

**Debearding:** No

**Scalping:** No

**Final cleaning:**

Top screen: 12/64" (0.47 cm) followed by 1/14" x 1/2" (0.18 x 1.25 cm) slotted.

Bottom screen: 6 x 24 mesh.

SEED YIELD:

**Irrigated:** Average, 200 to 500 lbs/acre (224 to 560 kg/ha).

**Dryland:** Average, 100 lbs/acre (112 kg/ha) or less.

POSTHARVEST MANAGEMENT:

**During Establishment:** See information on fertilization and irrigation.

**Established Stand:** See information on fertilization and irrigation. Graze or cut for hay. Will form a dense sod quickly, so frequent cultivation is necessary to maintain seed production.

EXPECTED PRODUCTIVE STAND LIFE: 4 to 5 years.

# Nuttall's alkali grass (*Puccinellia nuttalliana* [J.A. Schultes] A.S. Hitchc.)

SEED WEIGHT: 1,200,000/lb. (2,640,000/kg)

SEEDING RATE: (Pure live seed)
60 seeds per linear foot of row.
200 seeds per meter of row.

1 lb/acre (1.1 kg/ha) for 24" (60 cm) rows.
Multiply x 2.0 for 12" (30 cm) rows or x 0.75 for 36" (90 cm) rows.

ROW SPACING: 24" (60 cm) Irrigated or high rainfall areas.
36" (90 cm) Dryland areas.
(**Note:** Narrower row spacings are sometimes used without interrow cultivation, but seed yields and stand longevity can be reduced).

PLANTING DATE: Early spring.

WEED CONTROL:

**During Establishment:** If possible, plant in a field where weeds have been controlled by summer fallow or a broad spectrum herbicide during the previous 1 to 2 years. Wait until 3 to 5 leaf stage before applying herbicides at lower rates; clipping or bromoxynil according to label directions.

**Established Stand:** Bromoxynil, 2,4-D, dicamba and/or cultivation and hand roguing.
(**Note:** These products may not be registered on this grass species in your state or province).

FERTILIZATION:

**During Establishment:** Dryland and irrigated – apply phosphorus according to forage production rate and enough for 3 years. No nitrogen until seedlings are established or drill 50 lbs/acre (56 kg/ha) of 11-48-0 with seed. After seedlings are established, apply 30 lbs/acre (34 kg/ha) of nitrogen for dryland and 60 to 80 lbs/acre (67 to 90 kg/ha) of nitrogen for irrigated. On dryland, fallow the year before seeding.

**Established Stand:** Apply nitrogen each year – dryland, 30 lbs/acre (34 kg/ha); irrigated 60 to 80 lbs/acre (67 to 90 kg/ha).

IRRIGATION:

**During Establishment:** Apply enough water to get the stand established. Keep surface moist to avoid crusting. Bring soil moisture up to field capacity in early September.

**Established Stand:** Irrigate after harvest to promote vegetative production. Bring moisture level up to field capacity by early September. Irrigate in spring through the boot stage if rainfall does not provide sufficient moisture for continued plant growth (soil moisture should be above 50 per cent field capacity). Do not irrigate during flowering (pollination), but good soil moisture is essential during the early phase of seed development. Do not irrigate during seed ripening.
(**Note:** Never allow plants to be moisture stressed while floral primordia or immature seedheads are forming).

HARVEST:

**Range of harvest dates at Bridger, MT:** Mid to late July.
**Lodging:** No
**Shattering:** Moderate
**Stripping:** No
**Direct Combine:** Satisfactory
Stage: Mature seed.

## Nuttall's alkali grass continued

Ground speed: Dependent on stand, seed quantity and size of harvesting equipment. Adequate rate of feed and speed to ensure machine is operating at full capacity without overloading the cylinder and sieves.

**Swathing/Windrowing:** Preferred
- Stage: Hard dough.
- Ground speed: As described for direct combining.

**Days in Windrow:** 7 days.

**Combine Settings:**
- Air flow setting: No more than 5 per cent filled seed going out back of combine.
- Cylinder speed: Fast enough to thresh seed and not crack caryopsis kernels.
- Cylinder spacing: Closed enough to thresh seeds, but limited breakage of stems and seeds.

**Average Dockage of Harvested Seed:** 15 to 20 per cent; Actually depends on type of sieve and settings (Peterson Sieve recommended).

PRECLEANING TREATMENT/STORAGE:

**Drying:** Usually not necessary (not to exceed 104° F or 40° C).
- Direct Combined: May require some drying if trashy.
- Swathed: No

**Safe Storage Moisture Content:**
- Bins: 12 per cent
- Sacks: 15 per cent

PROCESSING:

**Debearding:** No

**Scalping:** No

**Final cleaning:**
- Top screen: 1/14" (0.18 cm).
- Bottom screen: 1/12" (0.21 cm).

SEED YIELD:

**Irrigated:** Average, 300 lbs/acre (336 kg/ha).

**Dryland:** Not recommended unless high precipitation or subirrigated.

POSTHARVEST MANAGEMENT:

**During Establishment:** See information on fertilizing and irrigating.

**Established Stand:** See information on fertilizing and irrigating. Graze or cut for hay in late fall after a killing frost. If cut for hay, cut stubble short.

EXPECTED PRODUCTIVE STAND LIFE: 4 years

# Prairie cordgrass (*Spartina pectinata* Link)

SEED WEIGHT: 165,000/lb. (364,000/kg)

SEEDING RATE: (Pure live seed)
30 seeds per linear foot of row.
98 seeds per meter of row.

1.3 lbs/acre (1.5 kg/ha) for 72" (180 cm) rows.
Multiply x 2.0 for 36" (90 cm) rows or x 0.6 for 120" (300 cm) rows.

ROW SPACING: 72 to 120" (180 to 300 cm) Irrigated or high rainfall areas.

PLANTING DATE: Late spring (May) to early summer (June); dormant seeding may be possible.

WEED CONTROL:

**During Establishment:** If possible, plant in a field where weeds have been controlled by summer fallow or a broad spectrum herbicide during the previous 1 to 2 years. Wait until 3 to 5 leaf stage before applying herbicides at lower rates; Bromoxynil, clipping and cultivation.

**Established Stand:** 2,4-D and/or hand roguing and cultivation.
(**Note:** These products may not be registered on this grass species in your state or province).

FERTILIZATION:

**During Establishment:** Not recommended.

**Established Stand:** Apply nitrogen at 60 to 100 lbs/acre (67 to 112 kg/ha). Apply phosphorus and potassium according to soil test recommendations.

IRRIGATION:

**During Establishment:** Apply enough water to get the stand established. Keep surface moist to avoid crusting. Bring soil moisture up to field capacity in early September.

**Established Stand:** Bring moisture level up to field capacity by early September. Irrigate in spring through the boot stage if rainfall does not provide sufficient moisture for continued plant growth (soil moisture should be above 50 per cent field capacity). Do not irrigate during flowering (pollination), but good soil moisture is essential during the early phase of seed development. Do not irrigate during seed ripening.
(**Note:** Never allow plants to be moisture stressed while floral primordia or immature seedheads are forming).

HARVEST:

**Range of harvest dates at Bismarck, ND:** October 5 to 30.

**Lodging:** None

**Shattering:** Low to medium.

**Stripping:** N/A

**Direct Combine:** Preferred

| | |
|---|---|
| Stage: | Hard dough. |
| Ground speed: | Dependent on stand, seed quantity and size of harvesting equipment. Adequate rate of feed and speed to ensure machine is operating at full capacity without overloading the cylinder and sieves. |

**Swathing/Windrowing:** Satisfactory

| | |
|---|---|
| Stage: | Medium dough. |
| Ground speed: | As described for direct combining. |

## Prairie cordgrass continued

**Days in Windrow:** 2 to 4 days.
**Combine Settings:**

| | |
|---|---|
| Air flow setting: | Low to medium. |
| Cylinder speed: | 1200 rpm |
| Cylinder spacing: | 1/4 to 3/8" (0.63 to 0.94 cm). |

PRECLEANING TREATMENT/STORAGE:

**Drying:** Yes (not to exceed 104° F or 40° C).
Direct Combined: Several days depending on humidity.
**Safe Storage Moisture Content:**
Bins: 12 per cent
Sacks: 15 per cent

PROCESSING:

**Debearding:** Yes

| | |
|---|---|
| Debearder: | Yes |
| Hammer mill: | Yes |
| Speed: | 210 rpm |
| Duration: | 30 minutes per batch. |

**Final cleaning:** Clipper 4 screen fanning mill.

| | |
|---|---|
| Top screens: | No.1 = #18; No.2 = #16. |
| Bottom screens: | No.3 = #14; No.4 = #9 triangle, 3" (7.5 cm) open. |
| Fan speed: | 110 rpm |
| Shake speed: | 420 rpm |

SEED YIELD:

**Irrigated:** Average, 100 lbs/acre (112 kg/ha)

POSTHARVEST MANAGEMENT:

**During Establishment:** See information on fertilization and irrigating.
**Established Stand:** Mow to 4 to 6" (10 to 15 cm) high after harvest, unless the field will be burned the following spring.

EXPECTED PRODUCTIVE STAND LIFE: Unknown

ADDITIONAL COMMENTS: Insects may cause seed damage in the field.

# Prairie sandreed (*Calamovilfa longifolia* [Hook.] Scribn.)

SEED WEIGHT: 274,000/lb. (603,000/kg)

SEEDING RATE: (Pure live seed)
25 to 30 seeds per linear foot of row.
82 to 100 seeds per meter of row.

2.4 lb/acre (2.7 kg/ha) for 24" (60 cm) rows.
Multiply x 2.0 for 12" (30 cm) rows or x 0.75 for 36" (90 cm) rows.

ROW SPACING: 24" (60 cm) Irrigated or high rainfall areas.
36" (90 cm) Dryland areas.

PLANTING DATE: Irrigated, May 1 to August 15. Dryland, May.

WEED CONTROL:

**During Establishment:** If possible, plant in a field where weeds have been controlled by summer fallow or a broad spectrum herbicide during the previous 1 to 2 years. Wait until 3 to 5 leaf stage before applying herbicides at lower rates; clipping and/or bromoxynil according to label directions.

**Established Stand:** Bromoxynil, 2,4-D, dicamba, atrazine (2 lbs - 2.24 kg in early June) and/or cultivation and hand roguing.
(**Note:** These products may not be registered on this grass species in your state or province).

FERTILIZATION:

**During Establishment:** Apply phosphorus according to forage production rate and enough for 3 years. No nitrogen until seedlings are established or drill 50 lbs/acre (56 kg/ha) of 11-48-0 with seed.

**Established Stand:** Apply nitrogen each spring – ryland, 30 lbs/acre (34 kg/ha); irrigated, 60 to 80 lbs/acre (67 to 90 kg/ha).

IRRIGATION:

**During Establishment:** Apply enough water to get the stand established. Keep surface moist to avoid crusting. Bring soil moisture up to field capacity in early September.

**Established Stand:** Irrigate after harvest to promote vegetative production. Bring moisture level up to field capacity by early September. Irrigate in spring through the boot stage if rainfall does not provide sufficient moisture for continued plant growth (soil moisture should be above 50 per cent field capacity). Do not irrigate during flowering (pollination), but good soil moisture is essential during the early phase of seed development. Do not irrigate during seed ripening.
(**Note:** Never allow plants to be moisture stressed while floral primordia or immature seedheads are forming).

HARVEST:

**Average date at Bridger, MT:** October 1.

**Average date at Bismarck, ND:** Late September.
Range of harvest dates: mid-September to mid-October

**Lodging:** No

**Shattering:** Yes, high.

**Stripping:** N/A

**Direct Combine:** Satisfactory to Preferred.

| | |
|---|---|
| Stage: | Hard dough to mature seed stage. |
| Ground speed: | Dependent on stand, seed quantity and size of harvesting equipment. Adequate rate of feed and speed to ensure machine is operating at full capacity without overloading the cylinder and sieves. |

**Swathing/Windrowing:** Satisfactory to Preferred.

## Prairie sandreed continued

Stage: Medium to hard dough.
Ground speed: As described for direct combining.

**Days in Windrow:** 7 to 10 days

**Combine Settings:**

Air flow setting: Closed to slightly open: No more than 5 per cent filled seed going out back of combine.
Cylinder speed: 900 to 1200 rpm; Set for minimum amount of naked caryopsis or kernels.
Cylinder spacing: 3/8" (0.95 cm) or Closed enough to thresh seeds, but limited breakage of stems and seeds.

**Average Dockage of Harvested Seed:** 40 to 50 per cent

**Other harvest recommendations:** Late harvest and tough straw can be problematic for plugging combine. Be aware of too much material coming back to return and plugging. Also, tough stems and leaves may cause wrapping problems on shafts and belts. Fuzz from seed is messy when combining.

PRECLEANING TREATMENT/STORAGE:

**Drying:** Usually not necessary (not to exceed 104° F or 40° C).
Swathed: Usually not necessary, No additional drying needed if allowed to dry in the field prior to harvest.
Direct Combined: May require some drying if trashy, typically 3 to 5 days.
Stripped: 1 to 2 days, stripping not recommended.

**Safe Storage Moisture Content:**
Bins: 12 per cent
Sacks: 15 per cent

PROCESSING:

**Debearding:** Yes
Barley debearder: Set to remove callus hairs, but minimize amount of naked caryopsis of kernels.
Hammer mill: Set to remove callus hairs, but minimize amount of naked caryopsis or kernels.
Speed: 170 rpm
Duration: 30 minutes

**Scalping:** Not always necessary; If required: Clipper 4 screen fanning mill with top door 4" (10 cm)open.
Top screen: #1 = 12; #2 = 11.
Bottom screen: #3 = 10; #4 = 9 triangle, 3" (7.5 cm) open.
Fan speed: 160 rpm
Shake speed: 400 rpm

**Final cleaning:**
Top screens: Option one: 3/64" x 5/16" (0.12 x 0.78 cm) slotted.
Option two: #11 and #10.
Bottom screens: Option one: #5 triangle.
Option two: #9 and 1/15" (0.17 cm).
Fan speed: 160 rpm
Shake speed: 400 rpm

**Special processing equipment, techniques or other considerations:**
Order of cleaning: 4 screen fanning mill, debearder, 4 screen fanning mill.

## Prairie sandreed continued

SEED YIELD:

**Irrigated:** Average, 250 lbs/acre (280 kg/ha).
Range, Bridger, MT - 200 to 500 lbs/acre (224 to 560 kg/ha).
Range, Bismarck, ND - 50 to 300 lbs/acre (56 to 336 kg/ha).

**Dryland:** Average, 100 lbs/acre (112 kg/ha) or less.
Range, 50 to 150 lbs/acre (56 to 168 kg/ha).

POSTHARVEST MANAGEMENT:

**During Establishment:** See information on fertilizing and irrigating.

**Established Stand:** See information on fertilizing and irrigating. Burning of crop residue and stubble recommended (following harvest, October or early April). Alternative: Rotary mow, rototill between rows in fall or spring.

EXPECTED PRODUCTIVE STAND LIFE: Bridger, MT - 5 to 6 years. Bismarck, ND - 10 to 15 years.

ADDITIONAL COMMENTS: Severe leaf and stem rust may be a problem in higher rainfall areas.

# Reed canarygrass (*Phalaris arundinacea* L.)

SEED WEIGHT: 227,200/lb. (500,500/kg)

SEEDING RATE: (Pure live seed)
25 to 30 seeds per linear foot of row.
82 to 100 seeds per meter of row.

3 lbs/acre (3.4 kg/ha) for 24" (60 cm) rows.
Multiply x 2.0 for 12" (30 cm) rows or x 0.75 for 36" (90 cm) rows.

ROW SPACING: 24 to 36" (60 to 90 cm) Irrigated or high rainfall areas.
36" (90 cm) Dryland areas.
(**Note:** Narrower row spacings are sometimes used without interrow cultivation, but seed yields and stand longevity can be reduced).

PLANTING DATE: Early spring.

WEED CONTROL:

**During Establishment:** If possible, plant in a field where weeds have been controlled by summer fallow or a broad spectrum herbicide during the previous 1 to 2 years. Wait until 3 to 5 leaf stage before applying herbicides at lower rates; mowing and approved chemicals.

**Established Stand:** Occasionally a broadleaf chemical may be used. Reed canarygrass is very competitive once established.
(**Note:** Use only products registered on this grass species in your state or province).

FERTILIZATION:

**During Establishment:** Apply fertilizer prior to seeding according to soil test recommendations.

**Established Stand:** Annual maintenance fertilizer should be applied in late fall/early spring and again in June. Total application of 75 to 125 lbs/acre (67 to 89 kg/ha).

IRRIGATION:

**During Establishment:** Apply enough water to get the stand established. Keep surface moist to avoid crusting. Bring soil moisture up to field capacity in early September.

**Established Stand:** Irrigate in spring through the boot stage if rainfall does not provide sufficient moisture for continued plant growth (soil moisture should be above 50 per cent field capacity). Do not irrigate during flowering (pollination), but good soil moisture is essential during the early phase of seed development. Do not irrigate during seed ripening.
(**Note:** Never allow plants to be moisture stressed while floral primordia or immature seedheads are forming. Irrigate after harvest to promote vegetative production. Bring moisture level up to field capacity by early September.)

HARVEST:

**Average date at Elsberry, MO:** June 15.
Range of harvest dates: June 10 to June 30.
**Lodging:** Moderate
**Shattering:** Yes
**Stripping:** N/A
**Direct Combine:** Preferred
Stage: Mature seed stage.
Ground speed: 2 mph (3km/h).
**Swathing/Windrowing:** Only satisfactory.
**Combine Settings:** John Deere self-propelled combine.
Air flow setting: Light air.

Cylinder speed: 900 rpm
Cylinder spacing: 2 turns (John Deere combine).

**Average Dockage of Harvested Seed:** N/A

**Other harvest recommendations:** Begin the harvesting process when the seed has just begun to shatter. Any wind movement will cause severe shattering.

PRECLEANING TREATMENT/STORAGE:

**Drying:** Yes (not to exceed 104° F or 40° C).
Direct Combined: 7 to 10 days.

**Safe Storage Moisture Content:**
Bins: 12 to 14 per cent
Sacks: Less than 10 per cent.

**Other precleaning considerations:** In the harvesting process, do not keep seed in combine hopper for more than 2 hours or heating will occur.

PROCESSING:

**Debearding:** No

**Scalping:** Yes, 67 D Clipper Cleaner.
Top screen: #10 Round screen.
Bottom screen: 1/25" (0.10 cm) round hole.
Fan speed: Light air.

**Final cleaning:**
Top screen: #8 round hole.
Middle screen: #6 round hole.
Bottom screen: 1/25" (0.10 cm) round hole.
Fan speed: 500 rpm

**Special processing equipment, techniques or other considerations:**
Seed dryer and clipper cleaner. Remove all green material from seed lot because it heats up may cause seed damage.

SEED YIELD:

**Irrigated:** Average

**Dryland:** Average, 140 lbs/acre (157 kg/ha).
Range, 45 to 283 lbs/acre (50 to 317 kg/ha).

POSTHARVEST MANAGEMENT:

**During Establishment:** See information on fertilizing.

**Established Stand:** Let vegetation stand after harvest until the following spring; burn when growth is about 1/2" (1 cm) tall, if in rows 36" (90 cm), rototill or cultivate and apply a split application of fertilizer in early late fall or early spring and again in June based on soil test results.

EXPECTED PRODUCTIVE STAND LIFE: Indefinite.

# Sand bluestem (*Andropogon hallii* Hack.)

SEED WEIGHT: 113,000/lb. (249,000/kg)

SEEDING RATE: (Pure live seed)
30 seeds per linear foot of row.
98 seeds per meter of row.

5.8 lbs/acre (6.5 kg/ha) for 24" (60 cm) rows.
Multiply x 2.0 for 12" (30 cm) rows, x 0.75 for 36" (90 cm) rows or x 0.5 for 48" (120 cm) rows.

ROW SPACING: 24 to 36" (60 to 90 cm) Irrigated or high rainfall areas.
36 to 48" (90 to 120cm) Dryland areas.
(**Note:** Narrower row spacings are sometimes used without interrow cultivation, but seed yields and stand longevity can be reduced).

PLANTING DATE: Late spring (May) to early summer (June).

WEED CONTROL:

**During Establishment:** If possible, plant in a field where weeds have been controlled by summer fallow or a broad spectrum herbicide during the previous 1 to 2 years. Wait until 3 to 5 leaf stage before applying herbicides at lower rates; Bromoxynil, 2,4-D, atrazine, clipping and cultivation.

**Established Stand:** Atrazine and/or hand roguing and cultivation.
(**Note:** These products may not be registered on this grass species in your state or province).

FERTILIZATION:

**During Establishment:** Not recommended

**Established Stand:** Apply nitrogen at 50 to 80 lbs/acre (56 to 89 kg/ha). Apply phosphorus and potassium according to soil test recommendations.

IRRIGATION:

**During Establishment:** Apply enough water to get the stand established. Keep surface moist to avoid crusting. Bring soil moisture up to field capacity in early September.

**Established Stand:** Bring moisture level up to field capacity by early September. Irrigate in spring through the boot stage if rainfall does not provide sufficient moisture for continued plant growth (soil moisture should be above 50 per cent field capacity). Do not irrigate during flowering (pollination), but good soil moisture is essential during the early phase of seed development. Do not irrigate during seed ripening.
(**Note:** Never allow plants to be moisture stressed while floral primordia or immature seedheads are forming).

HARVEST:

**Range of harvest dates at Bismarck, ND:** September 15 to 30.

**Lodging:** None

**Shattering:** Moderate

**Stripping:** Satisfactory.

| | |
|---|---|
| Stage: | Hard dough to mature seed. |
| Brush speed: | 600 to 900 rpm. |

**Direct Combine:** Preferred

| | |
|---|---|
| Stage: | Hard dough to mature seed. |
| Ground speed: | Dependent on stand, seed quantity and size of harvesting equipment. Adequate rate of feed and speed to ensure machine is operating at full capacity without overloading the cylinder and sieves. |

**Swathing/Windrowing:** Marginally satisfactory.

## Sand bluestem continued

Stage: Soft to medium dough.
Ground speed: As described for direct combining.

**Days in Windrow:** 3 to 7 days.

**Combine Settings:**

Air flow setting: Low to completely closed.
Cylinder speed: 900 to 1200 rpm
Cylinder spacing: 1/2 to 3/8" (1.25 to 0.94 cm).

**Average Dockage of Harvested Seed:** 30 to 50 per cent

PRECLEANING TREATMENT/STORAGE:

**Drying:** Often required (not to exceed 104° F or 40° C).
Swathed: Usually not necessary.
Direct Combined: Several days, depending on humidity.
Stripped: Several days, depending on humidity.

**Safe Storage Moisture Content:**

Bins: 12 per cent
Sacks: 15 per cent

PROCESSING:

**Debearding:** Yes
Clipper debearder: 170 rpm for 50 minutes.
Hammer mill: 1/4" (0.63 cm) screen.

**Scalping:** 2 screen fanning mill.
Top screen: #15 or #18 round hole.
Bottom screen: #9 triangle, 3" (7.5 cm) open.
Fan speed: 1/3 open.

**Final cleaning:** Clipper 4 screen fanning mill.
Top screen: No.1 = #14; No.2 = #13.
Bottom screen: No.3 = #12; No.4 = #9 triangle, 3" (7.5 cm) open.
Fan speed: 185 rpm
Shake speed: 340 rpm

**Special processing equipment, techniques or other considerations:**

Order of cleaning: Hammer mill, 2 screen fanning mill, hammermill, 2 or 4 screen fanning mill, debearder, 2 or 4 screen fanning mill.

SEED YIELD:

**Irrigated:** Average, 150 lbs/acre (168 kg/ha).
Range, 100 to 250 lbs/acre (112 to 280 kg/ha).

**Dryland:** Average, 75 lbs/acre (84 kg/ha).
Range, 50 to 150 lbs/acre (56 - 168 kg/ha).

POSTHARVEST MANAGEMENT:

**During Establishment:** See information on fertilization and irrigating.

**Established Stand:** Rotary mow and rototill or cultivate between rows in the fall or spring; or burning on a regular basis.

EXPECTED PRODUCTIVE STAND LIFE: 10 to 15 years

# Sedges (*Carex* spp.)

SEED WEIGHT: 1,050,000/lb. (2,300,000/kg)

SEEDING RATE: Unknown

ROW SPACING: Unknown

PLANTING DATE: Unknown

**Note:** At present, seeding is extremely difficult and not very productive. No seeding guidelines are available at present. Almost all propagation is greenhouse produced plugs or wild transplants.

HARVEST:

**Average date at Aberdeen, ID:** Mid-September

Range of harvest dates: Varies with elevation and latitude.

**Lodging:** No

**Shattering:** Yes

**Stripping:** Preferred.

**Direct Combine:** N/A

**Swathing/Windrowing:** N/A

**Combine Settings:** N/A

**Other harvest recommendations:**

Seedheads are often under heavy leaf growth and are difficult to find initially.

STORAGE:

Store seed in the dark, submerged in water at 34 to 360F (1 to 2°C).

PROCESSING:

**Debearding:** Yes

Hammer mill:

| | |
|---|---|
| Speed: | 900 rpm |
| Duration: | 1 or 2 seconds. |

**Scalping:** No

**Final cleaning:**

| | |
|---|---|
| Top screen: | #8 round hole. |
| Bottom screen: | 1/20" (0.13 cm) round hole. |
| Shake speed: | 1680 rpm |

**Special processing equipment, techniques or other considerations:**

Important to remove perigynia. Use Forsberg scarifier on dry seeds for a very short time (just enough to remove perigynia), but not extensively damage seed.

SEED YIELD: Extreme variation by year and location. Mainly native harvest at present.

POSTHARVEST MANAGEMENT: N/A

EXPECTED PRODUCTIVE STAND LIFE: Unknown

ADDITIONAL COMMENTS: Older stands tend to set more seed: Very old stand are an unknown. Very young stands tend to spread more.

# Side-oats grama (*Bouteloua curtipendula* [Michx.] Torr.)

SEED WEIGHT: 191,000/lb. (421,000/kg) - spikelets.

SEEDING RATE: (Pure live seed)
30 seeds per linear foot of row.
98 seeds per meter of row.

3.5 lbs/acre (3.9 kg/ha) for 24" (60 cm) rows.
Multiply x 2.0 for 12" (30 cm) rows, x 0.75 for 36" (90 cm) rows and x 0.5 for 48" rows.

ROW SPACING: 24 to 36" (60 to 90 cm) Irrigated or high rainfall areas.
36 to 48" (90 to 120cm) Dryland areas.
(**Note:** Narrower row spacings are sometimes used without interrow cultivation, but seed yields and stand longevity can be reduced).

PLANTING DATE: Late spring (May) or early summer (June).

WEED CONTROL:

**During Establishment:** If possible, plant in an field where weeds have been controlled by summer fallow or a broad spectrum herbicide during the previous 1 to 2 years. Wait until 3 to 5 leaf stage before applying herbicides at lower rates; Bromoxynil, 2,4-D, clipping and cultivation. Do not use atrazine the year of establishment.

**Established Stand:** Atrazine (may cause some leaf tip burn), imazethapyr (Pursuit), 2,4-D and/or hand roguing and cultivation.
(**Note:** These products may not be registered on this grass species in your state or province).

FERTILIZATION:

**During Establishment:** Not recommended.

**Established Stand:** Apply nitrogen at 40 to 60 lbs/acre (44.8 to 67.2 kg/ha). Apply phosphorus and potassium according to soil test recommendations.

IRRIGATION:

**During Establishment:** Apply enough water to get the stand established. Keep surface moist to avoid crusting. Bring soil moisture up to field capacity in early September.

**Established Stand:** Bring moisture level up to field capacity by early September. Irrigate in spring through the boot stage if rainfall does not provide sufficient moisture for continued plant growth (soil moisture should be above 50 per cent field capacity). Do not irrigate during flowering (pollination), but good soil moisture is essential during the early phase of seed development. Do not irrigate during seed ripening.
(**Note:** Never allow plants to be moisture stressed while floral primordia or immature seedheads are forming).

HARVEST:

**Range of harvest dates at Bismarck, ND:** August 5 to September 15.

**Lodging:** None

**Shattering:** Slight

**Stripping:** Satisfactory
Stage: Mature seed.

**Direct Combine:** Preferred method.
Stage: Hard dough.
Ground speed: Dependent on stand, seed quantity and size of harvesting equipment. Adequate rate of feed and speed to ensure machine is operating at full capacity without overloading the cylinder and sieves.

## Side-oats grama continued

**Swathing/Windrowing:** Satisfactory

| | |
|---|---|
| Stage: | Medium dough |
| Ground speed: | As described for direct combining. |

**Days in Windrow:** 2 to 4 days.

**Combine Settings:**

| | |
|---|---|
| Air flow setting: | Low |
| Cylinder speed: | 700 to 1100 rpm |
| Cylinder spacing: | 3/8 to 1/4" (0.94 to 1.25 cm). |

**Average Dockage of Harvested Seed:** 30 per cent

**Other harvest recommendations:** Uneven ripening is common with sideoats grama. Whena majority of the seed is ready to harvest, there will be some seed that will remain on the seed head after combining.

PRECLEANING TREATMENT/STORAGE:

**Drying:** Usually required (not to exceed 104° F or 40° C).

| | |
|---|---|
| Swathed: | May not be necessary. |
| Direct Combined: | Must be dried several days before bagging. |
| Stripped: | Usually should be dried. |

**Safe Storage Moisture Content:**

Bins: 12 per cent

Sacks: 15 per cent

PROCESSING:

**Debearding:** N/A

**Scalping:** N/A

**Final cleaning:** Clipper 4 screen fanning mill.

| | |
|---|---|
| Top screens: | No.1 = #16; No.2 = #14. |
| Bottom screens: | No.3 = #13; No.4 = #9 triangle, 3" (7.5 cm) open. |
| Fan speed: | 160 rpm |
| Shake speed: | 330 rpm |

**Special processing equipment, techniques or other considerations:**

After first run through with fanning mill, seed that remains in larger clumps (spikelets) is hammermilled using a 1/4" (.63 cm) screen with a speed of 750 rpm to further break up the spikelets and then run through the fanning mill again.

SEED YIELD:

**Irrigated:** Average, 250 lbs/acre (280 kg/ha).
Range, 100 to 400 lbs/acre (112 to 448 kg/ha).

**Dryland:** Average, 100 lb/acre (112 kg/ha).
Range, 50 to 200 lb/acre (56 to 224 kg/ha).

POSTHARVEST MANAGEMENT:

**During Establishment:** See information on fertilization and irrigating.

**Established Stand:** Rotary mow and rototill or cultivate between rows in the fall or spring or burning on a regular basis.

EXPECTED PRODUCTIVE STAND LIFE: 10 to 15 years

ADDITIONAL COMMENTS: Thrips can be a problem.

# Slender wheatgrass *(Elymus trachycaulus* [Link] Gould ex Shinners subsp. *trachycaulus;* formerly *Agropyron tracycaulum)*

SEED WEIGHT: 160,000/lb. (352,000/kg)

SEEDING RATE: (Pure live seed)
25 to 30 seeds per linear foot of row.
82 to 100 seeds per meter of row.

4.1 lbs/acre (4.6 kg/ha) for 24" (60 cm) rows.
Multiply x 2.0 for 12" (30 cm) rows or x 0.75 for 36" (90 cm) rows.

ROW SPACING: 24" (60 cm) Irrigated or high rainfall areas.
36" (90 cm) Dryland areas.
(**Note**: Narrower row spacings are sometimes used without interrow cultivation, but seed yields and stand longevity can be reduced).

PLANTING DATE: Early in spring; late summer by mid-August with irrigation.

WEED CONTROL:

**During Establishment:** If possible, plant in a field where weeds have been controlled by summer fallow or a broad spectrum herbicide during the previous 1 to 2 years. Wait until 3 to 5 leaf stage before applying herbicides at lower rates; clipping or Bromoxynil according to label directions.

**Established Stand:** Bromoxynil, metribuzin (Sencor), 2,4-D, dicamba and/or cultivation and hand- roguing. (**Note:** These products may not be registered on this grass species in your state or province).

FERTILIZATION:

**During Establishment:** Dryland and irrigated – apply phosphorus to last 3 years and work into soil. When seeding, apply 55 lbs/acre (62 kg/ha) of 11-55-0 or 11-52-0 (high phosphorus fertilizer) with seed. After seedlings are established, apply 30 lbs/acre (34 kg/ha) of nitrogen on dryland if seeding into stubble; none is needed if planted in summer fallow. Under irrigation, apply 60 to 80 lbs/acre (67 to 90 kg/ha) of nitrogen.

**Established Stand:** On dryland, apply at least 50 lbs/acre (56 kg/ha) of nitrogen each year in late fall; under irrigation, 60 to 80 lbs/acre (67 to 90 kg/ha).

IRRIGATION:

**During Establishment:** Apply enough water to get the stand established. Keep surface moist to avoid crusting. Bring soil moisture up to field capacity in early September.

**Established Stand:** Irrigate after harvest to promote vegetative production. Bring moisture level up to field capacity by early September. Irrigate in spring through the boot stage if rainfall does not provide sufficient moisture for continued plant growth (soil moisture should be above 50 per cent field capacity). Do not irrigate during flowering (pollination), but good soil moisture is essential during the early phase of seed development. Do not irrigate during seed ripening.
(**Note:** Never allow plants to be moisture stressed while floral primordia or immature seedheads are forming).

HARVEST:

**Range of harvest dates at Bridger, MT:** Mid-July to mid-August.
**Lodging:** No
**Shattering:** No
**Stripping:** N/A
**Direct Combine:** Satisfactory
Stage: Mature seed stage

## Slender wheatgrass continued

Ground speed: Dependent on stand, seed quantity and size of harvesting equipment. Adequate rate of feed and speed to ensure machine is operating at full capacity without overloading the cylinder and sieves.

**Swathing/Windrowing:** Preferred

Stage: Hard dough

Ground speed: As described for direct combining.

**Days in Windrow:** 4 to 7 days

**Combine Settings:**

Air flow setting: No more than 5 per cent filled seed going out back of combine.

Cylinder speed: Fast enough to thresh seeds and not crack caryopsis or kernels.

Cylinder spacing: Closed enough to thresh seeds, but limited breakage of stems and seeds.

**Average Dockage of Harvested Seed:** 10 per cent; Actually depends on type of sieve and settings (Peterson Sieve recommended).

PRECLEANING TREATMENT/STORAGE:

**Drying:** Usually not necessary (not to exceed 104° F or 40° C).

Swathed: Not usually necessary.

Direct Combined: May require some drying if trashy.

**Safe Storage Moisture Content:**

Bins: 12 per cent

Sacks: 15 per cent

PROCESSING:

**Debearding:** No

**Scalping:** No

**Final cleaning:**

Top screens: No.1 - 1/13" x 1/2" (0.19 x 1.25 cm) slotted.
No.2 - 1/14" x 1/12" (0.18 x 0.21 cm).

Bottom screen: 6 x 24 mesh.

SEED YIELD:

**Irrigated:** Average, 500 lbs/acre (560 kg/ha) plus.

**Dryland:** Average, 200 to 400 lbs/acre (224 to 448 kg/ha).

POSTHARVEST MANAGEMENT:

**During Establishment:** See information on fertilization and irrigation.

**Established Stand:** See information on fertilization and irrigation. Can fall graze or cut for hay.

EXPECTED PRODUCTIVE STAND LIFE: 3 to 4 years.

# Streambank wheatgrass (*Elymus lanceolatus* ssp. *lanceolatus*; formerly *Agropyrum riparium*)

SEED WEIGHT: 152,000/lb. (334,000/kg)

SEEDING RATE: (Pure live seed)
25 to 30 seeds per linear foot of row.
82 to 100 seeds per meter of row.

4.3 lbs/acre (4.8 kg/ha) for 24" (60 cm) rows.
Multiply x 2.0 for 12" (30 cm) rows or x 0.75 for 36" (90 cm) rows.

ROW SPACING: 24 to 36" (60 to 90 cm) Irrigated or high rainfall areas.
36" (90 cm) Dryland areas.
(**Note:** Narrower row spacings are sometimes used without interrow cultivation, but seed yields and stand longevity can be reduced).

PLANTING DATE: Early in spring; late summer by mid-August with irrigation. Alternative option: Dormant fall seeding just prior to freeze up.

WEED CONTROL:

**During Establishment:** If possible, plant in a field where weeds have been controlled by summer fallow or a broad spectrum herbicide during the previous 1 to 2 years. Wait until 3 to 5 leaf stage before applying herbicides at lower rates; clipping or bromoxynil according to label directions.

**Established Stand:** Bromoxynil, 2,4-D, dicamba and/or cultivation and hand roguing.
(**Note:** These products may not be registered on this grass species in your state or province).

FERTILIZATION:

**During Establishment:** Dryland and irrigated – apply phosphorus to last 3 years and work into soil. When seeding, apply 55 lbs/acre (62 kg/ha) of 11-55-0 or 11-52-0 (high phosphorus fertilizer) with seed. After seedlings are established, apply 30 lbs/acre (34 kg/ha) of nitrogen on dryland if seeding into stubble; none is needed if planted in summer fallow. Under irrigation, apply 60 to 80 lbs/acre (67 to 90 kg/ha) of nitrogen.

**Established Stand:** On dryland, apply at least 50 lbs/acre (56 kg/ha) of nitrogen each year in late fall; under irrigation, 60 to 80 lbs/acre (67 to 90 kg/ha).

IRRIGATION:

**During Establishment:** Apply enough water to get the stand established. Keep surface moist to avoid crusting. Bring soil moisture up to field capacity in early September.

**Established Stand:** Irrigate after harvest to promote vegetative production. Bring moisture level up to field capacity by early September. Irrigate in spring through the boot stage if rainfall does not provide sufficient moisture for continued plant growth (soil moisture should be above 50 per cent field capacity). Do not irrigate during flowering (pollination), but good soil moisture is essential during the early phase of seed development. Do not irrigate during seed ripening.
(**Note:** Never allow plants to be moisture stressed while floral primordia or immature seedheads are forming).

HARVEST:

**Range of harvest dates at Bridger, MT:** Late July to mid-August.
**Lodging:** No
**Shattering:** No
**Stripping:** N/A
**Direct Combine:** Satisfactory
Stage: Mature seed stage.

## Streambank wheatgrass continued

Ground speed: Dependent on stand, seed quantity and size of harvesting equipment. Adequate rate of feed and speed to ensure machine is operating at full capacity without overloading the cylinder and sieves.

**Swathing/Windrowing:** Preferred
- Stage: Hard dough.
- Ground speed: As described for direct combining.

**Days in Windrow:** 5 to 7 days.

**Combine Settings:**
- Air flow setting: No more than 5 per cent filled seed going out back of combine.
- Cylinder speed: Fast enough to thresh seeds and not to crack caryopsis or kernels.
- Cylinder spacing: Closed enough to thresh seeds, but limited breakage of stems and seeds.

**Average Dockage of Harvested Seed:** 10 per cent; Actually depends on type of sieve and its setting (Peterson Sieve recommended).

PRECLEANING TREATMENT/STORAGE:

**Drying:** Usually not necessary (not to exceed 104° F or 40° C).
- Swathed: Usually not necessary
- Direct Combined: May require some drying if trashy.

**Safe Storage Moisture Content:**
- Bins: 12 per cent
- Sacks: 15 per cent

PROCESSING:

**Debearding:** No

**Scalping:** No

**Final cleaning:**
- Top screens: 12/64" (0.47 cm) followed by 1/14" x 1/2" (0.18 x 1.25 cm) slotted.
- Bottom screen: 6 x 24 mesh.

SEED YIELD:

**Irrigated:** Average, 200 to 400 lbs/acre (224 to 448 kg/ha).

**Dryland:** Average, 100 lbs/acre (112 kg/ha) or less.

POSTHARVEST MANAGEMENT:

**During Establishment:** See information on fertilization and irrigation.

**Established Stand:** See information on fertilization and irrigation. Graze or cut for hay. Will form a dense sod quickly, so frequent cultivation is necessary to maintain seed production.

EXPECTED PRODUCTIVE STAND LIFE: 4 to 5 years.

# Switchgrass (*Panicum virgatum* L.)

SEED WEIGHT: 389,000/lb. (857,000/kg)

SEEDING RATE: (Pure live seed)
30 seeds per linear foot of row.
98 seeds per meter of row.

1.7 lb/acre (1.9 kg/ha) for 24" (60 cm) rows.
Multiply x 2.0 for 12" (30 cm) rows, x 0.75 for 36" (90 cm) rows or x 0.5 for 48" (120 cm) rows.

ROW SPACING: 24 to 36" (60 to 90 cm) Irrigated or high rainfall areas.
36 to 48" (90 to 120cm) Dryland areas.
(**Note:** Narrower row spacings are sometimes used without interrow cultivation, but seed yields and stand longevity can be reduced).

PLANTING DATE: Late spring (May), early summer (June) or dormant seeding (November)

WEED CONTROL:

**During Establishment:** If possible, plant in a field where weeds have been controlled by summer fallow or a broad spectrum herbicide during the previous 1 to 2 years. Wait until 3 to 5 leaf stage before applying herbicides at lower rates; Atrazine, Bromoxynil, 2,4-D, clipping and cultivation.

**Established Stand:** Atrazine, 2,4-D and/or hand roguing and cultivation.
(**Note:** These products may not be registered on this grass species in your state or province).

FERTILIZATION:

**During Establishment:** Not recommended.

**Established Stand:** Apply nitrogen at 60 to 120 lbs/acre (67 to 134 kg/ha) in late spring. Apply phosphorus and potassium according to soil test recommendations.

IRRIGATION:

**During Establishment:** Apply enough water to get the stand established. Keep surface moist to avoid crusting. Bring soil moisture up to field capacity in early September.

**Established Stand:** Bring moisture level up to field capacity by early September. Irrigate in spring through the boot stage if rainfall does not provide sufficient moisture for continued plant growth (soil moisture should be above 50 per cent field capacity). Do not irrigate during flowering (pollination), but good soil moisture is essential during the early phase of seed development. Do not irrigate during seed ripening.
(**Note:** Never allow plants to be moisture stressed while floral primordia or immature seedheads are forming).

HARVEST:

**Range of harvest dates at Bismarck, ND:** August 5 to September 15.

**Lodging:** Slight

**Shattering:** Low to moderate.

**Stripping:** N/A

**Direct Combine:** Preferred

| | |
|---|---|
| Stage: | Hard dough |
| Ground speed: | Dependent on stand, seed quantity and size of harvesting equipment. Adequate rate of feed and speed to ensure machine is operating at full capacity without overloading the cylinder and sieves. |

**Swathing/Windrowing:** Satisfactory

| | |
|---|---|
| Stage: | Medium dough. |
| Ground speed: | As described for direct combining. |

## Switchgrass continued

**Days in Windrow:** 3 to 5 days.
**Combine Settings:**
Air flow setting: Low
Cylinder speed: 900 to 1500 rpm.
Cylinder spacing: 1/4 to 1/16" (1.25 to 0.31 cm).
**Average Dockage of Harvested Seed:** 30 to 40 per cent
**Other harvest recommendations:** Seed must be dried as soon as possible to avoid heating.

PRECLEANING TREATMENT/STORAGE:
**Drying:** Yes (not to exceed 104° F or 40° C).
Swathed: Drying often required.
Direct Combined: Dry for several days starting immediately after harvest.
**Safe Storage Moisture Content:**
Bins: 12 per cent
Sacks: 15 per cent

PROCESSING:
**Debearding:** Yes
Hammer mill: 1/16" (0.16 cm) screen size.
Speed: Slow
Duration: Continuous flow.
**Scalping:** Clipper 4 screen fanning mill with top door open 2" (5 cm).
Top screens: No.1 = #8; No.2 = 1/15" (0.17 cm).
Bottom screens: No.3 = 1/16" (0.16 cm); No.4 = 1/22" (0.12 cm).
Fan speed: 320 rpm
Shake speed: 425 rpm
**Final cleaning:** Clipper 4 screen fanning mill.
Top screens: No.1 = #8; No.2 = 1/15" (0.17 cm).
Bottom screen: #3 = 1/16 (0.16 cm); #4 = 1/22 (0.12 cm).
Fan speed: 275 rpm
Shake speed: 425 rpm
**Special processing equipment, techniques or other considerations:**
Order of cleaning: 4 screen fanning mill; hammer mill; 4 screen fanning mill. Each year is a little different, but generally some of the harvested seed retains the hulls which need to be run through the hammer mill before going back through the fanning mill.

SEED YIELD:
**Irrigated:** Average, 400 lbs/acre (448 kg/ha).
Range, 200 to 700 lbs/acre ( 224 to 784 kg/ha).
**Dryland:** Average, 200 lbs/acre (224 kg/ha).
Range, 100 to 400 lbs/acre (112 to 448 kg/ha).

POSTHARVEST MANAGEMENT:
**During Establishment:** See information on fertilization and irrigating.
**Established Stand:** Rotary mow, rototill or cultivate between rows in fall or spring; or burning on a regular basis.

EXPECTED PRODUCTIVE STAND LIFE: 10 to 15 years

ADDITIONAL COMMENTS: Seed bags should be double-stitched to avoid seed leaking through seams. Foxtail (pigeon grass) seed is difficult to remove from clean switchgrass seed. It is essential to remove this weed from the field before harvesting.

# Tufted hairgrass (*Deschampsia caespitosa* [L.] Beauv.)

SEED WEIGHT: 2,500,000/lb. (5,500,000/kg)

SEEDING RATE: (Pure live seed)
36 seeds per linear foot of row.
120 seeds per meter of row.

1 lb/acre (1.1 kg/ha) for 24" (60 cm) rows.
Multiply x 2.0 for 12" (30 cm) rows or x 0.75 for 36" (90 cm) rows.

ROW SPACING: 24 to 36" (60-90 cm) Irrigated or high rainfall areas.
36" (90 cm) Dryland areas.
(**Note:**Narrower row spacings are sometimes used without interrow cultivation, but seed yields and stand longevity can be reduced).

PLANTING DATE: Spring, late summer, or dormant fall seeded just prior to freeze up.

WEED CONTROL:

**During Establishment:** If possible, plant in a field where weeds have been controlled by summer fallow or a broad spectrum herbicide during the previous 1 to 2 years. Wait until 3 to 5 leaf stage before applying herbicides at lower rates; clipping or Bromoxynil according to label directions.

**Established Stand:** Bromoxynil, 2,4-D, dicamba and/or cultivation and hand roguing.
(**Note:** These products may not be registered on this grass species in your state or province).

FERTILIZATION:

**During Establishment:** Apply phosphorus according to soil test recommendations. Needs approximately 30 lbs/acre (34 kg/ha) available nitrogen.

**Established Stand:** Needs approximately 45 lbs/acre (50 kg/ha) of available nitrogen.

IRRIGATION:

**During Establishment:** Apply enough water to get the stand established. Keep surface moist to avoid crusting. Bring soil moisture up to field capacity in early September.

**Established Stand:** Irrigate in spring through the boot stage if rainfall does not provide sufficient moisture for continued plant growth (soil moisture should be above 50 per cent field capacity). Do not irrigate during flowering (pollination), but good soil moisture is essential during the early phase of seed development. Do not irrigate during seed ripening.
(**Note:** Never allow plants to be moisture stressed while floral primordia or immature seedheads are forming. Irrigate after harvest to promote vegetative production. Bring moisture level up to field capacity by early September).

HARVEST:

**Average date at Meeker, CO:** July 1.
Range of harvest dates: June 15 to July 15.

**Lodging:** No

**Shattering:** Can be a problem.

**Stripping:** N/A

**Direct Combine:** Preferred

| | |
|---|---|
| Stage: | At 5 to 10 per cent shatter. |
| Ground speed: | 3 mph (4.9 km/h). |

**Swathing/Windrowing:** N/A

**Combine Settings:**

| | |
|---|---|
| Air flow setting: | Low |

## Tufted hairgrass continued

Cylinder speed: 850 rpm
Cylinder spacing: Close

**Average Dockage of Harvested Seed:**

PRECLEANING TREATMENT/STORAGE:

**Drying:** Yes (not to exceed 104° F or 40° C).
Swathed: Usually not necessary.
Direct Combined: May require some drying if trashy.
Stripped: Needs to be dried several days before bagging.

**Safe Storage Moisture Content:**
Bins: 10 per cent
Sacks: 10 per cent

PROCESSING:

**Debearding:** No
**Scalping:** No
**Final cleaning:**
Top screen: 1/16" (0.16 cm)
Bottom screen: Blank

SEED YIELD:

**Irrigated:** Average, 40 lbs/acre (44.8 kg/ha) clean seed.
Range, 20 to 60 lbs/acre (22 to 67 kg/ha).
**Dryland:** No experience.

POSTHARVEST MANAGEMENT:

**During Establishment:** See information on fertilizing and irrigation.
**Established Stand:** See information on fertilizing, irrigation and weed control.

EXPECTED PRODUCTIVE STAND LIFE: 8 years.

# Western wheatgrass (*Pascopyrum smithii* [Rydb.] A. Love; formerly *Agropyron smithii*)

SEED WEIGHT: 114,000/lb. (251,000/kg)

SEEDING RATE: (Pure live seed)
25 to 30 seeds per linear foot of row.
82 to 100 seeds per meter of row.

5.7 lbs/acre (6.4 kg/ha) for 24" (60 cm) rows.
Multiply x 2.0 for 12" (30 cm) rows or x 0.75 for 36" (90 cm) rows.

ROW SPACING: 24 to 36" (60 to 90 cm) Irrigated or high rainfall areas.
36" (90 cm) Dryland areas.
(**Note:** Narrower row spacings are sometimes used without interrow cultivation, but seed yields and stand longevity can be reduced).

PLANTING DATE: Dormant seeding in fall just prior to freeze up, spring (April to May), or late summer (August to September) with irrigation.

WEED CONTROL:

**During Establishment:** If possible, plant in a field where weeds have been controlled by summer fallow or a broad spectrum herbicide during the previous 1 to 2 years. Wait until 3 to 5 leaf stage before applying herbicides at lower rates; clipping or Bromoxynil according to label directions.

**Established Stand:** Bromoxynil, metribuzin (Sencor), 2,4-D, dicamba and/or cultivation and hand- roguing. (**Note**: These products may not be registered on this grass species in your state or province).

FERTILIZATION:

**During Establishment:** Dryland and irrigated – apply phosphorus according to forage production rate and enough for 3 years. No nitrogen until seedlings are established or drill 50 lbs/acre (56 kg/ha) of 11-48-0 with seed. After seedlings are established, apply 30 lbs/acre (34 kg/ha) of nitrogen for dryland; 60 to 80 lbs/acre (67 to 90 kg/ha) for irrigated. On dryland, fallow the year before seeding.

**Established Stand:** Apply nitrogen each year – dryland, 30 lbs/acre (34 kg/ha) of nitrogen; irrigated, 60 to 80 lbs/acre (67 to 90 kg/ha).

IRRIGATION:

**During Establishment:** Apply enough water to get the stand established. Keep surface moist to avoid crusting. Bring soil moisture up to field capacity in early September.

**Established Stand:** Irrigate after harvest to promote vegetative production. Bring moisture level up to field capacity by early September. Irrigate in spring through the boot stage if rainfall does not provide sufficient moisture for continued plant growth (soil moisture should be above 50 per cent field capacity). Do not irrigate during flowering (pollination), but good soil moisture is essential during the early phase of seed development. Do not irrigate during seed ripening.
(**Note:** Never allow plants to be moisture stressed while floral primordia or immature seedheads are forming).

HARVEST:

**Average date at Bridger, MT:** Mid-August.
**Average date at Bismarck, ND:** Early to mid-August.
**Lodging:** Yes
**Shattering:** No
**Stripping:** N/A
**Direct Combine:** Satisfactory
Stage: Hard dough.

## Western wheatgrass continued

Ground speed: Dependent on stand, seed quantity and size of harvesting equipment. Adequate rate of feed and speed to ensure machine is operating at full capacity without overloading the cylinder and sieves.

**Swathing/Windrowing:** Preferred
- Stage: Hard dough.
- Ground speed: As described for direct combining.

**Days in Windrow:** 3 to 8 days.

**Combine Settings:**
- Air flow setting: Low; No more than 5 per cent filled seed going out back of combine.
- Cylinder speed: Approx. 750 to 1500 rpm; Fast enough to thresh seeds and not crack caryopsis or kernels.
- Cylinder spacing: 3/8" to 1/8" (0.95 to 0.32 cm); Closed enough to thresh seeds, but limited breakage of stems and seeds.

**Average Dockage of Harvested Seed:** 30 per cent; Actually depends on type of sieve and settings (Peterson Sieve recommended).

PRECLEANING TREATMENT/STORAGE:

**Drying:** May be required (not to exceed 104° F or 40° C).
- Swathed: Usually not necessary.
- Direct Combined: Often required when trashy. Make sure seeds are dry before bagging.

**Safe Storage Moisture Content:**
- Bins: 12 per cent
- Sacks: 15 per cent

PROCESSING:

**Debearding:** Sometimes required.
- Hammer mill: Screen size 1/4" (0.63 cm) or 3/8" (0.94 cm).
- Speed: 1500 rpm

**Scalping:** May be required;
- Clipper 4 screen fanning mill. Top door open 2" (5 cm).
- Top screens: 1/13 x 1/2" (0.2 x 1.27 cm) then 1/14 x 1/2" (0.18 x 1.27 cm).
- Bottom screens: 1/14 x 1/4" (0.18 x 0.63 cm) then #9 triangle, 3" (7.5 cm) open.
- Fan speed: 250 rpm
- Shake speed: 380 rpm

**Final cleaning:**
- Top screens: Option one: 1/13 x 1/2" (0.20 x 1.27 cm) then 1/14 x 1/2 (0.18 x 1.27 cm). Option two: 12/64" (0.47 cm) followed by 1/14" x 1/2" (0.18 x 1.25 cm) slotted.
- Bottom screens: Option one: 1/14 x 1/4" (0.18 x 0.63 cm) then #9 triangle, 3" (7.5 cm) open. Option two: 6 x 22 mesh.
- Fan speed: 230 rpm
- Shake speed: 380 rpm

**Special processing equipment, techniques or other consideration:**
Sometimes seed is hammer milled after first run through fanning mill to break up doubles.

SEED YIELD:

**Irrigated:** Average, 200 lbs/acre (224 kg/ha).
Range, 150 to 300 lbs/acre (168 to 336 kg/ha).

**Dryland:** Average, 100 lbs/acre (112 kg/ha).
Range, 75 to 150 lbs/acre (84 to 168 kg/ha).

## Western wheatgrass continued

POSTHARVEST MANAGEMENT:

**During Establishment:** See information on fertilizing and irrigating.

**Established Stand:** See information on fertilizing and irrigating. Graze lightly or cut for hay in late fall after a killing frost. If cut for hay, cut stubble short. Cultivate in two directions in August or September. Some producers burn immediately after harvest or before regrowth in spring.

EXPECTED PRODUCTIVE STAND LIFE: 3 to 5 years. Intensive cultivation is required for stand to remain productive over 3 years.

ADDITIONAL COMMENTS: Thrips can sometimes be a problem in western wheatgrass.

# Native Forbs

## American hedysarum (N. Sweetvetch) (*Hedysarum boreale* or Nutt. *alpinum var. americanum*)

SEED WEIGHT: 60,000/lb. (132,000/kg)

SEEDING RATE: (Pure live seed)
25 to 30 seeds per linear foot of row.
82 to 100 seeds per meter of row.

9 lb/acre (10.1 kg/ha) for 24" (60 cm) rows.
Multiply x 0.75 for 36" (90 cm) rows.

ROW SPACING: 36" (90 cm) Irrigated or high rainfall areas.
36" (90 cm) Dryland areas.

PLANTING DATE: Early spring (**Note:** Indigenous plants provide rhizobia for inoculum).

WEED CONTROL:

**During Establishment:** If possible, plant in a field where weeds have been controlled by summer fallow or a broad spectrum herbicide during the previous 1 to 2 years. Wait until 3 to 5 leaf stage before applying herbicides at lower rates.

**Established Stand:** Apply a preemergent herbicide mid-August and as early as possible in the spring at rates recommended rates.
(**Note:** There may be a limited number of herbicide registered for this species in your state or province).

FERTILIZATION:

**During Establishment:** Apply phosphorus according to soil test recommendation. No nitrogen needed since this species is a N-fixer.

**Established Stand:** None required.

IRRIGATION:

**During Establishment:** Apply enough water to get the stand established. Keep surface moist to avoid crusting. Bring soil moisture up to field capacity in early September.

**Established Stand:** Be careful not to over irrigate. Irrigate in spring through the boot stage if rainfall does not provide sufficient moisture for continued plant growth (soil moisture should be above 50 per cent field capacity). Do not irrigate during flowering (pollination), but good soil moisture is essential during the early phase of seed development. Do not irrigate during seed ripening.
(**Note:** Never allow plants to be moisture stressed while floral primordia or immature seedheads are forming. Irrigate after harvest to promote vegetative production. Bring moisture level up to field capacity by early September).

HARVEST:

**Average date at Meeker, CO:** July 20
Range of harvest dates: July 1 to August 15.

**Lodging:** N/A

**Shattering:** Can be a problem.

**Stripping:** N/A

**Direct Combine:** Preferred

Stage: At 10 per cent shatter stage.
Ground speed: Fast enough for even flow of material.
**Swathing/Windrowing:** Not recommended.
**Combine Settings:**
Air flow setting: Low
Cylinder speed: 800 rpm
Cylinder spacing: Close
**Average Dockage of Harvested Seed:** None

PRECLEANING TREATMENT/STORAGE:
**Drying:** Yes (not to exceed 104° F or 40° C).
Direct Combined: Requires drying after harvest before processing.
**Safe Storage Moisture Content:**
Bins: 10 to 12 per cent
Sacks: 10 per cent

PROCESSING:
**Debearding:** Yes, to remove the fibrous hull.
Debearder: Causes the least seed damage.
Hammer mill: Can be used, but easy to damage seed.
Speed: 300 to 350 rpm
**Scalping:** N/A
**Final cleaning:**
Top screen: #11
Bottom screen: 1/12" (0.21 cm)

SEED YIELD:
**Irrigated:** Average ,60 lbs/acre (67 kg/ha).
Range, 0 to 200 lbs/acre (0 to 224 kg/ha).
**Dryland:** Average,Similar to irrigated.

POSTHARVEST MANAGEMENT:
**During Establishment:** See fertilizing and irrigation.
**Established Stand:** See irrigation and weed control.

EXPECTED PRODUCTIVE STAND LIFE: Approximately 6 years.

ADDITIONAL COMMENTS: Susceptible to insect damage, especially Acanthoscelides fraterculus (Horn) and seed beetles (Bruchidae).

# Fourwing saltbush (*Atriplex canescens* [Pursh.] Nutt. var. *aptera* [A. Nels.] C. Hitchc.)

SEED WEIGHT: 49,000/lb. (108,000/kg) dewinged; 24,500/lb. (54,000/kg) winged.

SEEDING RATE: (Pure live seed)
15 to 20 seeds per linear foot of row.
45 to 60 seeds per meter of row.

10 lbs/acre (11 kg/ha) for 24" (60 cm) rows with dewinged seeds.
Multiply x 0.75 for 36" (90 cm) rows and x 0.5 for 48" (120 cm) rows.

ROW SPACING: 30" Irrigated or high rainfall areas.
48" Dryland areas.

PLANTING DATE: Dormant seeding in the fall.

WEED CONTROL:

**During Establishment:** If possible, plant in a field where weeds have been controlled by summer fallow or a broad spectrum herbicide during the previous 1 to 2 years. Close cultivation and clipping.

**Established Stand:** Simizine (Princep) (2 lb. a.i./acre); spot spray with Glyphosate or cultivate. A triple-K/vibrashank works well.
(**Note:** These products may not be registered on this forb species in your state or province).

FERTILIZATION:

**During Establishment:** Not recommended.

**Established Stand:** Apply nitrogen at 60 lbs/acre (67 kg/ha) and 40 lbs/acre (P2O5) each year in the late fall.

IRRIGATION:

**During Establishment:** Apply enough water to get the stand established. Keep surface moist to avoid crusting. Keep soil moisture near field capacity through October.

**Established Stand:** Apply irrigation as needed to promote vegetative growth. Make sure soil moisture is adequate at early flowering, during seed set and early maturation. Irrigate to field capacity prior to freeze up.

HARVEST:

**Average date at Bridger, MT:** October 1
Range of harvest dates: September 20 to October 14.
**Lodging:** No
**Shattering:** Moderate
**Stripping:** No
**Direct Combine:** Acceptable
Stage: Hard dough.
**Swathing/Windrowing:** Preferred
Stage: Medium to hard dough.
**Days in Windrow:** 7 to 10 days.
**Combine Settings:**
Cylinder speed: Fast enough to thresh seed from plant and do some wing removal.
Cylinder spacing: Close enough to thresh seed from plant, but minimize leaf removal.
**Average Dockage of Harvested Seed:** 50 per cent
**Other harvest recommendations:** Russian thistle seed is very difficult to clean from fourwing saltbush seed. Critical to remove from field prior to harvest.

PRECLEANING TREATMENT/STORAGE:

**Drying:** May be required (not to exceed 104° F or 40° C).

Swathed: Usually not necessary.
Direct Combined: Sometimes necessary, especially when leaves are removed with the seed. Ideally, scalp off leaves immediately to reduce moisture source.

**Safe Storage Moisture Content:**
Bins: 12 per cent
Sacks: 15 per cent

PROCESSING:

**Debearding:** Yes, to remove wings on utricle.

**Scalping:** Yes
Top screen: 14/64" (0.56 cm) round hole.

**Final cleaning:**
Top screen: 13/64" (0.52 cm).
Bottom screen: 8/64" (0.32 cm).

SEED YIELD:

**Irrigated:** Average, 300 lbs/acre (336 kg/ha).
Range, 80 to 450 lbs/acre (90 to 504 kg/ha).

**Dryland:** Average, 150 lbs/acre (168 kg/ha).
Range, 50 to 250 lbs/acre (56 to 280 kg/ha).

POSTHARVEST MANAGEMENT:

**During Establishment:** Rotary mow to uniform stubble height (3 to 4" or 7.5 to 10 cm) the first fall. Bring soil moisture level up to field capacity prior to fall freeze up.

**Established Stand:** Rotary mow to uniform stubble height (3 to 4" or 7.5 to 10 cm) the first fall. Bring soil moisture level up to field capacity prior to fall freeze up. See information on fertilizing. Apply fall dormant chemical if desired.

EXPECTED PRODUCTIVE STAND LIFE: 5 to 6 years.

# Lewis flax (*Linum lewisii* Pursh.)

SEED WEIGHT: 286,700/lb. (632,700/kg)

SEEDING RATE: (Pure live seed)
30 to 35 seeds per linear foot of row.
100 to 115 seeds per meter of row.

2.7 lb/acre (3.0 kg/ha) for 24" (60 cm) rows.
Multiply x 0.875 for 30" (75 cm) rows and x 0.75 for 36" (90 cm) rows.

ROW SPACING: 30 to 36" (75 to 90 cm) Irrigated or high rainfall areas.
30 to 36" (75 to 90 cm) Dryland areas.

PLANTING DATE: May

WEED CONTROL:

**During Establishment:** If possible, plant in a field where weeds have been controlled by summer fallow or a broad spectrum herbicide during the previous 1 to 2 years. Cultivation, hand rogue and mow to control weeds after planting.

**Established Stand:** Surflan: Apply fall after plants are dormant. Dormant rate is 3 qts/acre (3.2 liters/ha) for downey brome and wild oats. Use broadleaf weed control products according to label. (**Note:** Surflan and most other pre-emergent products must be incorporated 1/2" (1.25 cm). Moisture is required within 10 days to 2 weeks to activate). Cultivation in spring and fall and hand rogue.
(**Note**: These products may not be registered on this species in your state or province).

FERTILIZATION:

**During Establishment:** Generally none.

**Established Stand:** Soil test to determine nitrogen and phosphorus requirements. Average nitrogen applications at 75 lbs/acre (84 kg/ha) when applied as Ammonium Nitrate and phosphorus requirements at 50 lbs/acre (56 kg/ha) P2O5.

IRRIGATION:

**During Establishment:** Apply enough water to get the stand established. Approximately 1 to 1/2" (2.5 to 3.75 cm) per week for 3 to 4 weeks. Goal is to prevent top 2" (5 cm) from drying out. Keep surface moist to avoid crusting. Maintain soil moisture at 50 per cent field capacity or greater after establishment.

**Established Stand:** Maintain 50 per cent or greater field capacity to harvest. Appar is somewhat indeterminate and flowers for 3 to 4 weeks. Flowers in the morning. No irrigation during flower period. All irrigations should be done in the late afternoon and nights. Flowers drop daily and produce a new flush each day. Gravity irrigation does not appear to have detrimental effect on production during anthesis. Sprinkler irrigation can damage production if done carelessly. Irrigate once after flowering once before harvest. Irrigate after harvest and again before winter.

HARVEST:

**Range of harvest dates in Aberdeen, ID:** August 1 to August 14.
**Lodging:** No
**Shattering:** Yes
**Stripping:** Unsure; Very little work has been conducted on stripping of this species.
**Direct Combine:** No
**Swathing/Windrowing:** Preferred.
Stage: Usually when 50 per cent of capsules are ripe. Flowering period is somewhat indeterminate, therefore harvest is a judgement call.

## Lewis flax continued

Ground speed: 2 to 4 mph (3.2 to 6.4 km/hr). Early morning to prevent shatter.

**Days in Windrow:** 3 to 5 days.

**Combine Settings:**

Air flow setting: Low

Cylinder speed: 400 to 700 rpm.

Cylinder spacing: 0 to 1" (0 to 2.5 cm).

**Average Dockage of Harvested Seed:** 30 to 40 per cent

**Other harvest recommendations:** Cannot be direct combined. Must be swathed. Wraps around retracting fingers on header auger if direct combined. Lends itself well to swath harvest. Pea lifters on swather header.

PRECLEANING TREATMENT/STORAGE:

**Drying:** Not usually (not to exceed 104° F or 40° C).

Swathed: Dry in field.

Direct Combined: N/A since must be swathed.

**Safe Storage Moisture Content:**

Bins: 10 per cent

Sacks: 12 per cent

**Other precleaning considerations:** Store dry and cool.

PROCESSING:

**Debearding:** Yes, to separate any unthrea

Barley debearder: Yes, to thresh any unthreshed capsules.

**Scalping:** Usually

Top screen: #8 Round.

Bottom screen: 1/14" (0.18 cm).

Fan speed: Adjust according to condition.

**Final cleaning:**

Top screen: #7 Round.

Middle screen: 6 x 24.

Bottom screen: 1/15" (0.17 cm).

Fan speed: 210 rpm

SEED YIELD:

Irrigated: Average, 800 lbs/acre (896 kg/ha).
Range, 400 to 1200 lbs/acre (448 to 1344 kg/ha).

Dryland: Unsure

POSTHARVEST MANAGEMENT:

**During Establishment:** Mow weeds occasionally to prevent seed formation. During the establishment year only 4 to 6" (10 to 15 cm) high.

**Established Stand:** Remove residue after harvest (baling, chopping). Irrigate after harvest to sprout shattered seed between rows then cultivate out to prevent solid stands.

EXPECTED PRODUCTIVE STAND LIFE: 4 to 5 years.

ADDITIONAL COMMENTS: Hand roguing essential. Rolling cultivator with gangs and spiders throwing soil away from rows is helpful in preventing buildup of rows over time. Aids harvest and residue management.

# Small burnet *(Sanguisorba minor* Scop.)

SEED WEIGHT: 42,200/lb. (92,900/kg)

SEEDING RATE: (Pure live seed)
30 to 35 seeds per linear foot of row.
100 to 115 seeds per meter of row.

15 lb/acre (16.8 kg/ha) for 24" (60 cm) rows.
Multiply x 0.875 for 30" (75 cm) rows or x 0.75 for 36" (90 cm) rows.

ROW SPACING: 30 to 36" (75 to 90 cm) Irrigated or high rainfall areas.
30 to 36" (75 to 90 cm) Dryland areas.

PLANTING DATE: May

WEED CONTROL:

**During Establishment:** If possible, plant in a field where weeds have been controlled by summer fallow or a broad spectrum herbicide during the previous 1 to 2 years. Cultivation, hand rogue and mow to control weeds in first year stand.

**Established Stand:** Surflan – apply fall after plants are dormant. Dormant rate is 3 qts/acre (3.2 liters/ha) for downey brome and wild oats. Use broadleaf weed control products according to label. Surflan and most other preemergent products must be incorporated 1/2" (1.25 cm). Moisture is required within 10 days to 2 weeks to activate). Cultivation in spring and fall and hand rogue. (**Note:** These products may not be registered on this species in your state or province).

FERTILIZATION:

**During Establishment:** Generally none.

**Established Stand:** Soil test to determine nitrogen and phosphorus requirements. Average nitrogen applications at 75 lbs/acre (84 kg/ha) when applied as Ammonium Nitrate and phosphorus requirements at 50 lbs/acre (56 kg/ha) P2O5.

IRRIGATION:

**During Establishment:** Apply enough water to get the stand established. Approximately 1 to 1/2" (2.5 to 3.75 cm) per week for 3 to 4 weeks. Goal is to prevent top 2" (5 cm) from drying out. Keep surface moist to avoid crusting. Maintain soil moisture at 50 per cent field capacity or greater after establishment.

**Established Stand:** Maintain 50 per cent or greater field capacity to harvest. Usually very indeterminate growth pattern. Irrigate after harvest and fill profile to field capacity before winter.

HARVEST:

**Range of harvest dates at Aberdeen, ID:** August 15 to August 30.

**Lodging:** No

**Shattering:** No

**Stripping:** Unsure; Very little work has been conducted on stripping of this species.

**Direct Combine:** Satisfactory.

| | |
|---|---|
| Stage: | When 50 per cent or greater of the pods are ripe. Flowering is indeterminate, therefore harvest is a judgement call. |
| Ground speed: | 1 to 2 mph (1.6 to 3.2 km/hr). |

**Swathing/Windrowing:** Preferred.

| | |
|---|---|
| Stage: | When 50 per cent or greater of the pods are ripe. Flowering is indeterminate, therefore harvest is a judgement call. |
| Ground speed: | 2 to 3 mph (3.2 to 4.8 km/hr). |

**Days in Windrow:** 3 to 5 days.

## Small burnet continued

**Combine Settings:**

| | |
|---|---|
| Air flow setting: | Low |
| Cylinder speed: | 900 to 1000 rpm direct combine. 400 to 600 rpm swath. |
| Cylinder spacing: | 0 to 1" (0 to 2.5 cm). |

**Average Dockage of Harvested Seed:** 30 per cent

**Other harvest recommendations:** Pea lifters on swather and combine header. Wait as long as possible to harvest. Is not prone to excessive shatter. Try and pick optimum time. Normally some flower clusters will still be blooming at harvest. This species flowers and seed ripens from bottom of stems to top.

PRECLEANING TREATMENT/STORAGE:

**Drying:** Yes (not to exceed 104° F or 40° C).

| | |
|---|---|
| Swathed: | Dry in field. |
| Direct Combined: | Must be dried for storage. |

**Safe Storage Moisture Content:**

Bins: 10 per cent

Sacks: 12 per cent

**Other precleaning considerations:** Direct combined seed should be dried in seed dryer or spread on shop floor with air circulation and turned twice daily for several days.

PROCESSING:

**Debearding:** No

**Scalping:** Yes

| | |
|---|---|
| Top screen: | #13 Round. |
| Bottom screen: | #8 Round. |
| Fan speed: | Adjust according to condition. |

**Final cleaning:**

| | |
|---|---|
| Top screen: | #13 Round. |
| Middle screen: | #12 Round. |
| Bottom screen: | #9 Round. |
| Fan speed: | 340 rpm. |

**Special processing equipment, techniques or other considerations:**

Carter-disc indent cleaner (optional).

SEED YIELD:

**Irrigated:** Average, 800 lbs/acre (896 kg/ha).
Range, 500 to 1000 lbs/acre (560 to 1120 kg/ha).

**Dryland:** Unsure.

POSTHARVEST MANAGEMENT:

**During Establishment:** Mow weeds occasionally to prevent seed formation at 4 to 6" (10 to 15 cm) high. Cultivate and hand rogue.

**Established Stand:** See irrigation and fertilization. Remove residue after harvest (baling, chopping). Irrigate after harvest to sprout shattered seed between rows then cultivate out to prevent solid stands.

EXPECTED PRODUCTIVE STAND LIFE: 3 to 4 years.

ADDITIONAL COMMENTS: Hand roguing essential. Rolling cultivator with gangs or spiders throwing soil away from rows is helpful in preventing buildup of rows over time. Aids harvest and residue management.

# Introduced Grasses

## Altai wildrye (*Leymus angustus* [Trin.] Pilger)

SEED WEIGHT: 100,000/lb. (221,000/kg)

SEEDING RATE: (Pure live seed)
30 seeds per linear foot of row.
98 seeds per meter of row.

6.5 lbs/acre (7.3 kg/ha) for 24" (60 cm) rows.
Multiply x 2.0 for 12" (30 cm) rows, x 0.75 for 36" (90 cm) rows or x 0.5 for 48" (120 cm) rows.

ROW SPACING: 24 to 36" (60 to 90 cm) Irrigated or high rainfall areas.
36 to 48" (90 to 120cm) Dryland areas.
(**Note:** Narrower row spacings are sometimes used without interrow cultivation, but seed yields and stand longevity can be reduced).

PLANTING DATE: Spring (April, May), late summer (August) or dormant seeding (November on).

WEED CONTROL:

**During Establishment:** If possible, plant in a field where weeds have been controlled by summer fallow or a broad spectrum herbicide during the previous 1 to 2 years. Wait until 3 to 5 leaf stage before applying herbicides at lower rates; Bromoxynil, 2,4-D, clipping and cultivation.

**Established Stand:** 2,4-D and/or hand roguing and cultivation.
(**Note:** These products may not be registered on this grass species in your state or province).

FERTILIZATION:

**During Establishment:** Not recommended.

**Established Stand:** Apply nitrogen at 50 to 80 lbs/acre (56 to 89.6 kg/ha) in early spring. Fall application of nitrogen may increase seed production. Apply phosphorus and potassium according to soil test recommendations.

IRRIGATION:

**During Establishment:** Apply enough water to get the stand established. Keep surface moist to avoid crusting. Bring soil moisture up to field capacity in early September.

**Established Stand:** Irrigate after harvest to promote vegetative production. Bring moisture level up to field capacity by early September. Irrigate in spring through the boot stage if rainfall does not provide sufficient moisture for continued plant growth (soil moisture should be above 50 per cent field capacity). Do not irrigate during flowering (pollination), but good soil moisture is essential during the early phase of seed development. Do not irrigate during seed ripening.
(**Note:** Never allow plants to be moisture stressed while floral primordia or immature seedheads are forming).

HARVEST:

**Range of harvest dates at Bismarck, ND:** July 15 to August 5.
**Lodging:** None
**Shattering:** Medium
**Stripping:** No
**Direct Combine:** Preferred

| | |
|---|---|
| Stage: | Hard dough |
| Ground speed: | Dependent on stand, seed quantity and size of harvesting equipment. |

Adequate rate of feed and speed to ensure machine is operating at full capacity without overloading the cylinder and sieves.

**Swathing/Windrowing:** Preferred
- Stage: Soft to medium dough.
- Ground speed: As described for direct combining.

**Days in Windrow:** 5 to 10 days.

**Combine Settings:**
- Air flow setting: 450 rpm
- Cylinder speed: 900 rpm
- Cylinder spacing: 3/8" (0.95 cm).

**Average Dockage of Harvested Seed:** 30 to 40 per cent

PRECLEANING TREATMENT/STORAGE:

**Drying:** Required when direct combining (not to exceed 104° F or 40° C).
- Swathed: Usually not necessary.
- Direct Combined: 4 to 5 days depending on relative humidity.

**Safe Storage Moisture Content:**
- Bins: 12 per cent
- Sacks: 15 per cent

PROCESSING:

**Debearding:** N/A

**Scalping:** 2 screen fanning mill.
- Top screen: #14
- Bottom screen: Blank
- Fan speed: 120 rpm

**Final cleaning:** 2 screen fanning mill
- Top screen: 1/13 x 1/2" (0.20 x 1.25 cm).
- Bottom screen: #9 triangle, 3" (7.5 cm) open.

SEED YIELD:

**Irrigated:** Average, 150 lbs/acre (168 kg/ha).
Range, 75 to 200 lbs/acre (84 to 224 kg/ha).

**Dryland:** Average, 100 lbs/acre (112 kg/ha).
Range, 50 to 150 lbs/acre (56 to 168 kg/ha).

POSTHARVEST MANAGEMENT:

**During Establishment:** See information on fertilization and irrigating.

**Established Stand:** Rotary mow, rototill and cultivate between rows in the fall or spring.

EXPECTED PRODUCTIVE STAND LIFE: 5 to 10 years.

# Creeping foxtail (*Alopecurus arundinaceus* Poir.)

SEED WEIGHT: 753,000/lb. (1,657,000/kg)

SEEDING RATE: (Pure live seed)
25 to 30 seeds per linear foot of row.
82 to 100 seeds per meter of row.

0.6 lbs/acre (0.7 kg/ha) for 24" (60 cm) rows.
Multiply x 2.0 for 12" (30 cm) rows or x 0.75 for 36" (90 cm) rows.

ROW SPACING: 36" (90 cm) Irrigated or high rainfall areas.
36" (90 cm) Dryland areas.
(**Note:** Narrower row spacings are sometimes used without interrow cultivation, but seed yields and stand longevity can be reduced).

PLANTING DATE: Early in spring; late summer by mid-August with adequate soil moisture or with irrigation.

WEED CONTROL:

**During Establishment:** If possible, plant in a field where weeds have been controlled by summer fallow or a broad spectrum herbicide during the previous 1 to 2 years. Wait until 3 to 5 leaf stage before applying herbicides at lower rates; clipping or Bromoxynil according to label directions.

**Established Stand:** Bromoxynil, 2,4-D, dicamba and/or cultivation and hand roguing.
(**Note:** These products may not be registered on this grass species in your state or province).

FERTILIZATION:

**During Establishment:** Dryland and irrigated – apply phosphorus according to forage production rate and enough for 3 years. No nitrogen until seedlings are established or drill 50 lbs/acre (56 kg/ha) of 11-48-0 with seed. After seedlings are established, apply 30 lbs/acre (34 kg/ha) of nitrogen for dryland and 60 to 80 lbs/acre (67 to 89 kg/ha) of nitrogen for irrigated. On dryland, fallow the year before seeding.

**Established Stand:** Apply nitrogen each year at 100 to 150 lbs/acre (112 to 168 kg/ha).

IRRIGATION:

**During Establishment:** Apply enough water to get the stand established. Keep surface moist to avoid crusting. Bring soil moisture up to field capacity in early September.

**Established Stand:** Irrigate in spring through the boot stage if rainfall does not provide sufficient moisture for continued plant growth (soil moisture should be above 50 per cent field capacity). Do not irrigate during flowering (pollination), but good soil moisture is essential during the early phase of seed development. Do not irrigate during seed ripening.
(**Note:** Never allow plants to be moisture stressed while floral primordia or immature seedheads are forming). Irrigate after harvest to promote vegetative production. Bring moisture level up to field capacity by early September.

HARVEST:

**Range of harvest dates at Bridger, MT:** Late June or early July.
**Lodging:** No
**Shattering:** Yes
**Stripping:** Preferred
Stage: When majority of seedheads are black.
**Direct Combine:** Not recommended.
**Swathing/Windrowing:** Satisfactory
Stage: Medium to hard dough.

Ground speed: 2 mph (3 km/hr). Dependent on stand, seed quantity and size of harvesting equipment. Adequate rate of feed and speed to ensure machine is operating at full capacity without overloading the cylinder and sieves.

**Days in Windrow:** 3 to 5 days; depending on humidity.

**Combine Settings:**

Air flow setting: No air to a little.
Cylinder speed: 750 to 850 rpm
Cylinder spacing: 1/2" (1.25 cm).

**Average Dockage of Harvested Seed:** 60 per cent

**Other harvest recommendations:** Combining in early mornings and late evenings reduces light trash from dry, brittle leaves during dry part of the day.

PRECLEANING TREATMENT/STORAGE:

**Drying:** Drying is necessary (not to exceed 104° F or 40°C).
Swathed: Often required.
Direct Combined: N/A
Stripped: Yes

**Safe Storage Moisture Content:**
Bins: 12 per cent
Sacks: 15 per cent

PROCESSING:

**Debearding:** Yes
Barley debearder:
Speed: 500 rpm
Duration: Long enough to break up stems and chaff.

**Scalping:** Yes

**Final cleaning:**
Top screen: #9 round hole.
Middle screen: 1/18" x 1/4" (0.14 x 0.63 cm) slotted.
Bottom screen: 6 x 36 mesh wire.
Fan speed: Light wind, slow speed; 100 to 150 rpm.

**Special processing equipment, techniques or other considerations:**

SEED YIELD:

**Irrigated:** Average, 200 lbs/acre (224 kg/ha)
Range, 100 to 300 lbs/acre (112 to 336 kg/ha).

**Dryland:** N/A

POSTHARVEST MANAGEMENT:

**During Establishment:** Cultivate for weed control. See information on fertilizing and irrigating.

**Established Stand:** See information on fertilizing and irrigating. Graze for hay in late fall after a killing frost. If cut for hay, cut stubble short.

EXPECTED PRODUCTIVE STAND LIFE: 5 years.

# Crested wheatgrass (*Agropyron desertorum* [Fisch. ex Link] Schultes and *A. cristatum* [L.] Gaertner)

SEED WEIGHT: Fairway type 200,000/lb. (440,000/kg)
Standard type 188,000/lb. (414,000/kg)

SEEDING RATE: (Pure live seed)
25 to 30 seeds per linear foot of row.
82 to 100 seeds per meter of row.

3.2 lbs/acre (3.6 kg/ha) for 24" (60 cm) rows.
Multiply x 2.0 for 12" (30 cm) rows or x 0.75 for 36" (90 cm) rows.

ROW SPACING: 24" (60 cm) Irrigated or high rainfall areas.
36" (90 cm) Dryland areas.
(**Note:** Narrower row spacings are sometimes used without interrow cultivation, but seed yields and stand longevity can be reduced).

PLANTING DATE: Early in spring; late summer by mid-August with adequate moisture or with irrigation.

WEED CONTROL:

**During Establishment:** If possible, plant in a field where weeds have been controlled by summer fallow or a broad spectrum herbicide during the previous 1 to 2 years. Wait until 3 to 5 leaf stage before applying herbicides at lower rates; clipping or Bromoxynil according to label directions.

**Established Stand:** Bromoxynil, 2,4-D, dicamba and/or cultivation and hand roguing.

FERTILIZATION:

**During Establishment:** Dryland and irrigated – apply enough phosphorus to last 3 years and work into soil. When seeding, apply 55 lbs/acre (62 kg/ha) of 11-55-0 or 11-52-0 (high phosphorus fertilizer) with seed. After seedlings are established, apply 30 lbs/acre (34 kg/ha) of nitrogen per acre on dryland if seeding is in stubble; none is needed if planted in summer fallow. Under irrigation, apply 60 to 80 lbs/acre (67 to 89 kg/ha) of nitrogen.

**Established Stand:** On dryland, apply at least 50 lbs/acre (56 kg/ha) of nitrogen each year in the late fall; under irrigation, 60 to 80 lbs/acre (67 to 89 kg/ha).

IRRIGATION:

**During Establishment:** Apply enough water to get the stand established. Keep surface moist to avoid crusting. Bring soil moisture up to field capacity in early September.

**Established Stand:** Irrigate in spring through the boot stage if rainfall does not provide sufficient moisture for continued plant growth (soil moisture should be above 50 per cent field capacity). Do not irrigate during flowering (pollination), but good soil moisture is essential during the early phase of seed development. Do not irrigate during seed ripening.
(**Note:** Never allow plants to be moisture stressed while floral primordia or immature seedheads are forming). Irrigate after harvest to promote vegetative production. Bring moisture level up to field capacity by early September.

HARVEST:

**Average date at Bridger, MT:** August
**Lodging:** No
**Shattering:** No
**Stripping:** N/A
**Direct Combine:** Preferred

| | |
|---|---|
| Stage: | Hard dough. |
| Ground speed: | Dependent on stand, seed quantity and size of harvesting equipment. Adequate rate of feed and speed to ensure machine is operating at full capacity without overloading the cylinder and sieves. |

## Crested wheatgrass continued

**Swathing/Windrowing:** Satisfactory.
Stage: Soft to hard dough.
Ground speed: As described for direct combining.
**Days in Windrow:** 3 to 6 days.
**Combine Settings:**
Air flow setting: 1/2 on L-2 Gleaner Combine.
Cylinder speed: 750 to 800 rpm
Cylinder spacing: 1/4" (0.63 cm) opening.
**Average Dockage of Harvested Seed:** 15 per cent

PRECLEANING TREATMENT/STORAGE:

**Drying:** Usually not necessary (not to exceed 104°F or 40°C).
Direct Combined: Only necessary when trashy.
Swathed: Not required.
**Safe Storage Moisture Content:**
Bins: 12 per cent
Sacks: 15 per cent

PROCESSING:

**Debearding:** Only occasionally.
Barley debearder: Preferred
Hammer mill: Sometimes required to break up doubles.
Speed: 500 rpm
Duration: Long enough to separate doubles.
**Scalping:** No
**Final cleaning:**
Top screen: #7 round hole.
Middle screen: 1/18" x 1/4" (0.14 x 0.63 cm) slotted.
Bottom screen: 6 x 26 wire mesh.
**Special processing equipment, techniques or other considerations:**
Carter disc - small indent for grasses that allow small weed seed to be removed.

SEED YIELD:

**Irrigated:** Average,800 lbs/acre (896 kg/ha).
Range, 600 to 1000 lbs/acre (672 to 1120 kg/ha).
**Dryland:** Average, 200 lbs/acre (224 kg/ha).
Range, 150 to 300 lbs/acre (168 to 336 kg/ha).

POSTHARVEST MANAGEMENT:

**During Establishment:** See information on fertilization and irrigation.
**Established Stand:** See information on fertilizing and irrigating. Can fall graze or cut for hay.

EXPECTED PRODUCTIVE STAND LIFE: 5 to 10 years.

# Hard fescue (*Festuca ovina* var. *duriuscula* [L.] Koch)

SEED WEIGHT: 500,000/lb. (1,100,000/kg)

SEEDING RATE: (Pure live seed)
40 to 60 seeds per linear foot of row.
132 to 200 seeds per meter of row.

2 lbs/acre (2.2 kg/ha) for 24" (60 cm) rows.
Multiply x 2.0 for 12" (30 cm) rows or x 0.75 for 36" (90 cm) rows.

ROW SPACING: 12 to 24" (30 to 60 cm) Irrigated or high rainfall areas.
36" (90 cm) Dryland areas.
(**Note:** Narrower row spacings are sometimes used without interrow cultivation, but seed yields and stand longevity can be reduced).

PLANTING DATE: Mid to late April in Pullman, WA.

WEED CONTROL:

**During Establishment:** If possible, plant in a field where weeds have been controlled by summer fallow or a broad spectrum herbicide during the previous 1 to 2 years. Wait until 3 to 5 leaf stage before applying herbicides at lower rates; Bromoxynil, MCPA Amine (after tillering), clipping, cultivation and hand roguing.

**Established Stand:** MCPA Amine (may be mixed with 4 oz/acre of dicamba) and hand roguing.
(**Note:** These products may not be registered on this grass species in your state or province).

FERTILIZATION:

**During Establishment:** Generally none. Make sure phosphorus adequate according to soil test recommendations.

**Established Stand:** 60 lbs/acre (67.2 kg/ha) actual nitrogen fall applied.

IRRIGATION:

**During Establishment:** Apply enough water to get the stand established. Keep surface moist to avoid crusting. Bring soil moisture up to field capacity in early September.

**Established Stand:** Irrigate in spring through the boot stage if rainfall does not provide sufficient moisture for continued plant growth (soil moisture should be above 50 per cent field capacity). Do not irrigate during flowering (pollination), but good soil moisture is essential during the early phase of seed development. Do not irrigate during seed ripening.
(**Note:** Never allow plants to be moisture stressed while floral primordia or immature seedheads are forming. Irrigate after harvest to promote vegetative production. Bring moisture level up to field capacity by early September).

HARVEST:

**Average date at Pullman, WA:**
Range of harvest dates:
**Lodging:** None
**Shattering:** 3 to 5 per cent shattering at the hard dough stage.
**Stripping:** N/A
**Direct Combine:** N/A
**Swathing/Windrowing:** Preferred
Stage: Hard dough.
**Days in Windrow:** 5 to 7 days.
**Combine Settings:**
Air flow setting: 400 to 500 rpm with fan opening 1/2 blocked.

Cylinder speed: 1000 rpm
Cylinder spacing: 1/2 to 1" (1.25 to 2.5 cm).

**Average Dockage of Harvested Seed:** 50 to 55 per cent clean seed.

PRECLEANING TREATMENT/STORAGE: None

**Drying:** Not required (not to exceed 104° F or 40° C).

**Safe Storage Moisture Content:**

Bins: 15 per cent
Sacks: 12 per cent

PROCESSING:

**Debearding:** Yes

Hammer mill:
Speed: 555 rpm
Duration: Gate closed, no weight.

**Scalping:** Yes
Top screen: #8 or #6.
Bottom screen: 6 x 40 or blank.
Shake speed: 440 rpm.

**Final cleaning:**
Top screen: 3/64" x 5/16" (0.12 x 0.79 cm).
Middle screen: 1/12" (0.21 cm).
Bottom screen: 6 x 40.
Fan speed: 130 to 140 rpm
Shake speed: 450 to 455 rpm

**Special processing equipment, techniques or other considerations:**

Indent cylinder #5, gate-4, lifting 6, speed 40 rpm.

SEED YIELD:

**Irrigated:** Average
Range

**Dryland:** Average, 300 lbs/acre (336 kg/ha) clean seed.
Range, 150 to 350 lbs/acre (168 to 392 kg/ha).

POSTHARVEST MANAGEMENT:

**During Establishment:** No harvest during establishment year.

**Established Stand:** See irrigation and fertilization. Bale and remove residue. Control weeds as needed. Fall fertilize.

EXPECTED PRODUCTIVE STAND LIFE: 4 to 5 years.

# Intermediate wheatgrass (*Thinopyrum intermedium* [Host] Barkw. & Dewey subsp. *intermedium*; *Elytrigia intermedia* subsp. *intermedia*; formerly *Agropyron intermedium*)

SEED WEIGHT: 79,000/lb. (174,000/kg)

SEEDING RATE: (Pure live seed)
25 to 30 seeds per linear foot of row.
82 to 100 seeds per meter of row.

8.2 lbs/acre (9.2 kg/ha) for 24" (60 cm) rows.
Multiply x 2.0 for 12" (30 cm) rows or x 0.75 for 36" (90 cm) rows.

ROW SPACING: 24" (60 cm) Irrigated or high rainfall areas.
36" (90 cm) Dryland areas.
(**Note:** Narrower row spacings are sometimes used without interrow cultivation, but seed yields and stand longevity can be reduced).

PLANTING DATE: Early in spring; late summer by mid-August with adequate soil moisture or with irrigation; Fall dormant seeding just prior to freeze up.

WEED CONTROL:

**During Establishment:** If possible, plant in a field where weeds have been controlled by summer fallow or a broad spectrum herbicide during the previous 1 to 2 years. Wait until 3 to 5 leaf stage before applying herbicides at lower rates; clipping or Bromoxynil according to label directions.

**Established Stand:** Bromoxynil, 2,4-D, dicamba and/or cultivation and hand roguing.
(**Note:** These products may not be registered on this grass species in your state or province).

FERTILIZATION:

**During Establishment:** Dryland and irrigated – apply enough phosphorus to last 3 years and work into soil. When seeding, apply 55 lbs/acre (62 kg/ha) of 11-55-0 or 11-52-0 (high phosphorus fertilizer) with seed. After seedlings are established, apply 30 lbs/acre (34 kg/ha) of nitrogen on dryland if seeding into stubble; none is needed if planted in summer fallow. Under irrigation, apply 60 to 80 lbs/acre (67 to 89 kg/ha) of nitrogen.

**Established Stand:** On dryland, apply at least 50 lbs/acre (56 kg/ha) of nitrogen each year in late fall; under irrigation, 60 to 80 lbs/acre (67 to 89 kg/ha).

IRRIGATION:

**During Establishment:** Apply enough water to get the stand established. Keep surface moist to avoid crusting. Bring soil moisture up to field capacity in early September.

**Established Stand:** Irrigate in spring through the boot stage if rainfall does not provide sufficient moisture for continued plant growth (soil moisture should be above 50 per cent field capacity). Do not irrigate during flowering (pollination), but good soil moisture is essential during the early phase of seed development. Do not irrigate during seed ripening.
(**Note:** Never allow plants to be moisture stressed while floral primordia or immature seedheads are forming. Irrigate after harvest to promote vegetative production. Bring moisture level up to field capacity by early September).

HARVEST:

**Average date at Bridger, MT:** August
**Lodging:** No
**Shattering:** Yes (Will shatter when mature; cut at 15 to 20 per cent moisture).
**Stripping:** N/A
**Direct Combine:** Satisfactory
Stage: Hard dough to mature seed.

Ground speed: Dependent on stand, seed quantity and size of harvesting equipment. Adequate rate of feed and speed to ensure machine is operating at full capacity without overloading the cylinder and sieves.

**Swathing/Windrowing:** Preferred
- Stage: Hard dough.
- Ground speed: As described for direct combining.

**Days in Windrow:** 3 to 6 days.

**Combine Settings:**
- Air flow setting: #2 on L-2 Gleaner Combine.
- Cylinder speed: 800 rpm
- Cylinder spacing: 1/4" x 1/8" (0.63 x 0.31 cm) open.

**Average Dockage of Harvested Seed:** 15 per cent

PRECLEANING TREATMENT/STORAGE:

**Drying:** Usually not necessary (not to exceed 104° F or 40° C).
- Swathed: Usually not necessary.
- Direct Combined: May be required if trashy.

**Safe Storage Moisture Content:**
- Bins: 12 per cent
- Sacks: 15 per cent

PROCESSING:

**Debearding:** Occasionally
- Hammer mill: Required to break up doubles.

**Scalping:** No

**Final cleaning:**
- Top screen: 13 round hole.
- Middle screen: 1/16" x 1/2" (0.16 x 1.25 cm) slotted.
- Bottom screen: 6 x 18 wire mesh.
- Fan speed: Moderate

SEED YIELD:

**Irrigated:** Average, 850 lbs/acre (952 kg/ha).
Range, 650 to 1050 lbs/acre (728 to 1176 kg/ha).

**Dryland:** Average, 350 lbs/acre (392 kg/ha).
Range, 200 to 500 lbs/acre (224 to 560 kg/ha).

POSTHARVEST MANAGEMENT:

**During Establishment:** See information on fertilization and irrigation.

**Established Stand:** See information on fertilizing and irrigating. Can fall graze or cut hay.

EXPECTED PRODUCTIVE STAND LIFE: 5 to 10 years.

# Mammoth wildrye (*Leymus racemosus* [Lam.] Tsvelev; formerly *Elymus giganteus*)

SEED WEIGHT: 47,000/lb. (103,400/kg)

SEEDING RATE: (Pure live seed)
30 seeds per linear foot of row.
98 seeds per meter of row.

14 lb/acre (15.6 kg/ha) for 24" (60 cm) rows.
Multiply x 2.0 for 12" (30 cm) rows, x 0.75 for 36" (90 cm) rows or x 0.5 for 48" (120 cm) rows.

ROW SPACING: 24 to 36" (60 to 90 cm) Irrigated or high rainfall areas.
36 to 48" (90 to 120cm) Dryland areas.
(**Note:** Narrower row spacings are sometimes used without interrow cultivation, but seed yields and stand longevity can be reduced).

PLANTING DATE: Spring (April to May), late summer (August to September) or dormant seeded (November on).

WEED CONTROL:

**During Establishment:** Wait until 3 to 5 leaf stage before applying herbicides at lower rates; Bromoxynil, 2,4-D, clipping and cultivation.

**Established Stand:** Herbicides as needed for broadleaf weed control; 2,4-D and/or hand roguing and cultivation; Preemergent herbicide could be used for weed control after establishment.
(**Note:** These products may not be registered on this grass species in your state or province).

FERTILIZATION:

**During Establishment:** Not recommended.

**Established Stand:** Apply nitrogen at 50 to 70 lbs (56 to 78 kg/ha) in late fall or early spring. Apply phosphorus and potassium according to soil test recommendations.

IRRIGATION:

**During Establishment:** Apply enough water to get the stand established. Keep surface moist to avoid crusting. Bring soil moisture up to field capacity in early September.

**Established Stand:** Irrigate after harvest to promote vegetative production. Bring moisture level up to field capacity by early September. Irrigate in spring through the boot stage if rainfall does not provide sufficient moisture for continued plant growth (soil moisture should be above 50 per cent field capacity). Do not irrigate during flowering (pollination), but good soil moisture is essential during the early phase of seed development. Do not irrigate during seed ripening.
(**Note:** Never allow plants to be moisture stressed while floral primordia or immature seedheads are forming).

HARVEST:

**Range of harvest dates at Bismarck, ND:** July 10 to August 10.
**Range of harvest dates at Meeker, CO:** July 25 to August 8.
**Range of harvest dates at Bridger, MT:** Early to mid-August.
**Lodging:** None
**Shattering:** Moderate to high.
**Stripping:** N/A
**Direct Combine:** Preferred method.
Stage: Medium dough
Ground speed: Dependent on stand, seed quantity and size of harvesting equipment. Adequate rate of feed and speed to ensure machine is operating at full capacity without overloading the cylinder and sieves.
**Swathing/Windrowing:** Satisfactory

## Mammoth wildrye continued

Stage: Soft to medium dough.
Ground speed: As described for direct combining.

**Days in Windrow:** 5 to 10 days.

**Combine Settings:**

Air flow setting: Low to medium.
Cylinder speed: 700 to 850 rpm
Cylinder spacing: 3/8" (0.94 cm) or closer.

**Average Dockage of Harvested Seed:** 30 to 40 per cent; sometimes much less.

**Other harvest recommendations:** Uneven ripening is common. Higher yields are achieved when seed is harvested at an earlier stage because mature seeds shatter too readily.

PRECLEANING TREATMENT/STORAGE:

**Drying:** Yes (not to exceed 104° F or 40° C).
Swathed: Not necessary if adequate dried in the field.
Direct Combined: 4 to 5 days depending on relative humidity.

**Safe Storage Moisture Content:**

Bins: 12 per cent
Sacks: 15 per cent

PROCESSING:

**Debearding:** Sometimes helpful.
Debearder: Adjust airflow to carry off maximum "lights" without loss of filled seed.
Speed: 350 rpm.

**Scalping:** Sometimes required, especially when combine not set correctly.
Top screen: 18/64" (0.71 cm) or #13.
Bottom screen: 1/20" (0.13 cm).

**Final cleaning:** Clipper 4 screen fanning mill with top door open 5" (12.5 cm)
Top screens: No.1 = #16; No.2 = #13.
Bottom screens: No.3 = #11; No.4 = #9 triangle, 3" (7.5 cm) open.
Fan speed: 165 rpm
Shake speed: 370 rpm

SEED YIELD:

**Irrigated:** Average, 350 lbs/acre (392 kg/ha).
Range, 200 to 700 lbs/acre (224 to 784 kg/ha). Yields in Colorado have been as high as 1200 lbs/acre (1340 kg/ha).

**Dryland:** Average, 200 lbs/acre (224 kg/ha).
Range, 100 to 300 lbs/acre (112 to 336 kg/ha).

POSTHARVEST MANAGEMENT:

**During Establishment:** See information on fertilization and irrigating.

**Established Stand:** Rotary mow, rototill and cultivate between rows in the fall or spring.

EXPECTED PRODUCTIVE STAND LIFE: 5 to 10 years.

ADDITIONAL COMMENTS: The leaves are highly preferred by grasshoppers.

# Meadow bromegrass (*Bromus riparius* Rehm.; formerly *B. erectus*)

SEED WEIGHT: 80,000/lb. (176,000/kg)

SEEDING RATE: (Pure live seed)
25 to 30 seeds per linear foot of row.
82 to 100 seeds per meter of row.

8 lbs/acre (9 kg/ha) for 24" (60 cm) rows.
Multiply x 2.0 for 12" (30 cm) rows or x 0.75 for 36" (90 cm) rows.

ROW SPACING: 24" (60 cm) Irrigated or high rainfall areas.
36" (90 cm) Dryland areas.
(**Note:** Narrower row spacings are sometimes used without interrow cultivation, but seed yields and stand longevity can be reduced).

PLANTING DATE: Early in spring; late summer by mid-August with adequate soil moisture or with irrigation.

WEED CONTROL:

**During Establishment:** If possible, plant in a field where weeds have been controlled by summer fallow or a broad spectrum herbicide during the previous 1 to 2 years. Wait until 3 to 5 leaf stage before applying herbicides at lower rates; clipping or Bromoxynil according to label directions.

**Established Stand:** Bromoxynil, 2,4-D, dicamba and/or cultivation and hand roguing.
(**Note:** These products may not be registered on this grass species in your state or province).

FERTILIZATION:

**During Establishment:** Dryland and irrigated – apply phosphorus according to forage production rate and enough for 3 years. No nitrogen until seedlings are established or drill 50 lbs/acre (56 kg/ha) of 11-48-0 with seed. After seedlings are established, apply 30 lbs/acre (34 kg/ha) of nitrogen for dryland and 60 to 80 lbs/acre (67 to 90 kg/ha) for irrigated. On dryland, fallow the year before seeding.

**Established Stand:** Apply nitrogen each year – dryland, 30 lbs/acre (34 kg/ha); irrigated, 60 to 80 lbs/acre (67 to 90 kg/ha).

IRRIGATION:

**During Establishment:** Apply enough water to get the stand established. Keep surface moist to avoid crusting. Bring soil moisture up to field capacity in early September.

**Established Stand:** Irrigate in spring through the boot stage if rainfall does not provide sufficient moisture for continued plant growth (soil moisture should be above 50 per cent field capacity). Do not irrigate during flowering (pollination), but good soil moisture is essential during the early phase of seed development. Do not irrigate during seed ripening.
(**Note:** Never allow plants to be moisture stressed while floral primordia or immature seedheads are forming. Irrigate after harvest to promote vegetative production. Bring moisture level up to field capacity by early September).

HARVEST:

**Average date at Bridger, MT:** Mid-July.
**Lodging:** No
**Shattering:** No
**Stripping:** N/A
**Direct Combine:** Satisfactory

| | |
|---|---|
| Stage: | Mature seed stage. |
| Ground speed: | Dependent on stand, seed quantity and size of harvesting equipment. Adequate rate of feed and speed to ensure machine is operating at full capacity without overloading the cylinder and sieves. |

## Meadow bromegrass continued

**Swathing/Windrowing:** Preferred
- Stage: Hard dough stage.
- Ground speed: As described for direct combining.

**Days in Windrow:** 3 to 5 days.

**Combine Settings:**
- Air flow setting: Light
- Cylinder speed: 950 to 1000 rpm
- Cylinder spacing: 3/8" (0.94 cm).

**Average Dockage of Harvested Seed:** 50 per cent

PRECLEANING TREATMENT/STORAGE:

**Drying:** Usually not necessary (not to exceed 104° F or 40° C).
- Swathed: Not necessary.
- Direct Combined: May be required.

**Safe Storage Moisture Content:**
- Bins: 12 per cent
- Sacks: 15 per cent

PROCESSING:

**Debearding:** No

**Scalping:** No

**Final cleaning:**
- Top screen: #13 round hole.
- Middle screen: 1/16" x 1/2" (0.16 x 1.25 cm) slotted.
- Bottom screen: 6 x 26 wire mesh.

**Special processing equipment, techniques or other considerations:**
Carter Disc – cleans out small round broadleaf weed seeds. Length separator.

SEED YIELD:

**Irrigated:** Average, 600 lbs/acre (672 kg/ha).
Range, 400 to 800 lbs/acre (448 to 896 kg/ha).

**Dryland:** Average, 200 lbs/acre (224 kg/ha).

POSTHARVEST MANAGEMENT:

**During Establishment:** See information on fertilizing and irrigating.

**Established Stand:** See information on fertilizing and irrigating. Graze or cut for hay late in the fall after a killing frost. If cut for hay, cut stubble short.

EXPECTED PRODUCTIVE STAND LIFE: 3 years.

ADDITIONAL COMMENTS:

# Orchardgrass (*Dactylis glomerata* L.)

SEED WEIGHT: 488,000/lb. (1,074,000/kg)

SEEDING RATE: (Pure live seed)
25 to 30 seeds per linear foot of row.
82 to 100 seeds per meter of row.

1.3 lbs/acre (1.5 kg/ha) for 24" (60 cm) rows.
Multiply x 2.0 for 12" (30 cm) rows or x 0.75 for 36" (90 cm) rows.

ROW SPACING: 24" (60 cm) Irrigated or high rainfall areas.
36" (90 cm) Dryland areas.
(**Note:** Narrower row spacings are sometimes used without interrow cultivation, but seed yields and stand longevity can be reduced).

PLANTING DATE: Early in spring; late summer by mid-August with adequate soil moisture or with irrigation.

WEED CONTROL:

**During Establishment:** If possible, plant in a field where weeds have been controlled by summer fallow or a broad spectrum herbicide during the previous 1 to 2 years. Wait until 3 to 5 leaf stage before applying herbicides at lower rates; clipping or Bromoxynil according to label directions.

**Established Stand:** Bromoxynil, 2,4-D, dicamba and/or cultivation and hand roguing.
(**Note:** These products may not be registered on this grass species in your state or province).

FERTILIZATION:

**During Establishment:** According to soil test. Little or no nitrogen until seedlings are established. Ammonium triple super phosphate can be applied to provide a 3 year supply of phosphorus.

**Established Stand:** 60 to 80 lbs/acre (67 to 89 kg/ha) of nitrogen in the spring, fall or side dressed each year.

IRRIGATION:

**During Establishment:** Apply enough water to get the stand established. Keep surface moist to avoid crusting. Bring soil moisture up to field capacity in early September.

**Established Stand:** Irrigate in spring through the boot stage if rainfall does not provide sufficient moisture for continued plant growth (soil moisture should be above 50 per cent field capacity). Do not irrigate during flowering (pollination), but good soil moisture is essential during the early phase of seed development. Do not irrigate during seed ripening.
(**Note:** Never allow plants to be moisture stressed while floral primordia or immature seedheads are forming. Irrigate after harvest to promote vegetative production. Bring moisture level up to field capacity by early September.

HARVEST:

**Range of harvest dates at Bridger, MT:** Late June to early July.

| | | |
|---|---|---|
| **Lodging:** | No | |
| **Shattering:** | Potential | |
| **Stripping:** | N/A | |
| **Direct Combine:** | | Not recommended. |
| **Swathing/Windrowing:** | | Preferred. |
| | Stage: | Hard dough. |
| | Ground speed: | Dependent on stand, seed quantity and size of harvesting equipment. Adequate rate of feed and speed to ensure machine is operating at full capacity without overloading the cylinder and sieves. |
| **Days in Windrow:** | | 7 to 10 days |

**Combine Settings:**

| | |
|---|---|
| Air flow setting: | No more than 5 per cent filled seed going out back of combine. |
| Cylinder speed: | Fast enough to thresh seed and not crack caryopsis or kernels. |
| Cylinder spacing: | Closed enough to thresh seeds, but limited breakage of stems and seeds. |

**Other harvest recommendations:** Combine within a 3 day period following ripening or seed will be lost to shatter.

PRECLEANING TREATMENT/STORAGE:

**Drying:** No (not to exceed 104° F or 40° C).

**Safe Storage Moisture Content:**

Bins: 12 per cent

Sacks: Less than 14 per cent

PROCESSING:

**Debearding:** No

**Scalping:** No

**Final cleaning:**

| | |
|---|---|
| Top screen: | 1/22" x 1/2" (0.11 x 1.25 cm) Diagonal, #6. |
| Bottom screen: | 6 x 32, #5 triangle. |

SEED YIELD:

**Irrigated:** Average, 350 lbs/acre (392 kg/ha)

Range, 300 to 500 lbs/acre (336 - 560 kg/ha).

**Dryland:** Only in areas with higher precipitation.

POSTHARVEST MANAGEMENT:

**During Establishment:** See information on fertilizing and irrigating.

**Established Stand:** See information on fertilizing and irrigating. Dormant graze or clip to 4" (10 cm) stubble height. Remove residue.

EXPECTED PRODUCTIVE STAND LIFE: 3 to 6 years.

# Pubescent wheatgrass (*Thinopyrum intermedium* ssp. *barbulatum* [Schur] Barkw. & Dewey; formerly *Elytrigia intermedia* ssp. trichophora; formerly *Agropyron trichophorum*)

SEED WEIGHT: 80,000/lb. (176,000/kg)

SEEDING RATE: (Pure live seed)
25 to 30 seeds per linear foot of row.
82 to 100 seeds per meter of row.

8.1 lbs/acre (9.1 kg/ha) for 24" (60 cm) rows.
Multiply x 2.0 for 12" (30 cm) rows or x 0.75 for 36" (90 cm) rows.

ROW SPACING: 24" (60 cm) Irrigated or high rainfall areas.
36" (90 cm) Dryland areas.
(**Note:** Narrower row spacings are sometimes used without interrow cultivation, but seed yields and stand longevity can be reduced).

PLANTING DATE: Early in spring; late summer by mid-August with adequate moisture or with irrigation. Fall dormant seeding just prior to freeze up.

WEED CONTROL:

**During Establishment:** If possible, plant in a field where weeds have been controlled by summer fallow or a broad spectrum herbicide during the previous 1 to 2 years. Wait until 3 to 5 leaf stage before applying herbicides at lower rates; clipping or Bromoxynil according to label directions.

**Established Stand:** Bromoxynil, 2,4-D, dicamba and/or cultivation and hand roguing.
(**Note:** These products may not be registered on this grass species in your state or province).

FERTILIZATION:

**During Establishment:** Dryland and irrigated – apply enough phosphorus to last 3 years and work into soil. When seeding, apply 55 lbs/acre (62 kg/ha) of 11-55-0 or 11-52-0 (high phosphorus fertilizer) with seed. After seedlings are established, apply 30 lbs/acre (33 kg/ha) of nitrogen on dryland if seeding is into stubble; none is needed if planted in summer fallow. Under irrigation, apply 60 to 80 lbs/acre (67 to 89 kg/ha) of nitrogen .

**Established Stand:** On dryland: Apply at least 50 lbs/acre (56 kg/ha) of nitrogen each year in late fall; under irrigation, 60 to 80 lbs/acre (67 to 89 kg/ha).

IRRIGATION:

**During Establishment**: Apply enough water to get the stand established. Keep surface moist to avoid crusting. Bring soil moisture up to field capacity in early September.

**Established Stand:** Irrigate in spring through the boot stage if rainfall does not provide sufficient moisture for continued plant growth (soil moisture should be above 50 per cent field capacity). Do not irrigate during flowering (pollination), but good soil moisture is essential during the early phase of seed development. Do not irrigate during seed ripening.
(**Note:** Never allow plants to be moisture stressed while floral primordia or immature seedheads are forming). Irrigate after harvest to promote vegetative production. Bring moisture level up to field capacity by early September.

HARVEST:

**Average date at Bridger, MT:** August
**Lodging:** No
**Shattering:** Yes (Will shatter when mature; cut at 15 to 20 per cent moisture).
**Stripping:** N/A
**Direct Combine:** Satisfactory
Stage: Hard dough to mature seed.

Ground speed: Dependent on stand, seed quantity and size of harvesting equipment. Adequate rate of feed and speed to ensure machine is operating at full capacity without overloading the cylinder and sieves.

**Swathing/Windrowing:** Preferred

Stage: Soft to hard dough

Ground speed: As described for direct combining.

**Days in Windrow:** 2 to 3 days.

**Combine Settings:**

Air flow setting: 2 to 2 1/2.

Cylinder speed: 900 rpm

Cylinder spacing: 3/8" (0.94 cm) open.

**Average Dockage of Harvested Seed:** 10 to 15 per cent

PRECLEANING TREATMENT/STORAGE:

**Drying:** May be required.

Swathed: If combined at 15 to 20 per cent moisture (not to exceed 104° F or 40° C).

Direct Combined: Required if trashy.

**Safe Storage Moisture Content:**

Bins: 12 per cent

Sacks: 15 per cent

PROCESSING:

**Debearding:** No

**Scalping:** No

**Final cleaning:**

Top screen: #13 round hole.

Middle screen: 1/13" x 1/2" (0.19 x 1.25 cm) slotted.

Bottom screen: 6 x 18 wire mesh.

**Special processing equipment, techniques or other considerations:**

Carter disc - small indent for grasses.

SEED YIELD:

**Irrigated:** Average, 800 lbs/acre (896 kg/ha).

Range, 600 to 1000 lbs/acre (672 to 1120 kg/ha).

**Dryland:** Average, 350 lbs/acre (392 kg/ha).

Range, 200 to 500 lbs/acre (224 to 560 kg/ha).

POSTHARVEST MANAGEMENT:

**During Establishment:** See information on fertilization and irrigation.

**Established Stand:** See information on fertilizing and irrigating. Can fall graze or cut for hay.

EXPECTED PRODUCTIVE STAND LIFE: 7 to 10 years.

# Russian wildrye *(Psathyostachys juncea* [Fisch.] Nevski)

SEED WEIGHT: 170,000/lb. (374,000/kg)

SEEDING RATE: (Pure live seed)
25 to 30 seeds per linear foot of row.
82 to 100 seeds per meter of row.

3.8 lbs/acre (4.3 kg/ha) for 24" (60 cm) rows.
Multiply x 2.0 for 12" (30 cm) rows, x 0.75 for 36" (90 cm) rows, x 0.5 for 48" (120 cm) and x 0.4 for 60" (150 cm) rows.

ROW SPACING: 36" (90 cm) Irrigated or high rainfall areas.
48 to 60" (120 to 150 cm) Dryland areas.
(**Note:** Narrower row spacings are sometimes used without interrow cultivation, but seed yields and stand longevity can be reduced).

PLANTING DATE: Early in spring or late summer by mid-August (with irrigation). Fall dormant seeding just prior to freeze up.

WEED CONTROL:

**During Establishment:** If possible, plant in a field where weeds have been controlled by summer fallow or a broad spectrum herbicide during the previous 1 to 2 years. Wait until 3 to 5 leaf stage before applying herbicides at lower rates; clipping or Bromoxynil according to label directions.

**Established Stand:** Bromoxynil, 2,4-D, dicamba and/or cultivation and hand roguing.
(**Note:** These products may not be registered on this grass species in your state or province).

FERTILIZATION:

**During Establishment:** Dryland and irrigated – apply enough phosphorus to last 3 years and work into soil. When seeding, apply 55 lbs/acre (62 kg/ha) of 11-55-0 or 11-52-0 (high phosphorus fertilizer) with seed. After seedlings are established, apply 30 lbs/acre (34 kg/ha) of nitrogen on dryland if seeding is in stubble; none is needed if planted in summer fallow. Under irrigation, apply 60 to 80 lbs/acre (67 to 89 kg/ha) of nitrogen..

**Established Stand:** On dryland, apply at least 50 pounds of nitrogen per acre each year in late fall; under irrigation, 60 to 80 pounds.

IRRIGATION:

**During Establishment:** Apply enough water to get the stand established. Keep surface moist to avoid crusting. Bring soil moisture up to field capacity in early September.

**Established Stand:** Irrigate in spring through the boot stage if rainfall does not provide sufficient moisture for continued plant growth (soil moisture should be above 50 per cent field capacity). Do not irrigate during flowering (pollination), but good soil moisture is essential during the early phase of seed development. Do not irrigate during seed ripening.
(**Note:** Never allow plants to be moisture stressed while floral primordia or immature seedheads are forming. Irrigate after harvest to promote vegetative production. Bring moisture level up to field capacity by early September).

HARVEST:

**Average date at Bridger, MT:** Late July.
**Lodging:** No
**Shattering:** Yes
**Stripping:** N/A
**Direct Combine:** Satisfactory
Stage: Mature seed stage.

Ground speed: Dependent on stand, seed quantity and size of harvesting equipment. Adequate rate of feed and speed to ensure machine is operating at full capacity without overloading the cylinder and sieves.

**Swathing/Windrowing:** Preferred

Stage: Hard dough.

Ground speed: As described for direct combining.

**Days in Windrow:** 2 to 3 days.

**Combine Settings:**

Air flow setting: #1 on L-2 Gleaner Combine.

Cylinder speed: 750 to 800 rpm

Cylinder spacing: 1/4" (0.64 cm) open.

**Average Dockage of Harvested Seed:** 10 per cent

PRECLEANING TREATMENT/STORAGE:

**Drying:** Usually not necessary (not to exceed 104° F or 40° C).

Swathed: Usually not required.

Direct Combined: May be required if trashy.

**Safe Storage Moisture Content:**

Bins: 12 per cent

Sacks: 15 per cent

PROCESSING:

**Debearding:** No

**Scalping:** No

**Final cleaning:**

Top screen: #13 round hole.

Middle screen: 1/20" x 1/2" (0.13 x 1.25 cm) slotted.

Bottom screen: 6 x 28 wire mesh.

**Special processing equipment, techniques or other considerations:**

Carter disc - grass indents special.

SEED YIELD:

**Irrigated:** Average, 500 lbs/acre (560 kg/ha).
Range, 300 to 700 lbs/acre (336 to 784 kg/ha).

**Dryland:** Average,150 lbs/acre (168 kg/ha).
Range, 100 to 200 lbs/acre (112 to 224 kg/ha).

POSTHARVEST MANAGEMENT:

**During Establishment:** See information on fertilization and irrigation.

**Established Stand:** See information on fertilizing and irrigating. All growth must be removed by October or November by grazing or burning to initiate new seedheads. Irrigate and fertilize in fall.

EXPECTED PRODUCTIVE STAND LIFE:

# Siberian wheatgrass (*Agropyron fragile* [Roth] Candargy; formerly *Agropyron sibiricum*)

SEED WEIGHT: 163,000/lb. (358,600/kg)

SEEDING RATE: (Pure live seed)
30 to 35 seeds per linear foot of row.
100 to 115 seeds per meter of row.

4 lbs/acre (4.48 kg/ha) for 24" (60 cm) rows.
Multiply x 2.0 for 12" (30 cm) rows or x 0.75 for 36" (90 cm) rows.

ROW SPACING: 24 to 36" (90 cm) Irrigated or high rainfall areas.
36" (90 cm) Dryland areas.
(**Note:** Narrower row spacings are sometimes used without interrow cultivation, but seed yields and stand longevity can be reduced).

PLANTING DATE: May

WEED CONTROL:

**During Establishment:** If possible, plant in a field where weeds have been controlled by summer fallow or a broad spectrum herbicide during the previous 1 to 2 years. Cultivation, anytime after emergence. Spray with Bronate (Bromoxynil + MCPA ester): 1/2 to 2 pt/acre (0.8 to 1.1 liter/ha) or 0.375 to 0.5 lbs active ingredient/acre (0.42 to 0.56 kg a.i./ha) after the 3 leaf stage. 2,4-D Amine: 1 to 2 pts/acre (0.54 to 1.1 kg/ha) or 0.5 to 1 lb a.i./acre (0.56 to 1.12 kg a.i./ha after the 4 to 6 leaf stage. Always refer to label.

**Established Stand:** Cultivation – spring and fall. Bronate (Bromoxynil + MCPA ester): 2 pt/acre (1.1 liters/ha) before boot stage. 2,4-D 2 pt/acre (1.1 liter/ha) before boot stage. Surflan (Oryzalin): apply in fall after plants are dormant at 3 qts/acre (3.2 liters/ha) for downey brome and wild oats. 1/2" moisture required to activate. Some broadleaf control may be required. Always refer to label.
(**Note:** These products may not be registered on this grass species in your state or province).

FERTILIZATION:

**During Establishment:** Generally none; Make sure phosphate is adequate according to soil test recommendations.

**Established Stand:** Soil test to determine nitrogen and phosphorus requirements. Average nitrogen applications at 75 lbs/acre (84 kg/ha) when applied as ammonium nitrate and phosphorus requirements at 50 lbs/acre (56 kg/ha) P2O5.

IRRIGATION:

**During Establishment:** Apply enough water to get the stand established. Approximately 1 to 1/2" (2.5 to 3.75 cm) per week for 3 to 4 weeks. Goal is to prevent top 2" (5 cm) from drying out. Keep surface moist to avoid crusting. Maintain soil moisture at 50 per cent field capacity or greater after establishment.

**Established Stand:** Maintain 50 per cent or greater field capacity to harvest. Irrigate just prior to flowering. Do not irrigate during flowering. Irrigate after flowering once prior to harvest. Irrigate after harvest and fill profile going into winter.

HARVEST:

**Range of harvest dates at Aberdeen, ID:** August 1 to August 15.
**Lodging:** No
**Shattering:** No
**Stripping:** Unsure.
**Direct Combine:** Generally satisfactory.

Stage: Hard dough; when 50 per cent or more of the culms turns brown.
Ground speed: 1 to 7 mph (1.6 to 11.2 km/hr).

**Swathing/Windrowing:** Preferred
Stage: Mid-dough; swath in early morning to prevent shatter.
Ground speed: 2 to 3 mph (3.2 to 4.8 km/hr).

**Days in Windrow:** 3 to 5 days.

**Combine Settings:**
Air flow setting: Closed
Cylinder speed: 900 to 1000 direct combined. 400 - 700 swathed.
Cylinder spacing: 0 to 1" (0 to 2.5 cm).

**Average Dockage of Harvested Seed:** 30 to 35 per cent

**Other harvest recommendations:** Pea lifters on header of swather and combine.

PRECLEANING TREATMENT/STORAGE:

**Drying:** Depending on harvest technique (not to exceed 104° F or 40° C).
Swathed: Dried in field.
Direct Combined: Must be dried for storage.

**Safe Storage Moisture Content:**
Bins: 10 per cent
Sacks: 12 per cent

**Other precleaning considerations:** Store dry and cool.

PROCESSING:

**Debearding:** Yes
Barley debearder: To break up doubles.

**Scalping:** Yes
Top screen: 1/12 x 1/2" (0.21 x 1.25 cm).
Bottom screen: 6 x 24.
Fan speed: Adjust to condition.

**Final cleaning:**
Top screen: 1/14 x 1/4" (0.18 x 0.63 cm).
Middle screen: #9 round.
Bottom screen: 6 x 24.
Fan speed: 250 rpm

**Special processing equipment, techniques or other considerations:**
Carter Disc Indent (optional).

SEED YIELD:

**Irrigated:** Average, 500 lbs/acre (560 kg/acre).
Range, 300 to 700 lbs/acre (336 to 784 kg/ha).

**Dryland:** Average, 400 lbs/acre (448 kg/ha).
Range, 200 to 600 lbs/acre (224 to 672 kg/ha).

POSTHARVEST MANAGEMENT:

**During Establishment:** Mow weeds occasionally to prevent seed formation 4" to 6" (10 to 15 cm) high. Establishment year only.

**Established Stand:** Remove residue after harvest (baling, etc.). Irrigate after harvest to sprout shattered seed between rows then cultivate out to prevent solid stands.

EXPECTED PRODUCTIVE STAND LIFE: 4 to 5 years.

ADDITIONAL COMMENTS: Hand roguing helpful. Rolling cultivator with gangs or spiders throwing soil away from rows is helpful in preventing buildup of rows over time. Aids harvest and residue management.

# Smooth bromegrass (*Bromus inermis* Leyss.)

SEED WEIGHT: 147,000/lb. (323,400/kg)

SEEDING RATE: (Pure live seed)
25 to 30 seeds per linear foot of row.
82 to 100 seeds per meter of row.

4.4 lbs/acre (4.9 kg/ha) for 24" (60 cm) rows.
Multiply x 2.0 for 12" (30 cm) rows, x 0.875 for 30" (75 cm) rows or x 0.75 for 36" (90 cm) rows.

ROW SPACING: 30" (75 cm) Irrigated or high rainfall areas.
36" (90 cm) Dryland areas.
(**Note:** Narrower row spacings are sometimes used without interrow cultivation, but seed yields and stand longevity can be reduced).

PLANTING DATE: Early in spring; late summer by mid-August if adequate soil moisture or with irrigation.

WEED CONTROL:

**During Establishment:** If possible, plant in a field where weeds have been controlled by summer fallow or a broad spectrum herbicide during the previous 1 to 2 years. Wait until 3 to 5 leaf stage before applying herbicides at lower rates; clipping or Bromoxynil according to label directions.

**Established Stand:** Bromoxynil, 2,4-D, dicamba and/or cultivation and hand roguing.
(**Note:** These products may not be registered on this grass species in your state or province).

FERTILIZATION:

**During Establishment:** Dryland and irrigated – apply phosphorus according to forage production rate and enough for 3 years. No nitrogen until seedlings are established or drill 50 lbs/acre (56 kg/ha) of 11-48-0 with seed. After seedlings are established, apply 30 lbs/acre (34 kg/ha) of nitrogen for dryland and 60 to 80 lbs/acre (67 to 90 kg/ha) for irrigated. On dryland, fallow the year before seeding.

**Established Stand:** Apply nitrogen in fall or early spring of each production year. Dryland, 30 to 40 lbs/acre (34 to 45 kg/ha); irrigated, 60 to 90 lbs/acre (67 to 100 kg/ha).

IRRIGATION:

**During Establishment:** Apply enough water to get the stand established. Keep surface moist to avoid crusting. Bring soil moisture up to field capacity in early September.

**Established Stand:** Irrigate in spring through the boot stage if rainfall does not provide sufficient moisture for continued plant growth (soil moisture should be above 50 per cent field capacity). Do not irrigate during flowering (pollination), but good soil moisture is essential during the early phase of seed development. Do not irrigate during seed ripening.
(**Note:** Never allow plants to be moisture stressed while floral primordia or immature seedheads are forming. Irrigate after harvest to promote vegetative production. Bring moisture level up to field capacity by early September).

HARVEST:

**Average date at Bridger, MT:** Mid-July, when culms have dried 3 to 5" (7 to 12 cm) below most of the heads.

**Lodging:** Yes, with heavy nitrogen applications.

**Shattering:** No

**Stripping:** N/A

**Direct Combine:** Satisfactory

Stage: Mature seed stage.

Ground speed: Dependent on stand, seed quantity and size of harvesting equipment. Adequate rate of feed and speed to ensure machine is operating at full capacity without overloading the cylinder and sieves.

**Swathing/Windrowing:** Preferred
- Stage: Hard dough.
- Ground speed: As described for direct combining.

**Days in Windrow:** 3 to 6 days.

**Combine Settings:**
- Air flow setting: Light
- Cylinder speed: 950 to 1000 rpm
- Cylinder spacing: 3/8" (0.94 cm).

**Average Dockage of Harvested Seed:** 30 per cent

PRECLEANING TREATMENT/STORAGE:

**Drying:** Usually not required (not to exceed 104° F or 40° C).
- Swathed: Not required.
- Direct Combined: May be required.

**Safe Storage Moisture Content:**
- Bins: 12 per cent
- Sacks: 15 per cent

PROCESSING:

**Debearding:** No

**Scalping:** Yes

**Final cleaning:**
- Top screen: #13 round hole.
- Middle screen: 1/16" x 1/2" (0.16 x 1.25 cm) slotted.
- Bottom screen: 6 x 26 wire mesh.

SEED YIELD:

**Irrigated:** Average, 500 lbs/acre (560 kg/ha) plus.

**Dryland:** Average, 200 to 500 lbs/acre (224 to 560 kg/ha).

POSTHARVEST MANAGEMENT:

**During Establishment:** See information on fertilizing and irrigating. Bring moisture level up to field capacity by early September.

**Established Stand:** See information on fertilizing and irrigating. Graze dormant aftermath; apply 40 to 80 lbs/acre (45 to 89 kg/ha) of nitrogen in September; leafy regrowth either harvested for hay or grazed.

EXPECTED PRODUCTIVE STAND LIFE: 4 to 5 years.

# Species Descriptions

# Native Grasses

Alpine bluegrass (*Poa alpina*) - Cool season

A densely tufted perennial bunchgrass. It is found in subalpine to alpine meadows and rocky slopes. It will grow on bare soils, acidic mine spoils and talus slopes and has been described as an active colonizer on most disturbances in alpine environments.

Basin (Giant) wildrye (*Leymus cinereus* [Scribn. & Merr.] - Cool season

A tall bunchgrass with short, thick rhizomes, basin wildrye usually occurs as single plants on moist soils. Adapted to a wide range of soil textures, it is most commonly found on deep soils which have good moisture holding ability. Basin wildrye has about the same tolerance as tall wheatgrass to salinity. It is known for its good seedling vigor and robust, erect growth.

Beardless wheatgrass (*Pseudoroegneria spicata* subsp. *inermis* [Scribn. & Smith] A. Love; formerly *Agropyron inerme*) - Cool season

An erect bunchgrass with excellent drought tolerance and good hardiness in winter. Closely related to bluebunch wheatgrass.

Beardless wildrye (*Leymus triticoides* [Buckley] Pilger; formerly *Elymus triticoides*) - Cool season

A basal leaved, rhizomatous species which is well adapted to wet, medium to heavy textured saline soils. It has an extensive root system reaching down some 20 inches (50 cm), with some roots extending deeper than 40 inches (1 m). Because of high levels of dormancy, it is recommended that beardless wildrye seed be scarified and/or dormant planted in late fall to improve germination. The seedlings develop slowly and offer little competition to other plants. On extremely saline soils, the mechanical planting (springing) of root and rhizome material often results in better stands than does seeding.

Big bluestem (*Andropogon gerardii* Vitman) - Warm season

An erect, tall bunchgrass with short scaly rhizomes. A major component of the tallgrass prairie of the eastern Great Plains. Big bluestem is most abundant on moist, well drained, fertile loams, where its roots may reach deeper than 10 feet (3 m). Big bluestem grows well in areas receiving greater 20 inches (50 cm) of annual precipitation and on sites receiving run on moisture.

Bluebunch wheatgrass (*Pseudoroegneria spicata* subsp. *spicata* [Pursh] A. Love; formerly *Elytrigia spicatum*; formerly *Agropyron spicatum*) - Cool season

An erect bunchgrass, best suited to silty soils, but also common on sandy and gravelly soils and on thin, rocky sites. It has excellent drought tolerance, good hardiness in winter and although it shows poor tolerance to flooding, it is tolerant of weakly saline soils.

Blue grama (*Bouteloua gracilis* [H.B.K.] Lag. ex Steud.) - Warm season

Blue grama is commonly found throughout the Great Plains, usually on thin upland sites in association with needle and thread and western wheatgrass. It is a low growing bunchgrass which may also have very short rhizomes. Because of its drought tolerance and persistence under harsh soil and climatic conditions, blue grama is especially well suited for use on thin upland sites.

California brome (*Bromus carinatus* Hook. & Arn.) - Cool season

An erect bunchgrass that has a short perennial lifespan, sometimes acting as a biennial.

Canada wildrye (*Elymus canadensis* L.) - Cool season

Canada wildrye is a tall, erect bunchgrass which may have short rhizomes when young. It is found throughout North America, usually growing as individual plants and not in dense stands. In prairie Canada, it most frequently occurs on sandy soils, in wooded areas and on disturbed sites like riverbanks. Establishing quickly in disturbed areas, it may be an important early successional species.

## Canby bluegrass (*Poa canbyi* [Scribn.] Piper) - Cool season

A low growing bunchgrass with a relatively shallow root system, not over 24 inches (60 cm). It tolerates slight salinity and alkalinity. The straw colored stems are seldom over 24 inches (60 cm) tall. Canby bluegrass is similar to Sandberg bluegrass (Poa secunda), but is more vigorous, taller and longer leaved, with later maturity than Sandberg.

## Early bluegrass (*Poa fendleriana* [Steud.] Vasey or *cusickii*) - Cool season

A small bunchgrass with short, dense roots that seldom extend deeper than 12 inches (30 cm). Numerous short, very slender leaves grow from the crown, as well as several nearly leafless, 16 inch (40 cm) stems.

## Green needlegrass (*Nassella viridula*; formerly *Stipa viridula*) - Cool season

An erect bunchgrass with a dense root system extending to a depth of 7 to 10 feet (2to 3 m). Green needlegrass is widely distributed throughout the prairies although it seldom occurs in dense stands. It most commonly grows on clay soils in association with western wheatgrass, blue grama and needle and thread. Germinating seedlings establish rapidly, are disease resistant and moderately resistant to drought and grasshopper damage.The species is characterized by a relatively high level of seed dormancy. Even in a cultivar selected for low seed dormancy, it is not uncommon for only 40 per cent of the viable seed to emerge in the planting year.

## Idaho or Bluebunch fescue (*Festuca idahoensis* Elmer) - Cool season

A bunchgrass that can grow up to 36 inches (90 cm) with very fine, bluish basal leaves. It is best suited to deep, fertile silt and clay soils. It is tolerant to weak alkaline, saline and acidic soils and can survive with as little as 10 inches (25 cm) of annual precipitation in cooler regions.

## Indiangrass (*Sorghastrum nutans* [L.] Nash) - Warm season

An erect, rhizomatous species which occurred in association with big bluestem and little bluestem and switch grass in tall grass prairie. Best suited to fertile, well drained soils with greater than 20 inches (50 cm) annual precipitation, indiangrass does have some tolerance to droughty conditions. It is not well adapted to saline soils.

## Indian ricegrass (*Oryzopsis hymenoides* [Roem. & Schult.] Ricker) - Cool season

A tall, tufted wiry plant with fibrous roots, Indian ricegrass is most common on sandy soils in the western part of the prairies. It is very well adapted to arid conditions. Because of a high level of seed dormancy due to a hard seed coat, it is more easily established after scarification with dormant fall plantings rather than spring seeding.

## Junegrass (*Koeleria macrantha* [Ledeb.] Schultes; formerly *K. cristata*) - Cool season

The most common and abundant species on the prairies, although it seldom occurs in dense stands. It is a shallow but densely rooted bunchgrass with a short growth form which usually grows as single plants within a mixed plant community. On thin upland sites, it is often associated with blue grama and Stipa spp. and with fescues in the Foothills.

## Little bluestem (*Schizachyrium scoparium* [Michx.] Nash) - Warm season

One of the most widely distributed native grasses in North America, it is adapted to a wide range of soil conditions. A bunchgrass with a dense root system reaching to 8 feet (2.5 m), it can spread by seed, tillers and short rhizomes. More drought tolerant than big bluestem, it frequently occurs on the thin soils found on knolls and steep slopes as well as on gravelly or sandy soils and in swales and coulees.

## Mountain rough fescue (*Festuca campestris*) - Cool season

A large, tufted bunchgrass species with dense, grey green, rough basal leaves. It is found as individual plants or as a dominant species in grassy openings and open forests in the Foothills.

## Needle and thread grass (*Stipa comata* Trin. & Rupr.) - Cool season

An erect, densely tufted bunchgrass, needle and thread is the most widely distributed of the Stipa species. It occurs in greatest abundance on dry sites where it is frequently associated with western wheatgrass and blue grama. Very drought tolerant, it requires well drained soils and will not tolerate extremes in soil pH.

## Nodding brome (*Bromus anomalus* Rupr.) - Cool season

## Northern or Thickspike wheatgrass (*Elymus lanceolatus* [Scrib. & Smith] Gould; formerly *Elytrigia dasystachya*; formerly *Agropyron dasystachyum*) - Cool season

The most widely distributed native grass on the prairies, northern wheatgrass is a erect, rhizomatous plant which reaches a height of 16 to 28 inches (40 to 70 cm). Because of its three way root system which includes rhizomes for vegetative spreading, very dense shallow roots to 25 cm and a few deep feeder roots to 24 inches (60 cm), northern wheatgrass is adapted to a wide range of soil and moisture conditions. It occurs in mixed stands with western wheatgrass and the needle grasses on clay and loam soil and occasionally in pure stands on sandy soils. When established, it is hardy, long lived and more drought tolerant than western wheatgrass.

## Nuttall's alkaligrass (*Puccinellia nuttalliana*) - Cool season

Perennial bunchgrass usually 12 to 24 inches (30 to 60 cm) in height. Seedhead is an open panicle. Often found on wet, usually alkaline or saline soils. Grows in association with alkali cordgrass, prairie cordgrass, western wheatgrass and alkali sacaton. Nuttall's alkaligrass is grazed by livestock and may furnish considerable forage where it is abundant.

## Prairie cordgrass (*Spartina pectinata* Link) - Warm season

A tall, strongly rhizomatous robust plant well adapted to marsh edges and nonsaline wet meadows where it often occurs in almost pure stands. It will also grow in mixed communities with other adapted plants on upland areas associated with freshwater marshes.

## Prairie sandreed (*Calamovilfa longifolia* [Hook.] Scribn.) - Cool season

A tall, erect grass with long, scaly rhizomes, prairie sandreed grows on sandy prairie and dune sand sites across the Great Plains. It may also occur along lakeshores and in open wooded areas on sandy soils. The dense root system is welladapted to stabilize sandy soils.

## Reed canarygrass (*Phalaris arundinacea* L.) - Cool season

A tall, vigorous sodforming species with aggressive rhizomatous growth. Extremely competitive once established. Reed canarygrass is especially well suited to poorly drained, wetland areas, tolerant to long period of flooding, but only moderate tolerance to drought conditions.

## Sand bluestem (*Andropogon hallii* Hack.) - Warm season

A tall sodforming species with more aggressive rhizomatous growth than big bluestem. Best suited to coarse, sandy soils.

## Sedges (*Carex spp.*) - Cool season

Easily identified with their three angled stems, this genus includes a large number of species with a wide range of adaptation. While some sedge species are found in brackish marshes, shallow sloughs, others are well adapted on sandy flats and exposed gravelly ridges. Establishment and seed harvest is difficult for most sedge species, therefore seed production information is limited.

## Side-oats grama (*Bouteloua curtipendula* [Michx.] Torr.) - Warm season

An erect, tufted grass with short, scaly rhizomes. It is often associated with western wheatgrass, blue grama, needle and thread and sometimes little bluestem on thin upland sites. While side-oats seedlings are vigorous, the plants are only weakly rhizomatous so they do not usually provide solid ground cover until the second year after planting.

Slender wheatgrass (*Elymus trachycaulus* [Link] Gould ex Shinners subsp. *trachycaulus*; formerly *Agropyron trachycaulum*) - Cool season

An erect bunchgrass with dense fibrous roots extending to a depth of 20 inches (50 cm). Young, 2 to 3 year old, plants may develop tillers to increase their basal area. Unlike other native wheatgrasses, slender has a relatively short life span, usually not longer that five years. It is, however, adaptable to a wide range of soil conditions provided moisture supplies are adequate and is tolerant of relatively high salinity levels. In addition, slender wheatgrass seed usually has a high germination rate and excellent seedling emergence and vigor. It is particularly well suited for use in low areas having saline soils.

Streambank wheatgrass (*Elymus lanceolatus* ssp. *lanceolatus*; formerly *Agropyron riparium*) - Cool season

A sod forming species with numerous slender rhizomes which quickly produce a dense, smooth sod. Top growth is relatively short, fine leaved and bears some resemblance to northern wheatgrass. Seed germinates quickly, even under dry conditions and plants will spread rapidly to form a good ground cover. While it will stand periodic flooding, streambank wheatgrass does require well drained soils. It will tolerant moderate salinity levels as long as the soils are not waterlogged. Despite its name, streambank wheatgrass is not restricted to riparian sites since it has good drought tolerance.

Switchgrass (*Panicum virgatum* L.) - Warm season

A tall, erect plant with numerous short scaly rhizomes. One of the major grasses in tall grass prairies, along with big bluestem and indiangrass. The species has a somewhat wider range of adaptation than the other major tall grasses species. It is adapted to a wide range of soil conditions, with good salinity and flooding tolerance but has poor tolerance to drought.

Tufted hairgrass (*Deschampsia caespitosa* [L.] Beauv.) - Cool season

A bunchgrass with dense, shallow roots and a mass of deep green leaves covering the crown. Well adapted to a wide range of soil types and textures, especially well suited to bogs, wetlands, stream banks and marshes. It is tolerant of saline and alkaline conditions.

Western wheatgrass (*Pascopyron smithii* [Rydb.] A. Love; formerly *Agropyron smithii*) - Cool season

An sod forming species, with aggressive rhizomes, a dense shallow rooting system and some deeper feeding roots extending to 24 inches (60 cm). It grows with green needlegrass in fairly dense stands on clay soils, with salt-tolerant plants on alkali soils and in sparse stands on thin upland sites with blue grama and needle grasses. Plants develop slowly from seed, but they usually spread rapidly in their second year. Widely adapted to a range of soil, moisture and salinity conditions.

# Native Forbs

American hedysarum (N. Sweetvetch) (*Hedysarum boreale or alpinum* var. *americanum*) - Cool season

A fairly erect taprooted legume, it usually grows as single plants rather than in dense stands. It is the most widely distributed Hedysarum species in western Canada. It occurs commonly in fescue prairie and often at wooded edges. It requires moderately to well drained soils and shows good drought tolerance, but only has fair flooding tolerance and poor tolerance to soil salinity.

Fourwing saltbush (*Atriplex canescens* var. *aptera*)

One of the most widely distributed native shrubs in western North American. Mature plants range from 2 to 8 feet (60 to 240 cm). Adapted to most soils, but it is best suited to deep, well drained loamy or sandy soils. It will grow on dense clays. It is tolerant of saline conditions and less tolerant of high alkalinity soils. It is extremely drought resistant and has fair shade and fire tolerance. Fourwing saltbush grows in areas that receive 8 to 15 inches (20 to 35 cm) annual precipitation.

Lewis flax (*Linum lewisii*)

This is tap rooted perennial forb. It is hardy but short lived (5 to 7 years). Height ranges from 12 to 36 inches (30 to 90 cm). It is adapted to well drained soils and normally grows in areas that receive 10 to 23 inches (25 to 58 cm) annual precipitation. It is not very shade tolerant.

Small burnet (*Sanguisorba minor*) - Cool season

This is a long lived species with numerous stems arising from a basal tuft and reaching a height of 1.5 to 2 feet (45 to 60 cm). The root system consists of both a central taproot and many short rootstalks. It is adapted to silt and clay soils, but does best on silt and loam soils. Small burnet grows in areas receiving 12 inches (30 cm)or more annual precipitation. It is tolerant of moderately saline or alkaline soils, infertile soils and sites that are partially shaded. Small burnet will not tolerate poor drainage or high water tables, but shows excellent winter survival.

# Current Publications

# Current Publications

This manual was written to give a general overview of grass seed production principles and practices and to provide specific management guidelines for successful seed production of a number of individual species. The authors realize that other publications can also be useful references and are providing a list for your convenience. General comments have been included to provide a quick guide to the contents of most of these publications. If you wish to obtain any of these publications, contact addresses are provided.

## Seed Production Manuals

**Atkins, M.D. and J.E. Smith. 1967. *Grass Seed Production and Harvest in the Great Plains.* USDA Farmers' Bulletin No. 2226. US Government Printing Office, Washington, DC. 30 pages.**

This is the original publication on grass seed production in the Great Plains. Although some sections are outdated, much of the discussion is as relevant today as it was in 1967. Particularly useful are the distribution maps of 26 native and introduced grass species. Many of the more recent seed production manuals have used this publication as their guide.

**Obtaining copies:** Now out of print. Try writing to a NRCS Plant Materials Center in the Great Plains region and ask them to make you a photocopy.

**Bolton, J.L., D.B. Wilson and S.R. Smith. 1996. *Pedigreed Forage Seed Production.* Canadian Seed Growers' Association. Ottawa, Canada. 53 pages.**

General seed production information and specific seed production guidelines for 27 introduced and native grasses and nine introduced legume species. Also contains general information about the Pedigreed Seed Certification System in Canada.

**Obtaining copies:** Canadian Seed Growers' Association, P.O. Box 8455, 240 Catherine Street, Suite 202, Ottawa, Canada K1G 3T1 Phone: 613-236-0497 Fax: 613-563-7855 e-mail: Seeds@eis.ca Electronic copies also available.

**Dodds, D., J. Carter, D. Meyer and R. Haas. 1987. *Grass Seed Production in North Dakota.* North Dakota State University Cooperative Extension Service Publication 14 Agr-7. Fargo, ND. 30 pages.**

General grass seed production manual. Contains a useful appendix of 47 tables summarizing dryland and irrigated grass seed production studies conducted over a number of years at different locations across North Dakota.

**Obtaining copies:** Cooperative Extension Service, North Dakota State University, Fargo, North Dakota USA 58105.

**Holzworth, L.K., L.E. Wiesner and H.F. Bowman. Revised 1990. *Grass and Legume Seed Production in Montana and Wyoming.* Special Report No. 12, Bridger Plant Materials Center. Bridger, Montana. 31 pages.**

General grass and legume seed production manual. The current manual contains an update of the seed production guidelines of the 18 native and introduced grass species in this manual as well as an update of the Economics of Seed Production chapter. This manual also contains guidelines for seed production of five important introduced legumes. Useful framework of seed production guidelines.

**Obtaining copies:** Write to Natural Resource Conservation Service, R.R. 1, Box 1189, Bridger, Montana, USA 59014.

**Joyce, J. 1993. *Native Plants: Exploring Grass Seed Production and Markets.* Agriculture Canada, PFRA and Ducks Unlimited Canada. 53 pages.**

The objective of this report was to explore the current supply and demand relationship for native grass seed in western Canada, noting technological and agronomic constraints experienced by producers and consumers who are currently involved in the native seed industry. It also contains suggested changes to the current situation as well as a future needs assessment.

**Obtaining copies:** Ducks Unlimited Canada, Oak Hammock Marsh Conservation Center, P.O. Box 1160, Stonewall, MB R0C 2Z0 Phone:204-467-3248 or a Prairie Farm Rehabilitation Administration (PFRA) office.

**Murrell, D., P. Curry, G. Kruger and G. Pearse. 1995.** ***Farm Facts: Production and Marketing of Native Grass Seed.*** **Saskatchewan Agriculture, Newfield Seeds, Ducks Unlimited Canada and Saskatchewan. Forage Council. 11 pages.**

General information on production practices and marketing of native grass seed.
**Obtaining copies:** Ducks Unlimited Canada, Oak Hammock Marsh Conservation Center, P.O. Box 1160, Stonewall, MB Canada R0C 2Z0 Phone: 204-467-3248.

***Native Plant Propagation Techniques for National Parks.*** **USDA-ARS and USDA-NPS.**

Seed production and propagation information for a number of native grasses, forbs, shrubs and trees that are not contained in any other existing publication.
**Obtaining copies:** Rose Lake Plant Materials Center, 7472 Stoll Road, East Lansing, Michigan USA 48823.

**Twidwell, E.K., M.K. Beutler, K.D. Kephart, A. Boe and R.J. Pollmann. 1988.** ***Grass Seed Production in South Dakota: Guidelines.*** **(Publication C244). South Dakota State University Agricultural Experiment Station. Brookings, South Dakota. 16 pages.**

General information on grass seed production. Contains useful tables and discussion on calculating the economic cost and returns for grass seed production.
**Obtaining copies:** Cooperative Extension Service, South Dakota State University, Brooking, South Dakota USA 57007.

## Native Seeding Manuals

**Abouguendia, Z. 1995. Seeded Native Range Plants. Grazing and Pasture Tech. Program, Sask. Wetland Cons. Corp and Saskatchewan Agriculture and Food. 32 pages.**

General information on the ecology of native species and the agronomic practices required for establishment and management. Useful point form species descriptions and appendix tables that catagorize the common native species found on different ecological sites.
**Obtaining copies:** Call the Grazing and Pasture Technology Program head office in Regina, Saskatchewan, Canada. Phone: 306-757-9499.

**Gerling, H.S., M.G. Willoughby, A. Schoept, C. Tannas and K. Tannas. 1996.** ***A Guide to Using Native Plants on Disturbed Lands.*** **Alberta Agriculture, Food and Rural Development and Alberta Environmental Protection. ISBN 0-7732-6125-7. 247 pages.**

General guidelines for establishing native species. Excellent descriptions on the vegetation communities for the natural regions of alberta in a series of tables. These tables list the native species present of five regions and each of 49 subregions including grasses, grass like plants, forbs, shrubs and trees. The percentage that each grass species exists in the climax community is also provided. The climate of each subregion is described along with soil and landscape characteristics, soil reclamation issues and the adapted native species of which seed is currently available. This publication also provides a series of tables outlining general characteristics, adaptation and seed availability for the 132 grass and grass like species, 259 forbs, 80 shrubs and 13 trees that are native to Alberta.
**Obtaining copies:** Publications Branch, Alberta Agriculture, Food and Rural Development, 7000-113 Street, Edmonton, Alberta, Canada T6H 5T6 Phone: 403-427-0391 Fax: 403-427-2861

**Morgan, J.P., D.R. Collicutt and J.D. Thompson. 1995.** ***Restoring Canada's Native Prairies: A Practical Manual.*** **Prairie Habitats, Argyle, Manitoba, Canada. ISBN 1-896520-09-X. 84 pages.**

User friendly native prairie restoration manual. Written for a general audience, but especially useful for those in urban settings who want to establish native plants. Topics include: the reasons for prairie restoration, restoration planning requirements, species selection, acquiring seeds, seed processing, native plant propagation, site preparation, seeding, alternative prairie restoration techniques and special restoration sites. The appendices are particularly useful listing Canadian sources of native plants and seeds; public information sources on ecosystem restoration, management and native plants; selected original and restored native prairie sites in Canada; restoration equipment sources; and an detailed annotated biography. An additional feature of

this publication is a series of close-up photos of 99 selected native prairie seedlings.
**Obtaining copies:** The Manitoba Naturalists Society, 401-63 Albert Street, Winnipeg, Manitoba, Canada R3B 1G4 Phone: 204-943-9029

**Wark, D.B., W.R. Poole, R.G. Arnott, L.R. Moats and L. Wetter. *Revegetating with Native Grasses.* Ducks Unlimited Canada. 133 pages.**

An excellent hands-on manual covering all aspects of successful revegetating with native grasses. Practical information for those interested in larger scale plantings. A must for individuals and organizations involved in planting native grasses for wildlife habitat; highway, pipeline and transmission line right-of-ways; mine reclamation; soil conservation and other purposes. As the supply of native grass seed becomes more plentiful in future years and as the cost per unit of seed decreases, this manual will become an important guidebook for those producers who wish to use native grasses for hayland and pasture.

This manual includes the following main sections: planting objectives, preplanting preparations, seed quality, preparing a seed mix, seed importation, planting year activities, postplanting weed control, grasshopper control, stand evaluation, postestablishment management, a supplemental reading list and a detailed bibliography. User friendly tables and figures are included throughout the text.

The appendix includes several useful sections including: cross-reference of Canadian common names and scientific names of plant species, an article on sculptured seeding, crop protection products, native grass cultivars and seed suppliers, recommended seed mixtures, and drill calibration methods. An extremely useful part of this manual is the ,easy to understand, species description pages which include adaptation and use, key field identification features, preferred environmental conditions and seed availability for 32 native grasses, forbs and shrubs.
**Obtaining copies:** Ducks Unlimited Canada, Oak Hammock Marsh Conservation Center, P.O. Box 1160, Stonewall, MB Canada R0C 2Z0 Phone: 204-467-3248

## Reports, Conference Proceedings

Baldridge, D.E. and R.G. Lohmiller. 1993. **Montana Interagency Plant Materials Handbook for Forage Production, Conservation, Reclamation and Wildlife.** Montana State University Extension Service EB 69, Bozeman, Montana.

Johnson, J.R. and M.K. Beutler. 1988. **Proceedings of Northern Plains Grass Seed Symposium.** January 7 to 8, 1988. Pierre, South Dakota. South Dakota State University Agricultural Experiment Station. Brookings, South Dakota.

**Native Plant Summit Program Summary.** 1995. USDA-NRCS, Bismarck Plant Materials Center and Ducks Unlimited Canada. February 28 to March 1, 1995. Bismarck, North Dakota.

**Native Plant Summit Program Summary.** 1996. USDA-NRCS, Bismarck Plant Materials Center and Ducks Unlimited Canada. October 22 to 23, 1996. Bismarck, North Dakota.

**Technical Report 1992-1993 Bismarck Plant Materials Center: Part 1 of 2 - Grasses, Forbs and Legumes.** USDA-NRCS. Bismarck, North Dakota.

Tremblay, M. 1994. **A Workshop on the Uses and Importance of Native Plants of Saskatchewan Proceedings.** September 21 to 22, 1994. Saskatoon, Saskatchewan. Saskatchewan Agriculture and Food, PFRA, Ducks Unlimited Canada and Pasture and Grazing Tech. Program.

**1994/1995 Activity Report: Bismarck Plant Materials Center.** USDA-NRCS. Bismarck, North Dakota.

# Native Plant and Seed Sources for the Northern Great Plains

This edition also contains "Important Introduced Grasses of the Great Plains"

August 1996

USDA
UNITED STATES DEPARTMENT OF AGRICULTURE
An Equal Opportunity Employer

Ducks Unlimited Canada

This is a partial list of grass seed growers and vendors who produce and/or sell the species and varieties of grass recommended for use in the application of soil and water conservation practices. Local retailers may be distributors for vendors or other sources shown on this list.

This listing was originally prepared by the Natural Resources Conservation Service (NRCS) Bismarck Plant Materials Centre staff for use as a reference for its county offices, SCD cooperators and other state and federal agencies. Additional species and varieties are available in the seed trade.

All listed species and varieties may not be adapted to all locations. For more information refer to Cooperative Extension Service Circular R-794, **Grass Varieties for North Dakota** (August 1994) and circular 890, **Available Grass Varieties for South Dakota** (April 1991). Consult the local NRCS Field Office Technical Guide for additional information regarding species and variety suitability to soil and site, compatibility in mixtures and intended use.

Vendors may have access to classes of seed other than those shown on this list. Vendors' inventories are constantly changing and additional species or varieties not listed may become available. Cooperators and agencies interested in purchasing seed should make their own contacts regarding availability and price of seed.

## How To Use The Directory

Grasses are listed alphabetically by common name on pages 1 through 9. The numbers following the species or variety correspond to vendors and/or growers listed on the following pages. Seed sources are classified as Foundation (F), Registered (R) and Certified (C). The use of certified seed is recommended whenever adapted varieties are available to assure genetic identity and purity.

**ALKALIGRASS** *Puccinellia distans*

| | |
|---|---|
| common | 5, 9, 26 |
| Chaplin | 83C |
| Fults | 5, 29, 34C, 87 |

**ALKALIGRASS, NUTTALL'S** *Puccinellia nuttalli*

| | |
|---|---|
| common | 12, 39, 87 |
| Quill | 83C |

**BENTGRASS, COLONIAL** *Agrostis tenuis*

| | |
|---|---|
| common | 26 |
| Highland | 5 |

**BLUEGRASS, ALPINE** *Poa alpina*

| | |
|---|---|
| common | 9, 87 |

**BLUEGRASS, BIG** *Poa secunda*

| | |
|---|---|
| Sherman | 8, 10, 34, 37, 41C, 86F, 87C, 90C |

**BLUEGRASS, CANADA** *Poa compressa*

| | |
|---|---|
| common | 3, 5, 12, 34 |
| Reubens | 5, 31, 34C, 87 |

**BLUEGRASS, CANBY** *Poa canbyi*

| | |
|---|---|
| common | 9 |
| Canbar | 10, 34C, 87C |

**BLUEGRASS, SANDBERGS** *Poa sandbergii*

| | |
|---|---|
| common | 9, 39, 87 |

**BLUEJOINT GRASS** *Calamagrostis canadensis*

| | |
|---|---|
| common | 25, 36 |

**BLUESTEM, BIG** *Andropogon gerardii*

| | |
|---|---|
| common | 9, 10, 12, 23, 26, 27, 34, 36, 39, 42, 43, 63, 65, 70, 79 |
| Bison | 14, 16, 18, 19, 21C, 22C, 25, 36, 44C, 45F, 49C, 75, 87 |
| Bonilla | 18, 24, 36, 44C, 45F, 69C, 74, 75, 77C, 78C, 80C, 87 |
| Champ | 10, 55C, 56C, 75, 87 |
| Kaw | 10, 18, 34, 56C |
| Pawnee | 10, 56C, 87 |
| Rountree | 10, 24C, 36, 56C, 87 |
| Sunnyview | 58C, 64F, 74, 80C |

**BLUESTEM, CAUCASIAN** *Andropogon bladhii*

| | |
|---|---|
| common | 10 |

**BLUESTEM, LITTLE** *Schizachyrium scoparium*

| | |
|---|---|
| common | 9, 10, 12, 22, 23, 25, 27, 34, 36, 37, 39, 41, 42, 43, 56, 63, 65, 75, 79 |
| Aldous | 10, 36, 56C, 87 |
| Badlands | 11C, 21C, 45F, 49, 94 |
| Blaze | 10, 18, 36, 44C, 56C, 75, 87C |
| Camper | 10, 18, 34, 36, 44C, 55C, 56C, 75, 87 |
| Cimmaron | 10, 87 |
| Pastura | 10 |

**BLUESTEM, SAND** *Andropogon hallii*

| | |
|---|---|
| common | 9, 11, 12, 39, 79 |
| Garden | 10, 34, 44C, 53C, 87 |
| Goldstrike | 10, 55C, 56C, 87 |
| Woodward | 10, 34, 87 |

**BLUESTEM, YELLOW** *Andropogon ischaemum*

| | |
|---|---|
| King Ranch | 10 |
| Plains | 10 |
| WW Spar | 10 |

**BROMEGRASS, FRINGED** *Bromus ciliatus*

| | |
|---|---|
| common | 1, 4, 5, 12 |

**BROMEGRASS, KALMS** *Bromus kalmii*

| | |
|---|---|
| common | 25 |

**BROMEGRASS, MEADOW** *Bromus biebersteinii*

| | |
|---|---|
| common | 3, 17 |
| Fleet | 3C, 5C, 7C, 17C, 39, 83C |
| Paddock | 83C |
| Regar | 3C, 10, 17C, 28, 29C, 31, 34C, 37C, 38C, 39, 40C, 41C, 44C, 52, 67C, 75C, 87C, 92C |

**BROMEGRASS, MOUNTAIN** *Bromus carinatus (marginatus)*

| | |
|---|---|
| common | 1, 4, 5, 6, 29, 37, 38, 39, 40C, 41 |
| Bromar | 10, 31, 34, 39, 86F, 87 |
| Deborah | 38 |

**BROMEGRASS, NODDING** *Bromus anomalus*

| | |
|---|---|
| common | 1 |

**BROMEGRASS, SMOOTH** *Bromus inermis*

| | |
|---|---|
| common | 3, 5, 6, 17, 26, 27, 28, 29, 35, 37, 38, 39, 41, 52, 56, 63, 65, 70, 72, 75, 79 |
| Achenbach | 10 |
| Carlton | 3C, 17C, 37, 41, 44, 47, 52, 83C |
| Lincoln | 10, 28, 29, 31, 34, 37, 38, 41, 44, 56C, 87 |
| Manchar | 3C, 7C, 10, 28, 29, 29C, 34C, 38C, 39, 86F, 87 |
| Magna | 5C, 83C |
| Rebound | 18, 72C, 87 |

**BUFFALOGRASS** *Buchloe dactyloides*

| | |
|---|---|
| common | 27, 29, 34, 36, 37, 38, 41, 63, 65 |
| Bison | 56C |
| Bismarck | 16, 45F, 95 |
| Cody | 34, 56C |
| Comanche | 87 |
| Plains | 87 |
| Sharps Imp. | 34, 44, 87 |
| Tatanka | 34, 56C |
| Topgun | 9C |
| Texoka | 10, 34, 56C, 87 |

**CORDGRASS, PRAIRIE** *Spartina pectinata*

| | |
|---|---|
| common | 12, 23, 25, 36, 87 |

**DROPSEED, PRAIRIE** *Sporobolus heterolepis*

| | |
|---|---|
| common | 10, 12, 23, 25, 42, 87 |

**DROPSEED, ROUGH** *Sporobolus asper*

| | |
|---|---|
| common | 12 |

**DROPSEED, SAND** *Sporobolus cryptandrus*

| | |
|---|---|
| common | 9, 10, 12, 18, 34, 36, 56, 75, 87 |

**FESCUE, ARIZONA** *Festuca arizonica*

| | |
|---|---|
| common | 9 |
| Redondo | 10, 87 |

**FESCUE, BLUE** *Festuca glauca*

| | |
|---|---|
| common | 9 |

**FESCUE, HARD** *Festuca longifolia*

| | |
|---|---|
| common | 3, 5, 29, 34, 38, 39, 56 |
| Aurora | 5C |
| Durar | 10, 29, 34C, 38, 39, 41C, 44C, 87 |
| Slalom | 83C |
| Waldina | 52 |

**FESCUE, IDAHO** *Festuca idahoensis*

| | |
|---|---|
| common | 4, 9, 10, 34, 38, 39 |
| Joseph | 87 |

**FESCUE, ROUGH** *Festuca campestris*

| | |
|---|---|
| common | 1, 4, 5, 12, 39, 40, 87 |

**FESCUE, SHEEP** *Festuca ovina*

| | |
|---|---|
| common | 12, 28, 31, 34, 38, 39, 41, 52, 56 |
| Covar | 9, 10, 29, 34C, 38C, 39, 41, 52, 87C |
| Monty | 83C |

**FESCUE, TALL** *Festuca arundinacea*

| | |
|---|---|
| common | 3, 5, 6, 10, 63 |
| Alta | 38, 87C |
| Barcel | 27 |
| Courtenay | 5C |
| Enforcer | 34 |
| Fawn | 18, 27, 28, 34, 38C, 39, 41, 52, 56C, 87C |
| KY-31 | 34, 39, 56, 65, 87 |

**FOXTAIL, CREEPING** *Alopecurus arundinacea*

| | |
|---|---|
| common | 3, 5, 17, 63, 83 |
| Garrison | 10, 18, 28, 29, 30, 31, 34, 38, 39, 41, 52, 62R, 65, 70, 73F, 75, 79, 87C, 90C |

**FOXTAIL, MEADOW** *Alopecurus pratensis*

| | |
|---|---|
| common | 3, 5, 17, 39, 87 |
| Dan | 5C |
| Epic | 17C |

**GAMAGRASS, EASTERN** *Tripsacum dactyloides*

| | |
|---|---|
| Pete | 56C |

**GRAMA, BLUE** *Bouteloua gracilis*

| | |
|---|---|
| common | 4, 5, 9, 10, 12, 18, 23, 25, 29, 34, 36, 37, 38, 39, 41, 43, 44, 56, 70, 75, 79 |
| Alma | 87 |
| Bad River | 45F, 49, 70, 94 |
| Hachita | 10, 34, 87 |
| Lovington | 10, 34C, 87 |

**GRAMA, SIDEOATS** *Bouteloua curtipendula*

| | |
|---|---|
| common | 10, 12, 25, 26, 36, 39, 42, 43, 63, 65, 75, 79 |
| Butte | 10, 18, 34C, 36, 55C, 56C, 75, 87 |
| El Reno | 10, 18, 34, 56C, 87 |
| Haskell | 87 |
| Killdeer | 11, 23, 36, 44, 49, 87 |
| Niner | 10, 87 |
| Pierre | 10, 21C, 22, 24, 36, 44C, 45F, 57, 67, 70, 74, 75, 81C, 85 |
| Trailway | 10, 18, 56C, 75, 87 |
| Vaughn | 10, 34, 87 |

**HAIRGRASS, TUFTED** *Deschampsia caespitosa*

| | |
|---|---|
| common | 9, 39, 87 |

**INDIANGRASS** *Sorghastrum nutans*

| | |
|---|---|
| common | 10, 11, 12, 25, 26, 27, 36, 42, 43, 63, 65, 75 |
| Cheyenne | 10, 18, 34 |
| Holt | 10, 36, 56C, 75 |

| | |
|---|---|
| NE 54 | 36, 56C |
| Osage | 10, 56C |
| Oto | 10, 36 |
| Rumsey | 10, 36 |
| Tomahawk | 18, 19, 21C, 22C, 23, 24, 36, 44, 69C, 74, 75, 77C |

**JUNEGRASS** *Koeleria macrantha*

| | |
|---|---|
| common | 4, 5, 12, 25, 36 |

**JUNEGRASS, PRAIRIE** *Koeleria cristata*

| | |
|---|---|
| common | 9, 34, 39, 44, 75, 87 |

**MANNA GRASS, TALL** *Glyceria grandis*

| | |
|---|---|
| common | 1 |

**LOVEGRASS, SAND** *Eragrostis trichodes*

| | |
|---|---|
| common | 9, 10, 34 |
| Bend | 10 |
| Neb-27 | 10 |

**LOVEGRASS, WEEPING** *Eragrostis curvula*

| | |
|---|---|
| common | 10 |
| Ermello | 10 |
| Morpa | 10, 34 |

**NEEDLE-AND-THREAD** *Stipa comata*

| | |
|---|---|
| common | 4, 5, 9, 12, 34, 39, 44, 75, 87 |

**NEEDLEGRASS, GREEN** *Nassella viridula*

| | |
|---|---|
| common | 4, 5, 10, 12, 17, 28, 34, 35, 36, 39, 56, 63, 65, 75, 79 |
| Lodorm | 8, 10, 14, 16C, 29, 31, 37, 38, 41C, 44C, 46F, 49C, 52, 83C, 87 |

**OATGRASS, PARRY** *Danthonia parryi*

| | |
|---|---|
| common | 4 |

**ORCHARDGRASS** *Dactylis glomerata*

| | |
|---|---|
| common | 3, 10, 17, 26, 29, 35, 63, 65 |
| Artic | 5C |
| Axiom | 29, 38 |
| Cambria | 27 |
| Condor | 72 |
| Comet | 29 |
| Dawn | 34C, 52 |
| Hallmark | 18 |
| Kay | 3C, 5C, 7C |
| Latar | 18, 27, 28, 29C, 31, 34C, 38, 38C, 39, 41, 86C, 87 |
| Napier | 28, 29, 38 |
| Nordic | 17C |
| Paiute | 10, 28, 29C, 31, 34C, 38C, 39, 41, 52, 87C |
| Potomac | 3C, 18, 18C, 27, 28, 29C, 31, 34, 38C, 39, 41, 52, 56C, 72, 79, 87 |

**PORCUPINEGRASS, WESTERN** *Stipa curtiseta*

| | |
|---|---|
| common | 4, 12, 36 |

**RED TOP** *Agrostis gigantea*

| | |
|---|---|
| common | 5, 39, 41, 63 |
| Streaker | 87 |
| Venture | 5C |

**CANARYGRASS, REED** *Phalaris arundinacea*

| | |
|---|---|
| common | 3, 10, 17, 20, 26, 27, 29, 34, 38, 39, 41, 56, 63, 65, 70, 75, 79 |
| Palaton | 3C, 18C, 27C, 34, 38C, 52, 87C |
| Rival | 17C |
| Venture | 3C, 27C, 63, 87C |

**RICEGRASS, INDIAN** *Oryzopsis hymenoides*

| | |
|---|---|
| common | 5, 9, 10, 39, 79 |
| Nezpar | 5C, 8, 10, 34C, 39, 87C, 92C |
| Paloma | 10, 34, 39, 87 |

**RYEGRASS, PERENNIAL** *Lolium perenne*

| | |
|---|---|
| common | 3, 5, 26, 37, 39, 41, 87 |
| Dandy | 29 |
| Delaware | 29 |
| Linn | 18C, 29, 63, 75 |
| Olson | 27 |
| Polly | 18 |

**SACATON, ALKALI** *Sporobolus airoides*

| | |
|---|---|
| common | 9, 10, 29, 34, 87 |

**SANDREED, PRAIRIE** *Calamovilfa longifolia*

| | |
|---|---|
| common | 5, 34, 39, 56 |
| Bowman | 16 |
| Goshen | 5C, 10, 30, 31, 44C, 73F, 87C |
| Pronghorn | 55C |

**SLOUGHGRASS** *Beckmannia syzigachne*

| | |
|---|---|
| common | 4, 12 |

**SWITCHGRASS** *Panicum virgatum*

| | |
|---|---|
| common | 12, 25, 26, 27, 36, 43, 63, 65 |
| Alamo | 10, 87 |
| Blackwell | 10, 18, 34, 56C, 87 |
| Cave-in-Rock | 10, 56C |
| Dacotah | 19, 21C, 23C, 36, 44C, 45F, 87 |
| Forestburg | 18, 36, 44C, 45F, 48, 70, 72, 74, 75, 78C, 79, 87 |
| Kanlow | 10 |
| Neb-28 | 10, 18, 24C, 34, 36, 53C, 56C, 59C, 75, 79, 87 |
| Pathfinder | 10, 55C, 70, 79, 87 |
| Summer | 10, 64F, 70, 87 |
| Sunburst | 36, 59C, 61C, 74, 75, 78C, 87 |
| Trailblazer | 34, 55C, 56C, 79, 87 |

**TIMOTHY** *Phleum pratense*

| | |
|---|---|
| common | 3, 5, 6, 17, 26, 29, 38, 39, 56, 65, 79 |
| Alma | 3C |
| Basho | 3C, 83C |

| | |
|---|---|
| Carola | 3C |
| Champ | 3C, 17C, 83, 83C |
| Clair | 29C, 38, 39 |
| Climax | 3C, 5, 17C, 18, 27, 28, 29, 29C, 34, 38C, 39, 41, 52, 63, 83C, 87C |
| Joliette | 83C |
| Promesse | 17C |
| Timfor | 29 |
| Top-Tim | 52 |

**SWEETGRASS** *Hierochloe odorata*

| | |
|---|---|
| common | 1, 12 |

**WHEATGRASS, BLUEBUNCH** *Pseudoroegneria spicata*

| | |
|---|---|
| common | 39 |
| Secar | 9, 10, 28, 29, 31, 34C, 37, 38, 39, 41C, 86F, 87C, 90C |
| Goldar | 30R, 87C, 90C |
| Whitmar | 10, 29, 31, 34C, 37, 38, 39, 41, 87C |

**WHEATGRASS, HYBRID** P*seudoroegneria spicata X Elytrigia repens*

| | |
|---|---|
| Newhy | 34C, 67C, 75C |

**WHEATGRASS, CRESTED (fairway)** *Agropyron cristatum*

| | |
|---|---|
| common | 3, 5, 6, 10, 17, 39, 65, 70 |
| Fairway | 3C, 5, 10, 17C, 29, 31, 34, 37, 38, 39, 41, 44C, 52, 56C, 67, 75, 79, 83C, 87C |
| Ephraim | 10, 29, 31, 34C, 37, 38, 39, 41, 44C, 52, 67C, 75C, 87, 88C, 89C |
| Kirk | 3C, 5, 7C, 17C, 83C |
| Parkway | 83C |
| Ruff | 10, 87 |

**WHEATGRASS, CRESTED (standard)** *Agropyron desertorum*

| | |
|---|---|
| common | 29, 34, 38, 63, 75 |
| Nordan | 3C, 5, 10, 28, 29, 31, 34, 37, 38, 41, 52, 70, 75, 79, 87 |

**WHEATGRASS, CRESTED (hybrid)** *Agropyron cristatum x desertorum*

| | |
|---|---|
| Hycrest | 10, 29C, 31, 34C, 37, 38, 39, 41, 44C, 52, 67, 68C, 75, 83, 87 |

**WHEATGRASS, INTERMEDIATE** *Elytrigia intermedia*

| | |
|---|---|
| common | 3, 5, 17 |
| Amur | 10 |
| Chief | 3C, 17C, 83C |
| Clarke | 5, 39 |
| Greenar | 10, 86F, 87 |
| Oahe | 10, 18, 28, 29, 31, 34, 37, 38, 39, 41, 44C, 52, 56C, 63, 67, 70, 72, 75, 79C, 87C |
| Reliant | 44C, 45F, 79C |
| Slate | 10, 56C, 66, 87 |
| Tegmar | 10, 29, 38, 39, 87 |

**WHEATGRASS, PUBESCENT** *Elytrigia intermedia*

| | |
|---|---|
| common | 3, 5, 7, 29, 34, 75, 83 |
| Greenleaf | 3C, 5, 7, 28, 29, 31, 37, 38, 39, 41C, 87C |
| Luna | 10, 28, 29, 31, 34C, 37, 38, 39, 41C, 87C, 89C |
| Mandan-759 | 10, 28, 29, 31, 37, 38, 39, 44C, 47, 50C, 52, 67, 75, 87C |
| Manska | 29, 31, 44C, 45F, 56C, 57, 60C, 67C, 71C, 75C, 79C, 87C, 92C |

**WHEATGRASS, SIBERIAN** *Agropyon fragile*

| | |
|---|---|
| common | 10, 41 |
| P-27 | 29, 31, 37, 38, 87C |

**WHEATGRASS, SLENDER** *Elymus trachycaulus*

| | |
|---|---|
| common | 3, 5, 6, 10, 12, 17, 27, 29, 31, 34, 36, 39, 63, 65, 83 |
| Adanac | 5 |
| Highlander | 6C, 6 |
| Primar | 44C, 87 |
| Pryor | 29, 31, 34C, 37, 38, 39, 41, 73F, 87C, 90C |
| Revenue | 3C, 5, 28, 29, 31, 37, 38, 39, 41, 44C, 52, 87 |
| San Luis | 87 |

**WHEATGRASS, STEAMBANK** *Elymus lanceolatus ssp. lanceolatus*

| | |
|---|---|
| common | 3, 5 |
| Sodar | 3C, 5, 7C, 10, 17C, 28, 29, 31, 34C, 37, 38, 39, 41, 44C, 52, 83C, 87C, 91C |

**WHEATGRASS, TALL** *Elytrigea elongata*

| | |
|---|---|
| common | 3, 5, 17, 27, 29, 34, 39, 56, 63, 65, 70, 72, 79, 83 |
| Alkar | 18, 28, 29, 34, 38, 39, 44C, 52, 75, 86F, 87C, 91C |
| Jose | 10, 29, 34C, 37, 38, 41C, 87C, 91C |
| Largo | 87 |
| Orbit | 39, 44C, 75, 87 |
| Platte | 87 |

**WHEATGRASS, THICKSPIKE (northern)** *Elymus lanceolatus*

| | |
|---|---|
| common | 3, 5, 17, 39, 83 |
| Critana | 8, 10, 16C, 28, 29C, 30C, 31, 34C, 37, 38C, 39, 41C, 44C, 52C, 54C, 73F, 87C, 90C, 93C |
| Elbee | 3C, 5, 7C |
| Schwendimar | 86F |

**WHEATGRASS, WESTERN** *Pascopyrum smithii*

| | |
|---|---|
| common | 3, 5, 10, 12, 17, 27, 28, 29, 31, 34, 36, 37, 38, 39, 41, 44, 52, 56, 63, 65, 70, 75, 76, 79, 82, 83 |
| Ariba | 10, 34C, 87C, 92C |
| Barton | 10, 34C, 56C, 87 |
| Flintlock | 10 |
| Rodan | 10, 16C, 44C, 45F, 87 |
| Rosana | 10, 28C, 29C, 31, 34, 37, 38C, 39, 40, 41C, 44C, 52, 73F, 87C, 89C, 92C |
| Walsh | 3C, 5 |

**WHITETOP** *Scolochloa festucacea*

| | |
|---|---|
| common | 13 |

**WILDRYE, ALTAI** *Leymus angustus*

| | |
|---|---|
| common | 3, 5, 29, 38, 39, 83 |
| Prairieland | 3, 7C, 17C, 31, 44C, 87 |
| Eejay | 5 |

**WILDRYE, BASIN** *Leymus cinereus*

| | |
|---|---|
| common | 39 |
| Trailhead | 8C, 73F, 87C |
| Magnar | 31, 34, 37, 39, 41C, 87C |

**WILDRYE, BEARDLESS** *Leymus triticoides*

| | |
|---|---|
| common | 10 |
| Shoshone | 16, 73F, 87C, 90C, 91C |

**WILDRYE, CANADA** *Elymus canadensis*

| | |
|---|---|
| common | 1, 9, 10, 11, 12, 25, 26, 36, 42, 43, 56, 87 |
| Mandan | 11, 22C, 45F |

**WILDRYE, DAHURIAN** *Elymus dahuricus*

| | |
|---|---|
| common | 3, 5, 38 |
| Arthur | 83C |
| James | 5, 8C, 17C |

**WILDRYE, MAMMOTH** *Leymus racemosa*

| | |
|---|---|
| Volga | 87, 93C |

**WILDRYE, RUSSIAN** *Psathyrostachys juncea*

| | |
|---|---|
| common | 3, 5, 17, 28, 29, 31, 37, 38, 39, 41, 70, 52 |
| Bozoisky | 28, 29, 30R, 31, 34, 37C, 38, 39, 41C, 44C, 52, 87C, 90C, 93C |
| Cabree | 3 |
| Mankota | 45F, 50C |
| Swift | 3, 37, 38, 41, 83C, 87 |
| Sawki | 3, 5 |
| Vinall | 10, 34, 44, 75, 87 |

**WILDRYE, SMOOTH** *Elymus glaucus*

| | |
|---|---|
| common | 1 |

**WILDRYE, VIRGINIA** *Elymus virginicus*

| | |
|---|---|
| common | 42 |
| O'Ma'Ha | 56C |

# Grass Seed Growers/Vendors

| | Name<br>Address | Telephone<br>Fax |
|---|---|---|
| 1. | E. Slopes Rangeland Seeds Ltd.<br>Box 273, Cremona, Alberta TOM ORO | 403-637-2473<br>403-637-2724 |
| 2. | United Grain Growers Ltd.<br>Box 7430, Edmonton, Alberta T5E 6K1 | 403-479-2051<br>403-479-6027 |
| 3. | Hanna Seeds<br>5037 49th St., Lacombe, Alberta T4L 1Y2 | 403-782-6671<br>403-782-6503 |
| 4. | Enviroscapes<br>1213 5th Ave So., Lethbridge, Alberta T1J 0V6 | 403-327-1902<br>403-327-2509 |
| 5. | Prairie Seeds<br>1805 8th St., Nisku, Alberta T9E 7S8 | 403-955-7906<br>403-955-7068 |
| 6. | Pickseed Canada<br>Box 3230, Sherwood Park, Alberta T8A 2A6 | 403-464-0350<br>403-464-0305 |
| 7. | Kenneth C. Long Seeds<br>Box 100, Spring Coulee, Alberta T0K 2C0 | 403-653-4114<br>403-653-4124 |
| 8. | Rangeland Seeds<br>Box 928, Vulcan, Alberta T0L 2B0 | 403-485-6448<br>403-485-6448 |
| 9. | NorthPlan/Mountain Seed<br>P.O. Box 9107, Moscow, Idaho 83843-1607 | 208-882-8040<br>208-882-7446 |
| 10. | Sharp Brothers Seed Co.<br>P.O. Box 140, Healy, Kansas 67850 | 316-398-2231<br>316-398-2220 |
| 11. | Voth Seed Farms<br>Box 1716, Altona, Manitoba R0G 0B0 | 204-324-8792<br>N/A |
| 12. | Prairie Habitats<br>P.O. Box 1, Argyle, Manitoba R0C 0B0 | 204-467-9371<br>204-467-5004 |
| 13. | J.R.Dyck<br>P.O. Box 591, Boissevain, Manitoba R0K 0E0 | 204-534-6608<br>N/A |
| 14. | Tamarack Farms<br>Box 366, Erickson, Manitoba R0J 0P0 | 204-636-2990<br>N/A |
| 15. | Northstar Seed Ltd.<br>Box 2220, Neepawa, Manitoba R0J 1H0 | 204-476-5241<br>204-476-3773 |
| 16. | Blight Native Seeds<br>Box 244, Oakville, Manitoba R0H 0Y0 | 204-267-2376<br>204-267-2699 |

| | Name<br>Address | Telephone<br>Fax |
|---|---|---|
| 17. | Brett Young Seeds<br>Box 99, St. Norbert P.S., Winnipeg, MB R3V 1L5 | 204-261-7932<br>204-275-7333 |
| 18. | Albert Lea Seed House<br>Box 127, Albert Lea, Minnesota 56007 | 507-373-3161<br>507-373-7032 |
| 19. | Norfarm Seeds, Inc.<br>Box 725, Bemidji, Minnesota 56619 | 218-751-8617<br>218-751-0485 |
| 20. | Werner Farm Seeds<br>3104 Millesburg Blvd., Dundas, Minnesota 55019 | 507-645-7995<br>612-496-3668 |
| 21. | Mark Gullickson<br>RR 2, Fertile, Minnesota 56540 | 218-945-6894<br>218-281-5211 |
| 22. | Paul Kaste<br>RR 2, Box 153, Fertile, Minnesota 56540 | 218-945-6738<br>218-945-6303 |
| 23. | Oscar Carlson<br>P.O. Box 157 Lake Bronson, Minnesota 56734-0157 | 218-754-4475<br>N/A |
| 24. | Don Vogt, Wildlife Habitat<br>RR 3, Box 178, Owatonna, Minnesota 55060 | 507-451-6771<br>507-451-6771 |
| 25. | Prairie Restorations<br>Box 327, Princeton, Minnesota 55371 | 612-389-4342<br>612-389-4346 |
| 26. | Peterson Seed Co.<br>Box 346, Savage, Minnesota 55378 | 612-445-2606<br>612-445-1679 |
| 27. | Premium Seed Co.<br>7800 E. Hwy. 101, Shakopee, Minnesota 55379 | 612-496-1783<br>N/A |
| 28. | AgriBasics Seed Co.<br>1400 Minnesota, Billings, Montana 59101 | 406-252-8012<br>406-252-8395 |
| 29. | Northland Seed Co.<br>P.O. Box 1675, Billings, Montana 59103 | 406-252-0568<br>406-259-9291 |
| 30. | Bill Skorupa<br>Rt. 1, Box 1211, Bridger, Montana 59014 | 406-662-3358<br>N/A |
| 31. | Treasure State Seed, Inc.<br>Box 698, Fairfield, Montana 59436 | 406-467-2557<br>406-467-3377 |
| 32. | Cenex/Farmers Union Oil Co.<br>Box 2483, Great Falls, Montana 59403 | N/A<br>N/A |
| 33. | Central Feed Co.<br>220 East Main, Lewistown, Montana 59457 | 406-538-5451<br>406-538-5452 |

| | Name<br>Address | Telephone<br>Fax |
|---|---|---|
| 34. | Valley Feed<br>Rt. 62, Box 3252, Livingston, Montana 59047 | 406-222-1132<br>406-222-1135 |
| 35. | Northern Ag. Service<br>HC 65, Box 5500, Malta, Montana 59538 | 406-654-2022<br>406-654-2253 |
| 36. | Mohn Frontier Seed<br>Rt. 1, Box 152, Cottonwood, Minnesota 56229 | 507-423-6482<br>507-423-5552 |
| 37. | Reynolds Feed & Seed<br>3460 Buffalo Trail, Molt, Montana 59057 | 406-669-3219<br>N/A |
| 38. | Westland Seeds, Inc<br>1308 Round Butte Rd W., Ronan, Montana 59864 | 406-676-4100<br>406-676-4101 |
| 39. | Big Sky Wholesale Seeds, Inc.<br>Box 852, Shelby, Montana 58474 | 406-434-5011<br>406-434-5014 |
| 40. | West Butte Ranch<br>P.O. Box 32, Sweetgrass, Montana 59484 | 406-937-2281<br>406-937-2282 |
| 41. | Circle S Seeds<br>Box 130, Three Forks, Montana 59752 | 406-285-3269<br>406-285-3269 |
| 42. | Shooting Star Native Seeds<br>RR2, Box M1, Spring Grove, Minnesota 55974 | 507-498-3993<br>N/A |
| 43. | Feders Prairie Seed Co.<br>12871 380th Ave, Blue Earth, Minnesota 56013 | 507-526-3049<br>507-526-3509 |
| 44. | Chesak Seed House<br>220 No. 23rd St., Bismarck, North Dakota 58501 | 701-223-0391<br>701-223-0980 |
| 45. | USDA, NRCS, Plant Materials Center<br>3308 University Drive, Bismarck, ND 58504-7564 | 701-223-8536<br>701-223-9024 |
| 46. | NDSU Agronomy Seed Farm<br>15449 37th St. SE, Casselton, North Dakota 58012 | 701-347-4743<br>701-347-4743 |
| 47. | Robinson Stock Farm Inc.<br>Rt. 1, Box 5C, Coleharbor, North Dakota 58531 | 701-442-5418<br>701-654-7693 |
| 48. | Barry Voulek Farms<br>222 Denver Drive, Crete, North Dakota 58040 | 701-753-7401<br>701-753-7931 |
| 49. | Rogne-Schumacher Seed Farm<br>RR 2, Box 231, Kindred, North Dakota 58501 | 701-428-3839<br>N/A |
| 50. | Fred Evans Triple T Ranch<br>Rt.1, Box 93, Stanley, North Dakota 58784 | 701-628-2418<br>701-628-2318 |

| | Name<br>Address | Telephone<br>Fax |
|---|---|---|
| 51. | Agassiz Seed & Supply<br>445 7th St N.W, West Fargo, North Dakota 58078 | 701-282-8118<br>701-282-9119 |
| 52. | Cenex Land O/Lakes Seed<br>Box 155, 111 11th Ave. W. Williston, ND 58802 | 701-572-5180<br>701-572-9442 |
| 53. | Laux Seed Farm<br>HC 85, Box 48, Bridgeport, Nebraska 69336 | 308-262-0512<br>N/A |
| 54. | Kendall Atkins<br>HC 89, Box 52 , Dix, Nebraska 69133 | 308-682-5647<br>N/A |
| 55. | Osler Seed Farms<br>HCR 55, Box 123, Elsie, Nebraska 69134 | 308-228-2287<br>N/A |
| 56. | Stock Seed Farms<br>28008 Mill Road, Murdock, Nebraska 68407 | 402-867-3771<br>402-867-2442 |
| 57. | Leo Kratovil<br>P.O. Box 55, Batesland, South Dakota 57716 | 605-288-1933<br>N/A |
| 58. | Locken Farms<br>39643 137th St., Bath, South Dakota 57427 | 605-225-1079<br>N/A |
| 59. | Roger McCulloch<br>RR 1, Box 235, Big Stone City, South Dakota 57216 | 605-432-4129<br>N/A |
| 60. | Lyle Stewart<br>30213 199th St., Blunt, South Dakota 57522 | 605-224-5682<br>N/A |
| 61. | Hansmeier & Son<br>Box 136, Bristol, South Dakota 57219 | 605-492-3611<br>N/A |
| 62. | Allen Watt<br>2024 Olwein St.,Brookings, South Dakota 57006 | 605-696-3600<br>605-696-3610 |
| 63. | Milborn Feed & Seeds, Inc.<br>3127 Hwy. 14 Bypass, Brookings, South Dakota 57006 | 605-697-6306<br>605-697-6308 |
| 64. | SD Crop Improvement/Foundation Seed Stocks<br>Box 2207-A, Brookings, South Dakota 57007 | 605-688-5418<br>N/A |
| 65. | Sexauer Company<br>Box 58, Brookings, South Dakota 57006 | 605-696-3600<br>605-696-3610 |
| 66. | Furrey Brothers<br>RR 3, Box 101, Carter, South Dakota 57526 | 605-879-2239<br>N/A |
| 67. | Gene Graves<br>1109 E. Main St., Chamberlain, SD 57325 | 605-734-6804<br>N/A |

| Name<br>Address | Telephone<br>Fax |
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| 68. Dennis Ruzicka<br>HC1, Box 38, Highmore, South Dakota 57345 | 605-852-2467<br>N/A |
| 69. Brad Magness<br>RR. 1, Box 140, Huron, South Dakota 57350 | 605-352-8759<br>N/A |
| 70. Pearl View Seeds<br>RR 1, Box 151, Cavour, South Dakota 57324 | 605-352-5933<br>N/A |
| 71. Ron Bieber<br>HCR 1, Box 17, Leola, South Dakota 57456 | 605-439-3628<br>605-439-3100 |
| 72. Domestic Seed & Supply<br>P.O. Box 466, Madison, South Dakota 57042 | 605-256-6529<br>605-256-6521 |
| 73. USDA, NRCS, Plant Materials Center<br>Route 1, Box 1189, Bridger, Montana 59014-9718 | 406-662-3579<br>406-662-3428 |
| 74. Bertsch Ranch<br>HC 76, Box 137, Miller, South Dakota 57362 | 605-853-2341<br>N/A |
| 75. Wilbers Feed & Seed Co.<br>P.O. Box 41, Miller, South Dakota 57362 | 605-853-2414<br>605-853-2639 |
| 76. Wm. Scott Phillips<br>Box 17, New Underwood, South Dakota 57761 | 605-985-5573<br>N/A |
| 77. Robert Weiss<br>41963 275th St. Parkston, South Dakota 57366 | 605-928-7981<br>N/A |
| 78. Eugene Raap<br>RR 1, Box 72, Pierpont, South Dakota 57408 | 605-325-3308<br>N/A |
| 79. Den Besten Seed Co<br>Box 896, Platte, South Dakota 57369 | 605-337-3318<br>605-337-9684 |
| 80. Clinton Fuerst<br>Box 417, Tripp, South Dakota 57376 | 605-935-6418<br>N/A |
| 81. Rethke Nurseries<br>47030 149th St., Twin Brooks, South Dakota 57269 | 605-432-6073<br>N/A |
| 82. Cammack Ranch Supply<br>Box 2, Union Center, South Dakota 57787 | 605-985-5591<br>605-985-5593 |
| 83. Newfield Seeds Co. Ltd.<br>Box 100, Nipawin, Saskatchewan S0E 1E0 | 306-862-4678<br>306-862-9505 |
| 84. Native Plants Inc.<br>417 Wakara Way, Salt Lake City, Utah 84108 | 801-582-0144<br>N/A |

| | Name<br>Address | Telephone<br>Fax |
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| 85. | Rainier Seeds, Inc.<br>P.O. Box 1549, Port Orchard, Washington 98366 | 360-769-8113<br>360-769-8205 |
| 86. | Washington State Crop Improvement Assn.<br>WSU Seedhouse, Grimesway, Pullman, WA 99164 | 509-335-4365<br>509-335-7007 |
| 87. | Wind River Seed Co.<br>3075 Lane 51½, Manderson, Wyoming 82432 | 307-568-3361<br>307-568-3364 |
| 88. | Bob Fornstrom<br>Box 927, Pine Bluffs, Wyoming 82032 | 307-245-3618<br>N/A |
| 89. | Dean Anderson<br>2527 Hwy 215, Pine Bluffs, Wyoming 82082 | 307-246-3356<br>N/A |
| 90. | Etheridge Seed Farms<br>2028 Lane 11, Powell, Wyoming 82435 | 307-754-2366<br>N/A |
| 91. | Faxon Farms<br>598 Rd. 11, Powell, Wyoming 82435 | N/A<br>N/A |
| 92. | Kelly Spiering<br>1170 Road 20, Powell, Wyoming 82414 | 307-754-4349<br>N/A |
| 93. | Mike Forman<br>990 Rd. 19, Powell, Wyoming 82435 | 307-754-5360<br>N/A |
| 94. | Lincoln-Oakes Nursery<br>P.O. Box 1601, Bismarck, North Dakota 58502 | 701-223-8575<br>701-223-1291 |
| 95. | S&B Landscaping & Nursery<br>1400 Airport Road, Bismarck, North Dakota 58504 | 701-224-0100<br>N/A |