Native Grass Seed Production for Southern Nevada

1. Scope

This report consists of all preparation and cultural operations necessary to establish and maintain a seed production field of specified native grass.

2. General Requirements

A. Site Selection

Success in the establishment and maintenance of plants 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 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 species will tolerate poorer soil conditions, but seed production potential can be 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.

Seed production fields should be as weed free as possible, especially from noxious weeds such as goatgrass, halogeton, white horsenettle, tumbleweeds, Bermuda grass, etc. Each state maintains a noxious weed list; the weeds on this list must be controlled (Appendix A). State seed certifying agencies may reject whole fields that are infested with plants on the state noxious weed list. Annual plants are always problematic in seed production fields. If the field is not clean, do not plant. Many weeds can be controlled in conjunction with seed production but this is not the way to start a production field. Fields must be adapted to irrigation without ponding or excessive erosion. Soil erosion by water can be a serious problem when producing seed in wide row spacing on rolling land. Select a level to gently sloping site for growing varieties in wide rows or plant on the contour to reduce soil erosion between rows. Rills and gullying between rows make harvesting very difficult. Runoff water

from heavy rains can carry seed from adjacent fields or field margins to another field, creating the potential for serious cross species contamination. Seed production fields must be located to avoid contamination by other species.

B. Site Preparation

It is essential to control competing vegetation before attempting to establish plants. Inadequate weed suppression leads to more seeding failures than any other single factor.

Fields that have not been tilled recently and contain annual or 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. Selective herbicides are available and should be evaluated as alternatives to tillage.

C. Field Preparation

Final field preparation typically involves some form of shallow tillage. A good rule of thumb is that a field prepared for planting will produce a footprint no deeper than one-quarter inch. A firm seedbed facilitates the capillary movement of moisture to the developing seedling. Inadequate field preparation often results in non-uniform uneven stands which reduce seed production potential and encourage weed infestation.

The field should be watered prior to planting to provide adequate soil moisture for the seedlings. This keeps the root ball and the seedlings from drying out during the planting process.

D. Planting Density

Plantings derived from transplants provide the producer with various spacing options. Grass plants that produce large clumps should be spaced to allow the clump to mature. Typically spacing between plants is 1 ft. and between the rows is 38 to 40 inches.

Determining the ideal row spacing depends on a number of factors including:

1) the potential for inter-row cultivation

2) the plants growth type

3) planting equipment available.

Most native plants yield higher in wider rows, compared to narrow rows and solid stands. If the species being grown is for pedigreed seed, then wider rows makes it easier to rogue off types, to remove volunteer plants and to control weeds with inter row cultivation.

Wide row spacing generally produces higher seed yields over a longer time period. Row plantings require fewer plants per acre for desired stand establishment. Cultivation for weed control is possible with row plantings and is not with solid planting.

E. Fertilization

During Establishment: Fertilization is suggested to promote early growth and provide vigorous plants. The macronutrients phosphorus (P), potassium (K), and sulfur (S) are essential for development of the root system, but generally are not required unless a soil test indicates low levels. As a general rule 100 lbs of ammonium sulfate $(NH_4)_2SO_4$ (21-0-0-24) may be applied before planting. The small amount of nitrogen will provide a starter for the seedling and the sulfate will lower the soil pH resulting in the release of bound nutrients.

Established stands: Typically, nitrogen rates for established stands range from 60 to 100 lbs/acre for irrigated fields. Excess N may promote lodging. Fertilizer applied to established stands can be side or deep banded between rows or broadcast. Banding is normally 4 to 6 inches off center to ensure that roots have access to the immobile or less mobile nutrients being added. If fertilizer is broadcast irrigation should follow promptly. Nitrogen fertilizer may be broken down when exposed to UV and result in a lower than intended amount becoming available to the plant.

Nitrogen application is in the early spring when plants begin to green up. Fertilizer will be more efficient if applications are split between the late fall and early spring. If the crop is harvested multiple times an application of fertilizer should be applied after each harvest.

F. Weed Control

Weed control in native species can be difficult. In the seedling stage, many natives tend to be poor competitors. Little, if any, information is available on native plant herbicide tolerance, and there are few herbicides currently registered for use on natives. The limited acreage of natives has meant that little emphasis has been placed on the evaluation 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 stand. It is essential to select fields and seed lots that contain no problem weeds. 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 seed producers are: mechanical control, herbicides and roguing.

Mechanical Weed Control: Mechanical control involves the use of cultivation equipment to uproot weeds. Various forms of inter-row cultivation equipment are available including shovels, sweeps and rotary tillers. Inter-row cultivation can take place as soon as the rows of the plants are visible. Cultivation should be no closer than 1 to 1-1/2 inches to the row, so as not to disturb the 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. Inter-row cultivation is also a valuable weed control practice on established stands. Cultivation should be shallow, ideally one to two inches deep, as cultivating too deep may cut off the fibrous roots of the native plants. Another benefit of inter-row cultivation is the restriction of rhizome growth in certain species. Restricting this growth keeps the

seed production field from becoming sod bound. Mowing is another form of mechanical weed control. Mowing is especially effective where annual weeds are a problem. Annual weeds are killed when mowed at the proper stage of maturity, but perennial seedlings not only survive, but clipping usually encourages growth. It is essential to wait until the annual weeds are at an early seed head stage before mowing. If annual weeds are mowed too soon and the growing point remains below mowing height, they often produce new tillers that grow close to the soil surface and create even greater competition than before mowing. Annual weeds must be mowed before they can produce viable seed.

Herbicides for Weed Control: Herbicide application in seedling fields can begin as early as the 4 to 5 leaf stage. Broadleaf herbicides such as 2,4-D may be applied roughly 2 to 3 weeks after planting. A delay in application can pose a problem because the efficiency of control decreases as the size of the weeds increase. A pre-emergent herbicide may provide control of weeds throughout the season. These should be applied in the spring and or fall before weeds or rogue plants emerge.

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 crop in order to be effective. Wicking is effective on short species.

Never apply 2,4-D products to Scratchgrass.

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 used in this document are solely to provide specific information. Mention of a trade name does not constitute a guarantee or endorsement.

Always check with appropriate state agencies for usage requirements of any pesticides.

Roguing for Weed Control and Seed Purity: Roguing is 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 laborious and time consuming method of weed control. It is done by removing the plants either by hand or spot spraying the weeds with a nonselective herbicide. The removal of off-type plants and plants of other species is an important component in the production of certified seed. Contamination of a 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 seed lot being rejected for certified status. Often there is zero tolerance for many weeds or even other crop kinds.

Plants removed by hand, should be removed from the field to reduce the possibility of contamination during harvest. Chemical roguing may be accomplished using a nonselective herbicide to spray out individual weeds, other species and off-type plants. Chemical roguing should be

Wide row spacings facilitate roguing by providing easier identification of undesirable plants and easier movement within the field.

accomplished prior to seed production of the undesirable plant, immature or nonviable seed will also lead to the rejection of the seed lot.

G. Diseases and Insects on Native Grasses

Little information is available on disease and insect damage of native plants. What is available is based on the observations of researchers in the field. The natural environment for most native plants is in mixed stands. This reduces the chance of inoculums buildup that is necessary for severe disease and insect infestations. The planting of the native plants in monoculture for seed production encourages the development of disease and insect problems. Stem and leaf rust (*Puccini* sp.) and ergot (*Clavicles* sp.) has been frequently reported in native grass production fields. These diseases are often controlled by the use of proper cultural practices. Insects can be a problem in native grass production fields. Thrips (*Chirothrips* sp., *Frankliniella* sp. and/or *Haplothrips* sp.) are not uncommon and in some instances reduce seed yield. Insects may be controlled by paying attention to cultural practices and also by application of insecticides. The insecticide used is based on which insect is preying on the plant.

H. Seed Harvest

Seed Maturity: Seed maturity varies among and within species. Seed maturity occurs over a period of time lasting from a few days to several weeks. The time from flowering (pollination) to mature seed typically takes 30 days or more. Wet, cool weather increases the number of days to maturity while dry, hot weather decreases the time to maturity. All plants 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.

A major limiting factor for seed production of many native plants is a tendency for seed to shatter before or during harvest. Most plants do not hold seed long after maturity. Timing of harvest is critical for species prone to shattering. Successful growers inspect seed fields often to determine when the majority of seed are ripe. Compromise is often required in deciding when to harvest. The challenge is to harvest before shattering, but to wait for seed maturity to avoid yield losses from immature seed. There is a fine line between viable seed that will germinate and immature shriveled seed that is worthless.

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.***
2. ***The seed heads of most native plants ripen from the top down, a stand is ready to harvest when the tips of the seed heads begin to shatter.***
3. ***If seed shatters when striking the seed head firmly against the palm, the grass seed stand is ready to harvest.***
4. ***Seed that shatters readily or are overly mature should be harvested during the early morning hours when the relative humidity is generally higher.***

I. Harvesting Techniques

Direct combining. The advantage of direct combining is that the necessary equipment is available on many farms. It is the method of choice for short stature plants. The seed is harvested mature, but because there may be a range of maturity within a seed field, post harvest seed drying may be required. This operation requires less harvest time, when compared to swathing and then combining. The major risk with direct combining is that the crop is left longer in the field, increasing the risk of crop loss due to inclement weather and/or seed shatter. Seed yields may be less than with swathing due to indeterminate ripening patterns.

Swathing and Combining is a rapid field operation because foliage is cured prior to combining. Retrieving the swath from the field may present problems. This occurs when swaths are small with short, sparse stubble or swaths have been rained on and become imbedded in the stubble. Seed quality declines when the swath has been rained on. There are many excellent pickup attachments on the market for combines.

Seed Strippers or flail vac harvesters are another option. These headers are good for plants that do not have uniform maturity, for those with light and fluffy seeds or with long awns or seed pubescence. The header strips mature seed from the plant, leaving immature seed still attached. This allows the harvest operation to be repeated, resulting in a higher yield potential.

Timing of harvest is dependent on the harvest method. In most instances harvesting is best when the humidity is low and temperature high. These conditions ensure separation of the seed from the head and reduce the need for post harvest drying. These conditions also cause the greatest amount of seed shattering. Seed should be threshed at 20 to 30 per cent moisture. Combines must be properly adjusted and carefully monitored to prevent physical damage or loss of seed. There is a delicate compromise between cylinder speed and concave setting to completely thresh seed without damage when using traditional combines.

J. Residue Management and Renovation

Residue should be removed after harvest to reduce disease pressure from stubble - borne diseases and to shading of the crowns. Native plants require periodic renovation in order to maintain optimum vigor. Burning, grazing and haying are all methods used to rejuvenate native plants. Burning is extremely effective in completely removing crop residue. Grazing and haying are also effective; however the residue must be removed without damaging the plants.

Chemical gapping is a less used renovation option. Strips are chemically removed, allowing room for new tiller initiation and growth from the remaining rows. Seed yield of rangeland blue grama has been increased 100% by using chemical gapping.

Every seed harvest contains contaminants such as weed seed, other crop seed and inert material such as stems, leaves and immature and broken seed. Depending on the harvest method, inert material can make up over 50 per cent of the bulk material received from the field. Impurities are separated from the seed based on physical

properties such as size, weight, surface texture and shape. The greatest concern is weed seed with physical characteristics similar to the desired seed. **The best, easiest and most economical way to produce clean seed is to keep the field weed free**. Good cultural and management practices including spray programs, crop rotation, inter-row cultivation and roguing, minimize many serious weed and contaminant problems.

3. Processing Native Seed

***Seed Cleaners and Separators*:** Seed cleaning machines use the physical properties of seed to separate the desirable from the undesirable. These machines can be used singly or in combination. The choice of machines and their sequence in processing depends on the seed being cleaned, the quantity of weed seed, contaminants in the mixture and the purity requirements. Following are brief descriptions of machines commonly used in a seed cleaning plant.

The Air-Screen Cleaner is the primary machine in a seed cleaning plant. It makes seed separations based on the physical properties of size, shape and density. There are many makes and models of air-screen cleaners. They rang from the small, one fan, single screen machine to the large, multiple fans, six or eight screen machine. Screens for these machines are manufactured with many sizes and shapes of openings. The typical air-screen cleaner 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. The remaining seed is uniformly distributed over the top screens. The top screen 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, while blowing 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 cleans seed that have been size graded by width and thickness and can be further separated based on 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 that is too shallow to accommodate long seeds. The disc separator consists of a series of indented discs that 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 seriating 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 Separators classify 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, 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, 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 primary machines used are scalpers, debearders, hammermills and huller scarifiers.

Scalping is a rough cleaning operation 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. In addition, removal of trash and high moisture green material will lower drying costs and permit safer storage. There are many types and sizes of scalpers available. The most common is a simple two screen machine that removes large stems and leaves quickly and provides for the removal of inert material by basic air separation. The greatest benefits from a scalper come when it is the first machine 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. A seed lot may contain untraced seed in the form of pods, heads, clusters or doubles. In addition, many native plants 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 that 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 screen. Seeds processed in the mill are subjected to vigorous beating or rolling action between the hammers and perforated screen that 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. When the speed is too fast, the seed is mutilated or cracked. When the speed is too slow, the awns are not 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 plants 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 affect seed viability and longevity. Seed that is too wet for immediate storage can be slowly dried with warm air, bringing the moisture down to 15 per cent before storage. Care must be taken not to use air temperatures above 108^0 F to dry the seed. Doing so will cause reduced viability or the death of the seed. To maintain viability, native seed should be stored in bulk at 10 to 12 per cent moisture and in bags at 12 to 15 per cent moisture. Seed 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 plants will reach their maximum germination 2 to 3 years following harvest and maintain a high level of viability for 3 to 6 years. Seed should be stored under carefully controlled environmental conditions to maintain viability over long periods. To maintain existing viability, seed has to be stored cool and with low relative humidity. The rule of thumb is that the sum of the

air temperature and relative humidity should be less than 100 to provide a suitable long-term storage environment.

4. Future Potential

Much of the current market for native seed is through contract seed production or bulk purchase by end users, such as government agencies, wildlife organizations, mining companies and highway departments. The remainder is through the sale of smaller quantities of seed to the public for small scale plantings and even for ornamental purposes. The price of seed is dependent upon the species. The price of seed is determined by the ease of production and the demand for the seed. 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 seed has been below the standards set for introduced forage plants. The adoption of the pedigree (certified) seed production system for native seed is being encouraged and will hopefully have the effect of increasing seed quality. Increasing the quality of native seed should also increase the ease of establishment and therefore increase demand.

The greening of the 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 seed.

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

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

5. Economics of Native Grass Seed Production

Cost and returns for producing native seed crops may be estimated using guidelines for crop production. Local cooperative extension offices will usually be able to assist growers in estimating their installation and production expenses. Costs will vary according to an individual's preferred management practices. The following example provides a way to estimate production and establishment costs. Establishment costs may be prorated over the life of the field.

Estimated Establishment Year Production Expenses for Native Seed Production

Establishment Year Costs/Acre	Estimated Average Total Production Costs[1]	Actual Expenses
Seedbed Preparation *plow, disc, harrow, level pack, etc.*		
Seed or Transplants		
Planting Costs		
Irrigation		
Cultivation		
Fertilizer (50 a.u. nitrogen) (fertilizer, labor, equipment)		
Herbicide – 2 applications (chemical, labor, equipment)		
Roguing – 1st year @ 3 hours/acre		
Water Cost - _____/acre		
Ditch and Structure Maintenance		
Taxes		
Total Cost of Establishment		
Prorated Costs – 5 year stand life = _____		

Estimated Production Expenses for Native Seed Production

Annual Costs/Acre	Estimated Average Total Production Costs[1]	Actual Expenses
Fertilizer (50 a.u. nitrogen)		
Cultivation		
Herbicide – 3 applications (chemical, labor, equipment)		
Roguing – 2 hours/acre		
Irrigation		
Water Cost - _____/acre		
Ditches and Structure Maintenance		
Harvesting		
Bailing		
Certification		
Taxes		
Total Annual Cost		

Expected Income

Expected yield _____ lb/acre.
Expected price $_____/lb
Aftermath and straw value $_____
Expected gross income $_____
Total annual costs $_____
NET RETURN PER ACRE (line 4 minus line 5) $_____.

Appendix A

Nevada Noxious-Weed Seeds[1]

2005

Prohibited = Nevada law prohibits the sale of agricultural, flower, vegetable or tree and shrub seeds consisting or containing any of the following noxious weed seed.

camelthorn	*Alhagi camelorum*
fieldcress, Austrian	*Rorippa austriaca*
goatgrass, barb	*Aegilops triuncialis*
halogeton	*Halogeton glomeratus*
horsenettle, Carolina	*Solanum carolinense*
horsenettle, white	*Solanum elaeagnifolium*
klamathweed	*Hypericum perforatum*
knapweed, Russian	*Centaurea repens*
medusa head, rye	*Taeniatherum asperum*
peaweed, Austrian	*Swainsona salsula*
quackgrass	*Agropyron repens*
skeletonweed, rush	*Chondrilla juncea*
sorghum, perennial such as, but not limited to, johnsongrass, sorghum almum and perennial sweet sudangrass	*Sorghum spp.*
sowthistle, perennial	*Sonchus arvensis*
spurge, leafy	*Euphorbia esula*
starthistle, Iberian	*Centeaurea iberica*
starthistle, purple	*Centaurea calcitrapa*
starthistle, yellow	*Centaurea solstitialis*
thistle, Canada	*Cirsium arvense*
toadflax, Dalmatian	*Linaria dalmatica*
whitetop or hoary cress	*Cardaria chalepensis* or *Cardaria draba* or *Cardaria pubescens*

Restricted = Agricultural seed, including lawn or turf seed mixtures, shall be labled to show the name and number per pound of each restricted noxious-weed seed present. Agricultural, flower, vegetable or tree and shrub seed containing in excess of 27 seed per pound of restricted noxious weed seeds, singly or collectively, is prohibited from sale.

bindweed, field	*Convolvulus arvensis*
charlock	*brassica kaber*
crabgrass	*Digitaria sanguinalis or Digitaria ischaemum*
dock, curly	*Rumex crispus*
dodder	*Cuscuta spp.*
fanweed	*Thlaspi arvense*
mustard, wild	*Brassica kaber*
pennycress	*Thlaspi arvense*
puncturevine	*Tribulus terrestris*
sandbur, field	*Cenchrus pauciflorus*

[1]United States Department of Agriculture. 2005. State Noxious-Weed Seed Requirements Recognized in the Administration of the Federal Seed Act.

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