

INTRODUCTION

This technical note may be used to guide establishment of native and introduced plantings of herbaceous vegetation for the purposes of meeting criteria in the Minnesota Natural Resources Conservation Service Field Office Technical Guide (FOTG) Practice Standards; **327-Conservation Cover, 332-Contour Buffer Strips, 342-Critical Area Planting, 390- Riparian Herbaceous Cover, 393-Filter Strip, 420-Wildlife Habitat Planting, 512-Forage and Biomass Planting, 589C- Cross Wind Trap Strips, 643-Restoration of Rare or Declining Natural Communities, 645-Upland Wildlife Habitat Management, and 657-Wetland Restoration.** Other ecological science and certain engineering standards may refer to this technical note Refer to those standards for specific practice criteria.

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Recommended Plant Species

Varieties of introduced grasses and legumes shall be selected from one of the following sources:

- University of Minnesota (UMN) Varietal Trials
- Plant Material Center varietal selections
- Varieties listed as recommended by Extension publications, Minnesota Crop Improvement Association or Varietal Trials of states adjacent to Minnesota
- Named varieties known to be locally adapted. Seek Area Office approval for varieties not identified as recommended by UMN or adjacent State Varietal Trials.

Select varieties that are adapted to specific site conditions, planned harvest schedule and harvest method, if applicable. To ensure longer life, alfalfa varieties shall have a Winter Survival Index of less than three, listed in the Very Good Winter Survival category. Varieties with no Winter Survival Index shall have a third-year yield of at least 105% of check varieties.

Seed Quality

All seed shall be of high quality and be labeled in accordance with Minnesota Seed Law, section 21.82 including limits on noxious weeds. If *Amaranth* species are found in the test results, it must be identified on the seed test report. The Minnesota Department of Agriculture (MDA) requires that a genetic test must be done to determine if the *Amaranth* species are Palmer amaranth.

Non-commercial (Bin-run) seed can be used as temporary cover or a companion crop, if the seed has been tested for germination and purity by a USDA Accredited Seed Laboratory along with scale tickets provided. Presence of MN noxious weed seed must also be tested for and presence requires cleaning of the seed lot to avoid spreading and reproduction of noxious weeds. Bin-run seed is defined as grain produced on farm and used for seed by the farm who grew it. Be aware of considerations to remain compliant with state and federal law. Find more information here: <https://www.mda.state.mn.us/plants-insects/can-i-sell-seed>. NRCS payments associated with conservation programs will not be allowed until seeding is established and field verified.

Wild or native harvest mixtures meeting the species diversity and quantity (minimum 35-40 PLS seeds/ft² total) requirements will be considered adequate. Seed tests are required to determine pure live seed requirements and presence of noxious weeds. Seed must be cleaned to an extent sufficient to allow passage through appropriate seeding equipment

Landowners who have purchased seed for use in NRCS financial assistance programs, must follow Minnesota state seed laws.

- The germination test date located on the seed label may not be more than 15 months old excluding the month of test for native grass and forb seeds when used as agricultural seed. A sell by date may be listed in addition to or in lieu of the test date and denote the end of the 15-month test date period.
- The germination test date, or sell by date, located on the seed label may not be more than 12 months old for introduced species.
- Landowners will have 12 months after the germination test date expires to plant the native and/or introduced seed and seed mixtures. If seeding will exceed these time limits, the seed shall be re-tested for germination to ensure seed quality. Variances may be granted by the State Resource Conservationist on a case-by-case basis.

Seed should be stored in a cool, dry place to maintain the purity, quality, and viability of the seed.

Inoculate legume seed before seeding with the inoculants specific for the species. Pre-inoculated seed may be used but shall be re-inoculated if used beyond dates specified on the seed tag. This does not apply to native legumes.

Native Seed Origin

Native seed origin must be labeled in accordance with federal and state seed laws including [Minnesota Seed Law](#) sections 21.80 through 21.92. Use source-identified local ecotypes, when available. This applicability is dependent upon program and practice requirements. Be aware that deviation from local origin could result in failure of establishment or long-lasting vegetative stand. Producers will document why origin was outside the recommended region and are aware that stand failure will be their responsibility.

The following is recommended when obtaining seeds/plants:

1. It is desirable for seed sources of native grass, forbs, and legumes to originate from as close to the planting site as possible. The preferred sequence: within the ecological sub-section, ecological section and then within a 200-mile radius of the project site, unless otherwise identified as an acceptable cultivar. Exception: Tallgrass Prairie Restoration shall be within a 175-mile radius of the project. Variances may be granted by the State Resource Conservationist on a case-by-case basis.
2. Seed origins native to Minnesota are preferred. When local Minnesota sources are not available, native seed shall originate from Wisconsin, North Dakota, South Dakota, Iowa, Illinois, and the Canadian provinces of Manitoba, or Ontario.
3. For native seed, the origin is the area where the original foundation seed was collected.
4. If the origin of the seed (generation 0) can be certified as one of the accepted states or provinces, then there would be no restriction on where the seed is grown. Certification must be provided by the grower, and responsibility for obtaining certification rests with the producer.
5. Where there are known remnant native prairies or certified native grass, or forb seed production fields present, maintain an isolation distance of 165 feet for grasses and 1320 feet for forbs when planting the same species that have different genetic origins.
6. The use of cultivars should be avoided within ¼ mile of existing remnant native prairie or other sensitive areas. “Yellow Tag” or source identified materials would be preferred.

Potentially Invasive Species

Ask for prior approval from the Area Resource Conservationist or Grazing Specialist before recommending reed canary grass, birdsfoot trefoil, crown vetch, sweet clover, or crested wheatgrass. These may be considered invasive if adjacent to restored native warm season grass stands or prairie remnants.

Seedbed Preparation and Seeding Methods

Prepare a firm seedbed for all planting methods.

Conventional Tillage - Prepare a fine, firm seedbed to a minimum of 3 inches. The seedbed should contain enough fine soil particles for uniform shallow coverage of the seed as well as contact with moisture and nutrients. If possible, use specialized native grass drills with depth bands designed to handle a wide variety of seed. For conventional drills, a minimum, cultipack before seeding.

Do not use heavy drills on conventionally prepared seedbeds as heavy drills tend to sink in the soil and depth control is difficult. Plant seed between ¼” and ½” inch deep depending on species recommendations. **The seedbed is firm enough when an adult footprint penetrates ¼” to ½” deep.** Some seed may be seen on the surface of the ground after seeding. Tillage should only be used on flatter slopes or in conjunction with erosion control measures.

No-Till - No-till drilling reduces the exposure of the newly seeded site to erosion. A drill should be selected that can handle a wide variety of seed (fluffy, smooth, large, and small) and low seeding rates. Plant seed between ¼” and ½” inch deep depending on species recommendations. Seed when the soil is slightly moist but not wet, especially when seeding inoculated legumes. Adjust the coulters and packing wheels of the drill to cover the seed based on the soil texture, moisture, and surface residue conditions.

- No-till Into Existing Vegetation:

Use of herbicides is essential to kill existing vegetation. (Organic producers will not have this option available to them.) Complete control often requires more than one application. Land that has been in grass for many years usually has a thick residue layer on the soil surface. To allow for the best no-till seedbed this residue must be removed. Three options are: (1) grazing; (2) mowing with residue removed; and (3) prescribed burn. In the fall a burndown herbicide can be applied to prepare for a spring no-till seeding. An additional spring herbicide application may be required, depending on weed growth.

No-till seeding should be used on existing pastures that lack diversity, either in grasses or legumes, on existing pastures that contain species unsuited to the kind and/or class of livestock, to improve the nutritional value of an existing pasture, improve forage production, and on pastures or grasslands that contain little debris, rocks, or boulders. Do not recommend inter-seeding alfalfa into existing alfalfa stands due to autotoxicity.

- No-Till into Crop Residue:

When native materials are planted into undisturbed ground, the crop residue should be uniformly distributed over the soil surface prior to planting to minimize the smothering of new seedlings and to provide conditions for the operation of planting equipment. Native material planted into undisturbed corn residue has proven successful at times, however soybean residue is preferred. Soybeans produce a moderate amount of crop residue that can be effectively managed and tend to leave the soil in a mellow condition that is well suited to no-till planting of prairie plants.

- Inter-seeding with Tillage into Existing Cool Season Grass Stands:

If a no-till drill is not available, it is still possible to inter-seed an existing grass stand by using tillage and a conventional grain drill. Disturb the existing sod with a light disc harrow or a harrow/field cultivator combination.

If there is an old dense stand of Kentucky bluegrass and quackgrass, fall tillage will help to reduce competition before spring planting. Use enough tillage passes to expose at least 50% bare soil. If the surface is rough after the initial tillage use a drag harrow to level prior to seeding with the drill. Seed into moist but not wet soil. Immediately after drilling, the soil should be run over with a cultipacker.

Broadcast: - Prepare a fine firm seedbed to a minimum of 3 inches. Use a roller, cultipacker or similar implement prior to seeding. The seedbed should contain enough fine soil particles for uniform shallow coverage of the seed as well as contact with moisture and nutrients. **The seedbed is firm enough when a footprint penetrates ¼ to ½ deep.** Broadcast seed at a rate of 1.5 times the normal seeding rate and roll or cultipack again after seeding. Do not harrow in the seed.

Frost seeding (late February or March):

Graze or clip to a 2" or less stubble height the season before seeding or use a suppression rate of herbicide according to label directions. Broadcast the legume seed on top of the ground in late winter or early spring when freezing and thawing help to incorporate the seed into the soil. Do not seed on snow cover, especially on steeper soils because snow melt may carry the seed away in runoff events. Frost seeding also works well on small, disturbed areas within a pasture. Use this method where it is impractical or impossible to use conventional seeding equipment such as steep slopes, rough terrain, and rock outcrops. Red clover and white clover are vigorous and competitive with existing sods and are the ideal species for adding legumes to grass pastures. Use flash grazing after seeding to suppress the grasses and allow legumes to establish.

Seeding Equipment

Seeding equipment that ensures proper seed placement and good seed-soil contact will be used. Modern grass seeding attachments that allow for proper seed flow, seed placement and soil packing are needed to ensure a successful seeding.

Slower seeding speeds should be used for fluffy or rough-coated seed species. Three to five miles per hour should be the seeding speed for most types of grass drills. Seeding speeds in excess of 6 miles per hour may result in uneven or inconsistent grass and legume stands.

If a carrier is needed to help feed seed through the drill; cracked corn, dead barley, granular clay, vermiculite or rolled oats are examples of material that may be added to the mixture.

A. Grass Drill

Grass drills are specifically designed and equipped to properly meter and place various grass, legume and/or forb seed and share the following design characteristics:

1. Different seed boxes are normally required to handle the three types of grass seed commonly used. This includes the relatively clean, smooth seed characteristic of many cool-season grasses, the chaffy or trashy seed characteristic of many warm season grasses, and fine, smooth seed, characteristic of legumes or grasses such as Switchgrass.

Seed boxes having the capability of seeding chaffy or awned grasses (i.e., blue grama, bluestems, and Indiangrass) are needed, only if such species are planned in the seeding mixture; likewise, fine-seed or legume seed boxes are needed, only if such species are to be seeded.

2. Agitators or similar mechanisms that prevent bridging of chaffy or trashy seed and ensure a constant flow of seed at the desired rate with uniform mixing of the species in the mixture.
3. Feeder mechanism (picker wheels, fluted feed, etc.) that ensures uniform flow of all types of grass seed either separately or in a mixture.
4. Oversized feeder tubes that allow constant flow of chaffy or trashy type seed from boxes to placement point (if such seed is used).
5. Individually mounted, adjustable, spring loaded, double-disc openers.
6. Depth bands or other depth-control systems that provide positive seed placement for final planting depth of one-fourth to one inch over varying degrees of seedbed firmness.
7. Press/packer wheels that provide adequate covering and firming of soil over and around the seed for necessary seed/soil contact after proper seed placement.

They should be mounted individually on each furrow opener or independently to follow behind each opener. Press/packer wheels are not intended to provide the basic "firm seedbed." The firm seedbed must exist before the drilling operation begins.

8. Drill calibration should be completed for both grass and grain drills prior to seeding. Refer to guidance below for completing drill calibration.

B. Small Grain Drill

1. Free-flowing grass seed (i.e., wheatgrasses) and legume seed can be successfully planted with a small grain drill provided proper seeding depth can be maintained throughout the field. Seeding depth is the most limiting factor to seeding success and contributes to most of the seeding failures when using a grain drill. It is extremely important to have a firm seedbed when using a grain drill. Periodic inspections should be done to check seeding depth especially when seeding across different soil types. Seeding depth will vary under actual planting conditions.
2. Checking the drill frequently and hand mixing the seed is essential to achieving a properly blended seed mix and helps ensure that seeds of different sizes are seeded evenly across the field. Periodic feeder mechanism adjustments are usually necessary to ensure proper seeding rates. A separate legume box is desirable for seeding small seeded species. (i.e., switchgrass and alfalfa). Ensure the grain drill's drop tubes are placed in front of the packer wheels to allow for seed-soil contact.
3. Chaffy or awned seeds (i.e., bluestems, Indiangrass, and blue grama) are difficult to plant with a grain drill. It is recommended that a grass drill be used for these types of grasses. Proper agitation is needed to prevent "bridging" of seed in the seed box, and the feeder mechanism must be capable of metering a uniform flow of seed at the desired rate. Very few grain drills have this capability. Use of debearded seeds is strongly recommended when considering seeding chaffy or awned seeds in a grain drill.

C. Broadcast Seeder

Broadcast seeding method may only be used when the slope, soil conditions, and/or size of area to be seeded makes the use of a drill impractical. All broadcast seedings will have a properly prepared seedbed (minimal residual cover with a smooth, firmly packed surface) and an operation which incorporates the seed into the soil at the proper depth (i.e., covering operation using a drag harrow, cultipacker, roller packer, or other suitable implement to cover and press the seed into the soil surface). When using the broadcast method, the seeding rates will be increased by 1.5 times.

D. Air seeders

Some air seeders and similar types of equipment may be used to seed free flowing grass seed (i.e., wheatgrasses) and legume seed if proper seeding depth can be obtained. However, seeding mixtures containing varying seed sizes may require an inert carrier to work properly in air seeders. The shallow planting depths for grasses and legumes can be difficult to maintain with this type of equipment. The equipment must be able to provide a uniform flow of seed at the desired rate. Use the correct seeding plates recommended by the manufacturer for the species to be planted. Use packer wheels or other suitable packing implement to press soil firmly around the seeds. **Air seeders are not recommended for seeding native grass and forb mixtures.**

Drill Calibration

Grass or grain drills may be calibrated using the following methods.

A. Bulk Weight Method

Raise the drill's drive wheel and measure its circumference in **feet**. Next, measure the distance between seed spouts or disc openers. Use Table 1 to determine the number of revolutions (R) to turn the drive wheel for the row spacing and wheel circumference in feet for your drill.

Table 1: Drill Calibration					
Row spacing in inches	No. of seed spouts to use	Turns of drive wheel	Row spacing in inches	No. of seed spouts to use	Turns of drive wheel
6	4	$96/C = R$	24	1	$96/C = R$
7	4	$82/C = R$	30	1	$77/C = R$
8	3	$96/C = R$	36	1	$64/C = R$
10	3	$77/C = R$	42	1	$55/C = R$
12	2	$96/C = R$	48	1	$48/C = R$

Place enough seed in the box to cover spouts from which you will collect seed. Turn the drive wheel until all spouts are feeding. Place a container under the correct number of seed spouts (as determined from the Table 1) and turn the drive wheel the number of revolutions previously determined. Weigh the sample in grams. Multiply this weight by 0.5. The result is the pounds per acre at that setting. Adjust the drill setting and continue trials until the desired seeding rate is obtained.

Remember: Seeding rates as determined by this method are in terms of **bulk seed**. You need to convert your seeding rate from pure live seed per acre to bulk seed per acre when using this calibration method. Seed vendor should be able to provide bulk seed weights and pure live seed weights.

Example:

- Row spacing = 7 inches
- Number of seed spouts = 4
- Circumference of drive wheel (C) = 6.8 ft
- Revolutions of drive wheel (R) = $82/C$ $R = 82/6.8 = 12$ revolutions
- Bulk seeding rate is 15.1 lbs/ac. The drill is properly set when the 4 seed spouts yield 30 grams of seed after 12 revolutions of the drive wheel.
 - $30 \text{ grams} \times 0.5 = 15 \text{ lbs/ac}$

B. Seeds Per Row Foot Method

This method of determining the amount of seed being distributed by the seeding equipment is to count the number of seeds per foot of drill row while the machine is in operation.

Fill the drill with seed, make setting, and drive equipment over a hard ground surface or canvas. Count the number of seeds per foot of row and adjust until proper seeding rate is attained.

Use the information below to determine the linear foot of row necessary to equal one square foot planted.

Row spacing in inches	Linear foot of row to equal one square foot
6	2.0 feet
7	1.8 feet
8	1.5 feet
10	1.2 feet
12	1.0 foot

To determine the proper number of seeds per foot of drill row for a specific seeding mixture; you will first need to calculate the bulk seeding rate for each species in the mix. From Table 1, calculate the number of seeds per square foot (ft²) for each pound seeded (seeds per pound divided by 43,560ft²/acre).

Multiply the number of seeds per square foot for each pound seeded by the bulk seeding rate for each species. Total the resulting numbers to determine the number of seeds per square foot for the mixture.

Example:

If you want to calibrate a drill for a mixture of 4.5 lbs. PLS/ac green needlegrass (80% purity and 70% germination) and 4.0 lbs PLS/ac western wheatgrass (92% purity and 85% germination), calculate the bulk seeding rate for each species.

Bulk seeding rate would be 8 lbs/ac for green needlegrass and 5.1 lbs/ac for western wheatgrass.

- Green needlegrass – $(.80 \times .70) = .56$. $4.5/.56 = 8.0$ lb./ac bulk
- Western wheatgrass – $(.92 \times .85) = .78$. $4.0/.78 = 5.1$ lb./ac bulk

Green needlegrass seed contains 180,000 or 4.1 seeds/ft² for each pound seeded (180,000/43560 ft²/acre).

Western wheatgrass has 112,000 seeds per pound or about 2.6 seeds /ft² for each pound seeded.

- $8.0 \text{ lbs/ac} \times 4.1 \text{ seeds/ft}^2/\text{lb.} = 32.8 \text{ seeds/ft}^2$
- $5.1 \text{ lbs/ac} \times 2.6 \text{ seeds/ft}^2/\text{lb.} = 13.3 \text{ seeds/ft}^2$

The total seeds per square foot for the mix would be 46. If the drill we are calibrating has 7-inch row spacing, the drill calibration would be 46 seeds per 1.8 feet of row length.

Broadcast Seeder Calibration

A. Seeds Per Square Foot Method

1. Spread a large tarp or piece of plastic on a smooth level surface and anchor the edges to hold in place.
2. Place seed in the seed compartment(s) and travel across the tarp at the anticipated speed you will travel in the field. Make one pass across the tarp to check seeding rate.
3. Using a one square foot frame count the seeds in one square foot. Count the seeds on three to five samples and average.
4. Compare the results from step #3 with the planned seeding rate number of seeds per square foot of bulk seed for the seed mixture. Use the planned seeds per square foot of bulk seed since you will be counting all seeds on the tarp. If necessary, adjust the control gate for the small seed compartment and/or travel speed and repeat the test until the desired seeding rate is achieved.
5. Make two or three passes across the tarp at a selected spacing to check seed distribution and seeding pattern overlap. Adjust the travel spacing to achieve the desired overlap.
6. It may be desirable to check the seed being delivered from each seed compartment individually. In this case carryout Steps 2 through 4 independently for each seed compartment.

B. Pounds Per Acre Method

1. Measure out some fraction of an acre. For example, 1000 square feet is 2.3% (0.023) of an acre; 2000 square feet is 4.6% (0.046) of an acre; or 10890 square feet is 25% (0.25) of an acre.
2. Calculate the amount of seed required for the measured area. Weigh out the appropriate amount of each seed type and place in the appropriate box(s).

3. Seed the measured area and check if you had sufficient seed to cover the area or ran out before covering the measured area.
4. Adjust the settings and/or travel speed and repeat the trial on a new area as necessary.

Herbicide and Insecticide Carryover

Prior to planting, check to ensure that any herbicides used on previous two crop years will not “carry over” and negatively impact newly seeded plants. Residues of some herbicides may prevent the establishment of some native plant materials for up to two years. If the residual effects of herbicides are possible, delay planting until after the recommended interval to allow residual herbicide levels to dissipate, establish temporary cover or change species to be planted.

To protect pollinators, any seed supplied for projects must be free of pollinator lethal insecticides. Systemic insecticides including but not limited to neonicotinoid insecticides, can persist in the soil, and absorbed by new plantings and transferred to pollinators that forage on them. Use temporary cover such as oats or winter wheat in areas where insecticides may be a problem to allow time for the chemicals to break down.

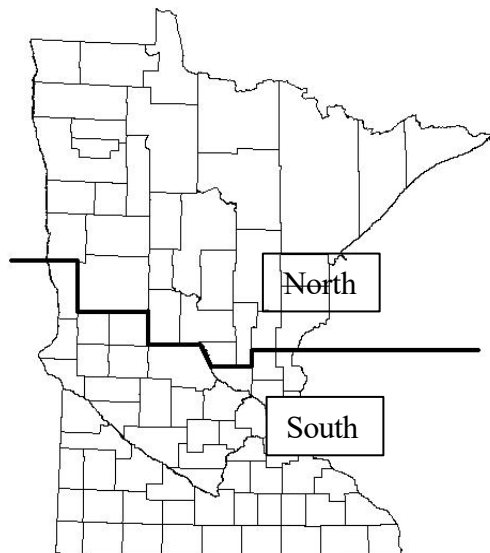
Planting Dates

Seeding dates are based on long term averages and may be extended based on moisture conditions. See MN Instruction 190-380. Extension of these deadlines shall be based on both favorable moisture and temperature for seed germination.

Seeding of warm season grasses may begin before May 15 when the soil temperature is consistently 50° F or higher. When mixtures containing both warm season native and cool season introduced grasses are to be planted, select the seeding date based on the predominant plants in the mixture.

Table 2: Planting Dates			
Cool Season Grasses and Legumes			
	Spring	Late Summer	Dormant
North	4/1 - 6/15	7/15 - 9/1	11/1 or a consistent soil temperature of <40° F.
South	4/1 - 6/1	8/1 - 9/10	11/1 or a consistent soil temperature of <40° F.
Warm Season Grasses, Forbs, and Legumes (includes warm and cool season natives planted in mixtures)			
	Spring	Late Summer	Dormant
Statewide	5/15 - 6/30	Not recommended	11/1 or a consistent soil temperature of <50° F.

Figure 1: Planting Zones



Seeding Rates

Seed tests must show the percentage of germination and percentage of purity. Seeding rates shall be based on Pure Live Seed (PLS), where **PLS = % germination (+ dormant seed) x % purity**. To calculate the pounds of bulk seed required, divide the PLS requirement for the seeding by the percent PLS (expressed as a decimal). See Table 22: Conversion of Bulk Pounds to Pure Live Seed.

For example, if 1,000 pounds of PLS of Indiangrass is required for the seeding, germination is 90% and purity is 98%. The amount of bulk seed to purchase and apply to the field is: $1,000 \text{ lbs.} / 0.882 = 1,134 \text{ lbs.}$ of bulk seed.

Legumes will have hard seed, seeds that do not germinate during the first year, and the amount of hard seed will be specified on the seed tag. If there are more than 20% hard seed adjust the seeding rate up to achieve the desired pure, live seed coverage. Do not recommend seeding alfalfa following alfalfa due to problems with autotoxicity. Pasture mixes should not contain more than 50% legumes on a pure live seed basis to avoid bloat in livestock.

Companion Crops

For spring seeding of cool season species, a companion crop may be used for erosion control and weed suppression. No companion crop is required for inter-seeding or for late summer seeding but may be desirable for erosion control and to protect developing seedlings. Companion crop seeding rates may be increased when the companion crop will be harvested for forage.

Companion crops are competition for moisture and sunlight. Early maturing varieties of oats with good lodging resistance are desirable.

Companion crop seeding rates shall be:

Crop	Seeding Rate
Oats	0.75 – 1.25 bu/ac
Barley	0.5 – 1.0 bu/ac
Winter Wheat*	0.5 bu/ac
Ryegrass**	< 2.5 lbs/ac
Cereal Rye***	NOT RECOMMENDED

* Spring seeded only.

** Ryegrass is extremely difficult to dry down after cutting. Haylage is the preferred method of storage.

*** Cereal Rye can have allelopathic effects on competing species and is not recommended as a companion crop.

Companion crops can be used for warm season seeding. On highly erodible sites it may be desirable unless you are no-tilling into 70% residue cover or standing small grain stubble. Use a seeding of oats at $\frac{3}{4}$ to $1 \frac{1}{4}$ bushels/acre.

A companion crop of oats seeded at a rate of 0.5-0.75 bu/ac can be utilized for native seedings.

Companion crops will be clipped or harvested for forage after jointing but before heading unless otherwise directed. Companion crops will not be harvested for grain. Clipping will be done when moisture conditions will not cause ruts or other field damage. Second and subsequent clippings are necessary when re-growth provides competition. Clipping height should be above developing seedlings – no less than 6". Where excessive growth has accumulated, the vegetation should be chopped and dispersed or harvested for forage rather than swathed. Companion crops seeded with late summer cool season grass seeding do not require clipping.

Temporary Cover Establishment

Where chemical residue carryover is the cause of delayed planting, refer to the product label for crops to rotate to. A bioassay test may be used to better determine chemical carryover.

Small grain temporary cover crops will be clipped in the boot stage to prevent seed formation. Spring seeded winter wheat and spring seeded winter rye will not require clipping. Millet and sorghums need to be clipped in the early heading stage to prevent viable seed formation. Forage sorghums, Sudangrass and sorghum-Sudangrass may need multiple clippings to control biomass accumulation and seed production. Residue from the temporary cover may be fall tilled, leaving a minimum of 40% residue cover.

Temporary Cover	Seeding Rate/Acre	Seeding Dates - Statewide
Oats	2.5 bu.	*-- April 1 to June 15 *-- August 1 to September 10
Barley	1.5 bu.	*--April 1 to June 15 *-- August 1 to September 10
Spring Wheat	1.25 bu.	*--April 1 to June 15
Winter Wheat	1.25 bu.	*-- August 1 to September 30
Spring Rye	1.0 bu.	*--April 1 to June 15
Winter Rye	1.0 bu.	*-- August 1 to September 30
Annual Ryegrass	8.0 lbs.	*--April 1 to June 15 *-- August 1 to September 10
Proso Millet	12.0 lbs.	May 15 to June 10
Sorghum/Sudangrass	12.0 lbs.	May 15 to June 10
Grain Sorghum	10.0 lbs.	May 15 to June 10
Corn	92.0 lbs.	May 15 to June 10

Weed Control

Approved herbicides may be used on both introduced and native plantings to control weed species. During the establishment year, mow weeds after they have reached a 12" height. Mow 2–3 times or as needed based on onsite evaluation, generally on 30-day intervals from the date of seeding. Mow to a height of 6" to 8". Use a rotary mower or remove the clippings so as not to smother the seedlings. This will slow the weeds but won't harm the prairie plants. Livestock grazing is not an acceptable method of weed control during the establishment period.

The second year, evaluate the stand to determine if weed control is necessary. If it is, spot mow the planting at a height of six inches. If there is enough material for a prescribed burn, this may be an effective method to control weeds, but fire should not be introduced until the third year of establishment.

Fertilizer and Lime Requirements for Practices 327, 332, 342, 393, 512 and 589C

- **Introduced Cool Season Grasses and Legumes**
 - Apply fertilizer, manure, and lime according to UMN fertilizer recommendations. Soil tests will be completed by a MDA certified lab. Soil tests will be no older than four years. Manure nutrient samples will be done in the year of application. The sample tests will also be performed by a MDA certified lab. Apply manure with a calibrated spreader using guidelines from the Nutrient Management (590) practice standard. Refer to Table 17, Fertilizer Recommendations for Grass, Grass/Legume Mixes, and Alfalfa Hay for UMN fertilizer recommendations.

For Conservation Cover (327), Filter Strip (393), and Critical Area Planting (342), use a two ton per acre yield goal. If soil tests are not available, fertilizer will be applied in equal amounts of Nitrogen-Phosphorus-Potassium (N-P-K) for grass and legume establishment. An example fertilizer blend would be 60-60-60.

- The recommended rate per acre of liming materials shall be used to raise pH to 6.5 for alfalfa or 6.0 for other legume species. Liming materials will meet UMN recommendations for fineness of material and will be applied and incorporated a minimum of one year prior to seeding to achieve the desired pH.

- **Native Grasses, Forbs, and Legumes**

N, P, and K fertilizer is not recommended.

Stand Evaluation

To determine adequacy of stands and to determine if reseeding or reinforcement seeding is required, please follow Agronomy Technical Note No. 17 “Guidelines for Herbaceous Stand Evaluation”, [FOTG > Section 1 > Reference List > Technical Notes and References by Discipline > Agronomy](#)

Seeding Tools

Optional seeding plan tools and calculators are located on the MN FOTG at: [Technical Resources/Seeding Tools](#).

STANDARD 327 – CONSERVATION COVER SEEDING SPECIFICATIONS

And

STANDARD 420 - WILDLIFE HABITAT PLANTING SPECIFICATIONS

Permanent, perennial vegetative cover should be established during the first recommended seeding or planting period for the selected species within the first year of the land use conversion. If this is not possible, a temporary cover may be used, and the permanent vegetative cover must be established during the next seeding period.

1. Specifications for Establishment of Upland Cover, and Upland Wildlife Habitat - Grasses, Legumes, Forbs

Commonly recommended native and introduced grass, legume and forb species are listed in Tables 3-5. Native plants and plant communities are encouraged since they are well-adapted to sites, less invasive, and likely to provide quality habitat without costly long-term maintenance. Native plants are required for Wildlife Habitat Plantings (420); however, due to cost, availability and landscape position, native plants may not be feasible in all Conservation Cover (327) situations.

A. Native Grasses, Forbs, and Legumes:

- Mixtures will comprise a minimum of 5 native species consisting of at least 3 native grasses and at least 2 native forbs/legumes. Mixtures will result in a minimum 35-40 total seeds/ft².
- Grasses shall not exceed 90% of the total mixture based on seeds/ft².
- No more than 20% of the grass component will be comprised of cool season grass species based on seeds/ft².

- Switchgrass in mixtures shall not exceed 10% of the grass component based on seeds/ft².
- Solid stands of Switchgrass seeded at 6.0 lbs/ac are allowed for site specific purposes such as providing winter cover in landscapes lacking adequate emergent wetlands or woody vegetation. ***NOT APPLICABLE TO CRP***
- When multiple forbs/legumes are included in a seed mixture, no individual species shall comprise more than 50% of the mixture based on seeds/ft².
- Refer to Biology Job Sheet #9 – “Establishment of Native Grass and Forbs” for additional establishment specifications. Refer to practice standard *Upland Wildlife Habitat Management (645)* for management recommendations.

B. Introduced Grasses and Legumes:

- Mixtures will comprise a minimum of 4 species consisting of at least 3 grasses and at least 1 forb or legume.
- Total recommended seeding rate is a minimum 35-40 total seeds/ft².
- At least 50% of the mixture shall be comprised of grasses based on seeds/ft².
- Introduced grass/legume mixtures may include up to 20% Switchgrass and/or Western Wheatgrass.
- The use of introduced species should be avoided adjacent to native prairie or other sensitive areas.
- Refer to Biology Job Sheet #8 - “Establishment of Introduced Grasses/Legumes” for additional establishment specifications. Refer to practice standard *Upland Wildlife Habitat Management (645)* for management recommendations.

2. Specifications for Native Pollinator, Honeybee and Monarch Habitat Establishment

Encourage blocks of cover as opposed to narrow linear plantings to improve habitat for grassland nesting birds and to decrease weed pressure along the edges of a native planting.

- Minimum size shall be 0.5 ac., with a minimum width of 20’.
- Apply techniques to prevent or mitigate offsite insecticide risks from drift from areas treated with insecticides (e.g., cropland). Achieve a target mitigation index value of ≥ 20 from Table 3 of [Agronomy Technical Note #9](#) – “Preventing or Mitigating Potential Negative Impacts of Pesticides on Pollinators using Integrated Pest Management and Other Conservation Practices”. Commonly recommended options which meet a target mitigation index value of 20 include, but are not limited to:
 1. Establish a $\geq 100'$ pesticide free setback from the edge of the planting into adjacent cropland. Pesticide free includes planting un-treated seed.
 2. Establish or incorporate an existing $\geq 30'$ flower free vegetated buffer between the habitat planting and cropland, and apply one of the following mitigation techniques to cropland beyond the vegetated buffer:
 - Utilize high volume/low pressure spray nozzles, and/or
 - Apply insecticides on adjacent cropland when wind speed is between 2 and 9 mph.
 3. Where cropland is adjacent to the planting, no application of insecticides within 30 feet of the habitat planting, and apply one of the following mitigation techniques to cropland beyond the insecticide free setback:
 - Utilize high volume/low pressure spray nozzles, and/or
 - Apply insecticides when wind speed is between 2 and 9 mph.

A. Native Grass and Forbs (Native Pollinator, Monarch, and Honeybee)

Plantings shall contain:

- A minimum of nine species of pollinator friendly native forbs – additional forbs are strongly encouraged.
- At least three species shall be from each bloom period – early, mid, and late flowering season so that pollinators have continuous food sources.
- A minimum of two native bunch grasses to provide nest sites.

Composition:

- The mixture will result in a minimum 35-40 seeds/ft² total. See Tables 6 and 10 for recommended species and individual composition.
- Forbs will comprise 50-75% of the mixture based on seeds/ft². No individual forb shall comprise more than 20% of the forb mixture based on seeds/ft². At least one forb shall be a legume.
- Grasses will comprise 25-50% of the mixture based on seeds/ft².
 - Canada or Virginia wildrye may be included in the mixture on erodible sites and shall comprise no more than 20% of the total grass mixture based on seeds/ft².
 - Certain species of native grass are restricted due to potential for aggressive growth and suppression of planted wildflowers or reducing the available bare soil in plantings. The seed mix cannot contain more than 10% total (by seeds/ft²) of any combination of the three grasses listed below.
 - Big bluestem (*Andropogon gerardii*)
 - Indiangrass (*Sorghastrum nutans*)
 - Switchgrass (*Panicum virgatum*)
- Mixtures designed to benefit monarch butterflies shall include nectar and larval plants beneficial to the monarch butterfly from Table 6. To provide food for monarch butterfly larvae, plantings shall include at least one species of milkweed (*Asclepias* spp.). Milkweed species shall comprise at least 1.5% of the total mixture (grass and forbs) based on seeds/ft². To provide food for adult Monarchs, at least 60% of the forbs in the mix shall be from the monarch butterfly planting list in Table 6.
- Blooming shrubs and trees can be an important source of pollen and nectar for pollinators, usually blooming well before many forb species. See Table 9 for native shrubs beneficial to pollinators.

Seeding Date: Fall dormant seeding favors forbs due to moist cold stratification. Fall dormant seeding is recommended unless the forb seed has been pre-stratified before purchase. See Table 2 for planting dates.

B. Introduced Perennial Grass and Legumes (Honeybee) - See Table 7 for recommended species and composition.

Refer to *Biology Job Sheet #16 – “Native Habitat Development for Pollinators, Honeybees and Monarchs”* and *Biology Job Sheet #18 – “Introduced Grasses and Legumes – Honeybee Habitat”* for additional establishment specifications. Refer to practice standard *Upland Wildlife Habitat Management (645)* for annual habitat recommendations.

STANDARD 645 – UPLAND WILDLIFE HABITAT MANAGEMENT SPECIFICATIONS

Specifications for Annual Forbs and Legumes for Honeybee Habitat

Encourage blocks of cover as opposed to narrow linear plantings.

- Minimum size shall be 0.5 ac., with a minimum width of 20’.

- Apply techniques to prevent or mitigate offsite insecticide risks from drift from areas treated with insecticides (e.g., cropland). Achieve a target mitigation index value of ≥ 20 from Table 3 of [Agronomy Technical Note #9](#) – “Preventing or Mitigating Potential Negative Impacts of Pesticides on Pollinators using Integrated Pest Management and Other Conservation Practices”. Commonly recommended options which meet a target mitigation index value of 20 include but are not limited to:
 1. Establish a $\geq 100'$ pesticide free setback from the edge of the planting into adjacent cropland. Pesticide free includes planting un-treated seed.
 2. Establish or incorporate an existing $\geq 30'$ flower free vegetated buffer between the habitat planting and cropland, and apply one of the following mitigation techniques to cropland beyond the vegetated buffer:
 - Utilize high volume/low pressure spray nozzles, and/or
 - Apply insecticides on adjacent cropland when wind speed is between 2 and 9 mph.
 3. Where cropland is adjacent to the planting, no application of insecticides within 30 feet of the habitat planting, and apply one of the following mitigation techniques to cropland beyond the insecticide free setback:
 - Utilize high volume/low pressure spray nozzles, and/or
 - Apply insecticides when wind speed is between 2 and 9 mph.

See Table 8 for species and seeding rates. Planting dates specific to annual forb/legume mixtures:

- South of Interstate 94 5/1 – 5/15
- North of Interstate 94 5/15 – 6/1

Refer to ***Biology Job Sheet #20 – “Annual Forbs and Legumes – Pollinator and Honeybee Habitat”*** for additional establishment specifications.

Specifications for Inter-seeding Milkweed for Monarch Habitat

This practice is intended to increase breeding habitat for monarchs by inter-seeding milkweed into an existing stand of vegetation that has sufficient nectar plant richness and abundance but lacks reproductive habitat, as determined by a monarch butterfly wildlife habitat evaluation guide (WHEG).

Inter-seeding milkweed should follow a disturbance such as prescribed burning, haying, grazing and/or herbicide spraying.

Option 1: Use a late summer or fall prescribed burn to remove above ground vegetation. Dormant inter-seed milkweed directly into seedbed. The following growing season, mow, or hay to a height of 6" whenever vegetation reaches 12-18" in height.

Option 2: Use a spring prescribed burn to remove previous year's residues. Inter-seed milkweed in strips with a no-till drill. Apply a grass selective herbicide to the planted strips during the growing season: warm season grasses (early summer), cool season grasses (spring, or late fall). Follow manufacturer's label directions. Mow or hay to a height of 6" when vegetation reaches 12-18" in height during the first year of establishment.

Seeding rates

Milkweed species (*Asclepias* sp.) should be seeded at a minimum rate of 0.15 seeds/sq. ft. and planted with a no-till drill at 1/4" depth.

STANDARD 643 – RESTORATION OF RARE OR DECLINING NATURAL COMMUNITIES – TALLGRASS PRAIRIE SEEDING SPECIFICATIONS

And

STANDARD 390 – RIPARIAN HERBACEOUS COVER

High species diversity is recommended to promote native community stability and function, to provide benefits to multiple wildlife species and to prevent establishment of invasive species.

Native prairie plant communities will be established utilizing seed harvested from existing Minnesota native prairies, or utilizing seed mixes comprised of Minnesota ecotype grasses, legumes, and forbs, developed to reflect "native prairie" communities as determined suitable for specific site conditions.

All seed, including native harvest, shall be supplied as pure-live seed (PLS) and conform to Minnesota Seed Law including limits on noxious weed content and State labeling requirements.

Restoration on Agricultural Fields and Other Disturbed Sites:

Seed Origin

It is desirable for seed sources of native grass, forbs, and legumes to originate from as close to the planting site as possible. When available, "Yellow Tag" or source identified materials are preferred. The following sequence defines the preferred wild/native harvest seed source for the project. Areas with similar site conditions and located as close to the project site as possible:

- Ecological Sub-sections
- Ecological Section
- Maximum distance of 175 miles of project
- Field tested native grass varieties and natural germplasm materials of known origin and adaptability. Refer to Table 21 for a listing of grass varieties/natural germplasm materials and their zone of adaptability.

Seeding Requirements

Diversity - Seed mixes will consist of a minimum 15 native species. The mixture will be comprised of a minimum 5 grasses, and a minimum 5 forbs. At least one forb shall be a legume.

Quantity - The mixture will result in a minimum 35-40 PLS seeds/ft² total, with a maximum 60% grass component based on seeds per square foot.

Composition

- No more than 20% of the grass component will be comprised of cool season grasses based on seeds/ft².
- Switchgrass shall not exceed 5% of the grass component based on seeds/ft²
- No individual forb specie will comprise more than 20% of the forb mixture based on seeds/ft².
- Constructed mixtures may be developed using Tables 3 and 6.

Optional criteria to benefit monarchs, pollinators, and beneficial

insects:

- Consider designing the mixture to benefit both pollinators and monarch butterflies by adding nectar and larval plants beneficial to monarchs and pollinators.

- A minimum 3 forbs from each bloom period (early, mid, and late) should be included in the mixture.
- To provide food for monarch butterfly larvae, plantings should include at least one species of milkweed (*Asclepias* spp.). Milkweed species should comprise at least 1.0% of the total mixture (grass and forbs) based on seeds/ft².
- Consider specific pollinator habitat requirements and select appropriate forb species using the columns listed in Table 6.

Refer to ***Biology Job Sheet #12 – “Restoration of Rare or Declining Plant Communities – Tallgrass Prairie”*** for additional establishment specifications. Refer to practice standard ***Upland Wildlife Habitat Management (645)*** for management recommendations.

Refer to ***Biology Technical Note #16 - Wild and Rare Riparian Habitat Guide*** for additional establishment specifications.

Table 3: Commonly Recommended Native Grasses

The following list identifies native grasses beneficial to upland wildlife and native habitat restoration. The list is not exhaustive and identifies species that are readily commercially available.

Species	% of Grass Component Seeds/Ft ²	Seeds/Ft ² (1 lb/ac)	pH Min.	Wet Soils ¹	Drought ² Tolerance	Flood Tolerance
Warm Season Grasses						
Big Bluestem <i>Andropogon gerardii</i>	0-30 ³	4.0	>6.0	Good	Fair	Fair
Indiangrass <i>Sorghastrum nutans</i>	0-30 ³	4.4	>4.8	Fair	Fair	Good
Blue Grama <i>Bouteloua gracilis</i>	0-20	17.2	>6.6	Poor	Good	Poor
Switchgrass <i>Panicum virgatum</i>	0-100 ⁴	9.0	>4.5	Good	Fair	Good
Little Bluestem <i>Schizachyrium scoparium</i>	0-30	6.6	>5.0	Poor	Good	Poor
Sideoats Grama <i>Bouteloua curtipendula</i>	0-30	4.1	>5.5	Poor	Good	Poor
Prairie Sandreed <i>Calamovilfa longifolia</i>	0-30	6.3	>5.6	Poor	Good	Poor
Prairie Cordgrass <i>Spartina pectinata</i>	0-5	4.2	>6.0	Excellent	Poor	Excellent
Prairie Dropseed <i>Sporopolus heterolepis</i>	0-10	5.1	>6.0	Fair	Fair	Good
Cool Season Grasses						
# Green Needlegrass <i>Stipa viridula</i>	0-10	4.1	>6.6	Poor	Good	Fair
# Canada Wildrye <i>Elymus canadensis</i>	0-10	2.6	>5.0	Good	Fair	Fair
# Slender Wheatgrass <i>Agropyron caninum</i>	0-10	3.6	>5.6	Fair	Good	Good
# Western Wheatgrass <i>Agropyron smithii</i>	0-10	2.6	>4.5	Fair	Good	Good
# Canada Bluejoint <i>Calamagrostis canadensis</i>	0-5	102.8	>4.5	Excellent	Poor	Excellent
# Virginia Wildrye <i>Elymus virginicus</i>	0-10	2.2	>5.0	Good	Fair	Good
# Kalms Brome <i>Bromus kalmii</i>	0-10	2.9	>5.5	Good	Fair	Fair
# Porcupine Grass <i>Hesperostipa spartea</i>	0-10	1.3	>6.6	Poor	Good	Fair
# Junegrass <i>Koeleria macrantha</i>	0-5	53.1	> 6.0	Poor	Good	Poor

Seeding rates are listed in pounds pure live seed per acre.

1/ Wet soils are those classified as somewhat poorly drained to very poorly drained.

2/ Droughty soils are those classified as excessively drained.

3/ Big bluestem or Indiangrass may not individually exceed 25% of the grass component in 643 – Restoration of Rare and Declining Habitat and 327 – Native Pollinator, Honeybee, and Monarch Habitat mixtures.

4/ Switchgrass may not exceed 10% of the grass component in 327 – Conservation Cover mixtures. Switchgrass may not exceed 5% of the grass component in 643 – Restoration of Rare and Declining Habitat mixtures.

Table 5: Commonly Recommended Introduced Grasses and Legumes The following list identifies introduced grass and legumes beneficial to upland wildlife and native habitat restoration. The list is not inclusive, and identifies those species, which are readily available through private vendor seed supplies.							
Species	% of Grass Component Seeds/Ft ²	Seeds/Ft ² (1.0 lb./ac)	pH Range	Wet Soils 1/	Drought Tolerance 2/	Flood Tolerance	Invasiveness 3/
Orchard grass	0-25	15.0	5.6 – 8.4	Yes	Fair	Poor	Low
Timothy	0-25	29.8	5.1 – 8.4	Yes	Poor	Good	Low
Intermediate Wheatgrass	0-50	2.0	7.0 - 8.5	No	Fair	Fair	Low
Tall Wheatgrass	0-50	1.8	7.0 - 8.5	Yes	Poor	Good	Low
Western Wheatgrass 4/	0-10	2.5	4.5 – 9.0	Yes	Good	Good	Low
Switchgrass 4/	0-10	9.0	4.5 – 8.0	Yes	Fair	Good	Low
Alfalfa	0-50	5.2	6.0 - 8.5	No	Good	Poor	Low
Red Clover	0-25	6.3	5.5 - 7.6	Yes	Fair	Fair	Low
White Clover	0-25	18.4	5.2 – 8.0	Yes	Poor	Good	Low
Alsike Clover	0-25	15.6	5.6 - 7.5	Yes	Poor	Good	Low

¹Wet soils are those classified as somewhat poorly drained to poorly drained.

²Droughty soils are those classified as excessively drained.

³Refers to the potential for a species to spread into adjoining areas.

⁴Switchgrass and/or Western Wheatgrass may be included in introduced grass-legume mixtures.

**Table 6: Native Forb Species Beneficial to Pollinators, Monarchs
and Other Beneficial Insects**

Species		Bloom Color	Honey bee	Monarch	Flowering Season Early = April - June Mid = June - August Late = August - October
DRY to MESIC					
Butterfly Weed	<i>Asclepias tuberosa</i>	Orange	H	LH	Mid
Canada Milkvetch	<i>Astragalus canadensis</i>	Cream	H		Mid
Compass Plant	<i>Silphium laciniatum</i>	Yellow		H	Mid
Dotted Blazing Star	<i>Liatris punctata</i>	Rose		VH	Mid
Evening Primrose	<i>Oenothera biennis</i>	Yellow			Mid
Foxglove Beardtongue	<i>Penstemon digitalis</i>	White	H		Early
Gray goldenrod	<i>Solidago nemoralis</i>	Yellow	H	H	Late
Hoary Vervain	<i>Verbena stricta</i>	Blue	H	H	Mid
Lance-leaved Coreopsis	<i>Coreopsis lanceolata</i>	Yellow	H	H	Early
Leadplant	<i>Amorpha canescens</i>	Purple	H	H	Mid
Long-headed Coneflower	<i>Ratibida columnifera</i>	Yellow			Mid
Ontario Blazing Star	<i>Liatris cylindracea</i>	Purple	H	VH	Late
Prairie onion	<i>Allium stellatum</i>	Pink	H		Mid
Purple Coneflower Narrow	<i>Echinacea angustifolia</i>	Pink	H	H	Mid
Purple Coneflower - Eastern	<i>Echinacea purpurea</i>	Pink	H	VH	Mid
Rough Blazing Star	<i>Liatris aspera</i>	Purple	H	VH	Late
Showy Goldenrod	<i>Solidago speciosa</i>	Yellow	H	VH	Late
Large-flowered Penstemon	<i>Penstemon grandiflorus</i>	Lavender	H		Early
Showy Milkweed	<i>Asclepias speciosa</i>	Pink	H	VH	Late
Silky Aster	<i>Symphotrichum sericeum</i>	Purple		H	Late
Skyblue Aster	<i>Symphotrichum oolentangiense</i>	Blue	H	H	Late
Smooth Aster	<i>Symphotrichum laeva</i>	Blue	H	H	Late
Spotted Beebalm	<i>Monarda punctata</i>	Lavender	H	H	Mid
Stiff Sunflower	<i>Helianthus paucifloris</i>	Yellow		H	Mid
Stiff Tickseed	<i>Coreopsis palmata</i>	Yellow		H	Mid
Wild Columbine	<i>Aquilegia canadensis</i>	Red	H		Early
Wild Lupine	<i>Lupinus perennis</i>	Lavender			Early
Wild White Indigo	<i>Baptista albaa</i>	White			Early
Whorled Milkweed	<i>Asclepias verticillata</i>	White	H	LH	Mid - Late
Yarrow	<i>Achillea millefolium</i>	White	H		Mid
MESIC to WET MESIC					
Blue Vervain	<i>Verbena hastata</i>	Blue		H	Mid - Late
Bottle Gentian	<i>Gentiana andrewsii</i>	Blue			Late
Canada Tick Trefoil	<i>Desmodium canadense</i>	Purple	H		Mid
Common Oxeye	<i>Heliopsis helianthoides</i>	Yellow		VH	Mid
Culvers Root	<i>Veronicastrum virginicum</i>	White	H	H	Mid
Giant Sunflower	<i>Helianthus giganteus</i>	Yellow	H	H	Late
Golden Alexanders	<i>Zizia aurea</i>	Yellow			Early
Great Blue Lobelia	<i>Lobelia siphilitica</i>	Blue		H	Late
Ironweed	<i>Veronia fasciculata</i>	Purple	H	H	Late
Meadow Blazing Star	<i>Liatris lingulistylis</i>	Purple		VH	Late
Mountain Mint	<i>Pycnanthemum virginianum</i>	White	VH	H	Mid
Obedient plant	<i>Physostegia virginiana</i>	Pink	H	H	Mid - Late
Partridge Pea	<i>Chamaechrista fasciculata</i>	Yellow	H		Mid
Rattlesnake Master	<i>Eryngium yuccifolium</i>	White		H	Mid
Sawtooth Sunflower	<i>Helianthus grosseserratus</i>	Yellow		VH	Late
Tall Blazing Star	<i>Liatris pycnostachya</i>	Purple		VH	Mid

Wild Bergamot	<i>Monarda fistulosa</i>	Lavender		H	Mid
Yellow Coneflower	<i>Ratibida pinnata</i>	Yellow			Mid
WET					
Blue Flag Iris	<i>Iris versicolor</i>	Blue	H		Early
Boneset	<i>Eupatorium perfoliatum</i>	White	H	H	Late
Cup Plant	<i>Silphium perfoliatum</i>	Yellow	H	H	Mid
Joe-pye Weed	<i>Eupatorium maculatum</i>	Rose	H	VH	Mid - Late
Giant Goldenrod	<i>Solidago gigantea</i>	Yellow	H	H	Mid - Late
New England Aster	<i>Symphyotrichum novae-angliae</i>	Purple	H	VH	Late
Panicled Aster	<i>Symphyotrichum lanceolatum</i>	White	H	H	Late
Sneezeweed	<i>Helenium autumnale</i>	Yellow	VH		Late
*Swamp Milkweed	<i>Asclepias incarnata</i>	Red	H	VH	Mid
DRY to WET MESIC					
Anise Hyssop	<i>Agastache foeniculum</i>	Purple	H	H	Mid
Black-eyed Susan	<i>Rudbeckia hirta</i>	Yellow		H	Mid - Late
*Common Milkweed	<i>Asclepias syriaca</i>	Purple	H	VH	Mid
Cream Gentian	<i>Gentiana flavida</i>	Cream			Late
Field thistle	<i>Cirsium discolor</i>	Pink	H	VH	Late
Grass-leaved Goldenrod	<i>Euthamia graminifolia</i>	Yellow	H	VH	Mid
Heath aster	<i>Symphyotrichum ericoides</i>	White	H	H	Late
Prairie phlox	<i>Phlox pilosa</i>	Pink		H	Early
Purple Prairie Clover	<i>Dalea purpurea</i>	Purple	VH		Mid
Maximilian Sunflower	<i>Helianthus maximiliani</i>	Yellow	H	H	Late
Spiderworts	<i>Tradescantia spp.</i>	Blue			Early
Stiff Goldenrod	<i>Solidago rigida</i>	Yellow	H	VH	Late
White Prairie Clover	<i>Dalea candida</i>	White	H	H	Mid

Monarch larval host = *

Honeybee and Monarch nectar value = Very High, High

Table 7: Introduced Perennial Grasses and Legumes - Honey Bee Habitat		
Recommended Basic Mixture	Rate in lbs./acres PLS	Flowering Season
Timothy	0.5	
Alfalfa	2.0	Mid-Late
White Clover	3.0	Early - Mid
Alsike Clover	4.0	Early - Mid
Red Clover	3.0	Early
Buckwheat 1/	16.0	Early - Mid
Additional Optional Species		
Purple Prairie Clover	0.5	Mid
Canada Milkvetch	0.25	Late

1/ Plantings containing buckwheat may not be seeded within 30 feet of an existing commodity wheat field, or in a field with a planned rotation to commodity wheat within two years. Note should be taken that buckwheat is an annual.

Table 8: Annual Forbs and Legumes - Honeybee Habitat			
Recommended Basic Mixture	Rate in lbs./acres PLS		Flowering Season
	Drill	Broadcast	
Mustard (<i>Sinapis alba</i> or <i>Brassica juncea</i>)	2.0	2.5	Early
Buckwheat 1/ Cowpea	16.0 18.0	22.0 25.0	Early - Mid Mid
Annual Sunflower Cultivar	0.5	0.5	Mid - Late
Additional Optional Species			
Dwarf Essex Rapeseed	1.0	1.5	Mid
Berseem Clover	3.5	5.0	Season Long
Red/Crimson Clover 2/	4.0	6.0	Early

1/ Plantings containing buckwheat may not be seeded within 30 feet of an existing commodity wheat field, or in a field with a planned rotation to commodity wheat within two years.

2/ This is only true for red clover that is already established (i.e., not an annual planting).

Table 9: Woody Species Beneficial to Native Pollinators and Honeybees			
Species		Value to Pollinators 1/	Flowering Season
American Basswood	<i>Tilia americana</i>	VH	Early - Mid
American Plum	<i>Prunus americana</i>	VH	Early
Black Cherry	<i>Prunus serotina</i>	VH	Early - Mid
Black Chokeberry	<i>Aronia melanocarpa</i>	VH	Early
Black Elderberry	<i>Sambucus canadensis</i>	VH	Early
Black Willow	<i>Salix nigra</i>	VH	Early
Button Bush	<i>Cephalanthus occidentalis</i>	VH	Mid
Chokecherry	<i>Prunus virginiana</i>	VH	Early
Cockspur Hawthorn	<i>Crataegus crus-galli</i>	VH	Early
Common Chokecherry	<i>Prunus virginiana</i>	VH	Early
Common Ninebark	<i>Physocarpus opulifolius</i>	VH	Early
Currant/Gooseberry	<i>Ribes spp.</i>	VH	Early - Mid
Dogwoods	<i>Cornus spp.</i>	H	Early
Downy Arrowwood	<i>Viburnum rafinesqueanum</i>	VH	Early - Mid
False Indigo Bush	<i>Amorpha fruticosa</i>	VH	Mid
Fragrant False Indigo	<i>Amorpha nana</i>	VH	Mid
Lowbush Blueberry	<i>Vaccinium angustifolium</i>	VH	Mid
Nannyberry	<i>Viburnum lentago</i>	VH	Early - Mid
Native Rose Species	<i>Rosa spp.</i>	VH	Mid
New Jersey Tea	<i>Ceanothus americanus</i>	VH	Mid
Northern bush honeysuckle	<i>Diervilla lonicera</i>	VH	Early - Mid
Pagoda dogwood	<i>Cornus alternifolia</i>	H	Early
Pin cherry	<i>Prunus pensylvanica</i>	VH	Early
Prairie rose	<i>Rosa arkansana</i>	VH	Mid
Raspberries/Blackberries	<i>Rubus spp.</i>	VH	Early
Redosier dogwood	<i>Cornus sericea</i>	VH	Early
Sandcherry	<i>Prunus pumila</i>	VH	Early - Mid
Saskatoon Serviceberry	<i>Amelanchier alnifolia</i>	VH	Early
Serviceberries	<i>Amelanchier spp.</i>	H	Early - Mid
Smooth rose	<i>Rosa blanda</i>	VH	Mid

Smooth Sumac	<i>Rhus glabra</i>	VH	Early
Western snowberry	<i>Symphoricarpos occidentalis</i>	H	Mid
Willow, Pussy or Black	<i>Salix spp.</i>	VH	Early

1/ H = High

VH = Very High

Table 10: Native Grasses for Native Pollinator, Monarch, and Honeybee Habitat	
Warm Season	
Big Bluestem	<i>Andropogon gerardii</i>
Sideoats Grama	<i>Bouteloua curtipendula</i>
Blue Grama	<i>Bouteloua gracilis</i>
Switchgrass	<i>Panicum virgatum</i>
Little Bluestem	<i>Schizachyrium scoparium</i>
Indiangrass	<i>Sorghastrum nutans</i>
Prairie Cordgrass	<i>Spartina pectinata</i>
Rough Dropseed	<i>Sporobolus compositus</i>
Prairie Dropseed	<i>Sporobolus heterolepis</i>
Cool Season	
Kalms brome	<i>Bromus kalmii</i>
Canada bluejoint	<i>Calamagrostis canadensis</i>
Canada wild rye	<i>Elymus canadensis</i>
Slender wheatgrass	<i>Elymus trachcaulus</i>
Virginia wild rye	<i>Elymus virginicus</i>
Porcupine grass	<i>Hesperostipa spartea</i>
Junegrass	<i>Koeleria macrantha</i>
Green needlegrass	<i>Nassella viridula</i>
Western wheatgrass	<i>Pascopyrum smithii</i>
Bicknell's sedge	<i>Carex bicknellii</i>
Short-beak sedge	<i>Carex brevior</i>
Pointed broom sedge	<i>Carex scoparia</i>
Stalkgrain sedge	<i>Carex stipata</i>
Common fox sedge	<i>Carex vulpinoidea</i>
Follow the practice standard specifications to determine acceptable rates for grasses and sedges. Additional species may be allowed with approval from an Area Resource Conservationist or Biologist.	

STANDARD 342 – CRITICAL AREA PLANTING SPECIFICATIONS

Recommended seed mixtures are found in Table 11. Seeding rates are based on pounds of Pure Live Seed (PLS) per acre. Design custom seed mixtures as follows:

Introduced Grass/Legume: Mixture will result in a minimum 150 seeds/ft², at least 50% of the mixture must be grass. Sod forming grasses will comprise a minimum 30% of the mixture. Legume seed shall be inoculated with the appropriate strain of nitrogen fixing bacteria prior to planting.

Native Grasses: Mixture will result in a minimum 75 seeds/ft². Sod forming grasses will comprise a minimum 30% of the mixture.

Table 11: Recommended Seed Mixtures for Critical Area Planting							
Seeding Mixture	Lbs/ ac	Seeds/ft ² Total Mix	% Sod Forming	Suitable Uses ^{1/}	Drainage	Capacity Retardance	Remarks
Smooth Brome ² Perennial Ryegrass	28 10	150	58	CO, WW, CA	Moderate to well, excessively drained	B	Add Red Clover or Alsike Clover if desired
Smooth Brome ² Timothy Perennial Ryegrass	15 3 3	155	30	CO, WW, CA	Moderate to well, excessively drained	B	Add Red Clover or Alsike Clover if desired
Smooth Brome ² Red Top Perennial Ryegrass	15 1 5	190	83	CO	Moderate to excessively drained	B	Add Alfalfa or Alsike Clover if desired
Int. Wheatgrass Timothy Canada Wildrye	23 3 7	155	30	CO, WW	Well to somewhat poorly drained	B	Add Alsike clover or Alfalfa if desired
Kentucky Bluegrass ² Creeping Red Fescue Perennial Ryegrass	3 5 10	210	70	CO, CA	Well to somewhat poorly drained	C	Add alsike or red clover if desired
Creeping Foxtail Timothy Red Top Perennial Ryegrass	10 2 1 3	362	78	CO, WW, CA	Somewhat poorly to poorly drained	C	Add Red Clover if desired
Timothy Perennial Ryegrass Kentucky Bluegrass ² Tall Fescue Annual Ryegrass	2 4.5 2.5 3 3	198	40	CO, WW, CA	Moderate to somewhat poorly drained	C	
Big Bluestem Indiangrass Switchgrass Canada Wildrye	6 6 6 7	123	63	CO, CA	Moderate to well drained	B	
Big Bluestem Indiangrass Switchgrass Sideoats grama Little Bluestem	4 4 3 3 3	93	60	CO	Moderate to Excessively drained	B	
Switchgrass Sideoats Grama Canada Wildrye Western Wheatgrass	4 4 7 5	84	78	CO, CA	Moderately to well drained	B	
Prairie Cordgrass Switchgrass Western Wheatgrass Canada Wildrye	3 3 7 7	76	76	CO, CA, WW	Somewhat poorly to poorly drained	B	

¹ Suitable Uses: CO = construction sites

CA = critical areas

WW = waterways

² Do not recommend these species adjacent to native prairie.

STANDARD 332 – CONTOUR BUFFER STRIP SEEDING SPECIFICATIONS AND STANDARD 393 – FILTER STRIP SEEDING SPECIFICATIONS AND STANDARD 589C – CROSS WIND TRAP STRIP SEEDING SPECIFICATIONS

Refer to the applicable practice standard for design and vegetation criteria.

Acceptable plant species and seeding rates are found in Tables 12 and 13. See Table 23 for a summary of plant species characteristics.

Seeding mixture will result in a minimum 55 seeds/ft² total.

Introduced grass/legume mixtures shall contain no more than one legume component not to exceed the maximum mixture composition in Table 12.

Native forbs may be added to native grass mixtures to enhance the practices for wildlife, pollinators, monarchs, and beneficial insects. Forbs can be added to a native species mixture. However, the criteria for pollutant reduction must be met. Forbs may comprise up to 10% of the mixture. For seedings ≤ 30 feet wide, and adjacent to cropland where pesticides are applied, forbs or legumes are not recommended. Refer to National Agronomy Technical Note #9 for mitigation recommendations related to pesticide application. Refer to Table 13 for recommended native forbs which can withstand sheet flow.

Table 12: Recommended Species for Contour Buffer (332), Cross Wind Trap (589c) and Filter Strip (393) Seed Mixtures

SPECIES C = Cool season W = Warm season R = Rhizomatous	% Allowed in Mix	Seeds/ft ² based on 1.0 PLS lb./Ac 1/	Drought	Flooding	Salts	Wet Soil	Effective Height	Longevity	Rooting Depth
Native Grasses									
Canada Wildrye C	0-25	2.6	Fair	Fair	Good	No	>12"	Short	M
Slender Wheatgrass # C	0-25	3.6	Good	Good	Good	No	< 12"	Short	M
Virginia Wildrye C	0-25	2.2	Fair	Good	Fair	S	>12"	Short	M
Green Needlegrass C	0-25	4.1	Good	Fair	Fair-Good	No	>12"	Long	D
Western Wheatgrass #C/R	0-50	2.6	Good	Good	Good-Ex	Yes	>12"	Long	D
Kalms Brome C	0-25	2.9	Fair	Fair	Poor	No	>12"	Short	M
Fringed Brome C	0-50	3.7	Fair	Fair	Poor	Yes	>12"	Moderate	M
Switchgrass # W/R	0-100	9.0	Fair	Good	Fair	Yes	>12"	Long	D
Prairie Cordgrass ⁴ W/R	0-100	4.2	Poor	Excellent	Poor	Yes	>12"	Long	D
Big Bluestem # W/R	0-50	4.0	Fair	Fair	Fair	No	>12"	Long	D
Indiangrass # W/R	0-25	4.4	Fair	Good	Fair	No	>12"	Long	M to D
Sideoats Grama # W/R	0-25	4.1	Good	Poor	Poor	No	< 12"	Long	S to M
Little Bluestem # W	0-25	6.6	Good	Poor	Poor	No	>12"	Long	D
Blue Grama W/R	0-25	17.2	Good	Poor	Fair	No	< 12"	Long	S

SPECIES C = Cool season W = Warm season R = Rhizomatous	% Allowe d in Mix	Seeds/ft ² based on 1.0 PLS lb./Ac 1/	Drought	Flooding	Salts	Wet Soil	Effective Height	Longevity	Rooting Depth
Introduced Grasses and Legumes²									
Creeping Foxtail # C/R	0-100	17.2	Poor	Good	Poor-Fair	Yes	>12"	Long	S to M
Smooth Brome ³ C/R	0-100	3.1	Fair	Good	Poor-Fair	No	>12"	Long	S to M
Redtop C/R	0-100	111.4	Poor	Good	Poor-Fair	Yes	>12"	Short	S to M
Meadow Brome C	0-100	1.8	Fair	Fair	Poor	No	>12"	Moderate	M
Int. Wheatgrass # C/R	0-100	2.0	Fair	Fair	Fair-Good	No	>12"	Long	D
Tall Wheatgrass # C	0-50	1.8	Fair	Good	Good-Ex	Yes	>12"	Moderate	D
Timothy # C	0-25	29.8	Poor	Good	Poor	Yes	>12"	Short	S to M
Alfalfa # C	0-25	5.2	Good	Poor	Fair	No	>12"	Moderate	D
Red Clover # C	0-25	6.3	Fair	Fair	Poor-Fair	No	< 12"	Short	D
Alsike Clover C	0-25	15.6	Fair	Good	Poor-Fair	Yes	< 12"	Short	D

Varietal selection important. See current edition of Minnesota Varietal Trials for Select Crops.

¹ PLS is Pure Live Seed.

² Do not mix introduced grass species with native grass species.

³ Do not recommend these species adjacent to native prairie.

⁴ Prairie Cordgrass should not exceed 20% of the mixture when combined with Big Bluestem, Indiangrass or Switchgrass.

Flooding ratings: **None** <1 week; **Poor** 1-2 weeks; **Fair** 2-4 weeks; **Good** 4-6 weeks; **Excellent** >6 weeks

Soluble salts ratings: **Poor** 0-2 mmhos; **Fair** 3-4 mmhos; **Good** 5-7 mmhos; **Excellent** 8-16 mmhos

Longevity: **Short** 1-4 Years; **Moderate** 5-10 Years; **Long** > 10 Years

Wet soils: **Yes**-tolerates poorly or very poorly drained. **S**-Tolerates somewhat poorly drained sites.

Rooting Depth: Rooting depths are based on typical growing conditions of the species

S (Shallow) = 0-12 inches, **M** (Medium) = 12-24 inches, **D** (Deep) = 24+ inches

Table 13: Native Forbs Suitable for Contour Buffer (332), Cross Wind Trap (589c) and Filter Strips (393)					
The following list identifies native forbs and wildflowers beneficial to wildlife, pollinators, monarchs, and other beneficial insects and support higher volumes of water flow and sedimentation.					
Common Name	Scientific Name	Bloom Period	Handle sheet flow	Dense stems to slow water flow	Rooting Depth
Canada Goldenrod	<i>Solidago canadensis</i>	Late	Yes	Yes	S
Cup Plant	<i>Silphium perfoliatum</i>	Mid	Yes		D
Giant Goldenrod	<i>Solidago gigantea</i>	Late	Yes		M to D
Giant Hyssop	<i>Agastache foeniculum</i>	Mid	Yes		M
Grass-leaved Goldenrod	<i>Euthamia graminifolia</i>	Late	Yes	Yes	D
Ironweed	<i>Vernonia fasciculata</i>	Mid	Yes		D
Joe-Pye Weed	<i>Eutrochium maculatum</i>	Mid	Yes		S
Marsh Milkweed	<i>Asclepias incarnata</i>	Mid	Yes		D
Mountain Mint	<i>Pycnanthemum virginianum</i>	Mid	Yes	Yes	D
New England Aster	<i>Symphyotrichum novae-angliae</i>	Late	Yes		S
Sneezeweed	<i>Helenium autumnale</i>	Late	Yes		S
Stiff Goldenrod	<i>Solidago rigida</i>	Late	Yes		D
Panicled Aster	<i>Symphyotrichum lanceolatum</i>	Late	Yes		S
White Sage	<i>Artemisia ludoviciana</i>	Late	Yes	Yes	D
Wild Bergamot	<i>Monarda fistulosa</i>	Mid	Yes	Yes	D
Yellow Coneflower	<i>Ratibida pinnata</i>	Mid	Yes		M

STANDARD 512 – PASTURE AND HAYLAND PLANTING SPECIFICATIONS

The following information contains specific requirements, recommendations, references, and guidelines to fully develop and implement a successful pasture or hayland planting.

When selecting or developing a seeding mixture, planners must consider what kind and class of livestock will consume the planned forage stand.

Experienced livestock producers may have preferences for forages, and the planner should consider those options. However, it is possible that the producer has overlooked additional species that might meet their goals.

Species Selection and Mix Development

Seed mixes shall be developed using the Pasture and Hay Planting Seed Tool available under the Pasture and Hayland Planting (512) conservation practice in Section IV of the FOTG. Refer to Tables 16, 17 and 24 for assistance with developing and/or approving seed mixes. If needed, consult an Area Resource Conservationist or Grazing/Rangeland Management Specialist for assistance with developing or certifying seed mixes.

When developing seed mixes, select species based on the following factors:

- Soil Drainage Classes present
- Soil Types present
- Management needs of the producer
- Soil fertility
- Soil pH
- Kind and class of animal (avoid planting species that may cause health concerns)
- Client suggestions.

Table 14 below contains seeding mixes that are adapted to a variety of soil drainage classes and livestock found in Minnesota. The mixes included in Table 14 should cover most situations and are a resource that conservation planners may use to assist with developing pasture and hayland seed mixes.

Do not use switchgrass in mixes consumed by sheep or horses. Do not use alsike clover in mixes consumed by horses.

Seed mixes must be approved by an Area Resource Conservationist, Grazing/Rangeland Management Specialist, or field office staff with the appropriate Job Approval Authority if the planner does not possess the appropriate level of JAA for the plan.

Fundamentally, a seed mix must provide sufficient perennial ground cover. A rate of **64-120 pure live seeds (PLS) per square foot of perennial species** are required to achieve a dense stand for pasture or hay production. The lower end of this range of seed concentration may be used when seedbed conditions are expected to be optimal. Use higher seeding rates when:

- the seedbed is clumpy/rough or too loose
- when broadcast seeding
- into high residue situations (examples: dead perennial sod or un-tilled corn stalks)
- variable soil drainage classes are present (example: poorly drained and well drained soils need to be covered by the same mix).
- Overall site preparation may be undesirable

General recommendations for seeds/square foot based on site conditions:

- Good site prep with adequate weed control and a firm seed bed: 64-80+ seeds/sq ft
- Broadcast with a spinner-type spreader: 150% of the drilled rate.
 - Broadcast with an airflow machine where seed is evenly spaced (example: terragator) may not need additional seed over drilled rate.
- No-till into high residue (such as dead perennial sod or un-tilled corn stalks): 100+ seeds/sq ft
- Variable soil drainage conditions present: 100+ seeds/sq ft
- Frost seeding legumes: 64+ seeds/sq ft
- Note: These are general recommendations. Exact amounts may vary based on site conditions/characteristics.

Pasture plantings

- Usually contain 4-6 species or more, depending on site-specific conditions and management objectives of the producers. Based on those factors, more or less species may be desirable.
 - Generally, pasture mixes contain 2-4 grass species and 1-3 legume species.
- 30-50% legumes are usually recommended to improve forage quality of the stand and provide good nitrogen fixing capabilities. Legume content in the seed mix will depend upon:
 - Kind and class of livestock
 - Soil conditions/drainage class
 - Soil fertility
 - Producer input
 - Types of legumes used. Most legumes used commonly in plantings (except for birdsfoot trefoil) cause bloat. When using all bloat causing legumes, keep legume content down to less than 40% of the seed mix (on a seeds/square foot basis).

Hayland Plantings

For Hayland plantings, the harvest method must also be considered. Some species do not dry down very easily for dry hay and the producer must have access to harvest equipment and storage facilities that correspond to the forages planted. Forage species that meet nutrient needs and palatability requirements of the livestock shall be selected. Soil drainage class, Forage Suitability Groups, and nutrient status will determine which forage species are adapted to the site. Seed mixes for hay may contain pure stands of grasses or a mixture of grasses and legumes. For ease of management, no more than two grass species per mix for hay production are recommended.

- Match species to producer's operation and harvest/storage capabilities. For example, does the producer make haylage/baleage or harvest everything as dry hay.
- Seed mixes generally contain 60-80% legumes. Exact amount depends on the goals/objectives of the producer.
- Usually contain 2-4 species.
 - Recommend no more than two grasses to ensure the quality of the forage at harvest can be easily managed.
 - Select varieties with similar maturity/growth curves to allow for consistent quality at harvest.
 - Note more or less species may be desirable based on site conditions and the goals/objectives of the producer.

Perennial ryegrass, Italian ryegrass, festulolium, annual ryegrass, and other short-lived perennials and annuals do not meet the 512 standard because they do not live long enough to meet the 5-year lifespan

of the practice. When including short-term perennials or annuals into the seed mix, do not count them towards the required minimum number of seeds/square foot.

Seeding rates are developed on a pure live seed basis. Refer to the Pasture and Hay Planting Seed Tool for assistance with calculating PLS prior to seeding as needed. Also, refer to table 23 in this tech note for assistance calculating PLS based on the purity and total germination of the seed. Make certain the seed mix meets the nutrient requirements of the kind and class of animal, the level of performance desired by the producer, and the harvest and storage method available to the producer.

Native grasses/forbs usually require special seeding equipment. Refer to the section on seeding equipment for details on equipment characteristics and calibration methods.

Variety Selection

Refer to the Recommended Plant Species section at the beginning of this document for more information about variety selection. Table 15 lists some recommended varieties but is not all-encompassing due to the large number of varieties present that may work for the various species.

Producers should select varieties that:

- have resistance for insects or diseases that may be present,
- that match the harvest schedule and method of the producer,
- match the intended livestock species, class, and utilization method,
- are adapted to climatic and microclimatic conditions in the area to be seeded
- fit the overall management needs of the producer

Avoid species with “Variety Not Stated”, if possible. Named varieties have specific documented traits that can be referred to with regards to persistence, production, etc.

Legumes

Use pre-inoculated legume seed with the rhizobia species specific to the legume(s) in the seed mix. If there are two kinds of legumes, each one will be inoculated with its specific rhizobia species.

Legumes may have relatively high amounts of hard seed, which are seeds that do not germinate during the first year, and the amount of hard seed will be specified on the seed tag. In many cases, these seeds may germinate in subsequent years. Increasing the seeding rate for species with higher than 20% hard seed may be desirable to ensure an adequate number of seedlings become established during the seeding year. Do not recommend seeding alfalfa following alfalfa due to problems with autotoxicity. Pasture mixes should not contain more than 50% legumes on a pure live seed basis to avoid bloat in livestock.

Management of New Seedings

Management during the seeding year is critical. Little or no grazing should be expected under normal conditions during the seeding year. Companion crops may be planted with new seedings and removed as hay. If growing conditions are favorable, grazing during the seeding year may be possible late in the season when the plants are dormant, and the ground is dry and/or frozen. Any grazing during the seeding year should result in low utilization/light grazing intensity. Avoid grazing or haying new seedings in the month of September and leave a minimum of six inches of residual height going into the winter. If growing conditions are not favorable, (such as excessive moisture or drought conditions that have affected establishment), then grazing must be deferred until the stand is fully established and conditions improve. If hay was harvested from new seedings, fertilizer may need to be applied based on soil test results to replace the amount of nutrients removed in the harvested hay.

Practice Certification

Use the Pasture and Hay Planting Seed Tool to determine the number of pure live seeds per square foot applied. **A minimum of 64 pure live seeds per square foot of acceptable perennial species are required to meet this practice standard.** When certifying this practice, do not include annual species or short-term perennials, such as annual ryegrass, perennial ryegrass, festulolium, warm season annual grasses, cool season annual grasses, annual legumes, brassicas, etc. when calculating the number of pure live seeds per square foot as these species do not meet the lifespan of this practice for growing conditions in Minnesota. Obtain copies of soil tests from an approved soil testing laboratory that are four years old or less. Also seed tags are required to allow for calculating the amount of pure live seed applied based on the purity and germination of the species in the seed mix.

Table 14: SEEDING MIXES FOR HAYLAND AND PASTURE

Cool Season Introduced Hay Mixes			
Soil Drainage Class: Very Poorly to Poorly Drained			
Species	Variety	Seeding Rate (PLS LBS/Acre)	% in Mixture
Creeping Foxtail	Garrison	1	24
Alsike Clover	Named Variety	4	76
Soil Drainage Class: Poorly Drained			
Species	Variety	Seeding Rate (PLS LBS/Acre)	% in Mixture
Timothy	Climax	2	57
Birdsfoot Trefoil ¹	Norcen	5	43

Table 14: Cool Season Introduced Hay Mixes			
Soil Drainage Class: Poorly Drained			
Species	Variety	Seeding Rate (PLS LBS/Acre)	% in Mixture
Creeping Foxtail	Named Variety	0.5	13
Timothy	Named Variety	0.5	18
Reed Canary Grass ¹	Named Variety	1	15
Meadow Fescue	Named Variety	3	20
White Clover	Named Variety	1	23
Birdsfoot Trefoil ¹	Named Variety	1	11
Note: This mix is best suited to baleage or silage.			
Soil Drainage Class: Somewhat Poorly to Moderately Well Drained			
Species	Variety	Seeding Rate (PLS LBS/Acre)	% in Mixture
Meadow Bromegrass	Fleet	10	16
Orchard grass	Orion	2	26
Tall Fescue	Bull	6	27
Birdsfoot Trefoil ¹	Roseau	1	7
White Clover	Alice	0.5	8
Red Clover	Medium	3	16
Soil Drainage Class: Moderately Well Drained to Well Drained			
Species	Variety	Seeding Rate (PLS LBS/Acre)	% in Mixture
Orchard grass	Named Variety	0.5	9
Meadow Fescue	Named Variety	6	40
Alfalfa*	Named Variety	8	51
Soil Drainage Class: Moderately Well Drained to Excessively Drained			
Species	Variety	Seeding Rate (PLS LBS/Acre)	% in Mixture
Intermediate Wheatgrass	Named Variety	8.5	23
Meadow Bromegrass	Named Variety	6.5	16
Alfalfa*	Named Variety	9	61

Table 14: Cool Season Introduced Hay Mixes

Soil Drainage Class: Moderately Well Drained to Excessively Drained			
Species	Variety	Seeding Rate (PLS LBS/Acre)	% in Mixture
Timothy	Named Variety	0.5	19
Orchard grass	Named Variety	0.5	10
Intermediate Wheatgrass**	Named Variety	6	16
Meadow Bromegrass	Named Variety	3	7
Smooth Bromegrass	Named Variety	1.5	6
Alfalfa*	Hay Type	6	41

Cool Season Introduced Pasture Mixes

Soil Drainage Class: Very Poorly to Poorly Drained			
Species	Variety	Seeding Rate (PLS LBS/Acre)	% in Mix
Creeping Foxtail	Garrison	2	34.6
Timothy	Climax	0.5	11.8
Tall Fescue	Bull	6	26.2
Alsike Clover	Recommended	1.5	20.2
Birdsfoot Trefoil ¹	Norcen	1	7.2
Soil Drainage Class: Very Poorly to Poorly Drained			
Species	Variety	Seeding Rate (PLS LBS/Acre)	% in Mix
Reed Canary Grass ¹	Named Variety	3	21.3
Creeping Foxtail	Named Variety	3	36.5
Timothy	Named Variety	0.5	8.3
Alsike Clover	Named Variety	3	28.4
Ladino Clover	Named Variety	0.5	5.4
Soil Drainage Class: Somewhat Poorly to Moderately Well Drained			
Species	Variety	Seeding Rate (PLS LBS/Acre)	% in Mix
Meadow Bromegrass	Fleet	10	15.8
Orchard grass	Orion	2	25.8
Tall Fescue	Bull	6	26.9
Birdsfoot Trefoil ¹	Roseau	1	7.3
White Clover	Alice	0.5	7.9
Red Clover	Medium	3	16.3

Table 14: Cool Season Introduced Pasture Mixes			
Soil Drainage Class: Somewhat Poorly Drained to Well Drained			
Species	Variety	Seeding Rate (PLS LBS/Acre)	% in Mix
Perennial Ryegrass	Named Variety	2	12
Orchard grass	Named Variety	0.5	9
Meadow Fescue	Named Variety	5	31
Tall Fescue	Named Variety	2	12
Red Clover	Named Variety	2	15
White Clover	Named Variety	0.5	11
Birdsfoot Trefoil ¹	Named Variety	1	10
Soil Drainage Class: Moderately Well Drained to Well Drained (All Grass)			
Species	Variety	Seeding Rate (PLS LBS/Acre)	% in Mix
Timothy	Named Variety	0.5	20.6
Orchard grass	Named Variety	0.5	10.9
Intermediate Wheatgrass**	Named Variety	11.5	33.8
Smooth Brome grass	Named Variety	3.5	15.9
Meadow Brome grass	Named Variety	7	18.7
Soil Drainage Class: Moderately Well Drained to Well Drained			
Species	Variety	Seeding Rate (PLS LBS/Acre)	% in Mix
Timothy	Named Variety	0.5	18.9
Orchard grass	Named Variety	0.5	10
Intermediate Wheatgrass**	Named Variety	5	13.5
Meadow Brome grass	Named Variety	5.5	10.4
Smooth Brome grass	Named Variety	2.5	13.5
Alfalfa*	Grazing Type	5	33.7
Soil Drainage Class: Moderately Well Drained to Well Drained			
Species	Variety	Seeding Rate (PLS LBS/Acre)	% in Mix
Intermediate Wheatgrass**	Named Variety	8.5	25.4
Smooth Brome grass	Named Variety	6.5	30
Orchard grass	Named Variety	0.5	11.1
Alfalfa*	Grazing Type	4.5	33.6

Table 14: Cool Season Introduced Pasture Mixes			
Soil Drainage Class: Moderately Well Drained to Excessively Drained			
Species	Variety	Seeding Rate (PLS LBS/Acre)	% in Mix
Meadow Bromegrass	Fleet	12	20.3
Intermediate Wheatgrass**	Oahe	10	18.6
Tall Fescue	Fawn	4	19.2
Alfalfa*	Grazing Type	4	18.6
Red Clover	Medium	4	23.3
Soil Drainage Class: Moderately Well Drained to Excessively Drained			
Species	Variety	Seeding Rate (PLS LBS/Acre)	% in Mix
Smooth Brome	Named Variety	5	23.4
Intermediate Wheatgrass**	Named Variety	5	15.2
Tall Fescue	Named Variety	3	23.5
Alfalfa*	Grazing Type	5	37.9

1/ Use birdsfoot trefoil or reed canary grass only in site specific circumstances and when it will not be invasive in native plant communities. Prior approval is required from the Area Grazing/Rangeland Management Specialist or Area Resource Conservationist Specialist.

*Alfalfa requires a minimum soil pH to be 6.5 or greater for optimum production.

**Intermediate wheatgrass requires a minimum soil pH of 6.0 or greater for optimum production.

Table 14: Legume Inter-seeding/Frost Seeding Mixes			
Soil Drainage Class: Very Poorly Drained to Well Drained			
Species	Variety	Seeding Rate (PLS LBS/Acre)	% in Mix
Alsike Clover	Named Variety	4	100
Soil Drainage Class: Very Poorly Drained to Well Drained			
Species	Variety	Seeding Rate (PLS LBS/Acre)	% in Mix
Alsike Clover	Named Variety	3	60.4
Red Clover	Named Variety	5	39.6
Soil Drainage Class: Somewhat Poorly Drained to Well Drained			
Species	Variety	Seeding Rate (PLS LBS/Acre)	% in Mix
Red Clover	Named Variety	10	100
Soil Drainage Class: Well Drained to Excessively Drained			
Species	Variety	Seeding Rate (PLS LBS/Acre)	% in Mix
Alfalfa	Named Variety	5	31.3
Birdsfoot Trefoil	Named Variety	5	53
Red Clover	Named Variety	2	23.5

Table 15: RECOMMENDED NATIVE AND INTRODUCED GRASS, FORB AND LEGUME FORAGE VARIETIES.

Recommended Introduced Grasses		Recommended Legumes and Forbs		Recommended Native Grasses	
Meadow Brome	Paddock Fleet	Alfalfa	Winter hardy grazing varieties	Big Bluestem	Bison Sunnyview Rountree Champ
Smooth Brome	Superior, Alpha Manchar, Bravo Carlton, Polar, Jubilee, Saratoga	White Clover	Ladino Alice	Little Bluestem	Itasca Badlands Blaze Camper
Orchard Grass	Potomac Orion Ambassador	Alsike Clover	Named Variety	Switchgrass	Dacotah Summer Sunburst Pathfinder Forestburg
Timothy	Climax Colt	Kura Clover	Named Variety	Indiangrass	Tomahawk Holt Oto
Tall Fescue	Courtenay Select	Birdsfoot Trefoil¹	Roseau	Side-oats Grama	Killdeer Pierre
Reed Canary Grass¹	Palaton Chieftan Venture	Cicer Milkvetch	Named Variety	Western Wheatgrass	Rodan
Intermediate Wheatgrass	Oahe Manska	Forage Chickory	Named Variety		
Tall Wheatgrass	Alkar	Red Clover	Named Variety		
Meadow Fescue	Pradel				
Creeping Foxtail	Garrison Retain				

¹/ Use birdsfoot trefoil or reed canary grass only in site specific circumstances and when it will not be invasive in native plant communities. Prior approval is required from the Area Grazing Specialist.

Table 16: SELECTED FORAGE SPECIES ADAPTABILITY BY SOIL DRAINAGE CLASS

INTRODUCED GRASSES							
Soil Drainage Classes	Very Poorly Drained	Poorly Drained	Somewhat Poorly Drained	Moderately Well Drained	Well Drained	Somewhat Excessively Drained	Excessively Drained
Kentucky Bluegrass	N	N	Y	Y	Y	N	N
Meadow Bromegrass	N	N	Y	Y	Y	Y	Y
Smooth Bromegrass	N	N	Y	Y	Y	Y	Y
Reed Canary grass	Y	Y	Y	Y	Y	Y	Y
Meadow Fescue	N	Y	Y	Y	Y	Y	N
Tall Fescue	N	Y	Y	Y	Y	Y	Y
Creeping Foxtail	Y	Y	N	N	N	N	N
Orchard grass	N	N	Y	Y	Y	N	N
Timothy	N	Y	Y	Y	Y	N	N
Intermediate Wheatgrass	N	N	Y	Y	Y	Y	Y
Pubescent Wheatgrass	N	N	Y	Y	Y	Y	Y
Tall Wheatgrass	N	N	Y	Y	Y	Y	Y
NATIVE GRASSES							
Big Bluestem	N	Y	Y	Y	Y	Y	Y
Little Bluestem	N	N	N	Y	Y	Y	Y
Side Oats Grama	N	N	N	Y	Y	Y	Y
Indiangrass	N	Y	Y	Y	Y	N	N
Switchgrass	N	Y	Y	Y	Y	N	N
Slender Wheatgrass	N	Y	Y	Y	Y	Y	N
Western Wheatgrass	N	Y	Y	Y	Y	Y	N
Canada Wildrye	N	N	N	Y	Y	Y	Y
Virginia Wildrye	N	Y	Y	Y	N	N	N
LEGUMES/FORBS							
Alfalfa	N	N	N	Y	Y	Y	Y
Alsike Clover	Y	Y	Y	Y	Y	N	N
Kura Clover	N	Y	Y	Y	Y	N	N
Ladino Clover	N	Y	Y	Y	Y	N	N
Red Clover	N	N	Y	Y	Y	N	N
White Clover	N	N	Y	Y	Y	N	N
Cicer Milkvetch	N	Y	Y	Y	Y	Y	Y
Birdsfoot Trefoil	N	Y	Y	Y	Y	Y	Y
Forage Chickory	N	N	N	Y	Y	N	N

Table 17: FERTILIZER RECOMMENDATIONS FOR GRASS, GRASS/LEGUME AND ALFALFA FORAGE

Nitrogen Recommendations						
	Conditions				N to Apply (units/Ac.)	
>20% Legume					Nitrogen not recommended	
< 20% Legume	Rotational grazing and adequate rainfall				150	
	Continuous grazing and adequate rainfall				100	
	Grazing and moderate rainfall				50	
	Practice 327, 393, 342				60	
	Sandy soils, steep slopes, low precipitation areas				30	
	Organic Soils				50	
Phosphorous Recommendations for Pasture > 20% Legume						
	0-5	6-10	11-15	16-20	21+	Bray
	0-3	4-7	8-11	12-15	16+	Olson
Yield Goal Tons/Acre						
2	35	25	15	0	0	
3	55	40	25	10	0	
4	70	50	30	10	0	
5	90	65	40	15	0	
6	90	65	40	15	0	
7+	90	65	40	15	0	
Phosphorous Recommendations for Pasture < 20% Legume						
	0-5	6-10	11-15	16-20	21+	Bray
	0-3	4-7	8-11	12-15	16+	Olson
Yield Goal Tons/Acre						
2	40	30	20	10	0	
3	50	40	30	20	0	
4	60	50	40	30	0	
5	70	60	50	40	0	
6	70	60	50	40	0	
7+	70	60	50	40	0	
Phosphorous Recommendations for Alfalfa Hay						
	0-5	6-10	11-15	16-20	21+	Bray
	0-3	4-7	8-11	12-15	16+	Olson
Yield Goal Tons/Acre						
2	45	35	20	10	0	
3	65	45	25	10	0	
4	80	55	30	15	0	
5	95	65	40	15	0	
6	110	80	45	20	0	
7+	125	90	55	25	0	

Table 17: FERTILIZER RECOMMENDATIONS FOR GRASS, GRASS/LEGUME AND ALFALFA FORAGE cont.						
Phosphorous Recommendations for Other Legume Hay						
	0-5	6-10	11-15	16-20	21+	Bray
	0-3	4-7	8-11	12-15	16+	Olson
Yield Goal Tons/Ac.						
2	40	30	20	10	0	
3	50	40	30	20	0	
4	60	50	40	30	0	
5	70	60	50	40	0	
6	70	60	50	40	0	
7+	70	60	50	40	0	
Potassium Recommendations for Pasture >20% Legume						
	0-40	41-80	81-120	121-160	161+	Soil Test Result
Yield Goal Tons/Ac.						
2	95	65	40	15	0	
3	140	100	60	20	0	
4	185	135	80	25	0	
5	230	165	100	35	0	
6	230	165	100	35	0	
7+	230	165	100	35	0	
Potassium Recommendations for Pasture <20% Legume						
	0-40	41-80	81-120	121-160	161+	Soil Test Result
Yield Goal Tons/Ac.						
2	90	60	30	0	0	
3	100	70	40	10	0	
4	110	80	50	20	0	
5	120	90	60	30	0	
6	120	90	60	30	0	
7+	120	90	60	30	0	
Potassium Recommendations for Alfalfa Hay						
	0-40	41-80	81-120	121-160	161+	Soil Test Result
Yield Goal Tons/Ac.						
2	145	100	55	10	0	
3	190	130	70	10	0	
4	240	165	90	15	0	
5	290	195	105	15	0	
6	335	230	125	20	0	
7+	380	265	145	20	0	
Table 17: FERTILIZER RECOMMENDATIONS FOR GRASS, GRASS/LEGUME AND ALFALFA FORAGE cont.						
Potassium Recommendations for Other Legume Hay						
	0-40	41-80	81-120	121-160	161+	Soil Test Result
Yield Goal Tons/Ac.						
2	90	60	30	0	0	
3	100	70	40	10	0	
4	110	80	50	20	0	
5	120	90	60	30	0	
6	120	90	60	30	0	
7+	120	90	60	30	0	

TABLE 18: FORAGE SPECIES CHARACTERISTICS KEY - Livestock Grazing and Mechanical Harvesting

Increaser, Decreaser & Invader Describe Plant Species Reaction to Increased Livestock Grazing Pressure.	Increaser	Decreaser	Invader	Cattle	Horses	Sheep	Goats	Hay	Haylage	Silage	Baleage	Recovery After Harvest
<i>NATIVE COOL SEASON GRASSES</i>												
American mannagrass												
Fowl bluegrass				P								P
Needlegrass												
Green needlegrass		X		G				G				G
Needleandthread	X			F		P						F
Porcupine grass		X		F		P						G
Mountain brome				G								P
Prairie junegrass		X		G								P
Wheatgrass												
Bearded		X		G								
Bluebunch		X		G								F
Slender		X		G								F
Western		X		G				G				F
Whitetop		X		G								F
Wildrye												
Basin				G								F
Beardless				F								P
Canada		X		F								F
Virginia				F								P
<i>NATIVE WARM SEASON GRASSES</i>												
Alkali sacaton				F								F
Bluestem												
Big		X		G				G				G
Little		X		F								F
Sand		X		G								F
Buffalo grass	X			G								F
Grama												
Blue	X			G								P
Sideoats		X		G				G				F
Indian rice grass		X		G								F
Indiangrass				G				G				G
Inland Saltgrass	X			P								P
Prairie cordgrass				F								F
Prairie sandreed		X		F								F
Prairie dropseed				F								F
Reed canary grass		X		G	G							G
Sand dropseed				P								P
Switchgrass		X		F								F

Increaser, Decreaser & Invader Describe Plant Species Reaction to Increased Livestock Grazing Pressure.	Increaser	Decreaser	Invader	Cattle	Horses	Sheep	Goats	Hay	Haylage	Silage	Baleage	Recovery After Harvest
INTRODUCED COOL SEASON GRASSES												
Bromegrass												
Meadow				G								G
Smooth			X	G								G
Creeping foxtail				G								G
Kentucky bluegrass												
Orchard grass				G								G
Fescue												
Tall												
Meadow			X									
Timothy				F	G							G
Wheatgrass												
Crested				F								F
Intermediate				G								F
Pubescent				G								F
Siberian				F								F
Tall				P								F
Wildrye												
Altai				F								P
Mammoth				P								F
Russian				G								G
LEGUMES												
Alfalfa				G	P							G
Birdsfoot trefoil				G	P							G
Crown vetch					P							
Cicer milkvetch				G	P							G
Clover												
Alsike				G	P							G
Kura				G	P	G						
Ladino (white)				G	P							F
Red				G	P	G						F
Strawberry				G	P							F
Sweet				F	P							P
Sainfoin				G	P							F
Small burnet				F	P							

STANDARD 657 – WETLAND RESTORATION: HERBACEOUS SEEDING SPECIFICATIONS

Vegetative Restoration

Restoration of sites involves planting with appropriate native species. Species planted may vary depending on the type of wetland being restored. Planting specifications should be developed for the different zones where vegetation is to be established. Zones range from shallow open water, deep marsh, shallow/emergent marsh, and sedge/wet meadow. This technical note addresses shallow/emergent marsh fringe and sedge/wet meadow zones. Reference *Section 5 of the Minnesota Wetland Restoration Guide* for additional vegetative establishment recommendations: [BWSR Wetland Restoration Guide](#).

Use of Native Seedbank

Maximizing the use of native seedbank is encouraged for wetland projects to promote the establishment of local seed/species. Seedbanks often contain annual species that provide important environmental benefits and often are not included in seed mixes. Survey information from nearby remnant communities can be used as a guide for developing a diversity standard and determining what additional species may be beneficial.

Seeding Wetlands

Wet meadow and sedge meadow seed mixes are designed to be used from the planned edge of open water (pool elevation) to around 1-1.5 feet in elevation depending on soil texture and capillary action of soil. Emergent seed mixes are commonly used in a 6 to 10-foot band that straddles the edge of open water. This strip of emergent seed is typically hand broadcast after water levels have stabilized within the wetland. It is not recommended to seed in areas that will have open water, as most wetland seed will float.

In most cases, wetland seed can be broadcast-seeded followed by rolling or packing, as most wetland seed needs light to germinate. Wetland grasses can be drill-seeded 1/8 to 1/4-inch-deep followed by broadcasting forbs and sedges. If a seed drill is used for installation of wetland seed the drill must be calibrated appropriately to ensure that small seed is planted correctly.

Establishment - Wetlands are typically dormant seeded in the fall or seeded in spring after hydrology conditions have stabilized. An advantage of fall dormant seeding is that forb and sedge seed is allowed to stratify over winter. Emergent wetland species may be seeded but are also commonly planted on the edge of open water and allowed to move to deeper areas on their own. Aggressive wetland species such as reed canary grass, non-native cattails and non-native phragmites need to be thoroughly controlled prior to wetland seeding or plantings will likely not be successful.

Seed Planting Density - Wetland seed mixes shall provide seed densities ranging from 110 to 200 seeds/ft². Wet/sedge meadow seed mixes shall contain 20-30 species. Shallow emergent marsh communities may be seeded with mixes of 10-20 species. For recommended species and optional seeding calculator refer to the MN NRCS Home Page at [Field Office Technical Guide](#). Higher diversity mixes will help support pollinators and other invertebrates that play a key role in the health of wetland habitats. Recommended composition of mixes, based on seeds/ft²:

Emergent Fringe		Sedge Meadow		Wet Meadow	
Grasses	20 – 65%	Grasses	20 – 50%	Grasses	20 – 60%
Sedges - Rushes	20 – 65%	Sedges - Rushes	40 – 70%	Sedges - Rushes	15 – 60%
Forbs	15 – 30%	Forbs	15 – 35%	Forbs	15 – 35%

*-- **NOTE** – Wet/Sedge meadow class wetland restorations that are intended to be short-term in duration, may utilize the following Conservation Practice Standards; Conservation Cover (327) or Restoration of Rare or Declining Natural Communities (643) specifications in lieu of 657 seeding specifications. Species shall be selected from Wet– Mesic drainage classes.

Early Successional Floodplain – The following mixtures are recommended on sites where natural regeneration of woody or herbaceous vegetation is expected to establish over time.

1. Switchgrass	6.0 lbs/ac	*-- 3. Riverbank Wild Rye	0.09 lb/ac
		Slender Wheatgrass	0.99 lb/ac
2. Virginia Wildrye	3.0 lbs/ac	Virginia Wild Rye	5.19 lbs/ac
Slender Wheatgrass	5.0 lbs/ac	Fowl Bluegrass	0.42 lb/ac
Switchgrass	3.0 lbs/ac	Marsh Milkweed	0.06 lb/ac
		Autumn Sneezeweed	0.04 lb/ac
		Tall Coneflower	0.02 lb/ac
		Blue Vervain	0.09 lb/ac

Table 21: Key Plant Species for Herbaceous Wetland Restoration Grasses, forbs, sedges, and rushes are all commonly used as part of herbaceous wetland restoration projects. Species should be selected that are native to the area and well adapted to site conditions. The listed seeds per square foot are a general recommendation for seed mixes.					
Shallow/Emergent Wetland Fringe (Saturated soils to water depths up to 6 inches)					
Common Name	Botanical Name	Succession	Zone	Seeds/ft ² at 1.0 lb/ac.	Seeds/ft ² at 1.0 oz/ac.
Sweet flag	<i>Acorus americanus</i>	L	E	2.4	0.2
Water plantain	<i>Alisma subcordatum</i>	M	E	22.0	1.5
Marsh milkweed	<i>Asclepias incarnata</i>	L	S	1.76	0.1
American slough grass	<i>Beckmannia syzigachne</i>	E	S	18.4	1.2
Canada bluejoint grass	<i>Calamagrostis canadensis</i>	L	S	102.8	6.4
Slough sedge	<i>Carex atherodes</i>	L	E	10.7	0.7
Bottlebrush sedge	<i>Carex comosa</i>	L	E	11.0	0.7
Porcupine sedge	<i>Carex hystericina</i>	L	E	11.0	0.7
Lake sedge	<i>Carex lacustris</i>	L	E	11.8	0.7
Tussock sedge	<i>Carex stricta</i>	L	E	19.5	1.2
Fox sedge	<i>Carex vulpinoidea</i>	L	E	36.7	2.3
Least spike-rush	<i>Eleocharis acicularis</i>	M	E	25.7	1.6
Marsh spike-rush	<i>Eleocharis palustris</i>	M	E	18.7	1.2
Joe-pye weed	<i>Eutrochium maculatum</i>	L	S	34.9	2.2
Rattlesnake manna grass	<i>Glyceria canadensis</i>	M	E	58.8	3.7
Tall/Reed manna grass	<i>Glyceria grandis</i>	L	E	29.4	1.8
Soft rush	<i>Juncus effusus</i>	L	E	367.3	23.0
Knotted rush	<i>Juncus nodosus</i>	L	E	679.9	42.5
Torrey's rush	<i>Juncus torreyi</i>	M	E	587.7	36.7
Rice cutgrass	<i>Leersia oryzoides</i>	M	S	12.5	0.8
Water smartweed	<i>Polygonum amphibium</i>	E	E	2.9	0.2
Great water dock	<i>Rumex orbiculatus</i>	M	S	4.3	0.3
Broad-leaved arrowhead	<i>Sagittaria latifolia</i>	M	E	22.4	1.4
Hard-stem bulrush	<i>Schoenoplectus acutus</i>	L	E	4.7	0.3
River bulrush	<i>Schoenoplectus fluviatilis</i>	L	E	1.6	0.1
Three-square bulrush	<i>Schoenoplectus pungens</i>	L	E	4.4	0.3
Soft-stem bulrush	<i>Schoenoplectus tabernaemontani</i>	M	E	11.4	0.7
Wool grass	<i>Scirpus cyperinus</i>	L	S	624.4	39.0
Giant bur-reed	<i>Sparganium eurycarpum</i>	L	E	.01	NA

Wet Meadow – Sedge Meadow Wetland (saturated soils dominated by grasses, sedges, and forbs)					
Common Name	Botanical Name	Succession	Zone	Seeds/ft ² at 1.0 lb/ac.	Seeds/ft ² at 1.0 oz/ac.
Blue giant hyssop	<i>Agastache foeniculum</i>	L	S	33.4	2.1
Big bluestem	<i>Andropogon gerardi</i>	M	S	4.0	0.3
Canada anemone	<i>Anemone canadensis</i>	L	S	2.9	0.2
Marsh milkweed	<i>Asclepias incarnata</i>	L	S	1.8	0.1
American slough grass	<i>Beckmannia syzigachne</i>	E	S	18.4	1.2
Beggar's ticks	<i>Bidens cernua</i>	E	S	7.7	0.5
Fringed brome	<i>Bromus ciliata</i>	M	S	3.7	0.2
Canada bluejoint grass	<i>Calamagrostis canadensis</i>	L	S	102.8	6.4
Bebb's sedge	<i>Carex bebbii</i>	L	S	12.5	0.8
Bottlebrush sedge	<i>Carex comosa</i>	L	S	11.0	0.7
Wooly sedge	<i>Carex pellita</i>	L	E	10.3	0.6
Retrorsa sedge	<i>Carex retrorsa</i>	L	S	4.0	0.3
Pointed broom sedge	<i>Carex scoparia</i>	L	S	30.9	1.9
Awl-fruited sedge	<i>Carex stipata</i>	L	S	12.5	0.8
Tussock sedge	<i>Carex stricta</i>	L	E	19.5	1.2
Fox sedge	<i>Carex vulpinoidea</i>	E	S	36.7	2.3
Canada tick trefoil	<i>Desmodium canadense</i>	M	S	2.1	0.1
Flat-topped aster	<i>Doellingeria umbellata</i>	L	S	24.6	1.5
Spike-rush	<i>Eleocharis acicularis</i>	M	S	25.7	1.6
Creeping spike-rush	<i>Eleocharis palustris</i>	M	S	18.7	1.2
Virginia wild-rye	<i>Elymus virginicus</i>	M	S	2.2	0.1
Boneset	<i>Eupatorium perfoliatum</i>	L	S	58.7	3.7
Grass-leaved goldenrod	<i>Euthamia graminifolia</i>	M	S	128.5	8.0
Joe-pye weed	<i>Eutrochium maculatum</i>	L	S	34.9	2.2
Tall/Reed manna grass	<i>Glyceria grandis</i>	L	S	29.4	1.8
Fowl manna grass	<i>Glyceria striata</i>	M	S	58.8	3.7
Sneezeweed	<i>Helenium autumnale</i>	M	S	47.7	3.0
Sawtooth sunflower	<i>Helianthus grossesserratus</i>	L	S	3.7	0.2
Blue-flag iris	<i>Iris versicolor</i>	L	S	.32	0.1
Knotted rush	<i>Juncus nodosus</i>	L	S	679.9	42.5
Slender rush	<i>Juncus tenuis</i>	M	S	367.3	23.0
Torrey's rush	<i>Juncus torreyi</i>	M	S	587.7	36.7
Rice-cut grass	<i>Leersia oryzoides</i>	M	S	12.5	0.8
Meadow blazingstar	<i>Liatris ligulistylis</i>	L	S	4.0	0.3
Tall blazingstar	<i>Liatris pycnostachya</i>	L	S	4.0	0.3
Great blue lobelia	<i>Lobelia siphilitica</i>	M	S	183.7	11.5
Water horehound	<i>Lycopus americanus</i>	E	S	47.7	2.98
Monkeyflower	<i>Mimulus ringens</i>	M	S	844.8	52.80
Switchgrass	<i>Panicum virgatum</i>	M	S	9.0	0.6
Fowl bluegrass	<i>Poa palustris</i>	M	S	47.8	3.0
Mountain mint	<i>Pycnanthemum virginianum</i>	L	S	80.8	5.1
Green bulrush	<i>Scirpus atrovirens</i>	M	S	168.9	10.6
Wool grass	<i>Scirpus cyperinus</i>	L	S	624.4	39.0
Giant goldenrod	<i>Solidago gigantea</i>	L	S	91.8	5.7
Indiangrass	<i>Sorghastrum nutans</i>	M	S	4.8	0.3

Common Name	Botanical Name	Succession	Zone	Seeds/ft ² at 1.0 lb/ac.	Seeds/ft ² at 1.0 oz/ac.
Prairie cordgrass	<i>Spartina pectinata</i>	M	S	4.2	0.3
Panicked aster	<i>Symphyotrichum lanceolatum</i>	L	S	57.3	3.6
New England aster	<i>Symphyotrichum novae-angliae</i>	L	S	24.3	1.5
Red-stem aster	<i>Symphyotrichum puniceum</i>	L	S	29.4	1.8
Tall meadow rue	<i>Thalictrum dasycarpum</i>	L	S	4.0	0.3
Blue vervain	<i>Verbena hastata</i>	M	S	34.1	2.1
Ironweed	<i>Veronica fasciculata</i>	L	S	8.8	0.6
Culver's root	<i>Veronicastrum virginicum</i>	L	S	293.9	18.3
Golden alexanders	<i>Zizia aurea</i>	M	S	4.0	0.3

Succession Definitions:

E = Early successional. Species is an annual or biennial.

M = Middle successional. Species is a short-term perennial or subdominant in the plant community. They generally establish in two years.

L = Late successional. Species is a dominant. Generally slow to establish from seed (3-5 years).

Zone Definitions:

E = Emergent – Plants are partially submerged with leaves, stems, and flowering parts partially or entirely out of the water. They can often grow under saturated conditions and may survive short periods of dry-down. The seed should be placed either on a mud flat or at the water's edge.

S = Saturated – Soils are saturated most of the year, plants will tolerate periodic flooding and dry-down periods. Species categorized as "Saturated" should generally be planted at the water's edge.

Table 22: Varieties and Natural Germplasm for Select Grass and Forbs for All Practice Standards						
Species	Variety	Adaptability Zone Ratings				
		A	B	C	D	E
Switchgrass	Forestburg*, Sunburst*	1	1	1	2	3
	Dacotah*	3	2	1	1	1
	Nebraska 28	1	1	2	3	4
	Pathfinder, Summer, Trailblazer	1	2	3	4	4
Big Bluestem	Bonilla*, Bounty*, Sunnyview	1	1	1	2	3
	Bison*	3	2	1	1	1
	Champ	1	1	2	3	4
	Roundtree	1	2	3	4	4
	Bonanza, Pawnee	1	2	3	3	4
Indiangrass	Tomahawk*	2	1	1	1	1
	Oto	2	3	4	4	4
	Holt	1	1	2	3	4
Sideoats Grama	Pierre*	1	1	1	2	3
	Killdeer*	3	2	1	1	1
	Butte	1	1	2	3	4
	Trailway	1	2	3	4	4
Little Bluestem	Itasca*	1	1	1	1	1
	Badlands*	2	1	1	1	1
	Camper	2	3	3	4	4
	Blaze	2	3	4	4	4
Prairie Sandreed	Goshen	1	1	2	4	4
Prairie Cordgrass	Red River*	Adapted in all zones				
Green Needlegrass	Lodorm*; MN, ND, SD Common*	Adapted in all zones				
Blue Grama	Bad River Ecotype*; ND or SD Common*	Adapted in all zones				
Slender Wheatgrass	Revenue*, Adanac, Primar, Pryor	Adapted in all zones				
Western Wheatgrass	Rodan*, Flintlock, Rosana	Adapted in all zones				
Canada Wildrye	Mandan*	Adapted in all zones				
Pubescent/Intermediate Wheatgrass	Beefmaker, Chief, Clarke, Haymaker, Manifest, Manska, Oahe, Reliant, Slate, Tegmar	Adapted in all zones				
Tall Wheatgrass	Alkar, Jose, Orbit, Platte	Adapted in all zones				
Maximilian Sunflower	Medicine Creek*	Adapted in all zones				
Stiff Sunflower	Bismarck Natural Germplasm*	Adapted in all zones				
Purple Prairie Clover	Bismarck Natural Germplasm*	Adapted in all zones				
Narrow-leaf Purple Coneflower	Bismarck Natural Germplasm*	Adapted in all zones				
Yellow Coneflower	Stillwater	Adapted in all zones				

* Varieties/natural germplasm materials suitable for Tallgrass Prairie Restoration.

Figure 2: Grass Variety and Natural Germplasm Adaptability Zones and Ratings

1. Adapted with optimum performance.
2. Moderately adapted under haying or grazing, may not always produce mature seed.
3. Poorly adapted.
4. Not adapted

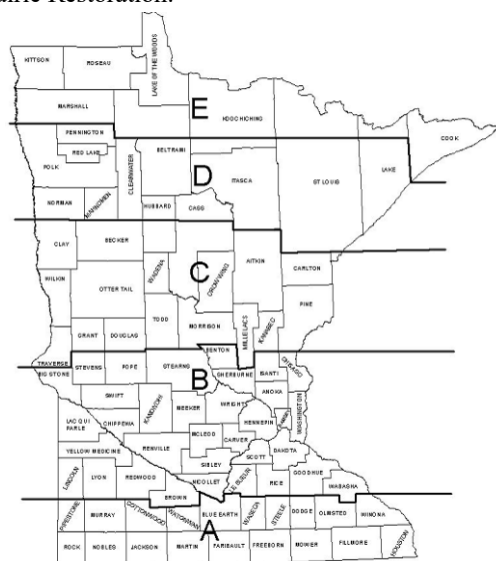


Table 23: Conversion of Bulk Pounds To Pure Live Seed

**POUNDS OF GRASS SEED; BULK MATERIAL REQUIRED
TO YIELD ONE POUND OF PURE LIVE SEED**

Percent Purity	Percent Germination																																
	100	99	98	97	96	95	94	93	92	91	90	89	88	87	86	85	84	83	82	81	80	75	70	65	60	55	50	45	40	35	30	25	
	100	1.00	1.01	1.02	1.03	1.04	1.05	1.06	1.08	1.09	1.10	1.11	1.12	1.14	1.15	1.16	1.18	1.19	1.20	1.22	1.23	1.25	1.33	1.43	1.54	1.67	1.82	2.00	2.22	2.50	2.86	3.33	4.00
	99	1.01	1.02	1.03	1.04	1.05	1.06	1.07	1.09	1.10	1.11	1.12	1.13	1.15	1.16	1.17	1.19	1.20	1.22	1.23	1.25	1.26	1.35	1.44	1.55	1.68	1.84	2.02	2.24	2.53	2.89	3.37	4.04
	98	1.02	1.03	1.04	1.05	1.06	1.07	1.09	1.10	1.11	1.12	1.13	1.15	1.16	1.17	1.19	1.20	1.21	1.23	1.24	1.26	1.28	1.36	1.46	1.57	1.70	1.86	2.04	2.27	2.55	2.92	3.40	4.08
	97	1.03	1.04	1.05	1.06	1.07	1.09	1.10	1.11	1.12	1.13	1.15	1.16	1.17	1.18	1.20	1.21	1.23	1.24	1.26	1.27	1.29	1.37	1.47	1.59	1.72	1.87	2.06	2.29	2.58	2.95	3.44	4.12
	96	1.04	1.05	1.06	1.07	1.09	1.10	1.11	1.12	1.13	1.14	1.16	1.17	1.18	1.20	1.21	1.23	1.24	1.26	1.27	1.29	1.30	1.39	1.49	1.60	1.74	1.89	2.08	2.31	2.60	2.98	3.47	4.17
	95	1.05	1.06	1.07	1.09	1.10	1.11	1.12	1.13	1.14	1.16	1.17	1.18	1.20	1.21	1.22	1.24	1.25	1.27	1.28	1.30	1.32	1.40	1.50	1.62	1.75	1.91	2.11	2.34	2.63	3.01	3.51	4.21
	94	1.06	1.07	1.09	1.10	1.11	1.12	1.13	1.14	1.16	1.17	1.18	1.20	1.21	1.22	1.24	1.25	1.27	1.28	1.30	1.31	1.33	1.42	1.52	1.64	1.77	1.93	2.13	2.36	2.66	3.04	3.55	4.26
	93	1.08	1.09	1.10	1.11	1.12	1.13	1.14	1.16	1.17	1.18	1.19	1.21	1.22	1.24	1.25	1.27	1.28	1.30	1.31	1.33	1.34	1.43	1.54	1.65	1.79	1.96	2.15	2.39	2.69	3.07	3.58	4.30
	92	1.09	1.10	1.11	1.12	1.13	1.14	1.16	1.17	1.18	1.19	1.21	1.22	1.24	1.25	1.26	1.28	1.29	1.31	1.33	1.34	1.36	1.45	1.55	1.67	1.81	1.98	2.17	2.42	2.72	3.11	3.62	4.35
	91	1.10	1.11	1.12	1.13	1.14	1.16	1.17	1.18	1.19	1.21	1.22	1.23	1.25	1.26	1.28	1.29	1.31	1.32	1.34	1.36	1.37	1.47	1.57	1.69	1.83	2.00	2.20	2.44	2.75	3.14	3.66	4.40
	90	1.11	1.12	1.13	1.15	1.16	1.17	1.18	1.19	1.21	1.22	1.23	1.25	1.26	1.28	1.29	1.31	1.32	1.34	1.36	1.37	1.39	1.48	1.59	1.71	1.85	2.02	2.22	2.47	2.78	3.17	3.70	4.44
	89	1.12	1.13	1.15	1.16	1.17	1.18	1.20	1.21	1.22	1.23	1.25	1.26	1.28	1.29	1.31	1.32	1.34	1.35	1.37	1.39	1.40	1.50	1.61	1.73	1.87	2.04	2.25	2.50	2.81	3.21	3.75	4.49
	88	1.14	1.15	1.16	1.17	1.18	1.20	1.21	1.22	1.24	1.25	1.26	1.28	1.29	1.31	1.32	1.34	1.35	1.37	1.39	1.40	1.42	1.52	1.62	1.75	1.89	2.07	2.27	2.53	2.84	3.25	3.79	4.55
	87	1.15	1.16	1.17	1.18	1.20	1.21	1.22	1.24	1.25	1.26	1.28	1.29	1.31	1.32	1.34	1.35	1.37	1.38	1.40	1.42	1.44	1.53	1.64	1.77	1.92	2.09	2.30	2.55	2.87	3.28	3.83	4.60
	86	1.16	1.17	1.19	1.20	1.21	1.22	1.24	1.25	1.26	1.28	1.29	1.31	1.32	1.34	1.35	1.37	1.38	1.40	1.42	1.44	1.45	1.55	1.66	1.79	1.94	2.11	2.33	2.58	2.91	3.32	3.88	4.65
	85	1.18	1.19	1.20	1.21	1.23	1.24	1.25	1.27	1.28	1.29	1.31	1.32	1.34	1.35	1.37	1.38	1.40	1.42	1.43	1.45	1.47	1.57	1.68	1.81	1.96	2.14	2.35	2.61	2.94	3.36	3.92	4.71
	84	1.19	1.20	1.21	1.23	1.24	1.25	1.27	1.28	1.29	1.31	1.32	1.34	1.35	1.37	1.38	1.40	1.42	1.43	1.45	1.47	1.49	1.59	1.70	1.83	1.98	2.16	2.38	2.65	2.98	3.40	3.97	4.76
	83	1.20	1.22	1.23	1.24	1.26	1.27	1.28	1.30	1.31	1.32	1.34	1.35	1.37	1.38	1.40	1.42	1.43	1.45	1.47	1.49	1.51	1.61	1.72	1.85	2.01	2.19	2.41	2.68	3.01	3.44	4.02	4.82
	82	1.22	1.23	1.24	1.26	1.27	1.28	1.30	1.31	1.33	1.34	1.36	1.37	1.39	1.40	1.42	1.43	1.45	1.47	1.49	1.51	1.52	1.63	1.74	1.88	2.03	2.22	2.44	2.71	3.05	3.48	4.07	4.88
	81	1.23	1.25	1.26	1.27	1.29	1.30	1.31	1.33	1.34	1.36	1.37	1.39	1.40	1.42	1.44	1.45	1.47	1.49	1.51	1.52	1.54	1.65	1.76	1.90	2.06	2.24	2.47	2.74	3.09	3.53	4.12	4.94
	80	1.25	1.26	1.28	1.29	1.30	1.32	1.33	1.34	1.36	1.37	1.39	1.40	1.42	1.44	1.45	1.47	1.49	1.51	1.52	1.54	1.56	1.67	1.79	1.92	2.08	2.27	2.50	2.78	3.13	3.57	4.17	5.00
	75	1.33	1.35	1.36	1.37	1.39	1.40	1.42	1.43	1.45	1.47	1.48	1.50	1.52	1.53	1.55	1.57	1.59	1.61	1.63	1.65	1.67	1.78	1.90	2.05	2.22	2.42	2.67	2.96	3.33	3.81	4.44	5.33
	70	1.43	1.44	1.46	1.47	1.49	1.50	1.52	1.54	1.55	1.57	1.59	1.61	1.62	1.64	1.66	1.68	1.70	1.72	1.74	1.76	1.79	1.90	2.04	2.20	2.38	2.60	2.86	3.17	3.57	4.08	4.76	5.71
	65	1.54	1.55	1.57	1.59	1.60	1.62	1.64	1.65	1.67	1.69	1.71	1.73	1.75	1.77	1.79	1.81	1.83	1.85	1.88	1.90	1.92	2.05	2.20	2.37	2.56	2.80	3.08	3.42	3.85	4.40	5.13	6.15
	60	1.67	1.68	1.70	1.72	1.74	1.75	1.77	1.79	1.81	1.83	1.85	1.87	1.89	1.92	1.94	1.96	1.98	2.01	2.03	2.06	2.08	2.22	2.38	2.56	2.78	3.03	3.33	3.70	4.17	4.76	5.56	6.67
	55	1.82	1.84	1.86	1.87	1.89	1.91	1.93	1.96	1.98	2.00	2.02	2.04	2.07	2.09	2.11	2.14	2.16	2.19	2.22	2.24	2.27	2.42	2.60	2.80	3.03	3.31	3.64	4.04	4.55	5.19	6.06	7.27
	50	2.00	2.02	2.04	2.06	2.08	2.11	2.13	2.15	2.17	2.20	2.22	2.25	2.27	2.30	2.33	2.35	2.38	2.41	2.44	2.47	2.50	2.67	2.86	3.08	3.33	3.64	4.00	4.44	5.00	5.71	6.67	8.00
	45	2.22	2.24	2.27	2.29	2.31	2.34	2.36	2.39	2.42	2.44	2.47	2.50	2.53	2.55	2.58	2.61	2.65	2.68	2.71	2.74	2.78	2.96	3.17	3.42	3.70	4.04	4.44	4.94	5.56	6.35	7.41	8.89
	40	2.50	2.53	2.55	2.58	2.60	2.63	2.66	2.69	2.72	2.75	2.78	2.81	2.84	2.87	2.91	2.94	2.98	3.01	3.05	3.09	3.13	3.33	3.57	3.85	4.17	4.55	5.00	5.56	6.25	7.14	8.33	10.00
	35	2.86	2.89	2.92	2.95	2.98	3.01	3.04	3.07	3.11	3.14	3.17	3.21	3.25	3.28	3.32	3.36	3.40	3.44	3.48	3.53	3.57	3.81	4.08	4.40	4.76	5.19	5.71	6.35	7.14	8.16	9.52	11.43
30	3.33	3.37	3.40	3.44	3.47	3.51	3.55	3.58	3.62	3.66	3.70	3.75	3.79	3.83	3.88	3.92	3.97	4.02	4.07	4.12	4.17	4.44	4.76	5.13	5.56	6.06	6.67	7.41	8.33	9.52	11.11	13.33	
25	4.00	4.04	4.08	4.12	4.17	4.21	4.26	4.30	4.35	4.40	4.44	4.49	4.55	4.60	4.65	4.71	4.76	4.82	4.88	4.94	5.00	5.33	5.71	6.15	6.67	7.27	8.00	8.89	10.00	11.43	13.33	16.00	

Table 24: Characteristics of Common Grass, Legume and Forb Species for All Practice Standards

	Growth Habit 1	Drought Tolerance 2	Flood Tolerance 3	Longevity 4	Stand Establishment 5	Moisture Regime 6	Height 7	Growth Form 8	Salt Tolerance	Shade Tolerance	pH	Seeds/ Lb
Introduced Cool - Season Grasses												
Bromegrass												
Meadow	P	Fair	Fair	Medium	Medium	WM - D	M	B	Poor	Intolerant	5.6-8.4	80,000
Smooth	P	Fair	Good	Long	Rapid	M - D	M	S/R	Poor	Intolerant	5.6-8.4	135,000
Creeping foxtail	P	Poor	Good	Long	Medium	W - M	M	S/R	Poor	Intolerant	6.1-8.4	750,000
Fescue												
Tall	P	Good	Good	Medium	Medium	M - D	M	B	Fair	Tolerant	4.5-9.0	210,000
Meadow	P	Good	Good	Medium	Medium	M - D	M	B	Fair	Tolerant	4.5-9.0	235,955
Kentucky bluegrass	P	Poor	Fair	Long	Rapid	WM - DM	S	S/R	Poor	Intolerant	5.6-7.3	1,389,840
Orchard grass	P	Fair	Fair	Medium	Medium	WM - DW	M	B	Poor	Tolerant	5.6-8.4	654,000
Timothy	P	Poor	Good	Short	Rapid	DM - D	M	B	Poor	Moderate	5.1-8.4	1,163,200
Red top	P	Poor	Good	Short	Medium	W - M	M	S/R	Poor	Intolerant	4.5-8.0	4,851,200
Wheatgrass												
Intermediate	P	Fair	Fair	Long	Medium	M - D	M	S/R	Fair	Intolerant	7.0-8.5	88,000
Pubescent	P	Fair	Fair	Long	Medium	M - D	M	S/R	Fair	Intolerant	7.0-8.5	88,000
Tall	P	Fair	Good	Medium	Medium	W - M	T	B	Good	Intolerant	7.0-8.5	79,000
Wildrye												
Altai	P	Fair	Good	Medium	Slow	M - D	M	B	Good	Intolerant	5.9-9.0	68,000
Mammoth	P	Good	Poor	Good	Slow	M - D	T	S/R	Fair	Intolerant	5.6-9.0	150,000
Russian	P	Good	Fair	Medium	Medium	M - D	M	B	Fair	Intolerant	6.0-9.0	55,000
Introduced Legumes												
Alfalfa	P	Good	Poor	Medium	Rapid	M - D	M	Crown	Fair	Intolerant	6.0-8.5	226,800
Birdsfoot trefoil	P	Fair	Fair	Medium	Rapid	W - DM	M	Pr	Good	Intolerant	5.8-8.0	369,840
Crown vetch	P	Good	Poor	Long	Medium	M - D	M	Pr	Poor	Intolerant	5.5-7.0	110,000
Cicer milkvetch	P	Good	Fair	Long	Medium	W - DM	T	Pr	Fair	Intolerant	6.0-8.1	134,000
Clover												
Alsike	P	Fair	Good		Medium	W - M	M	Crown	Poor	Intolerant	5.6-7.5	680,000
White	P	Poor	Good	Medium	Medium	WM - DM	S	Crown	Poor	Intolerant	5.2-8.0	800,000
Red	P	Fair	Fair	Short	Medium	WM - DM	M	Crown	Poor	Intolerant	5.5-7.6	275,000
Kura	P	Poor	Fair	Long	Medium	M - DM	S	P/Crown	Poor	Moderate	6.0-7.0	215,000
Sweet	P	Good	Fair	Medium	Rapid	WM - DM	T	Crown	Good	Intolerant	6.5-8.0	285,560

	Growth Habit 1	Drought Tolerance 2	Flood Tolerance 3	Longevity 4	Stand Establishment 5	Moisture Regime 6	Height 7	Growth Form 8	Salt Tolerance	Shade Tolerance	pH	Seeds/ Lb
Native Cool- Season Grasses												
Canada Bluejoint grass	P	Poor	Good	Long	Medium	W - M	T	S/R	Poor	Intolerant	4.5-8.0	4,480,000
Fowl bluegrass	P	Poor	Good	Medium	Med	W - WM	M	B	Poor	Intolerant	4.9-7.5	2,080,000
Fringed brome	P	Fair	Fair	Medium	Rapid	W - WM	M	B	Poor	Tolerant	5.5-7.5	160,000
Green needlegrass	P	Good	Fair	Long	Medium	DM - D	M	B	Fair	Intolerant	6.6-8.4	180,000
Kalms brome	P	Fair	Fair	Short	Medium	WM - M	M	B	Poor	Tolerant	5.5-7.5	128,000
Needle and thread grass	P	Good	Fair	Long	Slow	DM - D	M	B	Poor	Intolerant	6.6-8.4	25,600
Porcupine grass	P	Good	Fair	Long	Slow	DM - D	M	B	Poor	Intolerant	6.6-8.4	57,000
Prairie junegrass	P	Good	Poor	Long	Slow	DM - D	S	B	Poor	Tolerant	6.0-8.0	2,315,000
Reed canary grass	P	Fair	Good	Long	Medium	W - M	T	S/R	Fair	Intolerant	5.5-8.0	530,000
Wheatgrass												
Bearded	P	Good	Good	Short	Rapid	WM - D	M	B	Fair	Intolerant	5.6-9.0	155,000
Bluebunch	P	Good	Poor	Long	Medium	DM-D	T	B	Fair	Intolerant	6.6-8.4	125,680
Slender	P	Good	Good	Short	Rapid	WM - D	M	B	Good	Intolerant	5.6-9.0	155,000
Western	P	Good	Good	Long	Medium	DM - D	M	S/R	Good	Intolerant	4.5-9.0	112,000
Wildrye												
Canada	P	Fair	Fair	Short	Rapid	WM - D	M	B	Good	Tolerant	5.0-7.9	115,000
Virginia	P	Fair	Good	Short	Rapid	W - M	M	B	Fair	Tolerant	5.0-7.0	96,000
Native Warm- Season Grasses												
American slough grass	A	Poor	Good	NR	NR	W – WM	S	B	Fair	Moderate	5.5-7.5	800,000
Bluestem												
Big	P	Fair	Fair	Long	Slow	WM – D	T	R	Fair	Intolerant	6.0-7.5	176,000
Little	P	Good	Poor	Long	Medium	M - D	M	B	Poor	Intolerant	5.0-8.4	286,000
Sand	P	Good	Fair	Long	Slow	DM - D	T	R	Poor	Intolerant	5.6-8.4	100,000
Buffalo grass	P	Good	Fair	Long	Medium	M - D	S	S/St	Good	Intolerant	6.0-8.5	57,600
Grama												
Blue	P	Good	Poor	Long	Medium	DM - D	S	S/St	Fair	Intolerant	6.6-8.4	750,000
Sideoats	P	Good	Poor	Long	Medium	M - D	S	S/R	Poor	Intolerant	5.5-8.5	180,000
Indiangrass	P	Fair	Good	Long	Medium	M - D	T	B	Fair	Intolerant	4.8-8.0	193,000
Prairie cordgrass	P	Poor	Good	Long	Slow	W - M	T	S/R	Poor	Intolerant	6.0-8.5	183,000
Prairie slandered	P	Good	Poor	Long	Slow	D	T	S/R	Poor	Intolerant	5.6-8.4	275,000
Prairie dropseed	P	Fair	Good	Long	Slow	DM - D	M	B	Fair	Intolerant	6.0-7.2	224,000
Rough dropseed	P	Fair	Good	Long	Slow	DM - D	M	B	Fair	Intolerant	NR	480,000
Sand dropseed	P	Good	Poor	Short	Rapid	DM - D	M	B	Fair	Intolerant	6.6-8.0	3,200,000
Switchgrass	P	Fair	Good	Long	Medium	WM - D	T	S/R	Fair	Intolerant	4.5-8.0	390,000

	Growth Habit 1	Drought Tolerance 2	Flood Tolerance 3	Longevity 4	Stand Establishment 5	Moisture Regime 6	Height 7	Growth Form 8	Salt Tolerance	Shade Tolerance	pH	Seeds/ Oz
Native Forbs and Legumes												
American vetch	P	Good	Poor	Medium	Medium	WM – DM	S	Pr	Poor	Intolerant	5.9-7.2	2,052
Aster												
Heath	P	Good	Fair	Long	NR	M - D	M	E/R	NR	Intolerant	NR	200,000
New England	P	NR	Good	Long	Medium	W - DM	T	E/R	NR	Intolerant	5.5-7.0	66,000
Panicled	P	Fair	Fair	Long	Medium	WM - M	T	E	NR	Intolerant	NR	156,000
Silky	P	Good	Poor	Medium	Slow	DM - D	S	E	NR	Intolerant	NR	26,000
Smooth	P	Good	Poor	Long	Medium	WM – DM	T	E	NR	Intolerant	6.0-6.5	55,000
Swamp	P	NR	Good	Long	Medium	W - WM	T	E	NR	Intolerant	NR	80,000
Black-eyed Susan	Bi	Good	Good	Short	Rapid	WM - D	M	E	Poor	Intolerant	6.0-7.0	92,000
Blanket flower	P	Good	Fair	Medium	Medium	W - M	M	E	Poor	Intolerant	5.5-7.9	9,813
Blazingstar												
Dotted	P	Good	Poor	Long	Slow	DM - D	M	E	Poor	Intolerant	6.0-7.8	7,000
Ontario	P	Good	Poor	Long	Medium	DM - D	M	E	Poor	Intolerant	NR	14,000
Meadow	P	Good	Poor	Long	Medium	WM - M	T	E	Poor	Intolerant	6.0-8.5	11,000
Rough	P	Fair	Poor	Long	Medium	M - D	T	E	Poor	Intolerant	NR	16,000
Tall/Prairie	P	Good	Poor	Long	Medium	WM - M	T	E	Poor	Intolerant	6.0-8.5	11,000
Boneset	P	Good	Poor	Medium	Slow	W – WM	T	E	NR	Moderate	NR	160,000
Bush clover	P	Good	Poor	Long	Slow	DM - D	T	E/R	Poor	Intolerant	5.7-8.2	8,000
Canada milkvetch	P	Fair	Good	Short	Medium	WM - DM	T	E/R	Poor	Intolerant	6.0-8.0	17,000
Canada tick trefoil	P	Fair	Fair	Medium	NR	WM - DM	T	E	NR	Tolerant	NR	5,500
Common ox-eye	P	Good	Short	Short	Medium	WM - DM	T	E	NR	Moderate	NR	6,300
Compass plant	P	NR	NR	NR	NR	WM - D	T	E	NR	Moderate	4.5-7.5	660
Coneflower												
Yellow	Bi/P	Good	Fair	Medium	Medium	M - DM	T	E	Poor	Intolerant	5.6-6.8	30,000
Narrow-leaved purple	P	Good	Poor	Long	Slow	DM - D	M	E	Poor	Intolerant	6.5-7.2	7,000
Purple	P	Good	Poor	Long	Medium	WM - DM	T	E	Poor	Intolerant	6.5-7.2	7,000
Culver's root	P	NR	Fair	Long	NR	WM - DM	T	E	NR	Moderate	NR	800,000
Cup plant	P	Poor	Fair	Long	Medium	WM - M	T	E	Poor	Moderate	4.5-7.5	1,400
Evening primrose	Bi/P	Good	Poor	Long	Rapid	WM - D	T	E	Poor	Tolerant	5.0-7.0	90,000
Gentian												
Bottle	Bi	Poor	Poor	Short	Medium	WM - M	M	E	NR	Tolerant	NR	280,000
Cream	Bi	Poor	Poor	Short	Slow	WM - DM	T	E	NR	Tolerant	NR	140,000
Blue Giant hyssop	P	Poor	Fair	Medium	Rapid	M - DM	T	E/R	NR	Moderate	NR	91,000
Golden alexanders	P	NR	NR	NR	NR	WM - DM	T	E	NR	Moderate	NR	11,000

	Growth Habit 1	Drought Tolerance 2	Flood Tolerance 3	Longevity 4	Stand Establishment 5	Moisture Regime 6	Height 7	Growth Form 8	Salt Tolerance	Shade Tolerance	pH	Seeds/ Oz
Goldenrod												
Canada	P	Fair	NR	Long	NR	DM - D	T	E	Poor	Moderate	NR	287,500
Giant	P	NR	Fair	NR	NR	W - M	T	E	Poor	Moderate	NR	250,000
Grass-leaved	P	NR	Fair	NR	NR	W - M	T	E	Poor	Moderate	NR	350,000
Stiff	P	Good	Poor	Medium	Medium	WM - D	T	E	Poor	Moderate	5.0-7.5	41,000
Showy	P	NR	NR	NR	NR	M - D	T	E	NR	NR	NR	95,000
Great blue lobelia	P	Poor	Good	NR	Medium	W - M	T	E	NR	Moderate	NR	500,000
Ground plum	P	Fair	Poor	NR	NR	DM - D	S	Pr	Poor	NR	NR	5,200
Heart-leaved alexander	P	NR	NR	NR	NR	M - DM	M	E	NR	Moderate	NR	12,000
Illinois bundleflower	P	Fair	Poor	Long	Rapid	M - D	T	E	Poor	Intolerant	5.0-8.0	4,200
Ironweed	P	Fair	Good	Short	Rapid	WM - M	T	E	NR	Moderate	5.6-7.0	24,000
Joe pye weed	P	Fair	Good	Medium	NR	W - WM	T	E	NR	Moderate	NR	95,000
Lance-leaved coreopsis	P	Good	Good	Short	Rapid	M - D	M	E/R	Poor	NR	NR	20,000
Leadplant	P	Good	Poor	Long	Slow	M - D	M	E	Poor	Tolerant	5.5-8.0	16,000
Milkweed												
Butterfly	P	Good	Medium	Medium	Slow	M - D	M	E/R	Poor	Intolerant	4.8-6.8	4,300
Common	P	NR	NR	NR	Rapid	WM - D	T	E/R	NR	Intolerant	NR	4,000
Swamp - Marsh	P	Poor	Good	Medium	Slow	W - M	T	E/R	Poor	Intolerant	5.0-8.0	4,800
Whorled	P	Good	Poor	Long	Slow	M - D	M	E/R	NR	Intolerant	NR	11,000
Mountain Mint	P	Good	Poor	NR	NR	WM - M	T	E/R	Poor	Moderate	5.0-7.0	220,000
Partridge pea	A	NR	NR	NR	NR	M - D	M	E	NR	Tolerant	5.5-7.5	2,700
Penstemon												
Large-flowered	P	Good	Poor	Short	Medium	DM - D	M	E	Poor	Moderate	NR	14,000
Foxglove	P	Good	Poor	Short	Medium	M - DM	T	E	Poor	Tolerant	NR	130,000
Prairie cinquefoil	P	Poor	Fair	Short	Slow	DM - D	M	E	Poor	Moderate	NR	230,000
Prairie phlox	P	Good	Poor	Medium	Medium	WM - D	M	E	Poor	NR	NR	19,000
Prairie smoke	P	Good	Poor	Medium	Medium	WM - D	S	Pr	Poor	NR	NR	27,000
Purple prairie clover	P	Good	Fair	Medium	Medium	M - D	M	E	Fair	Moderate	5.5-6.6	18,000
Rattlesnake master	P	Good	Poor	Long	Medium	WM - DM	T	E	Poor	NR	NR	7,500
Sneezeweed	P	Poor	NR	Medium	NR	W - WM	T	E	Poor	Moderate	6.0-7.0	130,000
Spiderwort	P	Fair	Good	NR	NR	WM - D	S	E	NR	NR	NR	10,000
Spotted beebalm	Bi/P	Good	Poor	Short	Medium	M - D	M	E	Poor	Moderate	6.0-8.0	70,000
Sunflower												
Stiff	P	Good	Good	Long	Medium	DM - D	T	E/R	Poor	NR	NR	85,000
Maximilian	P	Poor	Good	Long	Medium	WM - DM	T	E/R	Poor	Intolerant	6.0-8.0	13,000
Giant	P	Poor	Good	Long	Medium	WM - M	T	E/R	Poor	NR	NR	10,000
Sawtooth	P	Fair	Poor	Medium	Medium	WM - DM	T	E/R	Poor	NR	5.8-7.3	10,000
Vervain												
Hoary	P	NR	NR	NR	NR	DM - D	M	E	NR	Moderate	NR	28,000
Blue	P	NR	NR	NR	NR	W - M	T	E	NR	Moderate	6.0-7.0	93,000
White prairie clover	P	Good	Fair	Medium	Medium	M - D	M	E	Fair	Moderate	5.5-6.6	19,000

	Growth Habit 1	Drought Tolerance 2	Flood Tolerance 3	Longevity 4	Stand Establishment 5	Moisture Regime 6	Height 7	Growth Form 8	Salt Tolerance	Shade Tolerance	pH	Seeds/ Oz
White sage	P	Good	NR	Short	Medium	DM - D	T	E/R	Good	Intolerant	6.0-9.0	4,048,000
White wild indigo	P	Fair	Fair	Medium	Medium	WM - D	T	E	NR	Moderate	< 6.8	1,700
Wild bergamot	P	Poor	Good	Medium	Medium	WM - D	T	E/R	Poor	Moderate	6.0-8.0	70,000
Wild lupine	P	Fair	Poor	Short	Medium	DM - D	M	E	Poor	Moderate	4.2-5.6	1,200
Wingstem	P	Poor	Fair	Medium	NR	WM - M	T	E/R	Poor	Tolerant	NR	9,000
Yarrow	P	Good	Good	Long	Medium	WM - D	M	E/R	Fair	Moderate	6.0-8.0	180,000

1. Growth Habit

- A - Annual
- P – Perennial
- Bi – Biannual

2. Drought Tolerance

Based on species recommended on an adapted site.

3. Flood Tolerance

- Good - 28-42 days.
- Fair - 14-28 days.
- Poor - less than 14 days.
- Creeping foxtail/ reed canary grass can tolerate up to 60 days.

4. Longevity

- Short - 1-4 years.
- Medium - 5-10 years.
- Long – longer than 10 years with proper management.

5. Stand Establishment

- Rapid – usually 1 growing season after planting.
- Medium – usually 1-2 growing seasons after planting.
- Slow - usually 2-3 growing seasons after planting.

6. Moisture Regime

- W -Wet
- WM – Wet Mesic
- M - Mesic
- DM – Dry Mesic
- D – Dry

7. Height

- S – Short <18”
- M – Mid 18” – 36”
- T – Tall >36”

8. Growth Form

- B – Bunch
- S – Sod Forming
- Pr – Prostrate
- E - Erect
- R – Rhizomatous
- St – Stoloniferous

NR – Not Rated