

NATURAL RESOURCES CONSERVATION SERVICE

HERBACEOUS VEGETATION DESIGN PROCEDURES

(550DP)

This guide pertains to the following Nebraska FOTG Practice Standards:

- *322 – Channel Bank Vegetation
- 327 – Conservation Cover
- 332 – Contour Buffer Strips
- *342 – Critical Area Planting
- 589C – Cross Wind Trap Strips
- 647 – Early Successional Habitat Development/Mgt
- 386 – Field Border
- 393 – Filter Strip
- 394 – Fire Break
- *412 – Grassed Waterway
- 603 – Herbaceous Wind Barriers
- 582 – Open Channel
- 512 – Pasture and Hay Planting
- 550 – Range Planting
- 643 – Restoration and Management of Declining Habitats
- 391 – Riparian Forest Buffer (low maintenance seedings)
- 390 – Riparian Herbaceous Cover
- 580 – Streambank and Shoreline Protection
- 395 – Stream Habitat Improvement and Management
- 612 – Tree/Shrub Establishment (low maintenance seedings)
- 645 – Upland Wildlife Habitat Management
- 635 – Wastewater Treatment Strip
- 658 – Wetland Creation
- 659 – Wetland Enhancement
- 644 – Wetland Wildlife Habitat Management
- 380 – Windbreak/Shelterbelt Establishment (low maintenance seedings)

***Critical area plantings for grassed waterways, channel bank vegetation, structures, and other critical areas subject to erosion have additional requirements such as mulching or other erosion control measures (refer to 342DP). There may also be allowances for seeding outside of the normal seeding date when it is not practical to seed at the preferred time. Refer to Mulching Section 7 and Seeding Dates Section 9 for details. .**

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1. Grass Seeding Specifications

- a. NE-CPA-8 Job Sheet for Grass Seeding in its entirety will be completed as follows: (Refer FOTG Section II – Pastureland and Hayland Interpretations “Grass and Forb Seed Source Requirements” and Section 12 “Pure Live Seed Calculations” for more detailed guidance on completing the grass seeding job sheet
- Section I “Performance Required” will be completed thoroughly. Details of seedbed preparation, weed control, grass seeding equipment and a map or sketch of the area to be seeded must be completed for every job. Cover crop establishment, mulching and fertilizer sections must be completed when appropriate as described in this document.
 - Additional Specifications
 1. When chemical weed control is recommended, product labels, pages from the current Guide for Weed Management in Nebraska or guidance from chemical companies will be attached to the grass seeding job sheet as appropriate.
 2. Detailed step by step procedures will be provided for complicated grass seeding jobs such as chemically killed sod for items such as residue management, growth stage, herbicide timing/rate, and other details.
 3. All other items in this design guide (Sections 2-16) will be addressed as appropriate and detailed and attached to seeding specifications provided to the client (Copies of this document or sections of it may be provided as well).
 - Section II “Evidence of Performance” must be completed and signed by the contractor, or client and specific performance items listed, completed (i.e. specific components, acres and the date completed).
 - The backside of the grass seeding job sheet must be completed in it’s entirety including scientific names for native forbs and seldom used legumes or grasses, grass seed and forb source requirements, PLS calculations, acres to be seeded and other details for the seed lots being utilized. Must be signed and completed by seed vendor and seed tags provided.

2. Soil Fertility and pH (at seeding time)

- a. General Requirements

- Soil test prior to planting following University of Nebraska procedures for the number of samples, depth and other requirements.
- If Soil tests results for pH, alkalinity, and salinity can not be adjusted with amendments adequately, species/varieties adapted to these conditions will be adjusted appropriately.

b. Grasses

- Nitrogen Fertilizer is not recommended at planting time, because of the increased potential for weed competition.
- If soil tests are low or very low for nutrients other than nitrogen, nutrients broadcasted prior to seeding or band-applied by the drill at planting may be beneficial to seedlings.
- Follow University of Nebraska recommendations (<http://www.ianrpubs.unl.edu/> from the Publications home page search for “grass establishment”).

c. Legumes

- Lime is the most important soil amendment for legumes, especially if pH of the surface is below 6.2.
- When phosphorus levels are low or very low (15 ppm or less for Bray P1 or Melich tests, and 10 ppm or less for Olsen-P test), P broadcasted prior to grass seeding, or band-applied by the grass drill at planting will be beneficial to seedling vigor.
- Zinc/Sulfur fertilizer may benefit legumes on eroded sites, sandy sites and when soil organic matter is less than 1 percent.
- Follow University of Nebraska-Lincoln Extension recommendations (<http://www.ianrpubs.unl.edu/> from the Publications home page search for “legume establishment”).

3. Existing Cover Conditions (acceptable cover conditions at planting time)

a. Row Crop Stubble

- Weed free row crop stubble such as corn, sorghum, soybean crop or summer annual forage stubble are the best cover type to seed into.
 1. Low residue crops such as soybeans, corn silage, edible beans, sunflowers, must provide adequate cover to protect the seedlings and to protect soil from wind and water erosion or a cover crop will be planted.
 2. Residue must be evenly spread and not be in windrows.
 3. Burn down herbicides will be used prior, or immediately after planting if significant weed pressure or volunteer crop is present (refer to weed control section).

b. Chemically Killed Sod (pasture/hayland renovations)

- Sod must be killed the season prior to planting grasses.
- Appropriate residue management, re-growth of grasses (growth stage), active ingredient(s), timing and rate of herbicide application

1. Refer to the herbicide label and current guide for weed management for guidelines on the correct growth stage, number of treatments, herbicides/additives, rate, timing, method of application and other details.
 2. Sod should be hayed and adequate re-growth allowed prior to spraying.
 3. Refer to Section 5 "Seedbed Preparation" for more guidelines on residue management necessary prior to seeding.
- Sod must be monitored to ensure it has been killed prior to planting grasses and additional treatments applied as necessary prior to emergence of planted grasses.
 - Planting Roundup Ready Crops or a summer annual cover crop into chemically killed sod the season prior to planting grass is recommended over seeding grass directly into sod. Planting Roundup Ready Crops allows for multiple treatments of grass sod with Roundup to ensure that sod is effectively killed.
 1. For guidelines on renovating pastures with Glyphosate Tolerant Soybeans, refer to Nebraska Range and Pasture Technical Note 14.
 - If desirable grass species are present, burn down herbicides must be applied when desirable grasses are dormant and undesirable grasses are actively growing.
 1. For warm season grasses this is typically in the spring of the year or in the fall if grasses are dormant and undesirable grasses (i.e. bromegrass, bluegrass) are actively growing.
 2. Contact your local or state specialist or chemical company representative for specific guidelines to avoid killing desirable species.
- c. Small Grain Stubble**
- Allelopathic effects from small grain stubble phytotoxins may be present in small grain fields.
 1. Phytotoxins from mature small grain are more of a problem in Western Nebraska as rainfall decreases, and during drought years, but are less of a problem when fields are irrigated or in above normal rainfall years.
 2. Rye stubble contains phytotoxins (benzoxazinones) and wheat stubble contains phytotoxins (DIMZBOA) that can potentially cause problems with grass establishment. Oats exhibits the least amount of allelopathic effect of the small grains.
 3. When forage is the primary purpose for seeding use the following guidance;
 - (a) A summer annual cover crop shall be planted on all dryland fields in Vegetative Zones I, II and III.
 - (b) A cover crop is recommended, but not required for the following:
 - (i) If small grain stubble is removed and weeds are killed with a burn down herbicide on dryland fields in Vegetative Zone IV or irrigated small grain fields across the state.
 4. When wildlife is the primary purpose (early successional habitat) use the following guidance:

- (a) A cover crop is recommended but not required when small grain stubble is baled off, and a burn down herbicide is utilized to eliminate all weeds and unwanted vegetation (all Vegetative Zones).
- (b) By not planting a cover crop, the client should agree and understand that it will take several years longer for herbaceous cover to establish.

4. Seedbed Preparation

a. Weed Control (prior to or at planting time)

- The presence or absence of weed populations, especially noxious weeds, will impact the success of grass establishment. Seeding on fields with significant weed populations will be delayed until weeds are controlled.
- Each field shall be evaluated for weed pressure prior to planting and during the growing season prior to planting. If weeds are present they shall be controlled prior to seeding by utilizing an appropriate burn down herbicide.
- If excessive weed pressure is expected to occur after planting grass, a cover crop will be planted, or an appropriate pre-emergent and/or post emergent herbicide applied. Refer to the current "Guide for Weed Management" in Nebraska (<http://www.ianrpubs.unl.edu/> from the Publications home page search for: "Guide for Weed Management").

b. Herbicide Carryover

- When planning a seeding, the previous two years of herbicide application should be considered. Any potential carryover problems should be addressed by delaying seeding, establishing a cover crop, and/or changing species to be planted.
- Refer to product labels for guidance on how long to wait before planting grasses or legumes, or do a field bioassay. Field bioassays can also be done by collecting a representative soil samples from the soil surface layer which is likely to contain herbicides, then planting grasses/legumes into flower pots and allowing adequate time after germination to ensure the seedlings are not damaged from herbicide carryover. Legumes are especially vulnerable to herbicide carryover.

c. Seedbed Preparation Methods

• No-Till Seedbeds

1. Seed directly into existing cover (i.e. crop stubble, chemically killed sod)

- (a) Weeds or volunteer crops that are present will be controlled with burn down herbicide(s) in accordance with product label directions and current recommendations "Guide for Weed Management" in Nebraska (<http://www.ianrpubs.unl.edu/> from the Publications home page search for: "Guide for Weed Management").
- (b) Excessive residue will be removed using one or more of the following methods if grass seeding equipment that can properly place seed is not available.
 - (i) Prescribed burning can be used to reduce excessive plant residue that may inhibit drilling. If used in conjunction with burndown herbicides, timing of the burn is critical to allow for adequate re-

growth of vegetation to adequately kill sod. Refer to the Prescribed Burning Standard and Specification (338) for further guidance.

- (ii) Mechanical removal (i.e. haying) of vegetation may be needed if residue is excessive (refer to cover crop 340 standard and Section 5 Summer Annual Cover Crops for guidance on ideal cover crop heights for irrigated and dryland plantings).

- Tilled Seedbed Methods

- 1. Guidelines

- (a) **Tillage should be limited to light tillage and not be used unless absolutely necessary.** Examples are as follows:

- (i) To level ridges in row crop fields that are too rough and cause problems with a light tillage operation
 - (ii) Seeding equipment will not work with heavy residue
 - (iii) On non-erodible soils where irrigated grass/legumes are going to be planted under irrigation by center pivot.

- (b) Tillage must be timed to achieve desired weed control, moisture conservation, and leave adequate residue on the soil surface for erosion control.

- (c) Tillage methods that leave a fluffy seedbed will require firming with a roller or other packing method. A firm seedbed will ensure that the seed will contact soil moisture uniformly, facilitates seeding emergence, and provides a medium that does not restrict or allow roots to become dry. **Seedbeds shall be firm enough so that footprints are hardly visible.**

5. Summer Annual Cover Crops

- a. A summer annual cover crop can be planted during the growing season prior to seeding grasses to provide cover to reduce evaporation, maintain cool soil temperatures, smother or reduce weeds, trap snow, protect seedlings from extreme climatic conditions and/or control wind and water erosion.

- b. When planting a cover crop refer to the Cover Crop Standard and Specification (340) for further guidance and seeding rates. Other requirements are as follows:

- Plant a summer annual cover crop from one of the following: grain sorghum, sudangrass, sorghum-sudan, forage sorghum, millet, or cane.

- Ideal cover crop height is 12-18" for dryland plantings and a 3" cover crop height for irrigated pasture plantings.

- 1. Taller cover crops such as sudangrass, sorghum sudan or cane will need to be harvested to achieve these heights.

- (a) Re-growth will need to be accounted for to achieve desired heights

- (b) If taller cover crops can not be harvested utilize a shorter cover crop such as grain sorghum or pearl millet.

- If volunteer crops are a concern (i.e. sorghum), plant early enough in the summer to allow for adequate growth, but late enough to ensure that viable seed does not mature. Utilize one or more of the following strategies:

- (a) Select late maturing varieties
- (b) Utilize varieties that produce sterile seed
- (c) Plant after July 1, but prior to August 1.
- (d) Clip or harvest the crop prior to seed maturing
- (e) Spray the crop with a burn down herbicide prior to seed maturing
- Small grain cover crops will not be used (i.e. oats, wheat, triticale, barley, rye).

6. Companion Crops

- a. A companion cover crop of oats may be planted along with cool season grasses/legume plantings in the spring, or with spring, fall irrigated cool season grass/legume or for critical area plantings when additional erosion control is necessary.
- b. If used, oats will be harvested and removed prior to maturity. Companion crops compete with seedlings for light, moisture, and soil nutrients.
- c. Companion crops are not recommended with warm season grass plantings.
- d. Perennial ryegrass "Linn" Variety may be used as a companion crop for critical area plantings when additional erosion control is needed in lieu of oats.

7. Mulching

- a. Mulching is required on all grassed waterways, channel banks, and other concentrated flow areas that do not have other appropriate erosion control measures (side dikes, cover crops, companion crops, or other approved erosion control measures).
- b. Mulching, cover crops, companion crops, or a combination of these is required on structures subject to erosion when cover is not likely to establish fast enough to control erosion.
- c. Mulching shall be placed immediately after seeding according to guidance in the Mulching 484 Practice Standard.

8. Species/Variety Selection

- a. Refer to the appropriate FOTG practice standard for guidance on species selection.
- b. Refer to Ecological Site Description/Range Site or Forage Suitability Groups in Section II of the FOTG for guidance for soils and site limitations on species selection.
- c. Refer to the FOTG Section II – Pastureland and Hayland Interpretations "Certified Perennial Grass Varieties Recommended for Nebraska" Extension Publication EC90-120 (<http://www.ianrpubs.unl.edu/> from the Publications home page search for: "Perennial Grass Varieties").
- d. Refer to Section 12 "Pure Live Seed Calculations" Table 2 for species, pure live seeding rates and MLRA adaptation.
 - Table 2 provides a complete list of potential species to select from in addition to those found in the FOTG practice standard.
 - Species selected from Table 2 must meet the requirements of the applicable FOTG practice standard.

9. Seeding Dates:

- a. Seeding dates are based on climatic records, research, and experience; they represent optimum periods for grass and legume establishment. These dates should provide for adequate development of adventitious roots prior to stressful periods, such as hot, dry summers and cold, open winters. The following table shows recommended seeding dates. Seeding dates may be adjusted up to 1 week after these planting dates when soil moisture and climatic conditions are favorable.

Species Type and Season of Planting	Vegetative Zones	² Seeding Dates
<p><u>Cool Season/Legumes (irrigated or dryland)</u> Optimum Seeding Time (fall is best if summer annual weed pressure is expected)</p>	ALL	August 20 – September 10 or March 1 – April 15
Late Fall (Dormant) – Early Spring ¹	ALL ALL	November 15 – April 30 (dryland) November 15 – May 15 (irrigated)
Early Fall	I and II	August 1 – September 15
Early Fall	III and IV	August 10 – September 30
<p><u>Predominately Warm Season</u> Optimum Seeding Time</p>	ALL	April 1 – May 20
Late Fall (Dormant) ¹ - Spring	ALL	November 1 – May 31
<p><u>Warm/Cool Season or Warm Season Legume Mix</u> Optimum Seeding Time</p>	ALL	March 1 – May 10
Late Fall (Dormant) ¹ - Spring	ALL	November 15 – May 15

¹Late fall seeding dates are for dormant plantings, once soil temperatures drop below 50° Fahrenheit.

²Critical area plantings on structures may not be possible during the appropriate seeding date range. In most cases seeding will need to occur immediately after construction is completed. Critical area plantings in concentrated flow areas such as grassed waterways and channel bank vegetation seedings shall be done no more than two weeks outside of the timeframes listed above.

10. Seed Requirements:

- a. All seed must meet all federal seed laws and the requirements of Nebraska State Seed Laws and Regulations. Information on State seed law is available at <http://www.agr.state.ne.us/regulate/bpi/actc.htm#5>.
- b. All seed must meet requirements from the FOTG Section II – Pastureland and Hayland Interpretations “Grass and Forb Seed Source Requirements”. This includes but is not limited to purity and germination tests by a certified seed lab, mileage and other requirements for uncertified seed, grass variety restrictions and other items listed.
- c. Use certified seed when available. If certified varieties of perennial grasses are not available, it is permissible to use common/native ecotype seed originating from the same general locality of the planting site. Refer to the FOTG Section II – Pastureland

and Hayland Interpretations “Certified Perennial Grass Varieties Recommended for Nebraska” Extension Publication EC90-120 (<http://www.ianrpubs.unl.edu/> from the Publications home page search for: "Perennial Grass Varieties").

- d. Legume seed shall be inoculated according to the directions on the inoculant’s container just prior to seeding. Use the correct inoculant’s (culture) for each legume species.

11. Seeding Rates

- a. Seeding rates will vary depending on the purpose and seeding method according to guidance in the applicable conservation practice standard.
- b. All seeding rates/mixtures will be based on pure live seed (PLS).
 - PLS can be calculated from the information on the seed tag.
 - PLS is derived by multiplying percent pure seed by percent germination (plus percent hard seed, if present) and dividing by 100.
 - Refer to Section 12, “Pure Live Seed Calculations” for guidance.
- c. A 5% tolerance in seeding rates is allowed.

12. Pure Live Seed Calculations:

a. SEED DISTRIBUTION

Most seeding rates are listed in pounds of pure live seed (PLS) per acre. The best method of determining PLS planted is to count the number of seeds per foot of drill row or per square foot while the machine is in operation. The formulas and examples for calculating pure live seed (PLS) seeding rates, total PLS per sq. ft, and PLS per sq. ft for a given species are as follows:

$$\frac{\text{PLS per sq. ft}}{\text{PLS per sq. ft at 1 pound per acre}} = \text{Seeding rate in PLS lbs per acre}$$

Example: Smooth bromegrass from Table 2 $\frac{30 \text{ pls/ft}^2}{3.1 \text{ PLS seeds per sq. ft at 1 lb/acre}}$ = 9.7 PLS lbs/acre

$$\frac{\text{Seeds per lb}}{43,560 \text{ sq. ft/acre}} = \text{Seeds per sq. ft/PLS lb of seed}$$

Example: Smooth bromegrass $\frac{136,000 \text{ seeds/lb}}{43,560 \text{ sq. ft/acre}}$ = 3.1 PLS seeds per sq. ft at 1 PLS lb/acre

Table 1
Pure Live Seeds (PLS) Per Foot of Row at Various Seeding Rates and drill row spacing

Drill Row Spacing:	6"	8"	10"	12"
20 PLS per square foot	10 seeds/ft	13 seeds/ft	17 seeds/ft	20 seeds/ft
30 PLS per square foot	15 seeds/ft	20 seeds/ft	25 seeds/ft	30 seeds/ft
60 PLS per square foot	30 seeds/ft	40 seeds/ft	50 seeds/ft	60 seeds/ft

Table 2 Instructions

Table 2 data was developed with published information shown in the reference section. This data will be used to provide seeding specifications for all seeding practices. When a variety of plant materials are known to greatly differ from seeds per pound listed, the seeding rate can be recalculated. For example, debearded seed will have more seeds per pound than listed in Table 2. Many of the native forbs listed are not commercially available. A current year seed list spreadsheet is available at http://efotg.nrcs.usda.gov/references/public/NE/Seed_Mixture_Calculator_Spreadsheet.xls that can be utilized for automate PLS calculations.

Customizing Seeding Mixtures

PLS seeding rates for mixtures can be developed for a specific seeding rate. Seeding rates will depend on an individual practice standard. For example range plantings are seeded at a rate of 20 pls/ft², native forbs are typically added to native grass plantings at 2 pls/ft², dryland pasture plantings are 30 pls/ft², critical area plantings may be as high as 120 pls/ft². These seeding rates can be developed by multiplying the percentage desired (in decimals) times the seeding rate in lb/ac for each species in a mixture. Seeding rates for mixtures of native forbs should be calculated to the hundreds of lbs/ac, and grass and introduced forbs to tenths of lbs/ac.

An automated spreadsheet to customize seeding mixtures and determine seeding rate is available at the following website:
http://efotg.nrcs.usda.gov/references/public/NE/Seed_Mixture_Calculator_Spreadsheet.xls.

Formula: Percentage (in decimals) X Seeding Rate (lb/ac from Table 2) = PLS lbs/ac of each species in mixture (refer to example below):

Example Seed Mixture Calculations

Range Seeding (20 pls/ft ²)		Pasture Seeding (30 pls/ft ²)		Native Forbs (2 pls/ft ²)	
Big bluestem	.20 X 5.3 = 1.1 lb/ac	Smooth bromegrass	.40 X 9.6 = 3.8 lbs/ac	American Vetch	.25 X 3.56 = 0.89 lbs/ac
Indiangrass	.15 X 5.0 = 0.8 lb/ac	Orchardgrass	.40 X 2.0 = 0.8 lbs/ac	Illinois bundleflower	.25 X 1.45 = 0.36 lbs/ac
Little bluestem	.25 X 3.4 = 0.9 lb/ac	Alfalfa	.20 X 6.5 = 1.3 lbs/ac	Purple coneflower	.25 X .75 = 0.18 lbs/ac
Sideoats grama	.20 X 4.6 = 0.9 lb/ac	TOTAL	100%	Roundhead lespedeza	.25 X .58 = 0.15 lbs/ac
Switchgrass	.20 X 2.2 = 0.4 lb/ac			TOTAL	100%
TOTAL	100%				

**Table 2
Pure Live Seeding Rates and MLRA Adaptation**

Species	Wt/Bu	Seeds/PLS lb	PLS Seeds/Sq. Ft at 1 lb/Ac	Seeding Rate lb/Ac @ 2 PLS/ft2	Seeding Rate lb/Ac @ 20 PLS/ft2	Seeding Rate lb/Ac @ 30 PLS/ft2	Seeding Rate lb/Ac @ 40 PLS/ft2	Seeding Rate lb/Ac @ 60 PLS/ft2	MLRA	COMMENTS
Native Grasses - Warm Season										Refer to UNL Cooperative Extension Circular "Certified Perennial Grass Varieties Recommended for Nebraska" for appropriate varieties
Alkali sacaton		1,758,000	40.4	0.05	0.5	0.7	1.0	1.5		
Big bluestem		165,000	3.8	0.53	5.3	7.9	10.6	15.8		
Blue grama		825,000	18.9	0.11	1.1	1.6	2.1	3.2		
Buffalograss (burs)		56,000	1.3	1.56	15.6	23.3	31.1	46.7		
Eastern gamagrass		7,200	0.2	12.10	121.0	181.5	242.0	363.0		Pasture and Hayland Planting (512) requires only 8.0 PLS lb/ac
Indiangrass		175,000	4.0	0.50	5.0	7.5	10.0	14.9		
Little bluestem		260,000	6.0	0.34	3.4	5.0	6.7	10.1		
Prairie cordgrass		105,600	2.4	0.83	8.3	12.4	16.5	24.8		
Prairie dropseed		481,000	11.0	0.18	1.8	2.7	3.6	5.4	63B, 66, 71, 75, 102C, 106, 107	Dry, nonsandy sites
Prairie sandreed		273,700	6.3	0.32	3.2	4.8	6.4	9.5		
Sand bluestem		113,000	2.6	0.77	7.7	11.6	15.4	23.1		
Sand bluestem (Champ variety)		165,000	3.8	0.53	5.3	7.9	10.6	15.8		
Sand dropseed		5,200,000	119.4	0.02	0.2	0.3	0.3	0.5		
Sand lovegrass		1,300,000	29.8	0.07	0.7	1.0	1.3	2.0		Short-lived
Sideoats grama		191,000	4.4	0.46	4.6	6.8	9.1	13.7		
Switchgrass		389,000	8.9	0.22	2.2	3.4	4.5	6.7		

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Species	Wt/ Bu	Seeds/PLS lb	PLS Seeds/ Sq. Ft at 1 lb/Ac	Seeding Rate lb/Ac @ 2 PLS/ft2	Seeding Rate lb/Ac @ 20 PLS/ft2	Seeding Rate lb/Ac @ 30 PLS/ft2	Seeding Rate lb/Ac @ 40 PLS/ft2	Seeding Rate lb/Ac @ 60 PLS/ft2	MLRA	COMMENTS
Native Grasses - Cool Season										
Bluebunch wheatgrass		118,000	2.7	0.74	7.4	11.1	14.8	22.1		
Canada wildrye	26	115,000	2.6	0.76	7.6	11.4	15.2	22.7		Adapted to Eastern Nebraska and wet meadows, short-lived but re-seeds itself
Green needlegrass		181,000	4.2	0.48	4.8	7.2	9.6	14.4		Best suited in Northwest Nebraska on hard sites
Indian ricegrass		155,000	3.6	0.56	5.6	8.4	11.2	16.9		
Inland saltgrass		672,500	15.4	0.13	1.3	1.9	2.6	3.9		
Needleandthread		115,000	2.6	0.76	7.6	11.4	15.2	22.7		Best on gravel and sandy soils
Porcupinegrass (Hesperostipa spartea)		150,000	3.4	0.58	5.8	8.7	11.6	17.4		For use statewide on droughty sites and non-sandy soils
Prairie junegrass		2,315,000	53.1	0.04	0.4	0.6	0.8	1.1		Statewide except for wet areas
Reed canarygrass	48	540,000	12.4	0.16	1.6	2.4	3.2	4.8		Invasive in wet areas, not always considered native
Slender wheatgrass	19	159,000	3.7	0.55	5.5	8.2	11.0	16.4	All but 106 and 107	Adapted to wet meadows
Thickspike wheatgrass		154,000	3.5	0.57	5.7	8.5	11.3	17.0	60A, 64, 67, 72, 73W, 65W	Critana is improved variety for use in Nebraska
Virginia wildrye		73,000	1.7	1.19	11.9	17.9	23.9	35.8		Wet areas and high rainfall areas
Western wheatgrass	19	110,000	2.5	0.79	7.9	11.9	15.8	23.8		Well adapted to many sites
Warm Season Cover Crops										
Foxtail millet		213,000	4.9	0.41	4.1	6.1	8.2	12.3		
Hybrid forage sudan		55,000	1.3	1.58	15.8	23.8	31.7	47.5		
Pearl millet		88,000	2.0	0.99	9.9	14.9	19.8	29.7		
Proso millet		81,648	1.9	1.07	10.7	16.0	21.3	32.0		
Sorghum	56	28,000	0.6	3.11	31.1	46.7	62.2	93.3		
Sudan grass	28	55,000	1.3	1.58	15.8	23.8	31.7	47.5		
Introduced Grasses - Cool Season										
Creeping foxtail	14	750,000	17.2	0.12	1.2	1.7	2.3	3.5		Refer to UNL Cooperative Extension Circular "Certified Perennial Grass Varieties Recommended for Nebraska" for appropriate varieties
Crested wheatgrass		175,000	4.0	0.50	5.0	7.5	10.0	14.9		
Fairway wheatgrass		302,000	6.9	0.29	2.9	4.3	5.8	8.7		
Intermediate wheatgrass		88,000	2.0	0.99	9.9	14.9	19.8	29.7		

HERBACEOUS VEGETATION DESIGN PROCEDURES (550DP)-13

Species	Wt/ Bu	Seeds/PLS lb	PLS Seeds/ Sq. Ft at 1 lb/Ac	Seeding Rate lb/Ac @ 2 PLS/ft2	Seeding Rate lb/Ac @ 20 PLS/ft2	Seeding Rate lb/Ac @ 30 PLS/ft2	Seeding Rate lb/Ac @ 40 PLS/ft2	Seeding Rate lb/Ac @ 60 PLS/ft2	MLRA	COMMENTS
Kentucky bluegrass	14	2,177,000	50.0	0.04	0.4	0.6	0.8	1.2		
Meadow bromegrass		71,000	1.6	1.23	12.3	18.4	24.5	36.8		
Orchardgrass	14	654,000	15.0	0.13	1.3	2.0	2.7	4.0		
Perennial ryegrass		227,000	5.2	0.38	3.8	5.8	7.7	11.5		"Linn" variety should be used when planting as a companion cover crop for erosion control on critical area plantings.
Pubescent wheatgrass		100,000	2.3	0.87	8.7	13.1	17.4	26.1		
Redtop		4,990,000	114.6	0.02	0.2	0.3	0.3	0.5		
Russian wildrye		175,000	4.0	0.50	5.0	7.5	10.0	14.9		
Smooth bromegrass	14	136,000	3.1	0.64	6.4	9.6	12.8	19.2		
Tall fescue	21	227,000	5.2	0.38	3.8	5.8	7.7	11.5		
Tall wheatgrass		79,000	1.8	1.10	11.0	16.5	22.1	33.1		
Timothy	45	1,230,000	28.2	0.07	0.7	1.1	1.4	2.1		
Introduced Forbs (Legumes)										
Alfalfa	60	200,000	4.6	0.44	4.4	6.5	8.7	13.1		Use varieties appropriate to the site/area of the state Statewide
Alsike clover	60	700,000	16.1	0.12	1.2	1.9	2.5	3.7		
Birdsfoot trefoil	60	375,000	8.6	0.23	2.3	3.5	4.6	7.0		
Cicer milkvetch	60	136,000	3.1	0.64	6.4	9.6	12.8	19.2		
Crimson clover	60	149,700	3.4	0.58	5.8	8.7	11.6	17.5		
Crownvetch	55	109,000	2.5	0.80	8.0	12.0	16.0	24.0		
Hairy vetch	60	20,000	0.5	4.36	43.6	65.3	87.1	130.7		Can spread and become aggressive in Western Nebraska
Korean lespedeza	40	225,000	5.2	0.39	3.9	5.8	7.7	11.6		
Ladino (white) clover	60	871,650	20.0	0.10	1.0	1.5	2.0	3.0		Large vigorous form of white clover widely used in pasture mixes on irrigated land
Purple vetch	60	10,000	0.2	8.71	87.1	130.7	174.2	261.4		
Red clover	60	275,000	6.3	0.32	3.2	4.8	6.3	9.5		Eastern half of the state does better in high rainfall areas
Sainfoin	28	30,000	0.7	2.90	29.0	43.6	58.1	87.1		
Strawberry clover	60	300,000	6.9	0.29	2.9	4.4	5.8	8.7		
Sweetclover (yellow & white)	60	260,000	6.0	0.34	3.4	5.0	6.7	10.1	Statewide	
Varia crownvetch	55	119,000	2.7	0.73	7.3	11.0	14.6	22.0		
White clover	60	856,000	19.7	0.10	1.0	1.5	2.0	3.1		
Native Forbs										
American germander (Teucrium canadense)		259,428	6.0	0.34	3.4	5.0	6.7	10.1	Statewide	moist sites

HERBACEOUS VEGETATION DESIGN PROCEDURES (550DP)-14

Species	Wt/ Bu	Seeds/PLS lb	PLS Seeds/ Sq. Ft at 1 lb/Ac	Seeding Rate lb/Ac @ 2 PLS/ft2	Seeding Rate lb/Ac @ 20 PLS/ft2	Seeding Rate lb/Ac @ 30 PLS/ft2	Seeding Rate lb/Ac @ 40 PLS/ft2	Seeding Rate lb/Ac @ 60 PLS/ft2	MLRA	COMMENTS
American vetch (Vicia americana)		24,500	0.6	3.56	35.6	53.3	71.1	106.7	All but 65	L
Annual sunflower (Helianthus annuus)		59,000	1.4	1.48	14.8	22.1	29.5	44.3	Statewide	A, M, plains sunflower is better on sandy sites
Arkansas rose (Rosa arkansana)		40,000	0.9	2.18	21.8	32.7	43.6	65.3	Statewide	H, M
Blackeyed Susan (Rudbeckia hirta)		1,450,000	33.3	0.06	0.6	0.9	1.2	1.8	Statewide	
Blacksamson/Purple coneflower (Echinacea angustifolia)		115,500	2.7	0.75	7.5	11.3	15.1	22.6	60A, 63B, 64, 65, 66, 67, 71, 72, 73, 75	
Blackseed plantain (Plantago rugelii)		?							?	
Blanketflower (Gaillardia aristata)		156,500	3.6	0.56	5.6	8.4	11.1	16.7	Statewide	
Breadroot scurfpea (Psoralea esculenta)		16,000	0.4	5.45	54.5	81.7	108.9	163.4	Statewide except course soils	Dry sites
Broadleaf beardtongue (Penstemon angustifolius)		313,000	7.2	0.28	2.8	4.2	5.6	8.4	Statewide	Adapted to wide range of soil textures and soils with a pH above 7.0
Bush morning-glory (Ipomoea leptophylla)		5900	0.1	14.77	147.7	221.5	295.3	443.0	All but 75, 102C, 106, 107	M, sandy/gravelly sites
Butterfly milkweed (Asclepias tuberosa)		67,000	1.5	1.30	13.0	19.5	26.0	39.0	MLRA's in Veg. Zone IV	moist sites
Canada goldenrod (Solidago canadensis)		2,000,000	45.9	0.04	0.4	0.7	0.9	1.3	Statewide	M, Aggressive
Canada milkvetch (Astragalus canadensis)		256,000	5.9	0.34	3.4	5.1	6.8	10.2	Statewide	L
Clammy groundcherry (Physalis heterophylla)		?							Statewide	
Common milkweed (Asclepias syriaca)		?							Statewide	Excellent for monarch butterflies
Compass Plant (Silphium laciniatum)		24,600	0.6	3.54	35.4	53.1	70.8	106.2	75, 102C, 106, 107	Tallgrass prairie sites
Cudweed sagewort (Artemisia ludoviciana)		4,500,000	103.3	0.02	0.2	0.3	0.4	0.6	Statewide	
Dotted gayfeather (Liatris punctata)		139,000	3.2	0.63	6.3	9.4	12.5	18.8	60A, 63B, 64, 65, 66, 67, 71, 72, 73, 75	
False sunflower (Heliopsis helianthoides)		60,000	1.4	1.45	14.5	21.8	29.0	43.6	63B, 65, 66, 71, 72, 102C, 106, 107, 73, 75,	
False-boneset (Brickellia eupatoriodes)		?							Statewide	Sandy sites

HERBACEOUS VEGETATION DESIGN PROCEDURES (550DP)-15

Species	Wt/ Bu	Seeds/PLS lb	PLS Seeds/ Sq. Ft at 1 lb/Ac	Seeding Rate lb/Ac @ 2 PLS/ft2	Seeding Rate lb/Ac @ 20 PLS/ft2	Seeding Rate lb/Ac @ 30 PLS/ft2	Seeding Rate lb/Ac @ 40 PLS/ft2	Seeding Rate lb/Ac @ 60 PLS/ft2	MLRA	COMMENTS
Field mint (<i>Mentha arvensis</i>)		?							?	
Fourwing saltbush (<i>Atriplex canescens</i>)		50,000	1.1	1.74	17.4	26.1	34.8	52.3	60A, 64, 67	H, M
Fringed sagewort (<i>Artemisia frigida</i>)		4,000,000	91.8	0.02	0.2	0.3	0.4	0.7	60A, 63B, 64,65, 66, 67, 71, 72, 73	
Grayhead coneflower (<i>Ratibida pinnata</i>)		625,000	14.3	0.14	1.4	2.1	2.8	4.2	71, 75, 102C, 106	
Groundplum milkvetch (<i>Astragalus crassicarpus</i>)		71,300	1.6	1.22	12.2	18.3	24.4	36.7	Statewide	Not on heavy clays
Hairy golden aster/Silky golden aster (<i>Chrysopsis villosa</i>)		403,000	9.3	0.22	2.2	3.2	4.3	6.5	60A, 63B, 64, 65	sandy/gravelly sites
Illinois bundleflower (<i>Desmanthud illinoensis</i>)		60,000	1.4	1.45	14.5	21.8	29.0	43.6	63, 66, 71, 73, 75, 102C, 106	L, moist sites
Jerusalem artichoke (<i>Helianthus tuberosus</i>)		75,666	1.7	1.15	11.5	17.3	23.0	34.5	71, 73, 75, 102C, 106, 107	
Leadplant (<i>Amorpha canescens</i>)		123,000	2.8	0.71	7.1	10.6	14.2	21.2	Statewide	H, L, M
Maximilian sunflower (<i>Helianthus maximiliani</i>)		150,000	3.4	0.58	5.8	8.7	11.6	17.4	Statewide	M, aggressive
Missouri goldenrod (<i>Solidago missouriensis</i>)		1,300,000	29.8	0.07	0.7	1.0	1.3	2.0	Statewide	
New England aster (<i>Aster novae angliae</i>)		1,300,000	29.8	0.07	0.7	1.0	1.3	2.0	75, 102C, 106	moist sites
New Jersey tea (<i>Americanus herbaceus</i>)		112,000	2.6	0.78	7.8	11.7	15.6	23.3	Statewide, except 60A, 64, 67, 72	
Pale purple coneflower (<i>Echinacea pallida</i>)		115,500	2.7	0.75	7.5	11.3	15.1	22.6	MLRA's within veg. Zone IV	Tall grass prairie species
Pitcher sage (<i>Salvia aqrea</i>)		150,000	3.4	0.58	5.8	8.7	11.6	17.4	75, 102C, 106	
Plains coreopsis (<i>Coreopsis tinctoria</i>)		1,650,000	37.9	0.05	0.5	0.8	1.1	1.6	63B, 65, 66, 71, 73, 75, 102C, 106, 107	A, M, moist sites
Prairie spiderwort (<i>Tradescantia occidentalis</i>)		7,900	0.2	11.03	110.3	165.4	220.6	330.8	Statewide	Dry sites
Prairie sunflower (<i>Helianthus petiolaris</i>)		216,190	5.0	0.40	4.0	6.0	8.1	12.1	Statewide	A, M, Sandy soils only
Prairie violet (<i>Viola pedatifida</i>)		46,500	1.1	1.87	18.7	28.1	37.5	56.2	75, 102C, 106, 107	Tallgrass prairie sites

HERBACEOUS VEGETATION DESIGN PROCEDURES (550DP)-16

Species	Wt/ Bu	Seeds/PLS lb	PLS Seeds/ Sq. Ft at 1 lb/Ac	Seeding Rate lb/Ac @ 2 PLS/ft2	Seeding Rate lb/Ac @ 20 PLS/ft2	Seeding Rate lb/Ac @ 30 PLS/ft2	Seeding Rate lb/Ac @ 40 PLS/ft2	Seeding Rate lb/Ac @ 60 PLS/ft2	MLRA	COMMENTS
Purple coneflower (Echinacea purpurea)		115,500	2.7	0.75	7.5	11.3	15.1	22.6	75, 102C, 106, 107	Tallgrass prairie sites (different species than Black samson)
Purple poppy mallow (Callirhoe involucrata)		145,280	3.3	0.60	6.0	9.0	12.0	18.0	71, 75, ?	Prefers moist sites
Purple prairieclover (Dalea purpurea)		275,000	6.3	0.32	3.2	4.8	6.3	9.5	Statewide	L, KanNeb variety preferred
Rocky Mountain Bee Plant (Cleomeserrulata)		63,000	1.4	1.38	13.8	20.7	27.7	41.5	64, 67, 72, 65	A, M, sandy/gravelly sites
Rough Blazingstar (Liatris aspera)		252,000	5.8	0.35	3.5	5.2	6.9	10.4	63B, 66, 71, 75, 102C, 106	L
Roundhead lespedeza (Lespedeza capitata)		151,000	3.5	0.58	5.8	8.7	11.5	17.3	63B, 65, 66, 71, 73, 75, 102C, 106, 107	
Sawtooth sunflower (Helianthus grosseserratus)		630,000	14.5	0.14	1.4	2.1	2.8	4.1	75, 102C, 106, 107	
Scarlet globemallow (Sphaeralcea coccinea)		800,000	18.4	0.11	1.1	1.6	2.2	3.3	60A, 63B, 64, 65, 66, 67, 71, 72, 73, 75, 102C	
Sensitive briar (Schrunkia nuttallii)		27,800	0.6	3.13	31.3	47.0	62.7	94.0	63B, 66, 71, 73, 75	L, dry sites
Serrateleaf evening primrose (Oenothera serrulata)		?							Statewide	rocky/sandy/gravelly sites
Shell-leaf /beardtongue penstemon (Penstemon grandiflorus)		272,200	6.2	0.32	3.2	4.8	6.4	9.6	63B, 65, 66, 71, 75, 102C, 106	
Showy partridgepea (Cassia chamaecrista)		50,000	1.1	1.74	17.4	26.1	34.8	52.3	63B, 65, 66, 71, 72, 73, 75, 102C, 106, 107	A, L, M, Platte variety preferred
Silky prairieclover (Daleo villosus)		113,400	2.6	0.77	7.7	11.5	15.4	23.0	Statewide except 106, 107S	sandy sites
Slender dalea (Dalea enneandra)		?							Statewide	Calcareous/rocky/ sandy sites
Slender greenthread (Thelesperma megapotamicum)		6,300?							60A, 64, 65, 67, 72, 73	
Slimleaf scurfpea (Psoralea tenuiflora)		26,300	0.6	3.31	33.1	49.7	66.3	99.4	60A, 64, 65, 66	A, L, M
Smooth Violet Prairie Aster		?							106, 107S	Open woods
Smoothseed wildbean (Strophostyles leiosperma)		?							Statewide	L
Stiff goldenrod (Solidago rigida)		1,300,000	29.8	0.07	0.7	1.0	1.3	2.0	Statewide	
Stiff sunflower (Helianthus rigidus)		740,000	17.0	0.12	1.2	1.8	2.4	3.5	Statewide	

HERBACEOUS VEGETATION DESIGN PROCEDURES (550DP)-17

Species	Wt/ Bu	Seeds/PLS lb	PLS Seeds/ Sq. Ft at 1 lb/Ac	Seeding Rate lb/Ac @ 2 PLS/ft2	Seeding Rate lb/Ac @ 20 PLS/ft2	Seeding Rate lb/Ac @ 30 PLS/ft2	Seeding Rate lb/Ac @ 40 PLS/ft2	Seeding Rate lb/Ac @ 60 PLS/ft2	MLRA	COMMENTS
Swamp milkweed (Asclepias incarnata)		72,000	1.7	1.21	12.1	18.2	24.2	36.3	Statewide	wet sites
Texas croton (Croton texensis)		?							60A, 63B, 64, 65, 66, 67, 71, 72, 73, 75	A, M, sandy sites
Thickspike gayfeather (Liatris pycnostachya)		110,000	2.5	0.79	7.9	11.9	15.8	23.8	75, 102C, 106	
Upright coneflower (Ratibida columnifera)		737,000	16.9	0.12	1.2	1.8	2.4	3.5	60A, 63B, 64, 65, 66, 67, 71, 72, 73, 75	
Virginia groundcherry (Physalis virginiana)		?							Statewide	
Virginia groundcherry (Physalis virginiana)		?							?	
Western false gromwell (Onosmodium occidentale)		?							?	
Western yarrow (Achillea millefolium/lanulosa)		2,300,000	52.8	0.04	0.4	0.6	0.8	1.1	Statewide	Upland sites
White aster (Aster ericoides)		2,200,000	50.5	0.04	0.4	0.6	0.8	1.2	Statewide	
White penstemon (Penstemon albidus)		?							Statewide except 106, 107S	sandy/gravelly sites
White Prairie Aster (Aster commutatus)		496,000	11.4	0.18	1.8	2.6	3.5	5.3	Statewide	Dry mesic sites, especially in western Nebraska
White prairieclover (Dalea candida Variety "candida")		384,000	8.8	0.23	2.3	3.4	4.5	6.8	63B, 65, 66, 71, 73E, 75, 102C, 106, 107	L Use eastern Great Plains origin if variety unknown.
White prairieclover (Dalea candida Variety "oligophylla")		384,000	8.8	0.23	2.3	3.4	4.5	6.8	60A, 64, 65W, 67, 72, 73	L Use eastern Great Plains origin if variety unknown.
Wild bergamot (Monarda fistulosa)		1,200,000	27.5	0.07	0.7	1.1	1.5	2.2	63B, 65, 66, 71, 72, 73, 75, 102C, 106, 107	
Winterfat (Ceratooides lanata)		125,000	2.9	0.70	7.0	10.5	13.9	20.9	60A, 64, 67, 72	H, M, fall seed only
Cereal Grain (Cool Season)										Use varieties appropriate to the site/area of the state (annual cover only, not recommended for cover crops for grass seeding)
Barley	48	14,000	0.3	6.22	62.2	93.3	124.5	186.7		
Oats	32	13,000	0.3	6.70	67.0	100.5	134.0	201.0		

Species	Wt/ Bu	Seeds/PLS lb	PLS Seeds/ Sq. Ft at 1 lb/Ac	Seeding Rate lb/Ac @ 2 PLS/ft ²	Seeding Rate lb/Ac @ 20 PLS/ft ²	Seeding Rate lb/Ac @ 30 PLS/ft ²	Seeding Rate lb/Ac @ 40 PLS/ft ²	Seeding Rate lb/Ac @ 60 PLS/ft ²	MLRA	COMMENTS
Rye	56	18,000	0.4	4.84	48.4	72.6	96.8	145.2		
Wheat	60	15,000	0.3	5.81	58.1	87.1	116.2	174.2		

Comment Legend

A - Plant is an annual; **H** - Plant is a shrub or half shrub that can be established from seed; **L** - Plant is a legume; **M** - Must plant/seed at no more than 1 PLS/ft² not to exceed half the forbs seeded in a native grass and forb mixture, and with at least one other non-annual forb; **?** - Species are generally not available commercially

13. Seeding Depth:

- a. Proper seeding depth is extremely important in successfully establishing grass and forbs from seed. Grasses, forbs, and shrubs need to be seeded at a shallow depth, as light plays a key role in the germination especially in many native species. Optimum grass seeding depths are as follows for the following soil types:
 - Loams, Silty Clay Loams, and Silty Clays – ¼” to ½” deep.
 - Loamy Sands, Sandy Loams, and Sands – ½” to 1” deep.

14. Seeding Equipment:

- a. General Requirements for Grass Seeding Equipment that will handle planting all types of grasses are as follows:
 - The best type of seeding equipment is a grass drill equipped to accurately meter seed from the seed box(s), provide seed flow without plugging, and plant seed at desired depth with good seed-to-soil contact. Refer to the requirements of grass drills for more information.
 - 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 six miles per hour may result in uneven or inconsistent grass and legume stands.
 - A carrier can be used to facilitate seeding at lower rates. Carriers include vermiculite, cracked corn or rolled oats which are added to the mixture.
 - Graphite can be used to help feed fluffy seed through drills.
 - Refer to Table 3 and Table 4, and requirements for specific equipment types listed below, to determine the appropriate seeding equipment to utilize.

***Table 3
Compatibility of Drill Type with Grass Seed Types (NR=Not Recommended)**

Drill Type\Grass Seed Type	Legumes, Switchgrass or other small slick seed	Chaffy native seed with awns	Wheatgrasses, Bromegrass and similar clean smooth seed	Trashy Seed	All Seed Types in a Mixture
Grass Drills without picker wheels or agitators	X	NR	X	NR	NR
Grass Drills with picker wheels, and agitators	X	X	X	X	X
Standard Small Grain Drills with small seed box	X	NR	X	NR	NR

*Grassland and standard drills must have depth control devices as described below and separate seed boxes for various types of grass/forbs.

**Table 4
Compatibility of Drill Types with Cover Types (NR=Not Recommended)**

Drill Type\Cover type	Row Crop Heavy cover (post harvest)	*Row Crop minimal cover (post harvest)	Cover Crop (18 inches or less in height)	Cover Crop (heavy cover > 18 inches)	Chemically killed sod	Tilled Seedbed with >50% ground Cover	Tilled Seedbed < 50% ground cover
No-Till Grass Drill with no-till attachments	X	X	X	X	X	X	X
Grass Drill with, double disk openers only	NR	X	X	NR	NR	X	X
Standard Small Grain Drill with small seed box	NR	X	NR	NR	NR	X	X
Brillion or Trillion Seeders	NR	NR	NR	NR	NR	NR	X
Broadcast Seeders with packing/incorporation device	NR	NR	NR	NR	NR	X	X

*Note minimal cover includes soybean stubble or low residue dryland cropland

b. Requirements for Grass Drills

- Grass drills are specifically designed and equipped to properly meter and place various grass and/or forb seed and have the following design characteristics.
 1. Separate seed boxes are required to handle the three main types of grass/forb seed commonly planted.
 - (a) These include the relatively clean, smooth seed characteristic of many cool-season grasses;
 - (b) Chaffy or awned seed, characteristic of many warm-season grasses (i.e. blue grama, bluestems, and Indiangrass);
 - (c) Fine, smooth seed, characteristic of legumes or grasses such as Switchgrass, Sand lovegrass, Tall fescue, or Reed canarygrass.

- (d) Seed boxes having the capability of seeding chaffy or awned grasses 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 are necessary when chaffy or trashy seed will be planted to prevent bridging in the drill box 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 ensure uniform flow of all types of grass seed either separately or in a mixture.
 4. Oversized feeder tubes (2" minimum inner diameter) that allow constant flow of chaffy or trashy type seed from boxes to placement point (if such seed is used). Feeder tubes must be placed in front of the packer wheels to allow for proper seed-soil contact.
 5. Proper Depth Control
 - (a) Individually mounted, adjustable, spring loaded, double-disc furrow openers with depth control bands behind each opener, or rear depth seeding depth control adjustment behind each double disk opener that provide positive seed placement at a consistent and desired planting depth over varying degrees of seedbed firmness and residue cover. Refer to section 13 for depth control requirements.
 6. 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 firm an already tilled/fluffy seedbed. A relatively firm seedbed must exist before the drilling operation begins.
 7. Grass drills must be equipped with coulters for no-till planting into sod or heavy residue cover (i.e. 5/16" fluted, 3/4" wavy, 5/8" fluted) ahead of the double disk openers. Wider fluted coulters are more suitable for heavy crop residue and narrower 5/16" coulters for sod plantings.
- c. Requirements for Standard Small Grain Drills
- Free-flowing grass seed (i.e., wheat grasses) and small slick seed (i.e. Switchgrass, legumes) are the only types of grass/forb seed that can be planted with this type of drill.
 - Chaffy or awned seeds (i.e. bluestems, Indiangrass, and Blue grama) shall not be planted with this type of drill.
 - Proper seeding depth
 1. Individually mounted, adjustable, spring loaded, double-disc furrow openers with depth control bands behind each opener, or rear depth seeding depth control adjustment behind each double disk opener that provide positive seed placement at a consistent and desired planting depth over varying degrees of seedbed firmness and residue cover. Refer to section 13 for depth control requirements.
 2. Improper seeding depth is a major factor that affects seeding success when using a small grain drill.

3. While drilling periodic inspections should be done to check seeding depth especially when seeding across different soil types or field conditions.
 4. It is extremely important to have a firm seedbed when using a grain drill to ensure proper seed soil contact.
- Seeding Mixtures (different sizes/types of seeds)
 1. Checking the drill frequently and hand mixing the seed is essential to achieve a properly blended seed mix and to ensure that seeds of different sizes are seeded evenly across the field. Most small grain drills do not have agitation devices and a grass drill shall be used if there are significant differences in seed size/type.
 2. Periodic feeder mechanism adjustments are usually necessary to ensure proper seeding rates.
 3. A separate legume box is necessary for seeding small seeded species. (i.e. Switchgrass, hard fescue, clovers, and alfalfa) along with wheat grasses or Smooth brome grass.
 4. Feeder tubes must be placed in front of the packer wheels to allow for proper seed-soil contact.
- d. Brillion and Trillion Seeders
- These seeders drop seed on the soil surface between cultipacker rollers. This type of seeding will place seed on the soil surface or very shallow (less than ¼ inch), depending on the seedbed conditions.
 - Small slick seeds such as legumes, Switchgrass, or other small slick seeds are the only types of seed that can be planted with this equipment.
 - A tilled/clean seedbed or a row crop seedbed with significant open ground with a smooth, firmly packed clean surface is required.
 - This method of seeding is not acceptable unless erosion and weed control are adequate (note pre-emergent herbicide or mulch may be necessary to control weeds).
- e. Broadcast Seeders
- Seed distribution will vary based on seed texture and density with heavier seeds being flung further than lightweight fluffy, chaffy seed.
 - This type of seeding equipment may only be used for critical area plantings, or when slope, site/soil conditions, and/or size of area to be seeded make it unpractical to use drills. An exception to this requirement is when early successional habitat is desired (i.e. certain prairie restoration plantings, and early successional habitat plantings).
 - All plantings will have a tilled seedbed (minimal residual cover with a smooth, firmly packed clean 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).
 - This method of seeding is not acceptable unless erosion and weed control are adequate (note pre-emergent herbicide or mulch may be necessary to control weeds).
 - Double the rate of seeding when broadcasting is used.

f. Hydroseeding

- Seed shall be applied prior to mulch, fertilizer and lime, unless mulch is not applied, in which case, fertilizer and lime shall be applied prior to hydroseeding.
- When required, mulch can be applied with this method by itself or in combination with fertilizer immediately after seed has been applied.
- Limit application of mulch to 150 pounds per 100 gallons of water.
- Double the rate of seeding when hydroseeding is used.

15. Drill Calibration:

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

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 5 to determine the number of revolutions (R) to turn the drive wheel for the row spacing and wheel circumference in feet (C) for your drill. If you have different row spacing than listed in this table refer to your operations manual provided by equipment manufacturer for calibration guidance.
- Some manufacturers offer a calibration crank or other calibration method that makes it unnecessary to turn the drive wheel and measure its circumference (contact the manufacture for more information).

Table 5
Determination of seeding rate using the bulk weight method

Row spacing in inches	No. of seed spouts to use	Turns of drive wheel
6	4	$96/C = R^*$
7	4	$82/C = R$
8	3	$96/C = R$
10	3	$77/C = R$
12	2	$96/C = R$

* C=wheel circumference; R=revolutions of drive wheel.

- 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 A) 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. Make adjustments in the drill setting and continue trials until the desired seeding rate is obtained.
- Remember seeding rates 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.
- Example:
 Row spacing = 7 inches
 Number of seed spouts = 4
 Circumference of drive wheel = 6.8 ft

Revolutions of drive wheel (R) = 82/C

$R = 82/6.8 = 12 \text{ revolutions}$

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 Table B to determine the linear foot of row necessary to equal one square foot planted.

**Table 6
Linear Foot Drill Calibration**

Table B	
Row spacing in inches	Linear foot of row to equal one square foot
6	2.0 feet
7	1.8 feet
7.5	1.65 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 43,560 ft²/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), we would calculate the bulk seeding rate for each species. Bulk seeding rate would be 8lbs./ac for the green needlegrass and 5.1 lbs./ac for the western wheatgrass. Assuming one pound of green needlegrass seed contains 181,000 or 4.2 seeds/ft² for each pound seeded (181,000/43,560 ft²/acre). Western wheatgrass has 110,000 seeds per pound or about 2.5 seeds/ft² for each pound seeded.

$8 \text{ lbs/ac} \times 4.2 \text{ seeds/ft}^2/\text{lb.} = 33.6 \text{ seeds/ft}^2$

$5.1 \text{ lbs/ac} \times 2.5 \text{ seeds/ft}^2/\text{lb.} = 12.7 \text{ seeds/ft}^2$

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.

16. Management and Protection during Establishment:

a. Grazing

- Do not graze until stand is fully established and a minimum of one full growing season.
- If an adequate stand has not established during the first growing season, or if seedlings do not have well-developed root systems as evidenced by the presence of adventitious roots above the sown seed, then grazing deferment should be extended through the second growing season.
- Grazing during the deferment period, or “flash grazing” for weed control will be handled on a case-by-case basis provided no damage will be done to the seeded species (refer to requirements for flash grazing below).

b. Weed Control

- General Requirements
 1. During the establishment period, excessive amounts of competitive weeds will be controlled. In many cases weed control is not necessary especially if early successional habitat is desired.
 2. Control weeds that compete with seedlings for sunlight and/or moisture during the growing season of the species planted.
 3. The first weed control operation will be needed as recommended or prior to weed seed maturity.
 4. Repeated weed control operations may be needed. Competitive weeds can be controlled mechanically, chemically, with a combination of these methods or with prescribed burning once grasses have a well established root system. In a few rare cases flash grazing may be appropriate.
- Mechanical
 1. Broadleaf - When broadleaf weeds threaten a seeding establishment because of severe shading, they should be mowed or shredded or sprayed. Mowing or shredding is generally the most effective prior to July 1 and should be discontinued by mid August. The height of mowing or shredding must be above the height of the seeded grasses. For most grass plantings 10-12 inches is ideal.
 2. Annual Grasses – Do not shred or mow unless severe shading occurs. Shredding or mowing may cause annual grasses to stool out causing more competition to the seeded grasses. If mowing or shredding is done ensure that more leaves are cut from the weedy grasses than from the seeded grasses. Mowing or shredding should be discontinued in late July to early August.
 3. If vegetation is too heavy and smothering of grass seedlings may occur consider haying or removing residue or use of equipment that chops residue into fine pieces.
- Chemical
 1. To control competitive weeds with herbicides use the appropriate herbicide(s) applied according to product label. Refer to the current “Guide for Weed

Management in Nebraska” for specific herbicide recommendations on forage crops in Nebraska (see the <http://www.ianrpubs.unl.edu/> link below under Support References to search for: "Guide for Weed Management").

2. The best control will be obtained when weeds are in the early stages of growth. Precautions should be taken to ensure that grass or legume seedlings are not injured by the selected herbicide(s).
- Prescribed Burning
 1. Prescribed burning can be utilized after the first growing season.
 - (a) Desirable grasses must have a well established root system to avoid damage.
 2. Refer to Prescribed burning standard 338 for guidance on utilizing this practice for weed control in grass/forb plantings.
 - Flash Grazing
 1. Grazing treatments for weed control should specify the timing and duration of the grazing period.
 2. Requires short term use of livestock to reduce competition from undesirable plants by grazing them.
 3. Flash grazing will be used as a last resort for weed control and is not recommended over other weed control methods.
 4. Use flash grazing until the height and time of grazing reaches the point of 15% defoliation or less of seeded plants.
 5. Length of grazing period, number of animals, and soil condition should be considered before flash grazing.
 6. When utilizing this option contact your local Range/Forage Management Specialist for guidance.
 - Noxious weed Control
 1. All noxious weeds must be controlled in accordance with State law
 2. Contact your local county officials for local guidance.
 - Guidance for Weed control for early successional habitat
 1. Only those rare instances that excessive weed competition will prevent establishment of seeded species will weed control measures be required.
 2. Weeds threatening stand establishment will be controlled by mowing and/or spraying with labeled herbicides (herbicides must not compromise the desired plant composition).
 3. Mowing should not be conducted beyond the first full growing season after seeding.
- c. Insect Control
- Insects such as grass hoppers can be a threat to new grass/forb seedlings.
 1. Contact professional agronomists, range specialists, University of Nebraska-Lincoln Extension specialists, or Chemical Company

representatives for determination of insect thresholds, existing/potential seedling damage and recommendations on control of specific insects affecting seeded species.

Caution: When using any insecticides read and follow the manufacturer's label recommendations. Read and follow all directions and precautions on the label.

17. Guidelines for Stand Evaluation:

- a. To determine adequacy of stands and to determine if reseeding or reinforcement seeding is required, use the following guidelines:
 - It should be recognized that environmental factors, such as climate, insects, soils, and fertility affect time required for establishment of stands. Timeliness of precipitation, drought, extreme temperatures, severe winds, or late soil thaw can delay seedling emergence and/or development.
 - Seedling emergence should be relatively uniform over the area. The density of established plants required for an adequate stand will depend upon the planned purpose of the seeding and practice requirements.
 - If specific practice guidelines are not available, stand counts should indicate a density of at least 3 to 5 seedlings per square foot of area. If at least 3 of the seedlings are rhizomatous species, the lower limit of 3 seedlings per square foot is adequate. The upper limit of 5 seedlings per square foot is necessary when all are bunch-type species or a mixture of rhizomatous and bunch-type species.
 - The adequacy of a stand will be based on density of established plants and stage of morphological development needed to ensure survival. To be considered established, a grass plant must have a well-developed adventitious root system and should exhibit signs of tillering or rhizome development. An alfalfa plant must have a well-developed taproot with secondary and tertiary roots and a well-developed crown set below the soil surface and/or branch rhizomes.
 - Preliminary stand evaluation can be made 4 to 8 weeks after germination; evaluate for progress and management problems (i.e. weeds, insects, etc.) - not for final establishment.
 - All stands must go through at least one winter before making final stand evaluation.
 - Stands resulting from late fall (dormant) or spring seedings must go through the first growing season and subsequent winter; evaluation for final establishment can be made any time during the second growing season.
 - Stands resulting from late summer seeding cannot be evaluated for final establishment until the end of subsequent, full growing season.
 - Most stands will require 2 growing seasons to become established; warm-season species may require 3 growing seasons for establishment.
- b. Stand counts may either be done using a 1-square foot frame or the row count method. If a frame count is used, all plants rooted within the frame should be counted. If the row count method is used, 2 side-by-side rows should be counted, the length to be determined by the row spacing. A 6-inch row spacing would require the observer to count all plants in 2 rows for a length of 12 inches; a 7-inch row spacing would require a 10.3-inch length of 2 rows; and an 8-inch row spacing would require a 9-inch length.

- A predetermined number of steps should be taken diagonal or perpendicular to the drill rows and the frame dropped at the toe of the foot on the final step. The frame should be dropped in a consistent alignment to the drill rows. The same procedure would be used when making a row count. Instead of dropping the frame at the toe of the foot, this point would then mark the beginning of the row count.
- The number of samples required depends on factors such as stand uniformity and the number of species to be counted. Generally, a minimum of 10 counts (or frames) per 10 acres or less of field size would result in a representative sample. End rows, turn around areas or other areas that may have been double seeded should be avoided. Ten counts per 10 acres of field size should only be used as a starting point. For example, a 70 to 80 acre pasture planting with a uniform stand may be sampled accurately using 40 counts or less. Whatever the situation, enough counts must be taken so that a representative sample is obtained.
- NE-CPA-8A, Grass/Legume Stand Evaluation jobsheet, may be used to document the stand counts.
- If evaluation reveals a marginal stand, consideration should be given to allowing a second growing season for establishment. Seedlings that contain a high percentage of "hard seed" are more likely to produce new seedlings during the second growing season.
- The alternative of a partial reinforcement seeding, in lieu of the full seeding rate, should be considered during the evaluations.
- "Spot" seeding weak areas may be a logical alternative in the case of spotty or intermittent stands, in lieu of whole field reseeding. Grazing deferment should follow spot seedings.

18. Support References

USDA NRCS, USDI National Park Service, 1996, Seeding Rate Statistics for Native and Introduced Species.

USDA, 1948, USDA Yearbook.

Wheeler W.A. and D.D. Hill, 1967, Grassland Seeds.

Stock Seed Farms, 1997, Prairie Grasses and Wildflowers catalogue.

Western Native Seed, 1998, Native Plant Seed for the Rocky Mountains and Western Great Plains (1998 Seed List).

[NRCS Plants Database](#)

[Grass Seeding Job Sheet, NE-CPA-8](#)

[Guide for Weed Management](#)

[Seed Mixture Calculator Spreadsheet](#)

[Grass and Forb Seed Source Requirements](#)

[Information on State seed law](#)

[Nebraska Range and Pasture Technical Note 14](#)