

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

- NE-CPA-8 Job Sheet for Grass Seeding in its entirety will be completed as follows:
- Section II “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 III “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).
- Page 2 of the Jobsheet for Grass Seeding must be completed in its 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.
- 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.

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 cannot 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.

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- 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. brome grass, 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 (DIM-5) 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 cannot 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](#).
- d. Refer to Section 12 “Pure Live Seed Calculations” Table 2 for species, pure live seeding rates and MLRA adaptation.
 - Table 2 provides a 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.

Season of Planting	Vegetative Zones	² Seeding Dates
<u>Cool Season/Legumes (irrigated or dryland)</u>		
Optimum Seeding Time (fall is best if summer annual weed pressure is expected)	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
<u>Predominately Warm Season</u>		
Optimum Seeding Time	ALL	April 1 – May 20
Late Fall (Dormant) ¹ - Spring	ALL	November 1 – May 31
<u>Warm/Cool Season or Warm Season Legume Mix</u>		
Optimum Seeding Time	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 on-line at <http://www.nda.nebraska.gov/regulations/plant/actc.pdf>
- 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

$$\frac{30 \text{ pls/ft}^2}{3.1 \text{ PLS seeds/ft}^2 \text{ at 1 lb/acre}} = 9.7 \text{ PLS lbs/acre}$$

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

Example: Smooth bromegrass from Table 2

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

**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, debarbed seed will have more seeds per pound than listed in Table 2. Many of the native forbs listed are not commercially available.

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,

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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 included in the Nebraska Jobsheet for Grass Seeding which is located in Section IV the Nebraska electronic field office technical guide.

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

<u>Range Seeding (20 pls/ft²)</u>	<u>Pasture Seeding (30 pls/ft²)</u>	<u>Native Forbs (2 pls/ft²)</u>
Big bluestem .20 X 5.3 = 1.1 lb/ac	Smooth brome grass .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

NATIVE WARM SEASON GRASSES											
Refer to UNL Cooperative Extension Circular "Certified Perennial Grass Varieties – Recommended for Nebraska" for appropriate varieties											
SPECIES	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	BLOOM PERIOD	COC	COMMENTS
Alkali sacaton	1,758,000	40.36	0.05	0.5	0.7	1.0	1.5	Statewide			Alkaline or saline sites
Big bluestem	165,000	3.79	0.53	5.3	7.9	10.6	15.8	Statewide		5	
Blue grama	825,000	18.94	0.11	1.1	1.6	2.1	3.2	Statewide		4	
Buffalograss (burs)	56,000	1.29	1.56	15.6	23.3	31.1	46.7	Statewide except not 65E, 65W			
Eastern gamagrass	7,200	0.17	12.10	121.0	181.5	242.0	363.0	73E, 75, 102C, 107N		7	Pasture and Hayland Planting (512) requires only 8.0 PLS lb/ac
Indiangrass	175,000	4.02	0.50	5.0	7.5	10.0	14.9	Statewide		5	
Little bluestem	260,000	5.97	0.34	3.4	5.0	6.7	10.1	Statewide		4	Subirrigated or wetter sites.
Prairie cordgrass	105,600	2.42	0.83	8.3	12.4	16.5	24.8	Statewide		5	
Prairie dropseed	1,200,000	27.55	0.07	0.73	1.09	1.45	2.18	63B, 66, 71, 75, 102C, 106, 107		7	Dry, nonsandy sites
Prairie sandreed	273,700	6.28	0.32	3.2	4.8	6.4	9.5	Statewide		5	Sandy sites
Rough/Tall Dropseed	1,500,000	34.44	0.06	0.58	0.87	1.16	1.74	Statewide except sandhills		3	Dry, upland sites
Sand bluestem	113,000	2.59	0.77	7.7	11.6	15.4	23.1	Statewide		5	
Sand bluestem (Champ variety)	165,000	3.79	0.53	5.3	7.9	10.6	15.8	Statewide		5	
Sand dropseed	5,200,000	119.38	0.02	0.2	0.3	0.3	0.5	Statewide		2	
Sand lovegrass	1,300,000	29.84	0.07	0.7	1.0	1.3	2.0	Statewide		5	Short-lived
Sideoats grama	191,000	4.38	0.46	4.6	6.8	9.1	13.7	Statewide		5	
Switchgrass	389,000	8.93	0.22	2.2	3.4	4.5	6.7	Statewide		4	

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NATIVE COOL SEASON GRASSES											
Refer to UNL Cooperative Extension Circular "Certified Perennial Grass Varieties – Recommended for Nebraska" for appropriate varieties											
SPECIES	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	BLOOM PERIOD	COC	COMMENTS
Bluebunch wheatgrass	125,680	2.89	0.69	6.93	10.40	13.86	20.80	60A, 64			Adapted to pine ridge area on open ponderosa pine woodlands, or dry, well-drained soils.
Bluejoint reedgrass / Canada bluejoint (Calamagrostis canadensis)	3,837,500	88.10	0.02	0.23	0.34	0.45	0.68	Statewide		6	Wet areas, marshes, sloughs, and bottomlands. Uncommon in western Panhandle.
Canada wildrye	115,000	2.64	0.76	7.58	11.36	15.15	22.73	Statewide except 106, 107.		5	Adapted to Eastern Nebraska and wet meadows, short-lived but re-seeds itself
Green needlegrass	181,000	4.16	0.48	4.81	7.22	9.63	14.44	60A, 63B, 64, 65, 66, 67A, 72, 73W		4	Best suited in Northwest Nebraska on hard sites
Indian ricegrass	161,920	3.72	0.54	5.38	8.07	10.76	16.14	60A, 64, 65W, 67A, 72, 73W			Best suited for Panhandle, SW and Western Sandhills
Inland Saltgrass	672,500	15.44	0.13	1.30	1.94	2.59	3.89	Statewide			Adapted to saline and alkaline soils
Needleandthread	115,000	2.64	0.76	7.58	11.36	15.15	22.73			6	Best on gravel and sandy soils
Porcupinegrass	34,100	0.78	2.6	25.8	38.5	51.6	77.0			6	For use statewide on droughty sites and non-sandy soils
Prairie junegrass	2,315,000	53.15	0.04	0.38	0.56	0.75	1.13			6	Statewide except for wet areas
Slender wheatgrass	159,000	3.65	0.55	5.48	8.22	10.96	16.44	All but 106 and 107		7	Adapted to wet meadows
Thickspike wheatgrass	153,000	3.51	0.57	5.69	8.54	11.39	17.08	60A, 64, 67, 72, 73W, 65W			Critana is improved variety for use in Nebraska
Virginia wildrye	73,000	1.68	1.19	11.93	17.90	23.87	35.80			4	Wet areas and high rainfall areas
Western wheatgrass	110,000	2.53	0.79	7.92	11.88	15.84	23.76			3	Well adapted to many sites

INTRODUCED COOL SEASON GRASSES											
Refer to UNL Cooperative Extension Circular "Certified Perennial Grass Varieties – Recommended for Nebraska" for appropriate varieties											
SPECIES	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	BLOOM PERIOD	COC	COMMENTS
Creeping foxtail	750,000	17.22	0.12	1.2	1.7	2.3	3.5	Statewide			Sod forming adapted to wet sites. Tolerates moderately acidic and moderately alkaline (has survived up to pH of 9.0). Aggressive invader of wet meadows.
Crested wheatgrass	175,000	4.02	0.50	5.0	7.5	10.0	14.9	Statewide except 102C, 106 and 107.			Provides early spring forage.
Intermediate wheatgrass	88,000	2.02	0.99	9.9	14.9	19.8	29.7	Statewide			Drought tolerant and does well for limited or full irrigation.
Meadow bromegrass	71,000	1.63	1.23	12.3	18.4	24.5	36.8	Statewide			Bunchgrass. Use only in mixtures.
Orchardgrass	654,000	15.01	0.13	1.3	2.0	2.7	4.0	Statewide			Bunchgrass, initiates growth later in spring. Use only in mixtures.
Perennial ryegrass	227,000	5.21	0.38	3.8	5.8	7.7	11.5	Statewide			Short-lived, use only in mixtures for quick, temporary cover.
Pubescent Wheatgrass	100,000	2.30	0.87	8.71	13.07	17.42	26.14	Statewide			Bunchgrass. Use only in mixtures.
Russian wildrye	175,000	4.02	0.50	5.0	7.5	10.0	14.9	60A,63B, 64, 65, 66, 67			Provides early spring forage
Smooth bromegrass	136,000	3.12	0.64	6.4	9.6	12.8	19.2	Statewide			Aggressive, will take over mixed stands and will invade nearby grasslands. Winter hardiness, seedling vigor and rapid stand establishment are rated high.
Tall fescue	227,000	5.2	0.38	3.8	5.8	7.7	11.5	Statewide			Western NE only on irrigated. May become invasive in SE Nebraska

HERBACEOUS VEGETATION DESIGN PROCEDURES (550DP)-14

Tall wheatgrass	79,000	1.81	1.10	11.0	16.5	22.1	33.1	Statewide			Tolerant of saline-alkaline soils with high water tables. Become coarse and unpalatable. May become invasive.
Timothy	1,230,000	28.24	0.07	0.7	1.1	1.4	2.1				Adapted to moist, bottomland, fine textured soils. Short-lived perennial.
Wheatgrass hybrid (Newwhy variety)	135,000	3.10	0.65	6.45	9.68	12.91	19.36	Statewide			Alkaline soils. Hybrid of blue bunch wheatgrass and quackgrass.

INTRODUCED LEGUMES

Use varieties appropriate to the sites and area of the state

SPECIES	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	BLOOM PERIOD	COC	COMMENTS
Alfalfa (Medicago)	226,800	5.21	0.38	3.84	5.76	7.68	11.52	Statewide	Early		Use varieties appropriate to the site and area of the state
Alsike clover (Trifolium hybridum)	700,000	16.07	0.12	1.2	1.9	2.5	3.7	63B, 65, 66, 73, 75, 102C, 106, 107B	Middle		Tolerates poorly drained soils. Most prominent in eastern half of state.
Birdsfoot trefoil (Lotus corniculatus)	375,000	8.61	0.23	2.32	3.48	4.65	6.97	63B, 66, 73, 75, 102C, 106, 107B	Middle		Heavier soils, can invade native rangeland . Suitable to a wide range of soil types; summer annual. Does not cause bloat.
Cicer milkvetch (Astragalus cicer)	122,560	2.81	0.71	7.11	10.66	14.22	21.33	60A, 64, 65W, 67A, 72	Late		Coarse textured soils. Tolerates alkalinity in wet soils. Non-bloating.
Crimson clover (Trifolium incarnatum)	149,700	3.44	0.58	5.82	8.73	11.64	17.46	106, 107B	Early		Provides rapid cover; does not survive Nebraska climate – annual growth habit.
Crown vetch (Securigera varia)	109,000	2.5	0.80	8.0	12.0	16.0	24.0	71, 75, 102C, 106, 107B	Early		Listed on Nebraska Invasive Plant Watch List.
Hairy (Winter) vetch (Vicia villosa)	20,000	0.46	4.36	43.6	65.3	87.1	130.7	Statewide	Middle		Can spread and become aggressive in Western Nebraska. Winter annual, can spread into crop fields.

HERBACEOUS VEGETATION DESIGN PROCEDURES (550DP)-15

Korean lespedeza (Kummerowia stipulacea)	225,000	5.17	0.39	3.87	5.81	7.74	11.62	106, 107B	Early		All soil types; found only in SE Nebraska
Red clover (Trifolium pratense)	275,000	6.31	0.32	3.17	4.75	6.34	9.50	Statewide	Middle		Eastern half of the state does better in high rainfall areas. Biennial or short-lived perennial
Sainfoin (Onobrychis viciifolia)	30,240	0.69	2.88	28.81	43.21	57.62	86.43	60A, 64, 67A, 72, 73	Early		Adapted to dry, calcareous soils. Non-bloating.
Small Burnet (Sanguisorba minor)	48,745	1.12	1.79	17.87	26.81	35.74	53.62	60A, 64, 67A, 72	Early		Prefers well drained soils and infertile and disturbed soil
Strawberry clover (Trifolium fragiferum)	299,371	6.87	0.29	2.91	4.37	5.82	8.73	64, 67A, 65W, 72	Early		Prefers sandy, slightly alkaline soils. Found along Platte River.
Sweet clover, yellow & white (Melilotus)	260,000	5.97	0.34	3.35	5.03	6.70	10.05	Statewide	Middle		Does well on all soil types except sands. White more suited to sandy soils. Biennial or annual. Becomes naturalized within native grasslands. Y
White or Dutch White clover including Ladino (Trifolium repens)	871,500	20.01	0.10	1.0	1.50	2.00	3.00	Statewide	Middle		Large vigorous form of white clover widely used in pasture mixes on irrigated land

INTRODUCED or NATURALIZED WILDFLOWERS

NOTE: These species are NOT native but are commonly included in commercial wildflower mixtures along with native species. Use of these species is generally NOT recommended due to the potential to invade native habitats or out-compete other seeded species.

SPECIES	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	BLOOM PERIOD	COC	COMMENTS
Catchfly, Sweet William (Silene armeria)	426,400								Middle		Annual
Cornflower (Centaurea cyanus)	96,000								Middle		Annual
Corn Poppy (Papaver rhoeas)	3,100,000								Middle		Annual
Cosmos, Sulphur (Cosmos sulphureus)	63,000								Middle		Annual

HERBACEOUS VEGETATION DESIGN PROCEDURES (550DP)-16

Cosmos, Sensation (Cosmos bipinnatus)	89,000								Middle		Annual
Chicory (Cichorium intybus)	426,400								Middle		Perennial
Dames Rocket (Hesperis matronalis)	224,000								Early		Listed on Nebraska Invasive Plant Watch List.
Shasta Daisy (Leucanthemum maximum var chrysanthemum)	436,000								Middle		Perennial
Scarlet Flax (Linum grandiflorum)	122,000								Middle		Annual

NATIVE FORBS and WILDFLOWERS

Use species that are appropriate to the ecological sites and area of the state.

SPECIES	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	BLOOM PERIOD	COC	COMMENTS
Alleghney Monkey Flower (Mimulus ringens)	32,000,000	734.62	0.01	0.03	0.04	0.05	0.08	Statewide	Late	6	Moist streambanks and other wet areas usually in wooded areas.
Alumroot (Heuchera richardsoni)	11,000,000	252.53	0.01	0.08	0.12	0.16	0.24	60A, 63B, 64, 65, 66, 102C, 107B	Early	8	Mesic to dry wooded ravines, often on sandy or limy soils.
American vetch (Vicia americana)	32,833	0.75	2.65	26.53	39.80	53.07	79.60	All but 65	Early	6	Legume. Moist to dry prairies, open woodlands and badlands.
Annual sunflower (Helianthus annuus)	46,919	1.08	1.86	18.6	27.9	37.2	55.8	Statewide	Late		A, M, Use plains sunflower on sandy sites
Arkansas rose (Rosa arkansana)	40,341	0.93	2.16	21.60	32.39	43.19	64.79	Statewide	Early	4	H, M. Shrub; upland prairies and open woodlands.
Aromatic aster (Symphyotrichum oblongifolium)	5,159,091	118.44	0.02	0.17	0.25	0.34	0.51	Statewide, except not 67A, 72	Late	5	Dry prairies
Ashy sunflower (Helianthus mollis)	201,777	4.63	0.43	4.32	6.48	8.64	12.95	106	Late		Upland prairies. Native only to extreme SE Nebraska.
Azure (Sky Blue) Aster	1,312,000	30.12	0.07	0.66	1.00	1.33	1.99	106, 107B	Late	7	Dry to mesic prairie and open woodlands.

HERBACEOUS VEGETATION DESIGN PROCEDURES (550DP)-17

(Symphyotrichum oolentangiense)											
Baldwin's Ironweed (Vernonia baldwinii)	698,000	16.02	0.12	1.25	1.87	2.50	3.74	63B, 65E, 71 pt 72, 73, 75, 102B, 106, 107B	Middle	3	Dry to damp prairies in E 2/3 but not in Sandhills or Panhandle
Beggar-ticks (Bidens frondosa)	195,300	4.48	0.45	4.46	6.69	8.92	13.38	Statewide	Late	1	A;damp woods and streamsides
Blackeyed Susan (Rudbeckia hirta)	1,575,760	36.17	0.06	0.55	0.83	1.11	1.66	Statewide	Middle	3	Moist to mesic prairies
Black samson / Purple coneflower (Echinacea angustifolia)	251,942	5.78	0.35	3.46	5.19	6.92	10.37	60A, 63B, 64, 65, 66, 67, 71, 72, 73, 75	Middle	5	Dry to mesic prairies, not common in Sandhills.
Blanketflower (Gaillardia aristata)	186,436	4.28	0.47	4.67	7.01	9.35	14.02	Statewide	Early	5	Annual. Dry, well-drained prairies. Native species is G. pulchella.
Blue Flag Iris (Iris virginica shrevei)	16,000	0.37	5.45	54.45	81.68	108.90	163.35	107B	Middle	6	Marshes, wet ares in extreme SE Nebraska
Blue Flax (Linum perenne)	295,000	6.77	0.30	2.95	4.43	5.91	8.86	Statewide	Middle		Introduced. Native species is L. perenne lewsii. Native variety found in MLRA 64.
Blue Lobelia / Great Blue Lobelia (Lobelia siphilitica)	18,917,000	434.27	0.01	0.05	0.07	0.09	0.14	Statewide	Middle	6	Shaded or open wet area. Near streams or standing water.
Blue vervain (Verbena hastata)	1,600,000	36.73	0.05	0.54	0.82	1.09	1.63	Statewide	Middle	4	Low prairies and meadows, along pond and creek edges, sandbars and low, open woodland
Boneset (Eupatorium perfoliatum)	2,986,842	68.57	0.03	0.29	0.44	0.58	0.88	Statewide	Late	5	Bottomlands, moist soils near streams and marshes.
Breadroot scurfpea (Pediomelum esculentum)	16,000	0.4	5.45	54.5	81.7	108.9	163.4	Statewide	Middle		Dry sites. Prairies and open woodlands
Broadleaf beardtongue (Penstemon angustifolius)	313,000	7.2	0.28	2.8	4.2	5.6	8.4	Statewide	Early		Adapted to wide range of soil textures and soils with a pH above 7.0

HERBACEOUS VEGETATION DESIGN PROCEDURES (550DP)-18

Brown-eyed Susan (<i>Rudbeckia trilobata</i>)	544,000	12.49	0.16	1.60	2.40	3.20	4.80	73, 75, 106	Middle		Tolerates more shade than Blackeyed Susan. Native to southern Plains (KS and south) not Nebraska. Can be aggressive
Bush morning-glory (<i>Ipomoea leptophylla</i>)	4,000	0.09	21.78	217.80	326.70	435.60	653.40	All but 75, 102C, 106, 107	Middle		M, sandy/gravelly sites
Butterfly milkweed (<i>Asclepias tuberosa</i>)	70,000	1.61	1.24	12.45	18.67	24.89	37.34	71, 75, 102C, 106, 107B	Middle	6	moist sites; wide range of soil textures
Camphor-weed (<i>Heterotheca latifolia</i>)	1,083,010	24.86	0.08	0.80	1.21	1.61	2.41	Statewide except 60A, 67A, 64, 72	Late		Dry to moist sands, especially in Sandhills and Central and Eastern Platte Valley
Canada goldenrod (<i>Solidago canadensis</i>)	7,087,500	162.71	0.01	0.12	0.18	0.25	0.37	Statewide	Middle	2	M, Aggressive
Canada milkvetch (<i>Astragalus canadensis</i>)	270,500	6.21	0.32	3.22	4.83	6.44	9.66	Statewide	Middle	5	Legume. Moist prairies, streambanks open woodlands.
Canada tick-trefoil / tick-clover (<i>Desmodium canadense</i>)	88,000	2.02	0.99	9.90	14.85	19.80	29.70	Statewide except 72	Middle	5	Moist to dry prairies
Candle anemone (<i>Anemone cylindrica</i>)	416,000	9.55	0.21	2.09	3.14	4.19	6.28	Statewide except 72	Middle	4	Common on upland prairies.
Cardinal flower (<i>Lobelia cardinalis</i>)	11,292,758	259.25	0.01	0.08	0.12	0.15	0.23	72, 73, 75	Late	6	Open or shaded wet areas; often near streams
Catnip (<i>Nepta cataria</i>)	759,157	17.43	0.11	1.15	1.72	2.30	3.44	Statewide	Middle		Introduced but naturalized;
Clasping coneflower (<i>Dracopis amplexicaulis</i>)	1,600,000	36.73	0.05	0.54	0.82	1.09	1.63	73, 75, 106	Early		Annual. Moist soils in bottomlands. Native to southern plains – not to Nebraska.
Common Evening Primrose (<i>Oenothera biennis</i>)	1,375,900	31.59	0.06	0.63	0.95	1.27	1.90	Statewide	Middle	1	Biennial. Disturbed areas. In Sandhills not found on dunes but may be present in interdunes areas.
Common Milkweed (<i>Asclepias syriaca</i>)	82,500	1.89	1.06	10.56	15.84	21.12	31.68	Statewide except 60A, 64, 67A and 72	Middle	1	All soil types except sandy soils. Excellent plant for monarch butterflies.

HERBACEOUS VEGETATION DESIGN PROCEDURES (550DP)-19

Common Ragweed (Ambrosia artemisiifolia)	220,837	5.07	0.39	3.94	5.92	7.89	11.83	Statewide			Common in E 2/3 on sandy to heavy and dry to moist soils. Especially common in disturbed or overgrazed areas.
Compass Plant (Silphium laciniatum)	10,560	0.24	8.25	82.5	123.75	165.00	247.50	75, 102C, 106, 107	Middle	5	Low mesic prairies; occasionally in uplands. Tall grass prairie species.
Cudweed sagewort / White Sage (Artemisia ludoviciana)	4,048,000	92.93	0.02	0.22	0.32	0.43	0.65	Statewide	Late	4	Dry prairies; all soil types and textures
Culver's Root (Veronicastrum virginicum)	12,000,000	275.48	0.01	0.07	0.11	0.15	0.22	106, 107B	Late	9	Remnant of mesic tall grass prairie of extreme SE part of state.
Cup-plant (Silphium perfoliatum)	64,085	1.47	1.36	13.59	20.39	27.19	40.78	75, 102C, 106, 107B	Middle	4	Low moist prairies and forest margins.
Curly-cup Gumweed (Grindelia squarrosa)	567,020	13.02	0.15	1.54	2.30	3.07	4.61	Statewide	Middle		Pastures, fields, roadsides and disturbed areas; not often on dunes in Sandhills.
Cutleaf coneflower (Rudbeckia laciniata)	406,300	9.33	0.21	2.14	3.22	4.29	6.43	Statewide, except 60A, 64, 67A, 72	Late	4	Marshes and moist woods
Cutleaf ironplant (Xanthisma spinulosum)	1,225,800	28.14	0.07	0.71	1.07	1.42	2.13	Statewide except 106, 107B	Middle	0	
Deer Vetch / American bird's foot trefoil (Lotus purshianus)	79,550	1.83	1.1	10.95	16.43	21.90	32.85	Statewide, except 72	Late	3	Moist sites.
Dotted Beebalm (Monarda punctata)	1,632,000	37.47	0.05	0.53	0.80	1.07	1.60		Middle		Known from Platte, Holt and Thomas counties; likely introduced.

HERBACEOUS VEGETATION DESIGN PROCEDURES (550DP)-20

Dotted gayfeather (<i>Liatris punctata</i>)	138,000	3.17	0.63	6.31	9.47	12.63	18.94	63B, 65, 66, 71, 72, 102B, 106, 107, 73, 75	Late	5	Found in upland native prairies on loess, glacial till and sand including Sandhills.
Entire-leaved rosinweed (<i>Silphium integrifolium</i>)	34,400	0.79	2.53	25.33	37.99	50.65	75.98	71, 73, 75, 102C, 106, 107B	Middle	4	Moist prairies.
False or oxeye sunflower (<i>Heliopsis helianthoides</i>)	104,100	2.39	0.84	8.37	12.55	16.74	25.11	63B, 65, 66, 71, 72, 102C, 106, 107, 73, 75,	Middle	4	Low prairies, forest margins, open woodlands
False-boneset (<i>Brickellia eupatoriodes</i>)	523,300	12.01	0.17	1.66	2.50	3.33	4.99	Statewide	Late	3	Wide range of soil types; heavy loess to sandy sites.
Field snake cotton (<i>Froelichia floridana</i>)	131,000	3.01	0.67	6.65	9.98	13.30	19.95	63B, 65, 66, 71, 72, 73, 75, 102C	Middle		Sandy soils; prairies and along rivers
Four-point evening primrose (<i>Oenothera rhombipetala</i>)	2,512,900	57.69	0.03	0.35	0.52	0.69	1.04	Statewide except 106	Middle	2	Sandy soils mesic to dry prairie sites.
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 Shrub
Foxtail prairie clover (<i>Dalea leporina</i>)	215,268	4.94	0.40	4.05	6.07	8.09	12.14	Statewide except panhandle	Middle		A, L found in disturbed, open ground. More common in E 1/2.
Fringed sagewort (<i>Artemisia frigida</i>)	4,536,000	104.13	0.02	0.19	0.29	0.38	0.58	60A, 63B, 64,65, 66, 67, 71, 72, 73	Late	6	Sand and sandy loam in W ½ of state; gravels and sands in the E ½. Scarce in sandhills.
Golden alexander (<i>Zizia aurea</i>)	176,000	4.04	0.50	4.95	7.43	9.90	14.85	107B, Eastern portions of 102C & 106	Early		Biennial. Low prairies, open woods of E 1/5 of Nebraska.
Grayhead coneflower (<i>Ratibida pinnata</i>)	427,500	9.81	0.20	2.04	3.06	4.08	6.11	71, 75, 102C, 106	Middle	6	Moist meadows and forest margins. Most common in counties adjacent to Missouri River.

HERBACEOUS VEGETATION DESIGN PROCEDURES (550DP)-21

Hairy golden aster / Silky golden aster (Heterotheca villosa)	1,124,000	25.8	0.08	0.78	1.16	1.55	2.33	60A, 63B, 64, 65	Middle	4	Sandy / gravelly sites. Heavier soils on dry slopes.
Hoary vervain (Verbena stricta)	586,046	13.45	0.15	1.49	2.23	2.97	4.46	Statewide	Middle	2	Common in disturbed prairies. Increases under grazing and forms large colonies under over-grazing.
Illinois bundleflower (Desmanthus illinoensis)	85,000	1.95	1.02	10.25	15.37	20.50	30.75	63, 66, 71, 73, 75, 102C, 106	Middle	5	L, moist ditches and streambanks. Rare in Panhandle.
Illinois tickclover (Desmodium illinoense)	67,000	1.54	1.30	13.00	19.50	26.01	39.01	17, 75, 102C, 106, 107B	Middle	6	L. prairie hillsides and roadsides E 1/3 of Nebraska.
Jerusalem artichoke (Helianthus tuberosus)	119,500	2.74	0.73	7.29	10.94	14.58	21.87	71, 73, 75, 102C, 106, 107	Late	4	Often in large, dense colonies in low meadows and damp ditches.
Lanceleaf Coreopsis (Coreopsis lanceolata)	221,000	5.07	0.39	3.94	5.91	7.88	11.83	75,102C, 106,107B	Middle		Introduced from Eastern US.
Late or Giant Goldenrod (Solidago gigantea)	700,000	16.07	0.12	1.24	1.87	2.49	3.73	Statewide	Late	3	Damp meadows and roadsides including sandhill and other sandy areas.
Leadplant (Amorpha canescens)	195,333	4.48	0.45	4.46	6.69	8.92	13.38	Statewide	Middle	6	L, M Shrub. Abundant on prairie hills. Absent from W 1/2 of Panhandle
Maryland Senna (Senna marlandica)	20,500	0.47	5.25	42.50	63.75	85.00	127.49	75, 106, 107b			Upland tallgrass prairie, ravines, creek banks and open woods
Maximilian sunflower (Helianthus maximiliani)	196,360	4.51	0.44	4.46	6.69	8.92	13.38	Statewide	Late	4	M, aggressive. Moist prairies and ditches state wide.
Missouri Evening Primrose (Oenothera macrocarpa ssp. macrocarpa)	75,500	1.73	1.15	11.54	17.31	23.08	34.62	73, 75, 106, 107			Southern tier of counties. Rocky prairies and slopes usually associated with limestone.
Missouri goldenrod (Solidago missouriensis)	6,312,130	144.91	0.01	0.14	0.21	0.28	0.41	Statewide	Middle	5	Common on dry prairies

HERBACEOUS VEGETATION DESIGN PROCEDURES (550DP)-22

New England aster (Symphyotrichum novae-angliae)	1,056,000	24.24	0.08	0.83	1.24	1.65	2.48	75, 102C, 106	Late	4	Low damp meadows and streamsid es.
New Jersey tea (Ceanothus americanus)	112,000	2.57	0.78	7.78	11.31	15.09	22.63	Statewide, except 60A, 64, 67, 72	Middle	6	Prairies and roadsides. Sandy and loamy soils
Obedience plant (Physostegia virginiana)	176,000	4.04	0.50	4.95	7.43	9.90	14.85	63B, 71, 75, 102B, 106, 107,	Late		Moist areas near streams or marshes often in or near woods
Ohio Spiderwort (Tradescantia ohioensis)	128,000	2.94	0.68	6.81	10.21	13.61	20.42	106, 107B	Early	5	Dry to moist prairies
Pale purple coneflower (Echinacea pallida)	106,000	2.43	770,0000.82	8.22	12.33	16.44	24.66	MLRA's within veg. Zone IV	Middle		Tall grass prairie species
Pink Poppy Mallow (Callirhoe alcaeooides)	89,476	2.05	0.97	9.74	14.61	19.47	29.21	71, 75, 106; Southern 102C, 107B	Middle	5	Upland tallgrass prairie and lowland tallgrass prairie along rivers
Pitcher sage (Salvia azurea)	300,000	6.89	0.29	2.90	4.36	5.81	8.71	75, 102C, 106	Late	6	Upland prairies
Plains Beebalm (Monarda pectinata)	1,843,900	42.33	0.05	0.47	0.71	0.94	1.42	60A, 64, 67A, 65, 72, 73	Middle		Open sandy places especially in Sandhills prairies
Plains coreopsis (Coreopsis tinctoria)	3,222,222	73.97	0.03	0.27	0.41	0.54	0.81	63B, 65, 66, 71, 73, 75, 102C, 106, 107	Middle	1	A, M, moist sites
Plains or Prairie sunflower (Helianthus petiolaris)	114,200	2.62	0.76	7.63	11.44	15.26	22.89	Statewide	Late	2	A, M, Sandy soils only
Plains wild or false indigo (Baptisia bracteata var, leucophaea)	27,200	0.62	3.20	32.03	48.04	64.06	96.09	75, 106	Middle	7	Upland prairies.
Prairie Coreopsis (Coreopsis palmata)	200,000	4.59	0.44	4.36	6.53	8.71	13.07	102, 106, 107B	Middle	8	Meadows and prairies of extreme Eastern Nebraska.

HERBACEOUS VEGETATION DESIGN PROCEDURES (550DP)-23

Prairie gentian (<i>Eustoma exaltatum</i> syn: <i>orgrandiflorum</i> or <i>russellianum</i>)	2,240,000	51.42	0.04	0.39	0.58	0.778	1.17	60A, 64, 65W 67, 72, 71, 74 South part 106	Middle	4	Low, damp areas and sandy and/or alkaline meadows. Common in the western Platte valley
Prairie (White) larkspur (<i>Delphinium carolinianum</i> ssp. <i>virescens</i>)	749,300	17.2	0.12	1.16	1.74	2.33	3.49	Statewide	Middle	6	Common in prairies throughout Nebraska
Prairie phlox (<i>Phlox pilosa</i>)	304,000	6.98	0.29	2.87	4.30	5.73	8.60	107B, Eastern parts 102C & 106	Middle	8	Tall grass prairie species
Prairie Ragwort (<i>Packera plattensis</i>)	2,338,500	53.68	0.04	0.37	0.56	0.75	1.12	Statewide	Early	5	Common on prairie sites except Sandhills, sand plains and other very sandy areas.
Prairie Sainfoin (<i>Onobrychis viciifolia</i>)	30,240	0.69	2.88	28.81	43.21	57.62	86,43	106			
Prairie spiderwort (<i>Tradescantia occidentalis</i>)	134,880	3.10	0.65	6.46	9.6	12.92	19.38	Statewide	Early	5	Dry sites
Prairie violet (<i>Viola pedatifida</i>)	46,500	1.1	1.87	18.7	28.1	37.5	56.2	102C, 106, 107B	Early	6	Tallgrass prairie sites
Purple coneflower (<i>Echinacea purpurea</i>)	115,500	2.66	0.75	7.53	11.30	15.06	22.60	75, 102C, 106, 107	Middle		Tallgrass prairie sites (different species than Black Samson)
Purple poppy mallow (<i>Callirhoe involucrata</i>)	122,000	2.8	0.714	7.14	10.71	14.28	21.42	71, 75, ?	Middle	2	Prefers moist sites
Purple prairie clover (<i>Dalea purpurea</i>)	317,000	7.28	0.27	2.75	4.12	5.50	8.24	Statewide	Middle	6	L, KanNeb variety preferred
Rattlesnake master (<i>Eryngium yuccifolium</i>)	177,776	4.08	0.49	4.90	7.35	9.80	14.70	Southern portions of 106, 107B	Middle	9	Lowland tallgrass prairies
Rayless Greenthread (<i>Thelesperma megapotamicum</i>)	232,618	5.34	0.37	3.75	5.62	7.49	11.24	Statewide except 63B, 65E, 102C, 106, 107	Middle		Common on sandy soils of panhandle, SW, S Central and Platte Valley
Rocky Mountain Bee Plant (<i>Cleome serrulata</i>)	64,000	1.47	1.36	13.61	20.42	27.23	40.84	Statewide except 63B, 75	Middle	0	A, M, sandy/gravelly sites. Sometimes found on roadsides and disturbed areas.

HERBACEOUS VEGETATION DESIGN PROCEDURES (550DP)-24

Rough Blazingstar (<i>Liatris aspera</i>)	191,000	4.38	0.46	4.56	6.84	9.12	13.68	63B, 65, 66, 71, 73, 75, 102C, 106, 107B	Late	5	Common in native prairies on loess, glacial till and sandy loam in E ½ of State. Absent from Sandhills.
Rough Purple Gerardia (<i>Agalinis aspera</i>)	2,575,545	59.13	0.03	0.34	0.51	0.68	1.01	63B, 65, 71, 73, 75, 106, S part 107B	Late	10	A, dry upland prairie slopes
Roundhead lespedeza (<i>Lespedeza capitata</i>)	174,000	3.99	0.50	5.01	7.51	10.01	15.02	63B, 65, 66, 71, 73, 75, 102C, 106, 107B	Late	5	Upland prairies and pastures
Sand Milkweed (<i>Asclepias arenaria</i>)	49,750	1.14	1.75	17.51	26.27	35.02	52.53	60A, 63B, 65, 67A, 72, 73, 71, 75, 102B	Middle		Deep, loose dry sand of sandhills and river valleys. Not found in heavy soils.
Sawtooth sunflower (<i>Helianthus grosseserratus</i>)	630,000	14.46	0.138	1.38	2.07	2.77	4.15	65, 66, 71, 75, 102C, 106, 107B	Late	4	Damp to dry, sunny sites on variety of soils
Scaly Blazingstar (<i>Liatris squarrosa</i> (syn. <i>Glabrata</i>))	269,276	6.18	0.32	3.24	4.85	6.47	9.71	Statewide except 75 and 106	Late	5	Dry native prairies and sand plains. Common in Sandhills.
Scarlet globemallow (<i>Sphaeralcea coccinea</i>)	500,00	11.48	0.17	1.74	2.61	3.48	5.23	60A, 63B, 64, 65, 66, 67, 71, 72, 73, 75, 102C	Early	4	Dry soils; light, gravelly, limestone or sandy clay soils
Seedbox (<i>Ludwigia alternifolia</i>)	20,800,000	477.50	0.01	0.04	0.06	0.08	0.13	75, 106, 107S	Late	4	Seeps and springs. Southern tier of counties.
Sensitive briar (<i>Mimosa nuttallii</i>)	44,000	1.01	1.98	19.8	29.70	39.60	59.40	63B, 66, 71, 73, 75	Middle	6	L, dry sites
Shell-leaf /beardtongue penstemon (<i>Penstemon grandiflorus</i>)	264,000	6.06	0.33	3.30	4.95	6.60	9.90	63B, 65, 66, 71, 72, 73, 75, 102C, 106	Early	5	Prairies, especially sandy or disturbed areas
Showy partridgepea (<i>Cassia fasciculata</i> var <i>fasciculata</i>)	65,000	1.49	1.34	13.40	20.10	26.81	40.21	63B, 65, 66, 71, 72, 73, 75, 102C, 106, 107B	Middle	1	A, L, M, Platte variety preferred

HERBACEOUS VEGETATION DESIGN PROCEDURES (550DP)-25

Showy-wand goldenrod (Solidago speciosa)	4,283,019	98.32	0.02	0.20	0.31	0.41	0.61	102C, 106, 107B and northern Sandhills	Late	7	Dry to mesic prairies on heavy to sandy soils.
Silky Aster (Symphyotrichum sericeum)	800,000	18.37	0.11	1.09	1.63	2.18	3.27	102C, 106, 107B			Dry prairies (not sandy soils) and woodland openings. More common in the SE ¼.
Silky prairie clover (Dalea villosa)	206,100	4.73	0.42	4.23	6.34	8.45	12.68	Statewide except 106, 107B	Middle	5	sandy sites
Sleepy catchfly (Silene antirrhina)	5,968,421	137.02	0.01	0.15	0.22	0.29	0.44	64, 65, 102, 71, 75, 106, 107B	Early	2	Disturbed ground of openuplands.
Slender Beardtongue (Penstemon gracilis)								63B, 64, 65, 71, 102B, 106, 107B	Middle	6	Prairie slopes; wide range of soil types
Slimflower scurfpea / Wild alfalfa (Psoralidium tenuiflorum)	34,000	0.78	2.56	25.62	38.44	51.25	76.87	60A, 64, 65, 66	Middle	3	A, L, M
Smooth blue aster (Symphyotrichum leave var leave)	1,014,000	1.	0.09	0.86	1.29	1.72	2.58	North and East tier of counties	Late		Woodlands, forests, forest margins and prairies along the Missouri River and Niobrara and White River drainages
Smooth milkweed (Asclepias sullivantii)	72,000	1.65	1.21	12.10	18.15	24.20	36.30	65E, 71, 75, 102C, 106, 107B	Middle		Common in lowland native prairies in E ½ of state. Does not tolerate disturbance.
Sneezeweed (Helenium autumnale)	1,771,875	40.68	0.05	0.49	0.74	0.98	1.48	Statewide	Late	7	Sandbars, sandy riverbanks, floodplain marshes and forests. In Sandhills is found on sedge-peat mounds and sandy depressions.
Soft Goldenrod (Solidago mollis)	9,265,326	212.70	0.01	0.09	0.14	0.19	0.28	Statewide except 107 and east tier of 102C & 106	Middle	6	Dry prairies on heavy to sandy soils. Common in Sandhills. Absent from E 1/6 of state.

HERBACEOUS VEGETATION DESIGN PROCEDURES (550DP)-26

Spotted Joe-Pye Weed (Eupatorium maculatum)	1,360,000	31.22	0.06	0.64	0.96	1.28	1.92	Statewide except	Late	4	Native is subspecies bruneri. Low moist woods and shaded marshes. Sunny marshes in Sandhills and North Platte Valley.
Stiff goldenrod (Oligoneuron rigidum)	673,591	15.46	0.13	1.29	1.94	2.59	3.88	Statewide	Late	6	Dry prairies on a wide variety of soil types.
Stiff sunflower (Helianthus pauciflorus)	740,000	16.99	0.12	1.18	1.77	2.35	3.53	Statewide	Middle	3	Dry prairies and ranges; common in sandhills
Swamp milkweed (Asclepias incarnata)	153,761	3.53	0.57	5.67	8.50	11.33	17.00	Statewide	Middle	5	Wet sites, Marshes, wet ditches, lake-and-stream sites
Tall boneset (Eupatorium altissimum)	2,560,00	58.77	0.03	0.34	0.51	0.68	1.02	71, 102C, 106, 107B	Late		Dry pastures and roadsides. One of the few native species that thrive in smooth brome infested rangelands.
Tall Coreopsis (Coreopsis tripteris)	1,648,000	37.83	0.05	0.53	0.79	1.06	1.59	106, 107S		4	Extreme SE portion of state
Tall cinquefoil (Drymocallis arguta)	3,687,804	84.66	0.02	0.24	0.35	0.47	0.71	State wide except 67A, 72, 73	Middle	3	Dry prairies, open woods; common in east ½ and North tier of counties.
Tall swamp marigold (Bidens connata)	130,000	2.98	0.67	6.70	10.05	13.40	20.10	63B, 65E, 71, 75, 102C, 106, 107B	Late	4	Marshes, shores and wet areas; may be found in saline wetlands.
Tall Thistle (Cirsium altissimum)	96,884	2.22	0.90	8.99	13.49	17.98	26.98	Statewide except not 60A,, 64, 67A, 65W	Late	1	Moist soils ranging from loams to somewhat sandy
Thickspike gayfeather (Liatris pycnostachya)	120,000	2.75	0.73	7.26	10.89	14.52	21.78	75, 102C, 106	Late	1	Low moist native prairies and prairie restorations
Upright Prairie coneflower (Ratibida columnifera)	737,104	16.92	0.12	1.18	1.77	2.36	3.55	60A, 63B, 64, 65, 66, 67, 71, 72, 73, 75	Middle	4	Prairies, meadows, pastures, rangelands on variety of soils including clay, loam and sand. Common in Sandhills

HERBACEOUS VEGETATION DESIGN PROCEDURES (550DP)-27

Velvety gaura (<i>Gaura parviflora</i>)	64,812	1.49	1.34	13.44	20.16	26.88	40.33	Statewide	Middle		Common in disturbed areas.
Virginia mountain mint (<i>Pycnanthemum virginianum</i>)	1,600,000	36.73	0.05	0.54	0.82	1.09	1.63	65, 63, 71, 75, 102C, 106, 107B	Middle	1	Lowland tallgrass prairie and wet meadows in floodplains in sandy loam soil in NC, SE and SC Nebraska
Western Salsify (<i>Tragopogon dubius</i>)	67,0808										
Western heath aster (Aster (<i>Symphotrichum</i>) <i>falcatus</i>)	5,044,444	115.80	0.02	0.17	0.26	0.35	0.52	60A, 63B, 64, 65, 67A, 71, 72, 73	Late	6	Mesic to dry prairies.
Western Ironweed (<i>Vernonia fasciculata</i>)	384,000	8.82	0.23	2.27	3.40	4.54	6.81	63A, 65, 71, 73, 75, 102C, 106, 107B and North Platte Valley	Middle		Moist prairies especially near streams
Western ragweed (<i>Ambrosia psilostachya</i>)	194,400	4.46	0.45	4.48	6.72	8.96	12.44	Statewide			Prairies, rangeland, pastures on sandy to heavy clay soils.
Western Salsify (<i>Tragopogon dubius</i>)	64,812	1.49	1.34	13.44	20.16	26.88	40.33	Statewide	Early		Introduced. Common on disturbed soils and meadows.
Western Wallflower (<i>Erysimum asperum</i>)	1,233,600	28.32	0.07	0.71	1.06	1.41	2.12	60A, 63B, 64, 65, 72, 71	Early		Biennial. Common in prairies. Native to western 3/4 of state.
Western wild (Wood's) rose (<i>Rosa woodsii</i>)	51,000	1.17	1.71	17.08	25.62	34.16	51.25	Statewide except 71, 106, 107B	Early		Common on a variety of soils.
Western yarrow (<i>Achillea millefolium</i> var <i>lanulosa</i>)	2,852,012	65.47	0.03	0.31	0.46	0.61	0.92	Statewide	Early	4	Dry to mesic meadows, pastures, rangeland and roadcuts
White false(wild) indigo (Baptisia <i>alba</i> var. <i>macrophylla</i> syn: <i>B. leucantha</i>)	27,200	0.62	3.20	32.03	48.04	64.06	96.09	106	Early	4	Locally common in SE Nebraska prairies
White heath aster (<i>Symphotrichum ericoides</i>)	3,200,000	73.46	0.03	0.27	0.41	0.54	0.82	Statewide	Late	3	Mesic to dry prairies and along roadsides

HERBACEOUS VEGETATION DESIGN PROCEDURES (550DP)-28

White Prairie Aster (Symphyotrichum falcatum var. commutatum)	496,000	11.39	0.18	1.76	2.63	3.51	5.27	Statewide			Dry mesic sites, especially in western Nebraska
White prairie clover (Dalea candida Variety "candida" and "oligophylla")	384,000	8.82	0.23	2.3	3.4	4.5	6.8	63B, 65, 66, 71, 73E, 75, 102C, 106, 107B	Middle	6	L Use eastern Great Plains origin if variety unknown.
White prairie clover (Dalea candida Var. "oligophylla")	384,000	8.82	0.23	2.3	3.4	4.5	6.8	60A, 64, 65W, 67, 72, 73	Middle	6	L Use eastern Great Plains origin if variety unknown.
Whorled milkweed (Asclepias verticillata)	176,000	4.04	0.50	4.95	7.43	9.90	14.85	Statewide	Middle	6	Common to abundant in native prairies and pastures
Wild bergamot (Monarda fistulosa)	1,272,500	29.21	29.21	0.07	0.68	1.03	2.05	63B, 65, 66, 71, 72, 73, 75, 102C, 106, 107	Middle	1	Pastures, prairies and woodland edges.
Wild 4 O'Clock (Mirabilis nyctaginea)	105,700	2.43	0.82	8.24	12.36	16.48	24.73	Statewide	Middle		Disturbed areas in prairies, open woodlands, floodplain meadows and edges of marshlands.
Wild garlic (Allium canadense)	150,597	3.46	0.58	5.78	8.68	11.57	17.35	Statewide except 60A, 64, 67A, 72	Early	5	There are 3 subspecies native to Nebraska; ranges from moist low meadows and forests to dry to mesic prairies on variety of soils.
Wild onion (Allium cernuum)	123,200	2.83	0.71	7.07	10.61	14.14	21.21	60A, 64, 65W, 67A	Middle		Open pine woodlands and prairies in Panhandle
Winterfat (Krascheninnikovia lanata)	125,000	2.87	0.70	6.97	10.45	13.94	20.91	60A, 64, 67, 72			H, M, Shrub, fall seed only
Woolly plantain (Plantago patagonica)	610,215	14.01	0.14	1.43	2.14	2.86	4.28	Statewide	Middle		Dry, sandy or gravelly soils
Yucca (Small soapweed) (yucca glauca)	19,837	0.46	4.39	43.92	65.88	87.84	131.75	Statewide except 107B	Early		Sandy and well drained sloping soils and dry river terraces

ANNUAL GRASSES / CEREAL GRAINS AND WARM SEASON COVERS FOR GRASS SEEDINGS

Use species that are appropriate to the area of the state and purpose of planting.

SPECIES	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	BLOOMING PERIOD		COMMENTS
Barley	14,000	0.3	6.22	62.2	93.3	124.5	186.7				
Oats	13,000	0.3	6.70	67.0	100.5	134.0	201.0				
Rye	18,000	0.4	4.84	48.4	72.6	96.8	145.2				
Wheat	15,000	0.3	5.81	58.1	87.1	116.2	174.2				
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	28,000	0.6	3.11	31.1	46.7	62.2	93.3				
Sudan grass	55,000	1.3	1.58	15.8	23.8	31.7	47.5				

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 bromegrass.
 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

$R = 82/6.8 = 12$ 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. Seedings 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](#)

[Grass and Forb Seed Source Requirements](#)

[Information on State seed law](#)

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