

## Calculating Seeding Rates for Conservation Plantings

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# Plant Materials Technical Note

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### Background

The amount of seed planted across the landscape is known as the seeding rate. Proper seeding rates are essential in conservation planting stand establishments. Low seeding rates yield a less dense established stand of desirable vegetation and greater weed competition. Although excessively high seeding rates can reduce weed pressure, they are not cost effective and reduce plant vigor due to competition for water and nutrients. Applying seed at the proper rate creates a balance between costs, weed suppression, and stand health.

### Purpose

The purpose of this technical note is to provide information on proper seeding rate calculations, calculating seeding mixtures, and list of seed per pound of conservation plant species that occur in Texas.

## Pure Live Seed (PLS) vs Bulk Seed

Not all seed will germinate and produce a healthy plant. In every bag of seed there exists a certain amount of pure living seed (which is capable of germinating and growing) along with non-viable seed and inert material such as bits of stalk, dust, pebbles, etc. The amount of pure living seed is referred to as pure live seed (PLS) while the combined amount of pure living seed, non living seed and inert material is referred to as bulk seed.

To assist in determining the percent pure and viable seed in a seed lot, many seed companies have seed tested to determine the percent purity and percent germination. The use of PLS guarantees that the same amount of viable seed per acre is planted even though different seed lots with varying seed quality is used.

## Calculating PLS

PLS can be determined for any lot of seed which has a current (< 9 month old) seed test. The seed test documents percent germination, percent purity and percent dormant seed for a specific lot of seed tested. The percent PLS is determined by using the following equation:

$$\frac{(\% \text{Germination} + \% \text{Hard Seed})(\% \text{Purity})}{100} = \% \text{ PLS}$$

## Definitions of Common Terms

The following definitions should assist in providing clarity relative to various terms associated with seeding rate calculations:

- Pure Seed - seeds of each kind and/or cultivar, or kind(s) and variety, under consideration, which are present in excess of 5% of the whole.
- Weed Seed – Seeds, florets, bulbletes, tubers or sporocaps of plants recognized as weeds by law, official regulation or by general usages.
- Germination – The maximum plant producing potential of a seed lot (i.e. the capability to germinate and produce a normal seedling under favorable conditions.)
- Dormant Seed – Viable seeds which fail to germinate when provided the specified germination conditions for the kind of seed in question. Dormant seeds have imbibed water and are swollen in size but have not germinated by the end of the test period. Many grasses and native species are known to have varying types and amounts of dormancy.
- Hard Seed – Seeds that remain hard at the end of the prescribed test period because they have not absorbed water due to an impermeable seed coat. Legumes are best known for hard seeds.
- Variety – A taxonomic subdivision of a species consisting of naturally occurring or selectively bred populations or individuals that differ from the remainder of the species in certain minor characteristics.

## Calculating Seed Mixtures

Most conservation plantings consist of multiple plant species rather than one single plant species. When developing a conservation planting mix, the total mixture should not exceed 100 percent. In calculating the mixture seeding rate, the full seeding rate per specie is multiplied by the percent that specie is represented in the mix then multiplied by the number of acres to be planted. For example:

| <b>Plant Species</b> | <b>% Mix Planned</b> | <b>Seeding Rate</b> | <b>Acres</b> | <b>Total PLS #</b> |
|----------------------|----------------------|---------------------|--------------|--------------------|
| Sand bluestem        | 40                   | 6                   | 1            | 2.4                |
| Sand dropseed        | 40                   | 1                   | 1            | .4                 |
| Bush sunflower       | <u>20</u>            | 2.6                 | 1            | .52                |
|                      | 100                  |                     |              |                    |

## Seeding Rate Calculation

There are two basic factors that must be determined in order to calculate a proper seeding rate. The first factor is determining the amount of desired seedling per square foot (density.) The second factor is the number of seed per pound of the species being planted.

A seeding rate is expressed in PLS pounds per acre and is based on planting a pre-determined number of live seed per square foot to achieve a specific plant density. For conservation planting purposes in Texas, seeding rates that achieve the desired plant density of 20 to 30 live seed per square foot is considered optimum. These figures are fairly standard except when calculating seeding rates for plant species with very large or very small seed sizes (e.g. eastern gamagrass vs. spike dropseed.) Under these situations seeding rates may be low as 5 PLS per square foot for large seeded species compared to over 200 PLS for small seeded species.



Eastern gamagrass seed



Spike dropseed seed

### **Example Seeding Rate Calculation**

In calculating seeding rates, a constant mathematical factor (seed/acre factor) relating to seed per square foot must be determined. For 20 PLS seed per square foot, the constant factor is 871,200 seed per acre. (e.g.  $(43,560 \text{ ft}^2/\text{ac})(20 \text{ PLS}/\text{ft}^2) = 871,200 \text{ seed}/\text{acre}$ )

After the seed/acre factor is determined, the seeding rate is calculated by using the following equation:  $(\text{Seed}/\text{acre factor}) / (\text{seed}/\text{pound}) = \text{pound}/\text{acre}$

### **Example calculation:**

'Alamo' switchgrass has 427,365 seed/pound. Using the seeding rate calculation equation  $\{(\text{Seed}/\text{ac factor}) / (\text{seed}/\text{pound}) = \text{pound}/\text{ac}\}$  it is determined that the proper seeding rate is 2.0 PLS pounds/ acre.

$(871,200 \text{ seed}/\text{acre}) / (427,365 \text{ seed}/\text{pound}) = 2.039$  or 2.0 PLS #/ac.

### **Considerations**

Seed per pound varies not only among species but within the same species and within different years. Certain plant varieties are selected according to seed weight which can be related to seed fill. A good example of this is kleingrass. 'Verde' kleingrass was developed and selected for increases seed size from kleingrass accessions. 'Verde' kleingrass was a cooperative plant release by the James E. "Bud" Smith Plant Materials Center and the Texas Agricultural Experiment Station in 1982. When calculating a new seeding rate, it cannot be assumed that the number of seed per pound is consistent with other plant varieties. Seeding rate numbers should be based upon multiple years of evaluation. Following is a table with the average pure seed per pound of various conservation plant species commonly found in Texas.

## Seed per Pound of Common Conservation Plants

\*\*Compiled from records of the Former Soil Conservation Service Seed Laboratory, San Antonio Nursery

| Common Name Of Seed                    | Scientific Name                      | Seeds Per Pound Of Pure Seed |
|--|--------------------------------------|------------------------------|
| <b>GRASSES</b>                         |                                      |                              |
| Bahiagrass                             | <i>Paspalum notatum</i>              | 239,000                      |
| Bahiagrass, Pensacola                  | <i>Paspalum notatum</i>              | 265,000                      |
| Bermudagrass                           | <i>Cynodon dactylon</i>              | 1,580,000                    |
| Bluegrass, Texas                       | <i>Poa archnifera</i>                | 1,847,000                    |
| Bluestem, Big (Grain)                  | <i>Andropogon gerardi</i>            | 191,000                      |
| Bluestem, Big - 'Earl'                 | <i>Andropogon gerardi</i>            | 145,000                      |
| Bluestem, Cane                         | <i>Andropogon barbinodis</i>         | 754,000                      |
| Bluestem, King Ranch (Processed Seed)  | <i>Andropogon ischaemun</i>          | 835,000                      |
| Bluestem, Little (Combine Run)         | <i>Andropogon scoparius</i>          | 255,000                      |
| Bluestem, Little (Grain)               | <i>Andropogon scoparius</i>          | 379,000                      |
| Bluestem, Sand (Semi-processed)        | <i>Andropogon hallii</i>             | 125,000                      |
| Bluestem, Seacoast                     | <i>Andropogon littoralis</i>         | 321,000                      |
| Bluestem, Silver                       | <i>Andropogon saccharoides</i>       | 506,000                      |
| Bristlegrass, Plains                   | <i>Setaria macrostachya</i>          | 293,000                      |
| Bristlegrass, Southwestern             | <i>Setaria schaelei</i>              | 390,000                      |
| Buffalograss                           | <i>Buchloe dactyloides</i>           | 275,000                      |
| Buffelgrass                            | <i>Pennisetum ciliare</i>            | 867,000                      |
| Cottontop, Arizona                     | <i>Digitaria californica</i>         | 726,000                      |
| Cottontop, Arizona – Lasalle Germplasm | <i>Digitaria californica</i>         | 677,000                      |
| Cottontop, Texas                       | <i>Digitaria patens</i>              | 711,000                      |
| Cupgrass, Texas                        | <i>Eriochloa sericea</i>             | 558,500                      |
| Curlymesquite                          | <i>Hilaria belangeri</i>             | 269,000                      |
| Dallisgrass                            | <i>Paspalum dilatatum</i>            | 260,000                      |
| Dropseed, Giant                        | <i>Sporobolus giganteus</i>          | 1,417,000                    |
| Dropseed, Meadow Tall                  | <i>Sporobolus asper var. hookeri</i> | 823,000                      |
| Dropseed, Mesa                         | <i>Sporobolus flexuosus</i>          | 3,329,000                    |
| Dropseed, Sand                         | <i>Sporobolus cryptandrus</i>        | 5,638,000                    |

| <b>Common Name Of Seed</b>      | <b>Scientific Name</b>                    | <b>Seeds Per Pound Of Pure Seed</b> |
|---------------------------------|---|-------------------------------------|
| Dropseed, Spike                 | <i>Sporobolus contractus</i>              | 2,885,000                           |
| Dropseed, Tall                  | <i>Sporobolus asper</i>                   | 503,000                             |
| Galleta                         | <i>Hilaria jamesii</i>                    | 159,000                             |
| Gamagrass, Eastern              | <i>Tripsacum dactyloides</i>              | 7,500                               |
| Grama, Black                    | <i>Bouteloua eriopoda</i>                 | 1,335,000                           |
| Grama, Blue                     | <i>Bouteloua gracilis</i>                 | 711,000                             |
| Grama, Hairy                    | <i>Bouteloua hirsuta</i>                  | 685,000                             |
| Grama, Red                      | <i>Bouteloua trifida</i>                  | 3,155,000                           |
| Grama, Sideoats                 | <i>Bouteloua curtipendula</i>             | 193,600                             |
| Grama, Sideoats - 'Haskell'     | <i>Bouteloua curtipendula</i>             | 579,000                             |
| Grama, Slender (Combine Run)    | <i>Bouteloua filiformis</i>               | 184,000                             |
| Grama, Slender (Grain)          | <i>Bouteloua filiformis</i>               | 981,000                             |
| Grama, Texas                    | <i>Bouteloua rigidiseta</i>               | 84,000                              |
| Indiangrass, Yellow - 'Lometa   | <i>Sorghastrum nutans</i>                 | 168,434                             |
| Indiangrass, Yellow (Processed) | <i>Sorghastrum nutans</i>                 | 175,000                             |
| Indiangrass, Yellow (Grain)     | <i>Sorghastrum nutans</i>                 | 180,000                             |
| Lovegrass, Plains               | <i>Eragrostis intermedia</i>              | 3,386,000                           |
| Lovegrass, Sand                 | <i>Eragrostis trichodes</i>               | 1,550,000                           |
| Lovegrass, Sandhill - 'Mason'   | <i>Eragrostis trichodes var. pilifera</i> | 2,014,852                           |
| Melic, Threeflower              | <i>Melica nitens</i>                      | 554,000                             |
| Millet, Foxtail                 | <i>Setaria italica</i>                    | 232,000                             |
| Muhly, Bush                     | <i>Muhlenbergia porteri</i>               | 2,424,000                           |
| Muhly, Green                    | <i>Muhlenbergia racemosa</i>              | 1,608,000                           |
| Muhly, Red                      | <i>Muhlenbergia repens</i>                | 1,417,000                           |
| Muhly, Sandhill                 | <i>Muhlenbergia pungens</i>               | 747,000                             |
| Muhly, Spike                    | <i>Muhlenbergia wrightii</i>              | 1,635,000                           |
| Needlegrass, Green              | <i>Stipa viridula</i>                     | 179,000                             |
| Needlegrass, Needleandthread    | <i>Stipa comata</i>                       | 115,000                             |
| Needlegrass, Texas              | <i>Stipa leucotricha</i>                  | 68,000                              |
| Panicum, Blue                   | <i>Panicum antidotale</i>                 | 651,000                             |
| Panicum, Halls                  | <i>Panicum hallii</i>                     | 559,000                             |

| <b>Common Name Of Seed</b>      | <b>Scientific Name</b>                  | <b>Seeds Per Pound Of Pure Seed</b> |
|---------------------------------|---|-------------------------------------|
| Panicum, Kleingrass             | <i>Panicum coloratum</i>                | 497,000                             |
| Panicum, Texas                  | <i>Panicum texanum</i>                  | 103,000                             |
| Pappusgrass, Pink               | <i>Pappophorum bicolor</i>              | 285920                              |
| Pappusgrass, Whiplash           | <i>Pappophorum mucronulatum</i>         | 389,000                             |
| Paspalum, Brownseed             | <i>Paspalum plicatulum</i>              | 282,000                             |
| Paspalum, Fringeleaf            | <i>Paspalum ciliatifolium</i>           | 422,000                             |
| Paspalum, Hartweg               | <i>Paspalum hartwegianum</i>            | 645,000                             |
| Redtop                          | <i>Agrostis alba</i>                    | 6,038,000                           |
| Rescuegrass                     | <i>Bromus catharticus</i>               | 48,000                              |
| Rescuegrass (Australian Strain) | <i>Bromus catharticus</i>               | 43,000                              |
| Rhodesgrass (Processed)         | <i>Chloris gayana</i>                   | 1,337,000                           |
| Rhodesgrass (Combine Run)       | <i>Chloris gayana</i>                   | 1,405,000                           |
| Rhodesgrass (Grain)             | <i>Chloris gayana</i>                   | 2,327,000                           |
| Ricegrass, Indian               | <i>Oryzopsis hymenoides</i>             | 141,000                             |
| Ryegrass, Italian               | <i>Lolium multiflorum</i>               | 241,000                             |
| Ryegrass, Perennial             | <i>Lolium perenne</i>                   | 227,000                             |
| Ryegrass, Westerwold            | <i>Lolium multiflorum var. woldicum</i> | 194,000                             |
| Sacaton                         | <i>Sporobolus wrightii</i>              | 1,965,000                           |
| Sacaton, Alkali                 | <i>Sporobolus airoides</i>              | 1,355,000                           |
| Sacaton, Alkali - 'Saltalk'     | <i>Sporobolus airoides</i>              | 1,669,812                           |
| Saltgrass, Inland               | <i>Distichlis stricta</i>               | 518,000                             |
| Sprangletop, Green              | <i>Leptochloa dubia</i>                 | 538,000                             |
| Switchgrass                     | <i>Panicum virgatum</i>                 | 278,000                             |
| Switchgrass - 'Alamo'           | <i>Panicum virgatum</i>                 | 427,365                             |
| Switchgrass, False              | <i>Panicum plenum</i>                   | 518,000                             |
| Texasgrass                      | <i>Vaseyochloa multinervosa</i>         | 198,000                             |
| Tobosa                          | <i>Hilaria mutica</i>                   | 204,000                             |
| Trichloris, Fourflower          | <i>Trichloris pluriflora</i>            | 1,258,000                           |
| Trichloris, Twoflower           | <i>Trichloris crinita</i>               | 1,428,000                           |
| Tridens, Longspike              | <i>Tridens strictus</i>                 | 2,138,000                           |
| Tridens, Purpletop              | <i>Tridens flavus</i>                   | 451,000                             |
| Tridens, Rough                  | <i>Tridens elongatus</i>                | 444,000                             |
| Tridens, Texas                  | <i>Tridens texanus</i>                  | 853,000                             |
| Tridens White                   | <i>Tridens albescens</i>                | 1,801,000                           |

| Common Name Of Seed                    | Scientific Name                  | Seeds Per Pound Of Pure Seed |
|--|----------------------------------|------------------------------|
| <b>GRASSES</b>                         |                                  |                              |
| Uniola, Broadleaf                      | <i>Uniola latifolia</i>          | 94,000                       |
| Vine-mesquite                          | <i>Panicum obtusum</i>           | 144,000                      |
| Wheatgrass, Western                    | <i>Agropyron smithii</i>         | 126,000                      |
| Wildrye, Canada                        | <i>Elymus canadensis</i>         | 106,000                      |
| Windmillgrass, Hooded                  | <i>Chloris cucullata</i>         | 2,194,000                    |
| Windmillgrass, Shortspike              | <i>Chloris subdolichostachya</i> | 1,989,000                    |
| Windmillgrass, Tumble                  | <i>Chloris verticillata</i>      | 1,867,000                    |
| Witchgrass, Fall                       | <i>Leptoloma cognatum</i>        | 921,000                      |
| <b>LEGUMES</b>                         |                                  |                              |
| Acacia, prairie - Plains Germplasm     | <i>Acacia angustissima</i>       | 22,600                       |
| Alfalfa, Common                        | <i>Medicago sativa</i>           | 268,000                      |
| Bluebonnet, Texas                      | <i>Lupinus subcamosus</i>        | 15,000                       |
| Bundleflower, Illinois                 | <i>Desmanthus illinoensis</i>    | 84,000                       |
| Bundleflower, Illinois - 'Sabine'      | <i>Desmanthus illinoensis</i>    | 64,014                       |
| Bundleflower, velvet - Hondo Germplasm | <i>Desmanthus illinoensis</i>    | 59,474                       |
| Crotalaria, Sunn                       | <i>Crotalaria juncea</i>         | 11,000                       |
| Lespedeza, Common                      | <i>Lespedeza striata</i>         | 340,000                      |
| Lespedeza, Roundhead                   | <i>Lespedeza capitata</i>        | 151,000                      |
| Lespedeza, Rush                        | <i>Lespedeza hedysaroides</i>    | 303,000                      |
| Lupine, Arroyo                         | <i>Lupinus succulentus</i>       | 19,000                       |
| Lupine, Bicolor                        | <i>Lupinus bicolor</i>           | 78,000                       |
| Lupine, Blue                           | <i>Lupinus angustifolius</i>     | 2,900                        |
| Lupine, European Blue                  | <i>Lupinus hirsutus</i>          | 2,200                        |
| Lupine, European Yellow                | <i>Lupinus luteus</i>            | 3,700                        |
| Lupinus, White                         | <i>Lupinus albus</i>             | 1,200                        |
| Partridgepea - 'Comanche'              | <i>Chamaecrista fasciculata</i>  | 65,376                       |
| Prairieclover, Purple                  | <i>Petalostemon purpureus</i>    | 315,000                      |
| Prairieclover, Roundheaded             | <i>Petalostemon multiflorus</i>  | 173,000                      |
| Rattlebox, Drummond                    | <i>Daubentonia drummondi</i>     | 4,400                        |



| <b>Common Name Of Seed</b>      | <b>Scientific Name</b>            | <b>Seeds Per Pound Of Pure Seed</b> |
|---------------------------------|-----------------------------------|-------------------------------------|
| Sesbania, Hemp                  | <i>Sesbania exaltata</i>          | 45,000                              |
| Sweetclover, Annual Yellow      | <i>Melilotus indica</i>           | 352,000                             |
| Sweetclover, Hubam              | <i>Melilotus alba var. annua</i>  | 250,000                             |
| Sweetclover, Madrid             | <i>Melilotus officinalis var.</i> | 257,000                             |
| Vetch, Hairy                    | <i>Vicia villosa</i>              | 17,000                              |
| Wildbean, Trailing              | <i>Strophostyles helvola</i>      | 11,000                              |
|                                 |                                   |                                     |
| <b>Forbs</b>                    |                                   |                                     |
| bushsunflower, awnless          | <i>Simsia calva</i>               | 330,966                             |
| Wright pavonia                  | <i>Pavonia lasiopetala</i>        | 35,866                              |
| Sunflower, Maximilian - 'Aztec' | <i>Helianthus maximiliani</i>     | 302364                              |
| Engelmann daisy                 | <i>Engelmannia pinnatifida</i>    | 58414                               |

## For additional information please contact:

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[http://www.tx.nrcs.usda.gov/technical/pmc/east\\_tx.html](http://www.tx.nrcs.usda.gov/technical/pmc/east_tx.html)

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## References

United States Department of Agriculture (USDA) Soil Conservation Service. 1991.  
*Native perennial warm season grasses for forage in southeastern United States (except South Florida)*. Ecol. Sci. and Planning Staff, Fort Worth, Texas.

United States Department of Agriculture (USDA). Soil Conservation Service. 1994.  
*Grass Varieties in the United States*. Agriculture Handbook, No. 170 USDA.  
Washington, D.C.

Launchbaugh, J.L. 1966. A stand establishment survey of grass plantings in the Great Plains. Nebraska Agric. Exp. Stn. Great Plains Council Publ. 23.

Launchbaugh, J.L. and C.E. Ownsby. 1970. Seeding rate and first year stand relationships for six native grasses. J. Range Manage. 23:414-417.

Mitchell, R.B., Vogel, K.P. Practices for Reliably Establishing Warm-Season Grasses. Forage Focus, March Issue pages 7 and 10. Midwest Forage Association, St. Paul, MN. 2010.

Front Range Seed Analysts. (n.d.). Seed Analysis Fact Sheet: Seed Label. In Front Range Seed Analysts. Retrieved November 7, 2011, from <http://www.frsa.org/SAfacts/SAFLabel.html>.

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