

# Seed Mix Design and Implementation

A Practitioners Guide for Native Reclamation

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June 5, 2023



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# Know Your Site

Tools to get the information you need

# Climate and Landform

- ▶ Gather critical data
  - ▶ Slope & Aspect
    - ▶ How much sun will the seeds get?
    - ▶ Are they being planted in a drainage, ridge, even slope or flat ground?
  - ▶ Elevation
  - ▶ Precipitation
    - ▶ Timing
    - ▶ Quantity
    - ▶ Source

Resources:  
[Find a Weather Station \(NOAA\)](#)  
Google Earth

# Soil

## ➤ Gather critical data

### ➤ Quality and quantity of growth medium

- Topsoil?
- Cover soil?
- Tailings
- Subsoil?

### ➤ Test your Soil

- pH
- Sodium Adsorption Ratio (SAR)
- Salinity (EC)
- Soil Organic Matter (SOM)
- Nitrogen Phosphorous Potassium (NPK)
- Particle Size Distribution (PSD)

## ➤ Understand site history

- What type of disturbance occurred?
- When did the disturbance occur?
- How compacted is the soil?

### Resources:

[Web Soil Survey](#) (USDA)

**Dig a Soil Pit**

**Analyze your Soil**

# Native Vegetation

- Identify your Ecological Site
- Find a reference area
  - Quantify vegetation cover, litter and bare ground
  - Take a census of all vegetation
  - Estimate the relative percentage of identified species
- Visit the site at the right time
  - Depends on where your site is
  - Depends on timing of precipitation in the year visiting

## Resources:

[Ecological Site Descriptions](#)  
[Rocky Mountain Herbarium](#)  
[Plants Database \(USDA\)](#)

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# Seed Mix Design

Choosing the right seeds for native restoration in the western US

# Species Details


Disturbed lands may not easily grow into native reference area

- ▶ Species have salt and acidity tolerances
- ▶ Species have elevation ranges
- ▶ Species have precipitation requirements
- ▶ Species prefer soil particle sizes
  - ▶ Shrubs create wind breaks and collect blowing debris, settling out high organic matter loamy material over decades and centuries, making their own fertile growing conditions
- ▶ Some species need more nutrients than others
  - ▶ Weedy species will often out compete natives when provided excess nutrients – BEWARE OF FERTILIZERS
- ▶ Locally collected ecotypes do better
- ▶ Species collected from similar elevations and climates do better, even when not spatially local

# Blue Grama – Species information

## Granite Seed details

### SPECIES ATTRIBUTES

Height:	1 - 24 in.	Life Form:	Bunchgrass Sodformer	Sun & Shade Tolerance:	
Native Or Introduced:	Native	Elevation:	ft.		
Season:	Warm	Precipitation:	7 in.		

#### SOIL TEXTURE

Coarse:	Average
Moderately Coarse:	Average
Medium:	Best
Moderately Fine:	Best
Fine:	Average

#### SOIL PH

Acidic:	Not Adapted
Neutral:	Best
Basic:	Average
Seeding Rate:	2 - 3 PLS lbs/Acre

Pure Seed Per Bushel:	9.10 lbs.	Mycorrhizal Dependent:	Yes
Seeds Per Pound:	825,000	Planting Season:	Summer
Germination Time:	Days		

### BLUE GRAMA *Bouteloua gracilis* (Willd. ex Kunth.) Lag. ex Griffiths Plant Symbol = BOGR2

Contributed by: USDA NRCS Plant Materials Center, Manhattan, Kansas.



Alan Shadow, USDA NRCS East Texas Plant Materials Center

#### Uses

**Forage:** A highly palatable grass for livestock on a year long basis. It is used sparingly by antelope and other wildlife species. Blue grama rates with buffalograss as one of the most important forage plants of the short-grass prairie (Weaver, 1926)

**Erosion control:** Blue grama can be used in mixtures with other grasses for use in erosion control situations. It is commonly used as a low maintenance turf planting, such as rough areas of a golf course or between rows in multiple row wind break plantings and in locations prone to drought. It is also used in surface mine re-vegetation plantings.

phenotypic plasticity since in the southern states it grows normally as a bunch grass, but in the northern states and in the mountains, or in areas under heavy grazing pressure it is a sod former. Phenotypic plasticity is the ability of an organism to alter its physiology or morphology in response to changes in environmental conditions (Schlichting, 1986). Blue grama possesses the C-4 photosynthetic pathway for carbon fixation (Waller and Lewis, 1979).

**Distribution:** For current distribution, please consult the Plant Profile page for this species on the PLANTS Web site. Blue grama is a major species of the western Great Plains and southwestern United States. It is also found growing in Mexico and the Canadian Provinces of Alberta, Saskatchewan and Manitoba.

**Habitat:** Blue grama is most effective when grown in the dryer parts of the northern and southern Great Plains and southwestern region of the U.S. It naturally grows in mixed stands, primarily with buffalograss (*Bouteloua dactyloides*), needle-and-thread (*Hesperostipa comata*), western wheatgrass (*Pascopyrum smithii*), and green needlegrass (*Nassella viridula*) in a short grass prairie setting. It will be associated with other species such as prairie sandreed and sand sagebrush in a sandier habitat.

#### Adaptation

Blue grama demonstrates good drought, fair salinity and moderate alkalinity tolerance. It grows well on soil types as varied as sandy to clayey in texture; however its growth is not as vigorous on true sands or clays. Blue grama is not tolerant of frequent flooding or submergence. It is also intolerant of shade and acidic soils. It is variably tolerant of fire and can be damaged if burned during active growth, especially under drought conditions. Blue grama

Resources:  
USDA Plant Guides  
Granite Seed



# Seed

## Understand your seed lab report

- ▶ Pure Live Seed
- ▶ Purity
- ▶ Inert matter (chaff / awns / not seed)
- ▶ Weedy species
  - ▶ Make sure the seed lot is tested for weeds!
  - ▶ Plant weed free seed
- ▶ Seed Origin
- ▶ Other Crop Species

**Resources:**  
**Seed Lab Tests**

# Example Seed Lab Report



## Montana State Seed Lab

PO Box 173145  
Bozeman, MT 59717-3150  
Laboratory Report Of Analysis

Bruce Seed Farm  
91 Lower Deep Creek  
Townsend, MT 59644

Account No.	Date Received	Date Completed	Lab Number
1047	10/10/22	11/03/22	23-1032

### Information Provided by Sender

Product Arriba  
Kind Wheatgrass, western  
Genus/Species Pascopyrum smithii  
Lot Number 22-0-23  
Class Registered  
Origin: MT, MISGA Certification number 2227662

Purity Analysis		Viability Analysis					Total %	PLS
Component	in 9.8364 grams	Purity	Germ Date	Germ %	Dormant %	Hard %	Viable %	%
Wheatgrass, western	<i>Pascopyrum smithii</i>	93.98%	11/03/22	86	8	-N-	94	88.34
	Weed seed	0.00%						
	Crop seed	0.04%						
	Inert matter	5.98%						
Other Crop Seeds		# Seeds	# per lb	Noxious Weed Seeds		None Found		
in 9.8364 grams				in 101.2 grams				
Wheatgrass, slender	<i>Elymus trachycaulus</i>	1	46	For: Western States				
<i>subsp. trachycaulus</i>				(P)Prohibited Noxious (R)Restricted Noxious				
Weed Seeds		None Found		Other Determinations				
				TZ test		Wheatgrass, western 97 %		
				Ergot=		2.4% of working portion		

### Remarks

Noxious Exam - Western USA - WA, OR, ID, MT, ND, SD, NE, KS, OK, TX, NM, AZ, UT, CO, NV, WY, CA - As found in the State Noxious-Weed Seed requirements recognized in the Federal Seed Act


Status: Completed

Tests Requested: Germination, Noxious exam - Western USA, Purity, TZ test. No other tests requested.

Services Requested: Rush

**This is not a bill. Please do not pay until we send you an invoice.**

WARRANTY: We warrant that the purity and germination test results reported on this form have been carried out in accordance with AOSA rules unless otherwise specified. Test results reflect the condition of the submitted sample and may not reflect the condition of the seed lot from which the sample was taken.  
DISCLAIMER OF WARRANTIES: WE MAKE NO OTHER WARRANTIES OF ANY KIND, EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

Signature:   
Bridget Westfall, RST  
Seal #139

# Selecting your Species

- ▶ One site may need multiple mixes
  - ▶ A drainage isn't a ridge isn't a flat land
  - ▶ Look at the native landscape and see how species distribution varies across the landscape.
- ▶ Choosing compatible desirable natives
  - ▶ Grasses
    - ▶ Rhizomatous or Bunch
    - ▶ Warm or Cool season
    - ▶ Dominant weed competition
  - ▶ Forbs
    - ▶ Flowering times
    - ▶ Availability
    - ▶ Cost
  - ▶ Shrubs
    - ▶ Wildlife habitat
    - ▶ Browse or forage quality

CONSIDER  
THIS

Volunteerism

What is abundant in the area  
What species may have no local seed source



# Select Forbs with Bloom Time in Mind

TABLE 3: POLLINATOR PLANT LIST 9 - 12 INCH PRECIPITATION

## Plants for Pollinators in the Inter Mountain West

Scientific Name	Common Name	Bloom Color and Time			Origin	Height (in)	Seeding Depth (in)	Seeds/lb	Full Seeding Rate (PLS lbs/ac)	Soils		
		spring	summer	late summer						fine	med	coarse
<b>Forbs</b>												
<i>Achillea millefolium</i>	Western yarrow	☼	☼		Native	6-24	0 - 1/8	4,400,000	0.5		X	X
<i>Astragalus filipes</i>	Basalt milkvetch		☼		Native	12-36	1/4 - 1/2	120,000	9		X	X
<i>Balsamorhiza hookeri</i>	Hooker's balsamroot	☼	☼		Native	12-24	0-1/4	55,000	18	X	X	X
<i>Chaenactis douglasii</i>	Douglas' dustymaiden		☼		Native	12-36	0 - 1/8	350,000	3		X	X
<i>Cleome lutea</i>	Yellow bee plant	☼			Native	24-36	1/8 – 1/4	101,000	11	X	X	
<i>Dalea spp.</i>	Prairie coneflower		☼		Native	12-36	1/4-1/2	148,000	7		X	X
<i>Grindelia squarrosa</i>	Curlycup gumweed		☼	☼	Native	12-36	0 – 1/4	410,000	3	X	X	X
<i>Helianthus annuus</i>	Annual sunflower		☼	☼	Native	36-120	1/4 - 1/2	81,000	13	X	X	X
<i>Ipomopsis aggregata</i>	Scarlet gilia	☼	☼		Native	24-36	0-1/8	360,000	6		X	X
<i>Lathyrus pauciflorus</i>	Fewflower pea	☼			Native	8-30	1/8-1/2	12,500	87	X	X	X
<i>Linum lewisii</i>	Lewis flax	☼			Native	12-24	0 - 1/8	260,000	4		X	X
<i>L. perenne</i>	Blue flax	☼			Introduced	12-24	0 - 1/8	278,000	4		X	X
<i>Machaeranthera canescens</i>	Hoary tansyaster		☼	☼	Native	24-36	0 - 1/8	1,300,000	2		X	X
<i>Medicago sativa ssp. falcata</i>	Yellow blossom alfalfa	☼			Introduced	24-36	1/8 - 1/2	211,000	5	X	X	
<i>Melilotus alba</i>	White sweetclover	☼	☼		Introduced	12-36	1/8 - 1/2	260,000	4	X	X	X
<i>M. officinalis</i>	Yellow sweetclover	☼	☼		Introduced	12-36	1/8 - 1/2	260,000	4	X	X	X
<i>Mentzelia laevicaulis</i>	Smoothstem blazingstar		☼		Native	12-36	1/4-1/2	300,000	4		X	X
<i>Penstemon eatonii</i>	Firecracker penstemon	☼	☼		Native	12-30	0 - 1/8	315,000	3		X	X
<i>Penstemon palmeri</i>	Palmer's penstemon	☼	☼		Native	24-36	0 - 1/8	294,000	4		X	X
<i>Phacelia hastata</i>	Silverleaf phacelia		☼		Native	18-24	1/8 – 1/4	450,000	2		X	X
<i>Sphaeralcea spp.</i>	Globemallow	☼	☼		Native	12-24	1/4 - 1/2	500,000	2		X	X
<i>Vicia Americana</i>	American vetch	☼			Native	6-12	1 - 2	33,000	33		X	X

# Choose the Right Ratio – Growth Form and Niche Fulfilment

- ▶ Overseeding grasses can out compete shrubs and forbs.
  - ▶ Ratio of growth form vary by total seeds per square foot
- ▶ Under seeding grasses allows invasion by weeds
- ▶ Overseeding shrubs and forbs won't out compete grasses
  - ▶ Depending on the mix, can add significant cost
  - ▶ Can often be done as a secondary broadcast effort
    - ▶ DON'T RECOMPACT THE SOIL. HAND OR SMALL WHEEL BROADCAST
- ▶ Consider adding a sterile nurse crop
  - ▶ Rapid cover and stability
  - ▶ Can be heavily seeded to compete with weeds

# Seed Characteristics

Just because you plant it doesn't mean it will grow

- ▶ Seed size
  - ▶ Controls planting depth
  - ▶ Broadcast smaller seed
  - ▶ Most native seeds should be planted 1/8" to 1/2" deep
- ▶ Pure Live Seeds (PLS) per pound controls seeds / ft<sup>2</sup>
  - ▶ NOT BULK POUNDS
  - ▶ KNOW THIS NUMBER
- ▶ Varieties and seed source matter
  - ▶ Look for sources of a similar climate and landform

## Resources:

[Plants Database \(USDA\)](#)

[Rocky Mountain Herbarium](#)



# Designing your mix

- ▶ Determining how much seed to order (for each species)
  - ▶ Choose desired Pure Live Seeds (PLS) / ft<sup>2</sup>
    - ▶ Very good conditions rule of thumb: 20 to 25 seeds / ft<sup>2</sup>
    - ▶ Very poor conditions, slopes or critical areas –double or triple rates
  - ▶ Use the lab seed data to determine how many pounds of seed will seed one acre
  - ▶ Calculate total pounds of seed needed for the project
    - ▶ Then order extra!
- ▶ If using multiple hopper boxes, have each hopper box pre-mixed by the supplier
- ▶ Consider planting methods and the use of carrier agents
  - ▶ Mixing ratio
  - ▶ Mixing method (seed suppliers can pre-mix carrier agents)
- ▶ Calculate total bulk pounds per acre to be seeded
- ▶ Place your order

# Seed Storage

## Best Management Practices

- ▶ Seed Storage < 30 days
  - ▶ Off the ground and protected from weather
  - ▶ Avoid damage from water, humidity, fungi, mold and rodents, birds and other animals
  - ▶ Cool, dark and dry
- ▶ Seed Storage  $\geq$  30 day
  - ▶ In an airtight container
  - ▶ At  $\approx$  40°F in a self-defrosting refrigerator
  - ▶ Maintain between 10% to 40% humidity
  - ▶ Keep cool, dark & dry



# Example Seed Mix

Example Drill Seed Mix For Sage-Grouse Brood Rearing Habitat <sup>†</sup>											
ESDs RO34AY304WY ; RO34AY312WY ; RO34AY326WY											
Species	Scientific Name	Seeds/ft <sup>2</sup> @ 1lbs/ac	Pure Stand Target Seeds/ft <sup>2</sup> ††	Percent of Pure Stand	PLS/ft <sup>2</sup>	Total PLS lbs/ac	Seed Size & Type	Hopper Box	Carrier Agent	Carrier Agent Total lbs/ac	Target Seed Depth Inches
Bluebunch Wheatgrass	<i>Pseudoroegneria spicata</i>	3.2	22	12.0%	2.6	2.48	Medium	Drill	Rice Hulls	2.59	≤1/2
Western Wheatgrass	<i>Pascopyrum smithii</i>	2.5	22	9.0%	2.0	2.38	Medium	Drill	Rice Hulls	2.66	≤1/2
Green Needlegrass	<i>Nassella viridula</i>	4.2	22	7.0%	1.5	1.10	Medium	Drill	Rice Hulls	1.19	≤1/2
Indian Ricegrass	<i>Achnatherum hymenoides</i>	3.2	22	7.0%	1.5	1.43	Medium	Drill	Rice Hulls	1.46	≤1/2
Basin Wildrye	<i>Leymus cinereus</i>	3.0	22	7.0%	1.5	1.54	Medium	Drill	Rice Hulls	1.82	≤1/2
Bottlebrush Squirreltail	<i>Elymus elymoides</i>	4.4	23	7.0%	1.6	1.10	Medium	Drill	Rice Hulls	1.19	≤1/2
Blue Gramma	<i>Bouteloua gracilis</i>	18.9	30	6.0%	1.8	0.29	Small	Fluffy	Rice Hulls	0.55	≤1/4
Sandberg Bluegrass	<i>Poa Secunda</i>	24.0	45	5.0%	2.3	0.28	Small	Legume	Corn Grit	0.65	≤1/4
Quickguard Sterile Trifoliate	Trifoliate	0.3	15	5.0%	0.8	7.50	Medium	Drill	Rice Hulls	7.70	≤1/2
Fringed Sage	<i>Artemisia frigida</i>	104.1	110	8.0%	8.8	0.25	Small	Legume	Corn Grit	0.61	≤1/8
Fernleaf Biscuitroot	<i>Lomatium dissectum</i>	1.0	17	8.5%	1.4	4.21	Large	Fluffy	Rice Hulls	8.7	≤1/8
Western Yarrow	<i>Achillea millefolium</i>	63.6	50	8.5%	4.3	0.20	Small	Legume	Corn Grit	0.47	≤1/8
Black Sagebrush	<i>Artemisia nova</i>	20.8	300	3.0%	9.0	1.30	Medium	Fluffy	Rice Hulls	3.43	≤1/8
Winterfat	<i>Karschensinitovia lasata</i>	2.8	22.0	3.0%	0.7	0.71	Medium	Fluffy	Rice Hulls	1.33	≤1/8
Wyoming Big Sagebrush	<i>Artemisia tridentata</i> , WY	57.4	1200	4.0%	48.0	2.51	Small	Fluffy	Rice Hulls	6.26	≤1/8
Totals				100.0%	87.8	27.26					

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# Getting Your Seed in the Ground

Selecting the right equipment and method

# Rangeland Drills

- ▶ Multiple Hopper Boxes
  - ▶ Address different seed sizes and chaf content
  - ▶ Provides different seeding depth
  - ▶ Can broadcast (dribble tube)
- ▶ Create good seed to soil contact
  - ▶ Chains / discs / cutting wheels
- ▶ Rugged construction.
- ▶ Can be calibrated
- ▶ Can seed along contour for low grade slopes

## Resources:

[Truax](#) / [P & F Drills](#)

**Local Conservation District  
Reclamation Contractor**

**Calibration Videos [#1](#) and [#2](#)**

# Broadcast Seeders

- ▶ Great for small seed or seed buried < 1/8 inch
- ▶ Great as one component of a complex design
- ▶ Many varieties
  - ▶ Hand dispersed
  - ▶ Small wheel driven spreaders
  - ▶ Large tractor driven hoppers with wide spread
- ▶ Should be calibrated for each seed mix
- ▶ Hydro-mulching
  - ▶ Immediate stabilization
  - ▶ Can carry seed
  - ▶ Excellent for steep slopes

# Seed Bed Preparation

The right soil conditions are critical

- ▶ The seed bed should be loose and rough
- ▶ Ripping followed by discing should be done to alleviate compaction, where conditions allow
  - ▶ 12" deep on 12" spacing
  - ▶ As a single pass along contour
  - ▶ Where soil moisture is 10% - 15% -
  - ▶ When the ground is not frozen
- If available, cover soil should be placed AFTER surface grading at a minimum depth of 12"
- Confirm subsoil or unsuitable growth media is not mixed with topsoil or cover soil
- Seed bed preparation should be conducted based on seeding equipment, slope and drainage channels.

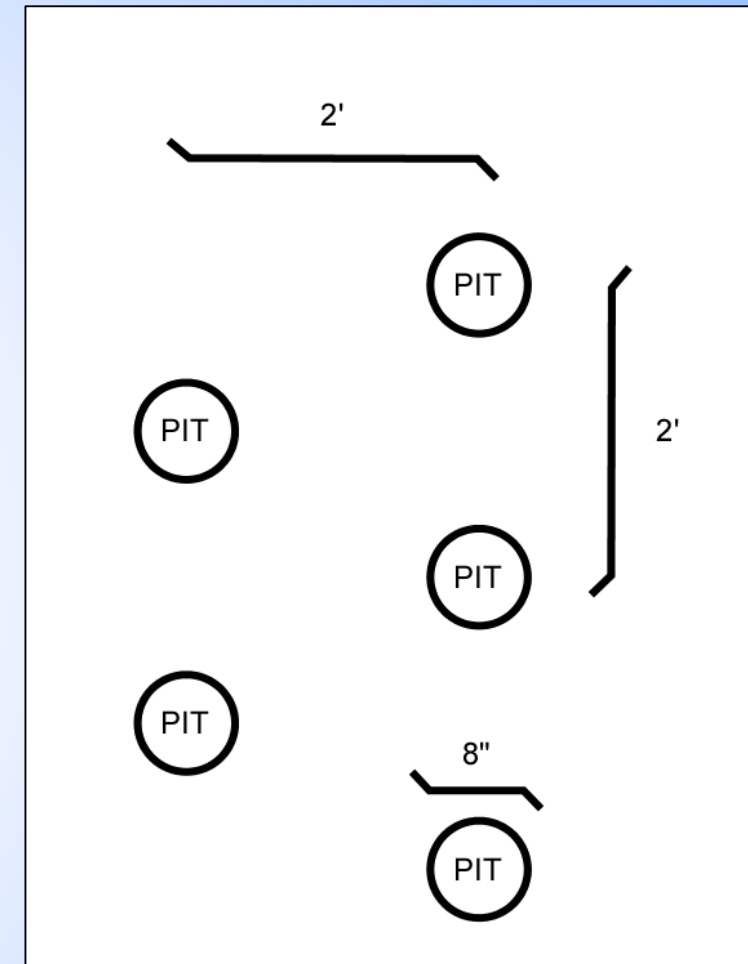
Resources:  
[NRCS Guidance](#)  
[Squeeze Test](#)

# Pitting

Creating micro topography and Niches

- ▶ Pitting should occur within 48 hours of seed bed preparation
  - ▶ Useful on all sites between less than 30% slopes
  - ▶ As a single pass with seeding
  - ▶ Along contour
  - ▶ Staggered on parallel rows (reduce erosion and water through flow)
  - ▶ Depth of ~ 8" and width of ~ 8 – 16" ( upside down hard hat size)
- **No compaction** should occur on seed bed after pitting and seeding

## Example Schematic of Pits



There is more to native ecosystem restoration than a good seed mix.

## Things not covered:

- ▶ Geomorphic Land Contouring
- ▶ Soil Amendments
- ▶ Timing of Seeding
- ▶ Live Plantings
- ▶ Woody Debris and Rock Habitat
- ▶ Weed Monitoring and Control
- ▶ Vegetation Monitoring
- ▶ Much More

# THANK YOU!

## Questions?

Contact:  
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