



Choosing the appropriate plant material for a rangeland rehabilitation project is critical for long term success. There are many considerations to what may seem like a simple question; what are we going to seed?

Plant material tests are a means to evaluate multiple plants for defined traits such as drought tolerance, forage production, or any measurable feature. The primary characteristic we define our tests by is establishment. Since all other features, such as forage production, rely on the assumption of establishment, we find it to be a high priority for plant material tests. We seed multiple species side by side for analysis.





Since the late 1950's the Reno, Nevada location of the Agricultural Research Service has conducted wildland seeding research in an effort to identify the optimal plant species to manage the diverse problems of this harsh environment.

Research sites

- ve. Precipitation for all years t 1. Noble 5.4"
 - 2. Doyle 6.51"
 - 3. Sand Hills 7.34"
 - 4. Bedel 6.89"
 - 5. Flanigan 4.76"
 - 6. Empire 11.17"
 - 7. Squaw Creek
 - 8. Antelope 5.42"

2012

eeded species and years Common name

Actinatier uni occidentale	western needle grass	2013		1
Achnatherum				
thurberianum	thurber's needlegrass		2014	201
Agropyron cristatum	crested wheatgrass 'roadcrest'	2013		201
Agropyron cristatum	crested wheatgrass 'fairway'			201
Agropyron cristatum	crested wheatgrass 'ephraims'			201
Agropyron cristatum X				
desertorum	crested wheatgrass 'hycrest'	2013	2014	201
Agropyron desertorum	crested wheatgrass 'nordan'		2014	201
Agropyron desertorum	crested wheatgrass 'standard'			201
Agronyron fragile	siberian wheatgrass	2013	2014	201
Alonecurus arundinaceus	garrison creening fortail	2013	2014	201
Artomicia tridontata con		2015		
Artemisia tridentata spp.	wwoming hig cogobrush	2012		201
wyonningensis		2013		201
	silverscale saltbush	2013		
Atriplex lentiformis		2013		
Atriplex torreyi	torrey's saltbush	2013		
Bassia prostrata spp.				
grisea	forage kochia 'snowstorm'	2013		201
Bassia prostrata spp.				
virescens	forage kochia 'immigrant'	2013		201
Bromus carinatus	california brome	2013	2014	201
Bromus carinatus	california brome 'local'	2013	2014	201
Bromus ciliatus	fringed brome	2013		
Bromus hordeaceus	soft chess	2013		
Bromus inermis	smoothe brome	-010	2014	201
Cleome lutea	vellow bee plant		201/	201
Cloomo corrulata	rocky Mt. boo plant	2012	2014	201
Creonie sen ulata	rucion cruntantha	2013	2014	201
		2013		
Deschampsia spp	nairgrass	2013	2044	
Elymus danuricus	danurian wildrye	2013	2014	
Elymus elymoides	squirreltail 'vns'	2013		
Elymus elymoides	squirreltail 'local blue'		2014	201
Elymus elymoides	squirreltail 'local gray'		2014	201
Elymus elymoides	squirreltail 'local green'		2014	201
Elymus elymoides ssp.				
californicus	squirreltail 'toe jam'		2014	201
Elymus glaucus	blue wildrye		2014	201
Elymus lanceolatus	thickspike wheatgrass	2013		
Elymus trachycaulus	slender wheatgrass			201
Elymus wawawaiensis	snake river wheatgrass		2014	201
, Elvtrigia repens x	C C			
Pseudoroegneria spicata	hybrid wheatgrass 'newhy'	2013		201
Flytrigia renens x		2010		201
Dseudoroegneria snicata	AC saltlander	2013		
Fragractic fondlariana	muttongrass	2013		
		2013		20/
Ericameria nauseosa	gray rabbitorush			20.
Eriogonum baileyi	bally's buckwheat			202
Hesperostipa comata	needle and thread grass	2013	2014	20
Leymus angustus	altai wildrye	2013		20
Leymus cinereus	great basin wildrye	2013	2014	201
Melilotus officinalis	yellow sweetclover	2013		
Menzelia albicaulis	whitestem blazingstar	2013		
Oryzopsis hymenoides	indian ricegrass	2013	2014	201
Poa bulbosa	bulbous bluegrass	2013	2014	201
Poa secunda	sandbergs bluegrass	2013	2014	201
Poa secunda	sherman big bluegrass	2013	2014	201
Poa secunda	canby bluegrass			201
Psathyrostachys junceus	russian wild rve	2013		201
Pseudoroegneria snicata	hluehunch wheatgrass	2013	2014	201
Puccinollia Distans	alkaligrass 'fults'	2013	2014	201
Socalo montanum	analigrass ruits	2013	2014	201
	deport poodle areas	2013	2014	201
Supa speciosa	uesert needlegrass	2013	2014	
Suaeda nigra	seepweed	2013		
I hinopyrum intermedium	intermediate wheatgrass	2013	2014	201
Thinopyrum intermedium	intermediate wheatgrass 'amur'	2013	2014	201
Thinopyrum intermedium	pubescent intermediate			
spp. barbulatum	wheatgrass 'luna'	2013	2014	201
Thinopyrum ponticum	tall wheatgrass	2013		

attail fescue

Small Plot Tests

The advantage of small plot tests 1/2" pipe added is that we can test a high volume for strength of species using less resources than standard rangeland drill techniques (Figure 1). Small plot tests can be done by a single person, require less space, less seed and thus can be conducted at multiple sites every year strengthening replication of tests. Seeding is conducted using an Earthway garden seeder (~\$100). The seeder in the photo has seeded over 10 miles of drill row and still works great!

Annually, since 2013 we have seeded multiple (6-8) degraded xeric sites with numerous species (Table 1). At all sites each species was seeded separately in a 50ft row (15lb/acre rate) using a small hand seeder.



Each species (row) is monitored monthly throughout the growing season. Seedlings per foot (4 samples x 3 reps) are counted at fixed points. For reference, to test 50 at each site. Precipitation, soil moisture and available soil Nitrogen are also monitored at each site.

Plant Material Tests: Can We Learn from Small Plots?

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Defining the Goals

We find it necessary to define the objectives and goals before debating the merits of any plant material. Our objective is to suppress cheatgrass (Bromus tectorum) and decrease wildfire fuel (Figure 2). Our goal to meet that objective is to establish a high density of perennial grass (~1/ft). Without suppressing cheatgrass (i.e. resistance) seedling competition and repeated fires will halt succession.



species, 600 1ft seedling counts are conducted monthly

Noble Site 2013



March 2013: Seedlings emerged.



June 2013: Seedlings flowered. Often flowering does not occur until the second growing season.



April 2014: Second year growth is much more vigorous especially for species such as crested wheatgrass, which greens up early.



June 2015: The drought limitations of intermediate wheatgrass greatly reduces its growth by the 2nd growing season dry months



Colored circles are same rows Yellow = pubescent intermediate wheatgrass [1.35/ft], **Blue** = bluebunch wheatgrass [0.75/ft] Plant Material Test Green = crested wheatgrass 'hycrest' [0.775/ft])

May 2013: Seedlings past the 3 leaf stage. It is critical for seedlings to reach the 3 leaf stage by June (dry) to increase survival rates.

August 2013: The bluebunch wheatgrass (center) has gone dormant compared to the intermediate and crested wheatgrasses.

May 2014: Productivity of intermediate wheatgrass which requires more water than crested wheatgrass is comparably less under dry conditions.



Our results are based on 1st year seedling establishment. Our goal (~1 plant/ft) however is best measured after the 2nd or 3rd growth year. These results then do not represent our final goal as much as a ranking order of first year seedling establishment. Averaging all sites and years, less than 5 species (4.9) established 1 plant per square foot of all species tested. Promisingly 12 native species established 1 seedling per foot at least once for 17 tests (highest was squirreltail 3 of 17 tests). The most common species to establish 1 seedling per foot were Siberian wheatgrass (8 of 17 tests) and hycrest crested wheatgrass (7 of 17 tests).

Antelope 5.42 2.2 crested wheatgrass 'no 1.8 crested wheatgrass ' 1.6 soft chess 1.2 thickspike wheatgra 1.1 pubescent intermediate 1.1 squirreltail 'local gray 1.1 siberian wheatgrass 1.0 squirreltail 'local blue 1.0 intermediate wheatgr 0.9 forage kochia 'snowsto 0.8 snake river wheatgra 0.8 squirreltail 'local gree 0.7 russian wild rye 0.7 tall wheatgrass 0.7 bluebunch wheatg 0.5 rocky Mt. bee plant 0.5 altai wildrye 0.5 forage kochia 'immigra

0.5 california brome

0.4 california brome 'loca

0.4 yellow sweetclo 0.3 great basin wildrye 0.3 crested wheatgrass ' 0.3 sherman big bluegr 0.2 intermediate wheatg 0.2 squirreltail 'vns' 0.2 hybrid wheatgrass 'new 0.1 seepweed 0.1 crested wheatgrass ' 0.1 crested wheatgrass ' 0.1 bulbous bluegrass 0.1 smoothe brome Flanigan 4.46" *single y

1.2 crested wheatgrass 'n 0.4 siberian wheatgrass 0.3 needle and thread gra 0.3 intermediate wheatg 0.3 crested wheatgrass 'e 0.2 pubescent intermediate 0.2 indian ricegrass 0.2 california brome 'local 0.2 mountain rye 0.1 crested wheatgrass ' 0.1 snake river wheatg

Comparing tests from multiple years, highlights the strong effect of annual conditions on establishment.



Results

Table 2. Ranking order of 1st year seedling establishment (seedling/ft) Results and precipitation are averages of all years tests. *green = native

	•••	•	•	S 1	<u> </u>	9	• •	<u> </u>	<u> </u>

	Bedel 6 89"	Dovle 6 51"
rdan'	1 9 crested wheatgrass 'enhraims'	1 9 crested wheatgrass 'nordan'
hraims'	1.8 crested wheatgrass 'standard'	1.8 squirreltail 'local blue'
inains	1 5 sherman hig hluegrass	1.6 squirreltail 'local green'
	1.3 canby bluegrass	1.5 squirreltail 'local grav'
whoatgrass	1.3 crested wheatgrass 'nordan'	1.5 blue wildrye
wiicalgiass	1 Asiberian wheatgrass	1.5 blue wild ye
	0.9 crosted wheatgrass 'roadcrost'	1.4 pubescent intermediate wheat
	0.9 crosted wheatgrass 'fairway'	1.5 side han wheatgrass 'bycrost'
c c	0.5 crosted wheatgrass 'bycrost'	1.1 california brome 'local'
rm ⁱ	0.5 created wheatgrass hycrest	0.9 crested wheatgrass 'enhraims
	0.5 squirreltail 'local blue'	0.8 canby bluegrass
	0.1 baily's buckwheat	0.8 snake river wheatgrass
	0.3 slander wheatgrass	0.7 crosted wheatgrass 'fairway'
	0.3 sandhargs bluggrass	0.5 thickspike wheatgrass
	0.2 intermediate wheatgrass 'amur'	0.5 crested wheatgrass 'roadcrest
	0.2 intermediate wheatgrass and	0 Sindian ricograss
	0.1 nubeccent intermediate wheatgrass	0.4 crested wheatgrass 'standard
at'	0.1 squirreltail 'too jam'	0.4 needle and thread grass
iii.	0.1 bluchunch whoatgrass	0.2 shormon hig bluogross
	0.1 thickspike wheatgrass	0.1 tall wheatgrass
	0.1 blue wildrye	0.1 bluebunch wheatgrass
	0.1 california bromo 'local'	0.1 intermediate wheatgrass 'am
derect	0.1 dosort poodlograss	0.1 intermediate wheatgrass am
aucrest	0.1 rocky Mt boo plant	0.1 hybrid whoatgrass 'nowby'
ss 'amur'	0.1 spake river wheatgrass	0.1 california bromo
ss annui	0.1 tall wheatgrass	
vbv'	0.1 tall wheatgrass	
,, y		
rest'		
ndard'	Noble 5.4"	Sandhills 7.34"
	1.0 blue wildrye	4.4 crested wheatgrass 'fairway'
	0.9 california brome 'local'	4.3 sherman big bluegrass
	0.8 nubescent intermediate wheatgrass	3.5 baily's buckwheat
r 2012	0.8 crested wheatgrass 'standard'	3.1 crested wheatgrass 'standard
rdan'	0.6 intermediate wheatgrass	3.1 slender wheatgrass
	0.5 thickspike wheatgrass	3.0 blue wildrye
s	0.4 crested wheatgrass 'nordan'	2.9 crested wheatgrass 'nordan'
SS	0.4 crested wheatgrass 'hycrest'	2.3 crested wheatgrass 'ephraims
hraims'	0.4 tall wheatgrass	1.9 crested wheatgrass 'hycrest'
wheatgrass	0.3 crested wheatgrass 'ephraims'	1.8 canby bluegrass
	0.3 crested wheatgrass 'fairway'	1.8 pubescent intermediate wheats
	0.3 squirreltail 'local gray'	1.8 squirreltail 'local green'
	0.3 great basin wildrye	1.5 intermediate wheatgrass
crest'	0.3 siberian wheatgrass	1.5 squirreltail 'toe iam'
	0.3 altai wildrve	1.2 crested wheatgrass 'roadcrest
	0.3 bluebunch wheatgrass	1.0 california brome 'local'
	0.3 squirreltail 'local green'	1.0 squirreltail 'local blue'
	0.2 indian ricegrass	0.9 squirreltail 'local grav'
	0.2 crested wheatgrass 'roadcrest'	0.8 grav rabbitbrush
	0.2 intermediate wheatgrass 'amur'	0.7 needle and thread grass
	0.2 slender wheatgrass	0.7 hybrid wheatgrass 'newhy'
	0.2 mountain rye	0.6 thickspike wheatgrass
	0.1 hybrid wheatgrass 'newhy'	0.6 russian wild rve
	0.1 sherman big bluegrass	0.6 siberian wheatgrass
	0.1 snake river wheatgrass	0.4 snake river wheatgrass
	0.1 california brome	0.3 thurber's needlegrass
	0.1 needle and thread grass	0.3 bluebunch wheatgrass
	0.1 AC saltlander	0.3 intermediate wheatgrass 'am
	0.1 squirreltail 'local blue'	0.3 smoothe brome
	·	0.2 altai wildrye

0.2 sandbergs bluegras

0.2 great basin wildry

- 0.1 california bron
- 0.1 indian ricegra

0.6 crested wheatgrass 'nordan 0.4 siberian wheatgrass **).3 crested wheatgrass 'roadcrest** 0.3 crested wheatgrass 'hycrest 0.3 squirreltail 'local gray' 0.3 pubescent intermediate wheatgrass 0.2 snake river wheatgras 0.2 sherman big bluegras 0.2 tall wheatgrass 0.2 slender wheatgras 0.2 squirreltail 'local blue 0.2 squirreltail 'local green 0.2 intermediate wheatgrass 'amur 0.1 forage kochia 'immigran 0.1 russian wild rye 0.1 intermediate wheatgras 0.1 baily's buckwhe 0.1 thickspike wheatgra 0.1 squirreltail 'vns 0.1 canby bluegras 0.1 bluebunch wheatgra 0.1 forage kochia 'snowstorm 0.1 indian ricegrass Squaw Creek 2.3 crested wheatgrass 'nordan 2.2 crested wheatgrass 'standard' 2.1 crested wheatgrass 'roadcrest

Empire 11.1/

1.3 crested wheatgrass 'fairway'

0.9 crested wheatgrass 'ephraims

0.7 crested wheatgrass 'standard'

0.6 california brome 'local'

- 1.8 crested wheatgrass 'fairway'
- 1.6 crested wheatgrass 'ephraims
- 1.2 crested wheatgrass 'hycrest 1.1 slender wheatgras
- 1.1 siberian wheatgras
- 1.1 snake river wheatgr
- 0.9 sherman big bluegras
- 0.9 squirreltail 'local gree
- 0.8 squirreltail 'toe jam
- 0.8 blue wildrye 0.8 squirreltail 'local blue
- 0.7 intermediate wheatgrass 'amur'
- 0.7 squirreltail 'local gray'
- 0.6 pubescent intermediate wheatgrass
- 0.5 thickspike wheatgras 0.4 intermediate wheatgra
- 0.3 sandbergs bluegrass
- 0.3 california brome 'local
- 0.3 bluebunch wheatgra
- 0.2 canby bluegr 0.2 california brom
- 0.2 great basin wildry

- .1 russian wild rve

In conclusion, we find that small plot tests can provide great learning opportunities for species and site potential so that resource managers can improve rehabilitation efforts. In an environment as dynamic as the Great Basin, having site and yearly replication is critical to make the best plant material choices. We find small plot tests are a reliable and efficient means to achieve this.