The Development and Use of Forbs in Restoration

Scott Jensen

RMRS GSD, Provo, UT.

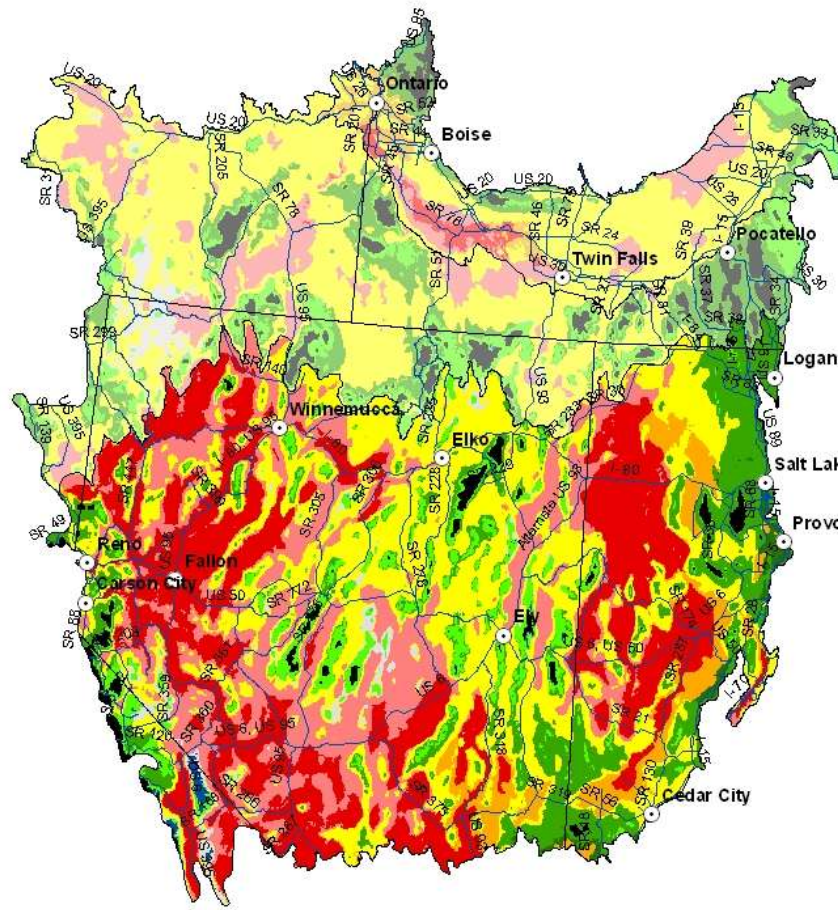
Current Trends in Plant Materials Development

Scott Jensen, Jason Stettler
Botanists
USDA FS RMRS GSD, Provo, UT

Johnson. R, et.al Native Plants. 11 2 Summer 2010

- …seed sources for restoration…should be made up of parents that come from ecosystems (seed zones) similar to those at the restoration site.
- Collecting seeds from parents from multiple locations within a seed zone or ecosystem to serve as foundation seed increases the opportunity to broaden the genetic base of the restoration population.

Provisional Seed Zones for the Great Basin



Legend

Great Basin Provisional Seed Zones

Annual precip. / Degrees F.

Zone	Annual precip. / Degrees F.
1	<10 in. precip. / >80 Deg.
2	<10 in. precip. / <80 deg.
3	10-14 in. precip. / <70 deg.
4	10-14 in. precip. / 70-80 deg.
	10-14 in. precip. / 80-90 Deg.
6	14-24 in. precip. / <70 deg.
7	14-24 in. precip. / 70-80 deg.
8	14-24 in. precip. / 80-90 Deg.
9	<60 deg.
10	>24 in. precip.

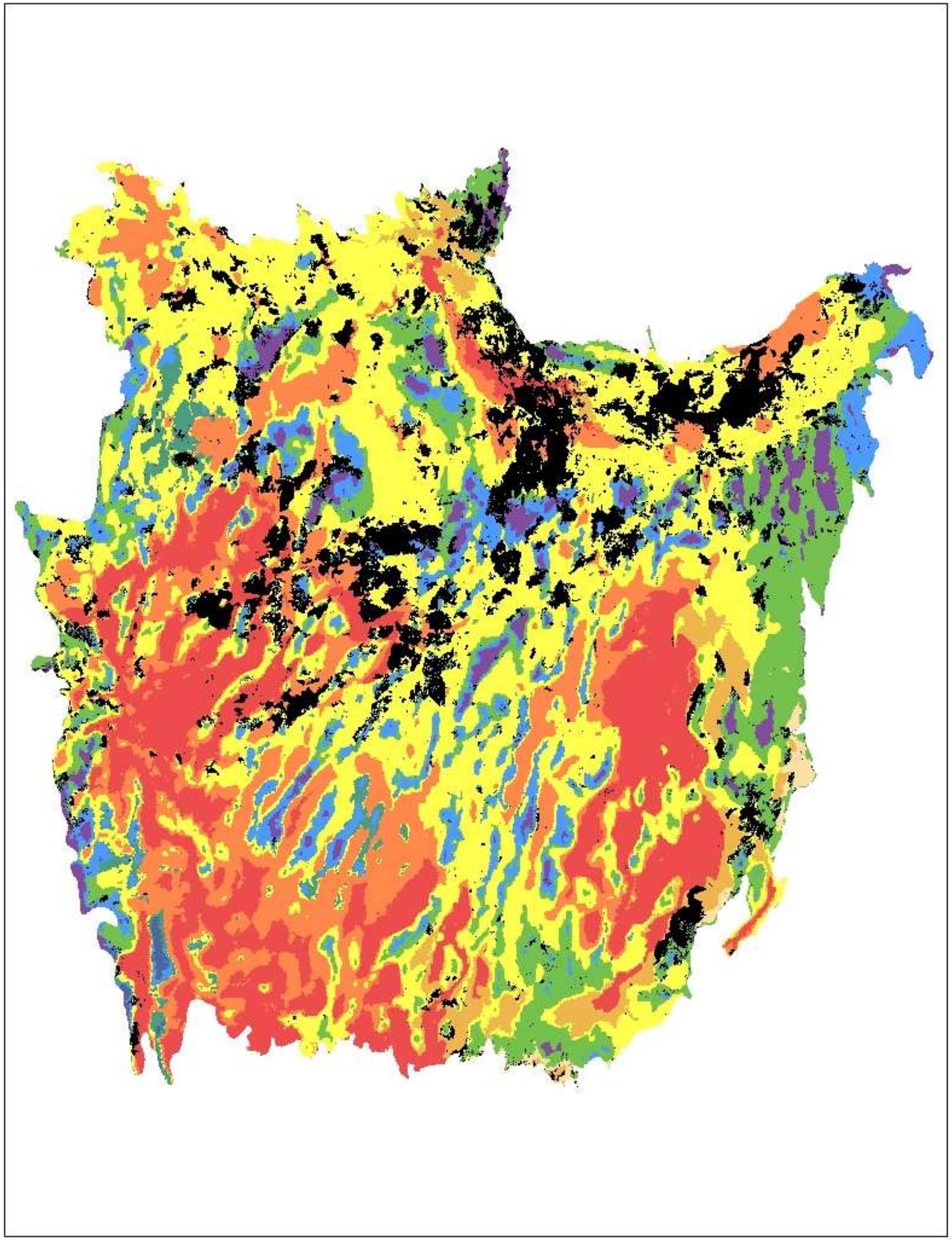
Bower, A., St. Clair J.B., and V.J. Erickson. 2010. Provisional seed zones for native plants. http://www.fs.fed.us/wildflowers/nativeplantmaterials/rightmaterials.shtml

http://www.fs.fed.us/wwetac/threat_map/SeedZones_Intro.html

The Western Fire Map 1870-2007

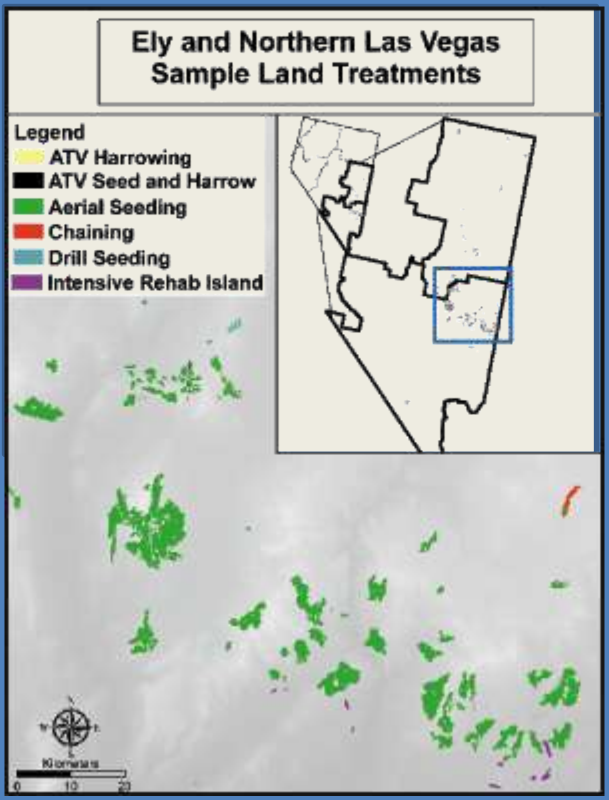
Sean P. Finn, Steven E. Hanser, Cara W. Meinke, and Adam Smith, USGS Snake River Field Station, SAGEMAP Project.

http://sagemap.wr.usgs.gov/ftp/SAB/western_fires_(1870-2007).txt



Land Treatment Digital Library

http://greatbasin.wr.usgs.gov/ltdl/Default.aspx



A dynamic system to enter, store, retrieve, and analyze Federal land treatment data.

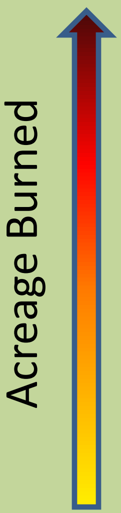
	Number of Treatments			
	1995–1999	2000–2004	2005–2008	Total
Confirmed Treatments				
Aerial Seeding	5	46	62	113
Ground Seeding	1	2	6	9
Seedling Planting	1	1	1	3
Livestock Closures (confirmed)	2	14	52	68
Livestock Closures (unconfirmed)	4	25	4	33
Fence Construction/Repair	1	14	16	31
Monitoring Only	0	0	4	4

The majority of available Great Basin data has been entered.

Pilliod, David, 2009. U.S. Geological Survey Fact Sheet 2009-3095, 2 p.

Fire Ranking

Seed zone ranking based on acreage burned in five-year increments



1980-1984	1985-1989	1990-1994	1995-1999	2000-2004	2005-2007
Zone 5	Zone 5	Zone 5	Zone 5	Zone 5	Zone 5
Zone 2	Zone 2	Zone 6	Zone 2	Zone 6	Zone 6
Zone 6	Zone 6	Zone 8	Zone 6	Zone 2	Zone 2
Zone 1	Zone 1	Zone 2	Zone 8	Zone 8	Zone 8
Zone 8	Zone 10	Zone 7	Zone 1	Zone 7	Zone 3
Zone 3	Zone 8	Zone 10	Zone 3	Zone 1	Zone 1
Zone 10	Zone 3	Zone 3	Zone 7	Zone 3	Zone 7
Zone 7	Zone 7	Zone 1	Zone 10	Zone 10	Zone 10
Zone 4	Zone 4	Zone 4	Zone 4	Zone 4	Zone 4
Zone 9	Zone 9	Zone 9	Zone 9	Zone 9	Zone 9

30 Year Fire Rank	Acreage Burned
1 - Zone 5	9,096,562
2 - Zone 6	2,592,426
3 - Zone 2	2,503,216
4 - Zone 8	1,033,197
5 - Zone 1	614,167
6 - Zone 3	472,662
7 - Zone 7	258,809
8 - Zone 10	251,701
9 - Zone 4	39,667
10 - Zone 9	683

30 Year Seeding Rank

30 Year Seed Zone Ranking Based on Acreage Treated

Acreage Seeded

1980-1984	1985-1989	1990-1994	1995-1999	2000-2004	2005-2010
Zone 5	Zone 5	Zone 5	Zone 5	Zone 5	Zone 5
Zone 2	Zone 2	Zone 6	Zone 2	Zone 6	Zone 6
Zone 6	Zone 6	Zone 2	Zone 6	Zone 2	Zone 2
Zone 3	Zone 1	Zone 3	Zone 1	Zone 8	Zone 8
Zone 8	Zone 7	Zone 1	Zone 8	Zone 7	Zone 3
Zone 7	Zone 8	Zone 10	Zone 3	Zone 3	Zone 7
Zone 1	Zone 3	Zone 8	Zone 4	Zone 10	Zone 4
Zone 4	Zone 4	Zone 4	Zone 10	Zone 4	Zone 1
Zone 9	Zone 9	Zone 7	Zone 7	Zone 9	Zone 10
Zone 10	Zone 10	Zone 9	Zone 9	Zone 1	Zone 9

30 Yr Seeding Rank	Total Acreage Acreage
1 - Zone 5	2,678,954
2 - Zone 2	646,792
3 - Zone 6	624,489
4 - Zone 8	191,079
5 - Zone 3	99,151
6 - Zone 7	59,574
7 - Zone 1	50,245
8 - Zone 4	32,188
9 - Zone 10	18,263
10 - Zone 9	785

Average Annual Forb Demand Computed by Usage Rates Then Ranked by Seed Zone.

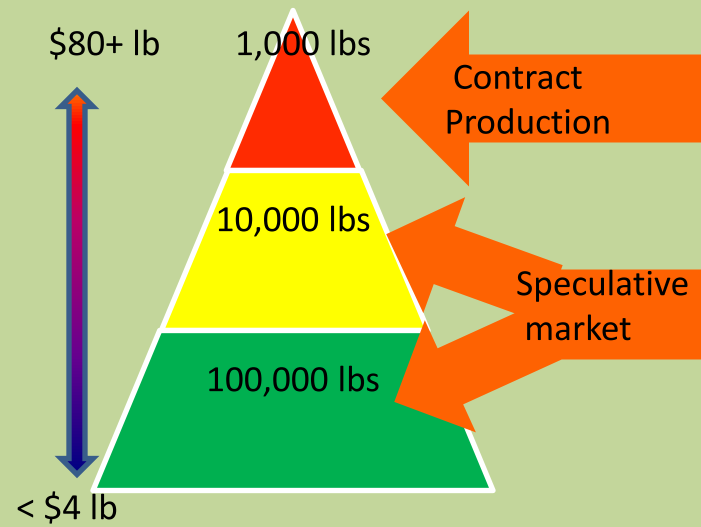
2000-2004

Zone Ranking		Seed Mix-11, 13 lbs/ac - % Forb Composition				
		Historic Use			Recommended Mix	
		5%	10%	20%	16%	32%
Zone 5	10-14 in precip / 70-80 deg	145,214	290,428	580,855		929,368
Zone 6	14-24 in precip / 70-80 deg	32,878	65,755	131,510		210,417
Zone 2	< 10 in precip / < 80 deg	19,940	39,880	79,760	63,808	
Zone 8	14-24 in precip / < 70 deg	13,638	27,276	54,553		87,285
Zone 7	10-14 in precip / < 70 deg	4,169	8,338	16,677		26,683
Zone 3	10-14 in precip / 80-90 deg	3,350	6,701	13,401		21,442
Zone 10	> 24 in precip	1,853	3,705	7,411		11,857
Zone 4	14-24 in precip / 80-90 deg	791	1,582	3,164		5,063
Zone 9	< 60 deg	102	204	408		653
Zone 1	< 10 in precip / > 80 deg	0	0	0	0	

2005-2010

Zone 5	10-14 in precip / 70-80 deg	99,603	199,206	398,412		637,459
Zone 6	14-24 in precip / 70-80 deg	29,540	59,080	118,160		189,056
Zone 2	< 10 in precip / < 80 deg	21,228	42,455	84,911	67,929	
Zone 8	14-24 in precip / < 70 deg	7,298	14,597	29,194		46,710
Zone 3	10-14 in precip / 80-90 deg	5,499	10,997	21,994		35,191
Zone 7	10-14 in precip / < 70 deg	2,699	5,398	10,797		17,275
Zone 4	14-24 in precip / 80-90 deg	2,494	4,987	9,974		15,959
Zone 1	< 10 in precip / > 80 deg	1,457	2,914	5,829	4,663	
Zone 10	> 24 in precip	75	150	300		479
Zone 9	< 60 deg	0	0	0		

Color-code to market category.



Evaluating Land Treatments to Establish Native Forbs in Wyoming Big Sagebrush sites.

Utah Division of Wildlife Resources Great Basin Research Center, Ephraim, UT

Alison Whittaker, Danny Summers, Covy Jones, Jason Vernon

What piece of equipment do we use?

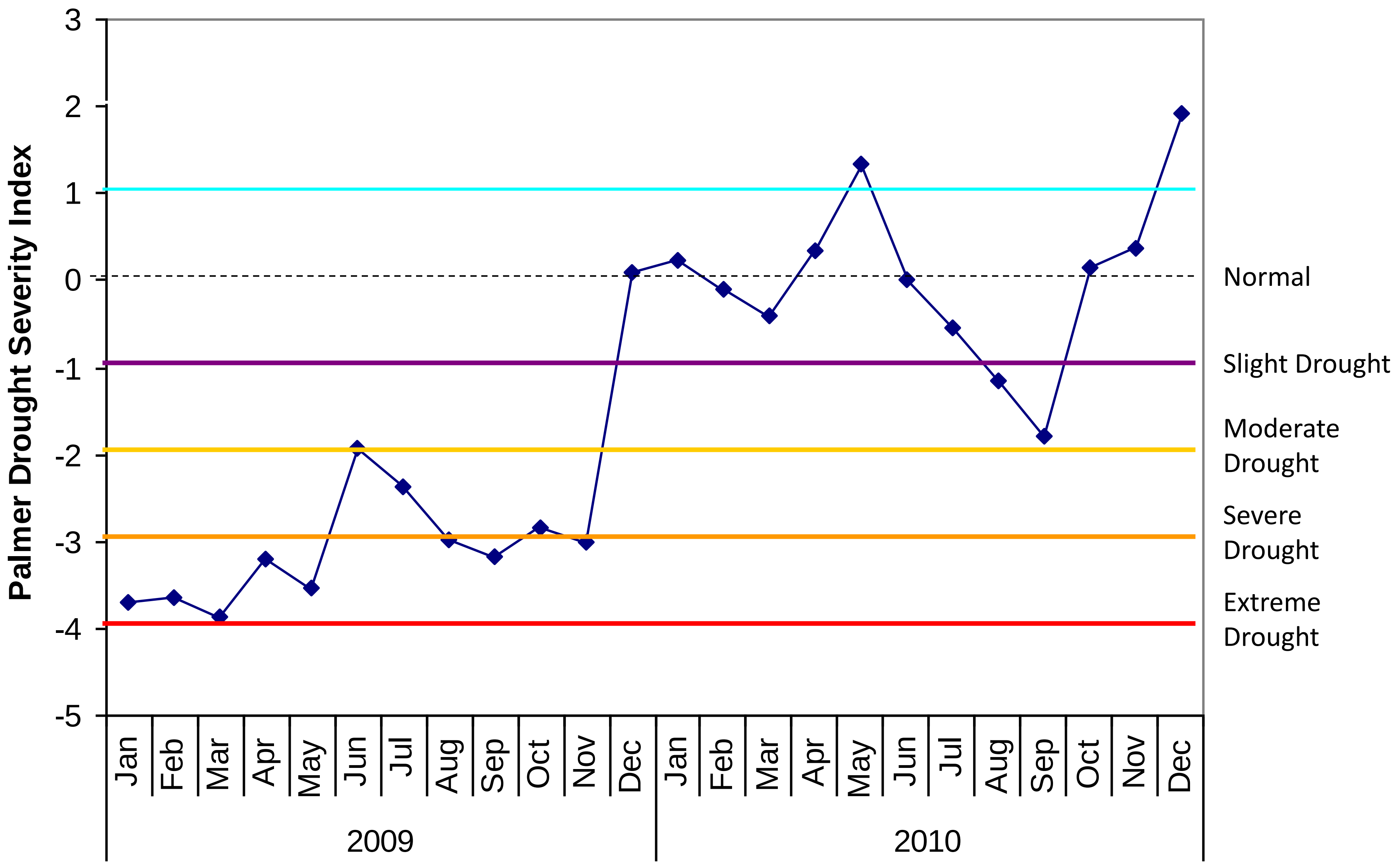
Study Design

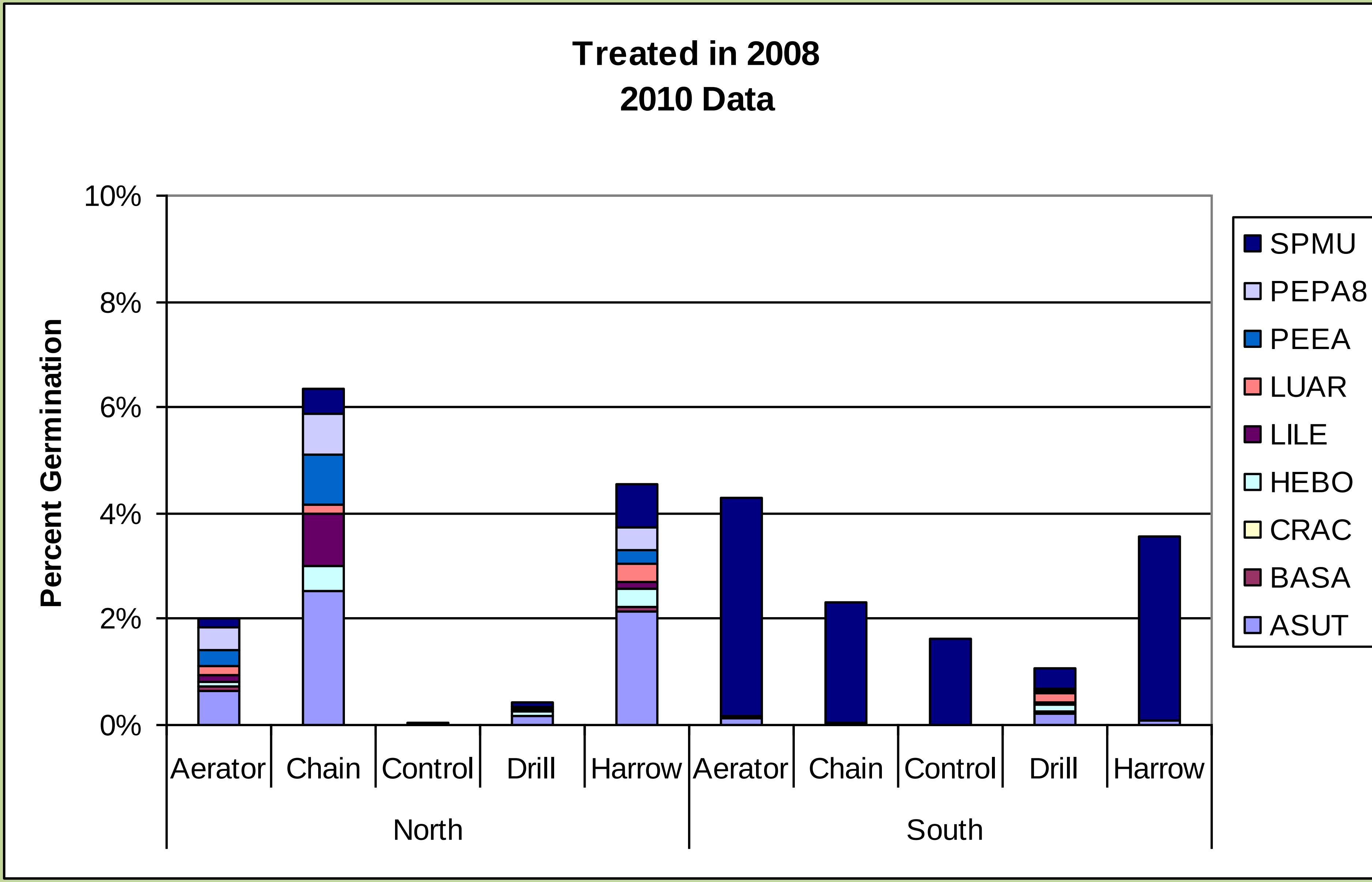
- 2 sites
  - Hatch Ranch, Utah (North)
  - Lookout Pass, Utah (South)
- 2 years – Treated in 2008 and 2009
- 5 treatments
  - Control   Control
  - Broadcast seed   Aerator
  - Broadcast seed   Chain
  - Rangeland Drill Rangeland Drill
  - Broadcast seed   Pipe Harrow

Seed Mix

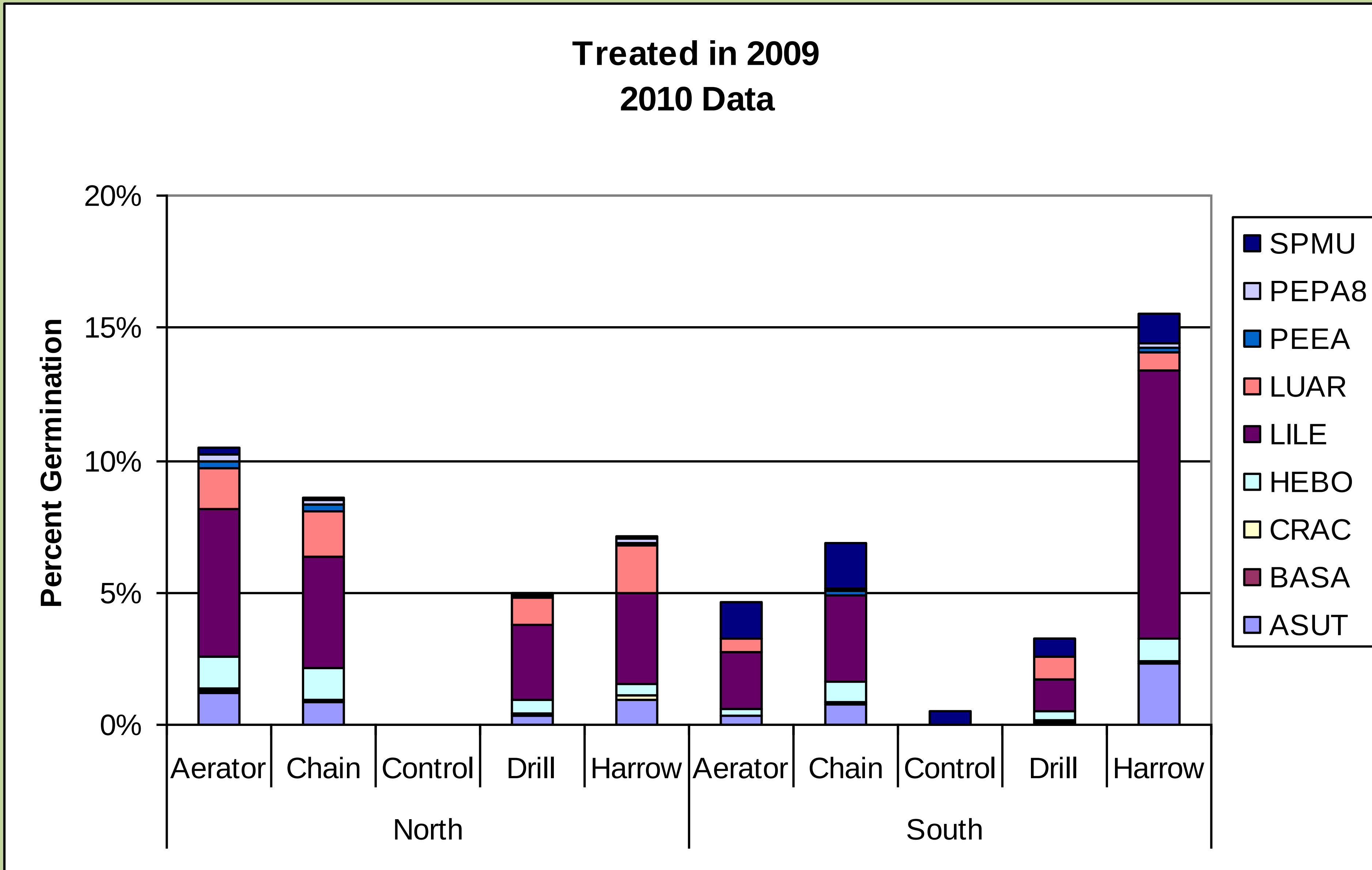
Species	Rate (lbs/acre)	Seeds/sq.ft.
Munro Globemallow	0.5	4.32
Blue Flax	1	6.04
Utah Sweetvetch	1	0.60
Silvery Lupine	1.5	0.27
Palmer Penstemon	0.5	4.86
Utah Astragalus	0.6	2.03
Arrowleaf Balsamroot	2	2.28
Firecracker Penstemon	0.29	3.18
Tapertip Hawksbeard	0.16	0.48
Total	7.55	24.04

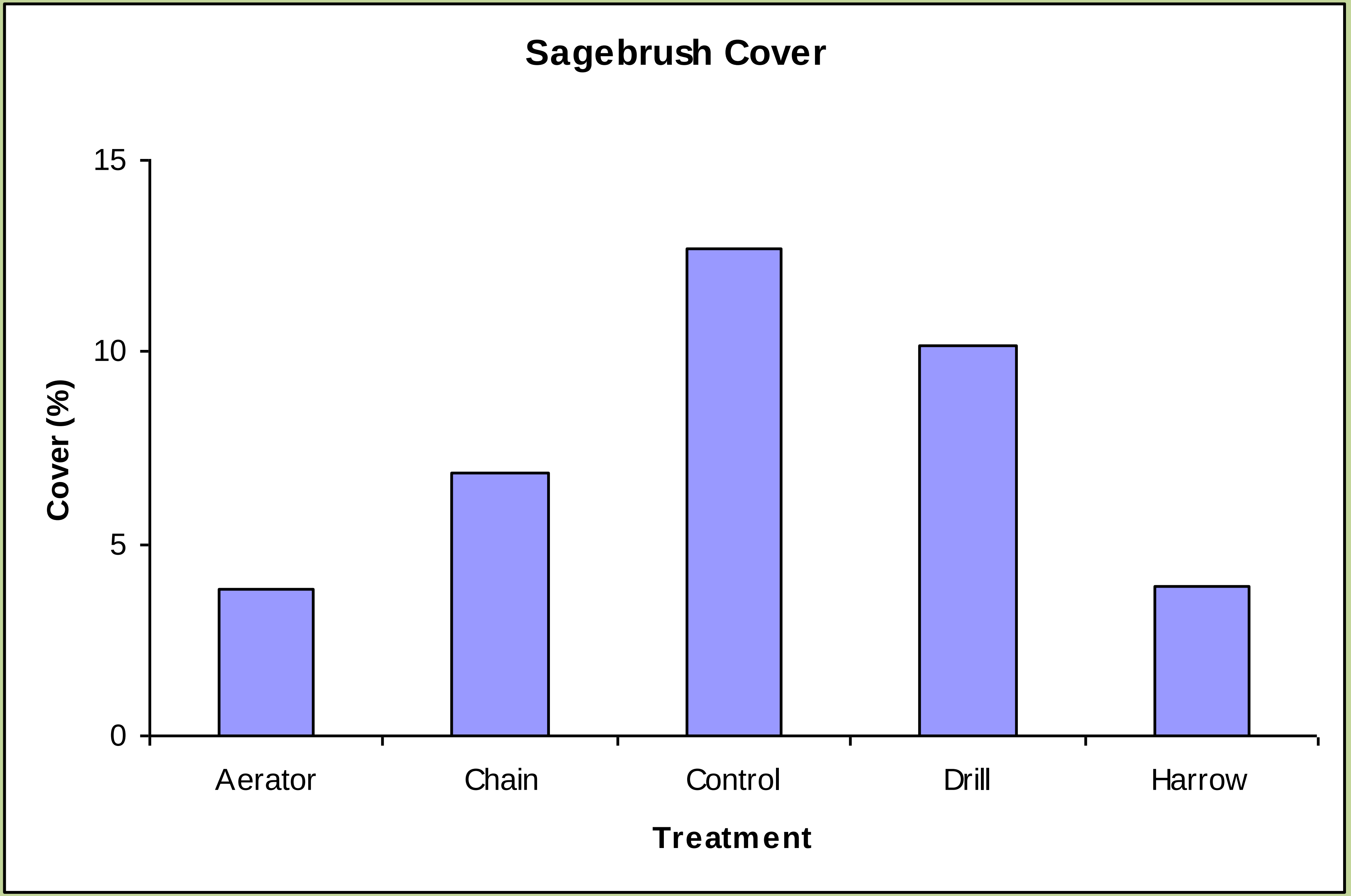
Precipitation





Treated in 2008
2010 Data
Percent Germination
10%
8%
6%
4%
2%
0%
Aerator
Chain
Control
Drill
Harrow
Aerator
Chain
Control
Drill
Harrow
North
South
SPMU
PEPA8
PEEA
LUAR
LILE
HEBO
CRAC
BASA
ASUT


Treated in 2009
2010 Data
Percent Germination
20%
15%
10%
5%
0%
SPMU
PEPA8
PEEA
LUAR
LILE
HEBO
CRAC
BASA
ASUT
Aerator
Chain
Control
Drill
Harrow
Aerator
Chain
Control
Drill
Harrow
North
South


Sagebrush Cover
Cover (%)
15
10
5
0
Aerator
Chain
Control
Drill
Harrow
Treatment

Forb Island Study





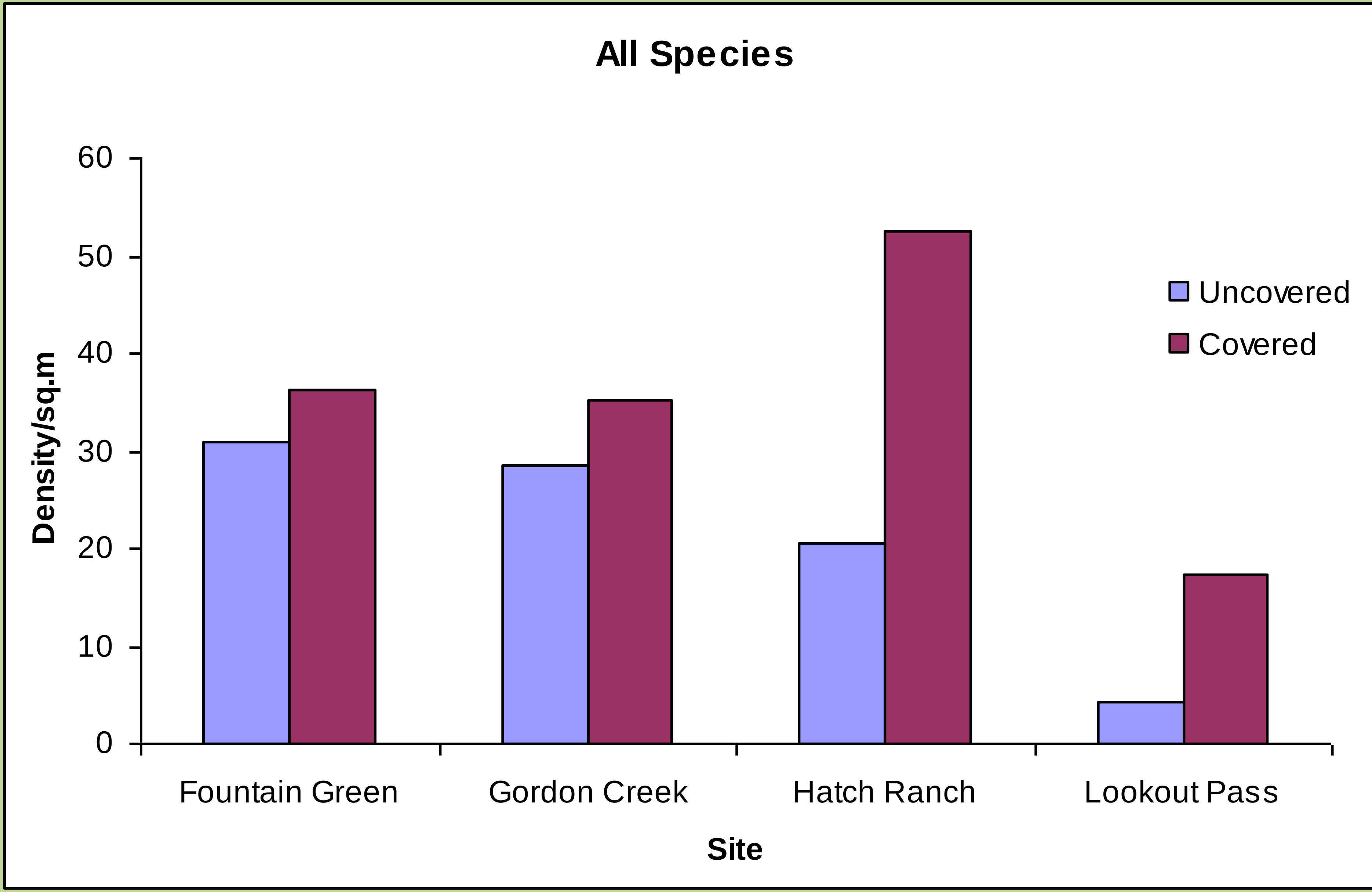
Study Design

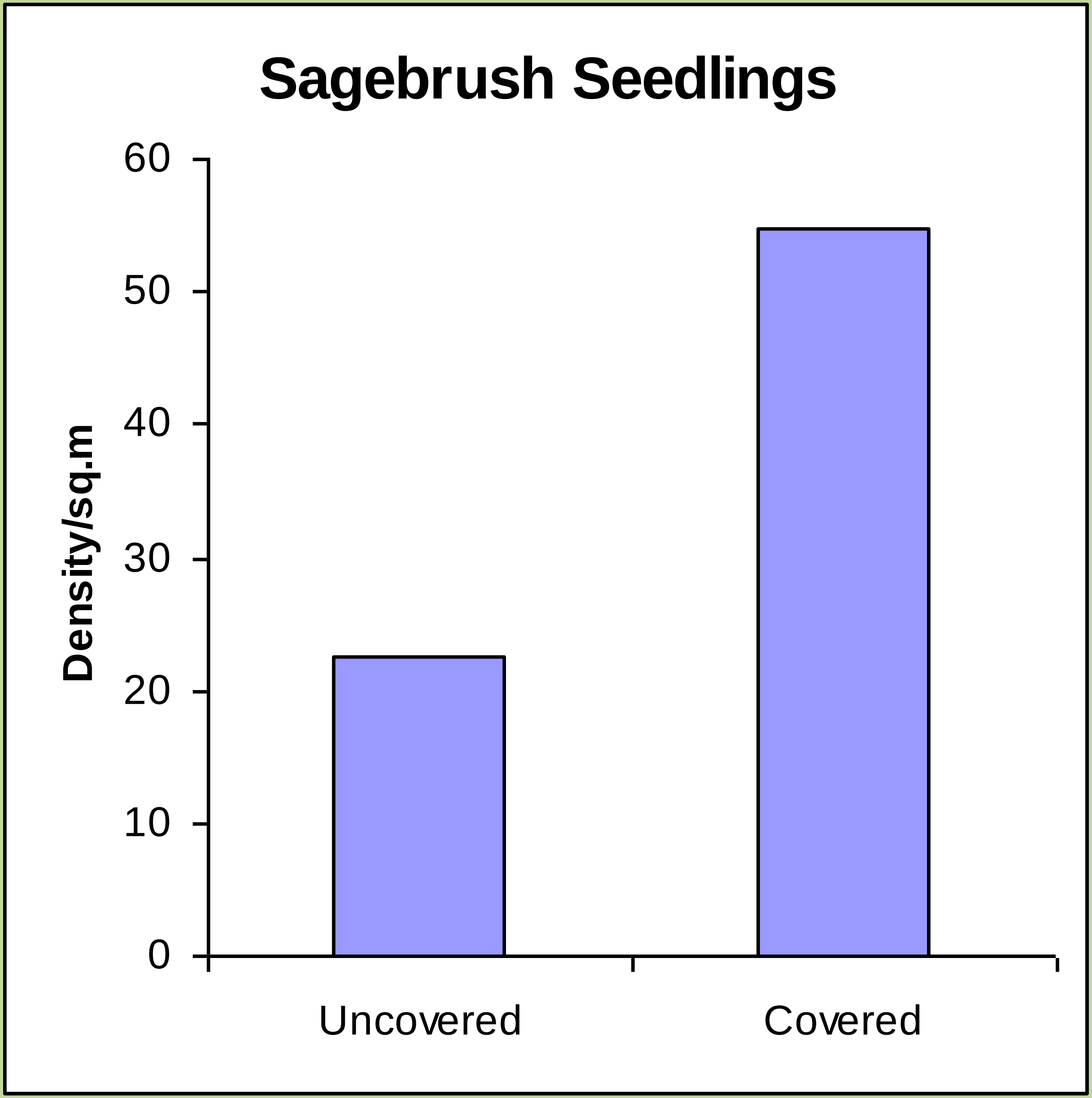
- 4 sites
  - Fountain Green, UT
  - Gordon Creek, UT
  - Lookout Pass, UT
  - Hatch Ranch, UT
- 2 N-sulate treatments
  - Covered
  - Uncovered
- 2 Seed Mixes

Seed Mixes

Seed Mix 1	**Rate**
	Seeds/ft^2
Linum lewisii	9
Poa fendleriana	17
Cleome serrulata	3
Lupinus argenteus	21
Sphaeralcea grossularifolia	20
Balsamorhiza sagittata	16
Hedysarum boreale	17
Penstemon pachyphyllus	17
Total	122

Seed Mix 2	**Rate**
	Seeds/ft^2
Agoseris grandiflora	24
Agoseris heterophylla	18
Nicotiana attenuata	26
Lomatium nudicaule	25
Argemone munita	18
Heliomeris multiflora nevadensis	17
Thelypodium milleflorum	18
Total	146


All Species
Density/sq.m
60
50
40
30
20
10
0
Uncovered
Covered
Fountain Green
Gordon Creek
Hatch Ranch
Lookout Pass
Site


Sagebrush Seedlings
60
50
40
30
20
10
0
Density/sq.m
Uncovered
Covered

FORB RESPONSE TO HERBICIDES FOR SEED PRODUCTION AND RANGELAND RESTORATION

Corey Ransom and Kim Edvarchuk
Utah State University

Objective - Seed Production

Identify herbicides for weed management in forb seed production.

- *Astragalus filipies*
- *Dalea ornata*
- *Dalea searlsiae*

Objective – Rangeland Restoration

Evaluate native species response to herbicides applied to control downy brome.

How will they handle exposure to these herbicides when germinating?

Post-fire Seeding Strategies and Native Plant Materials for the Northern Great Basin

Nancy Shaw, Matt Fisk, Erin Denney
USDA FS, Rocky Mountain Research Station, Boise, Idaho

Robert Cox
Texas Tech University, Lubbock, TX

Jim Truax
Truax Co., New Hope, MN

The effects of smoke water and heat shock on seed germination of Great Basin species

Robert D. Cox
Texas Tech University

Smoke and Heat Effects on Germination

- Seeds in fire-prone areas may respond to smoke, heat, or both.
- Such fire-cues indicate that space and nutrients are available for establishment of new plants.
- Hundreds of species worldwide have such responses

Seedling Emergence of Diverse Seed Mixes in Post-Wildfire Rangelands

Robert D. Cox

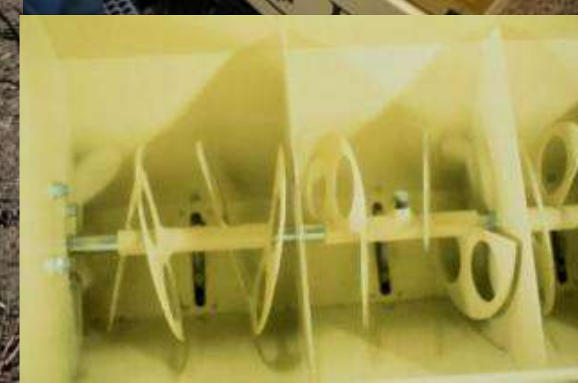
Nancy L. Shaw

Mike Pellant

Treatments

Control (no drilling or seeding)
Rangeland drill (no seed, low rate, high rate)
Minimum-till drill (no seed, low rate, high rate)

7 treatments x 5 replications x 2 sites

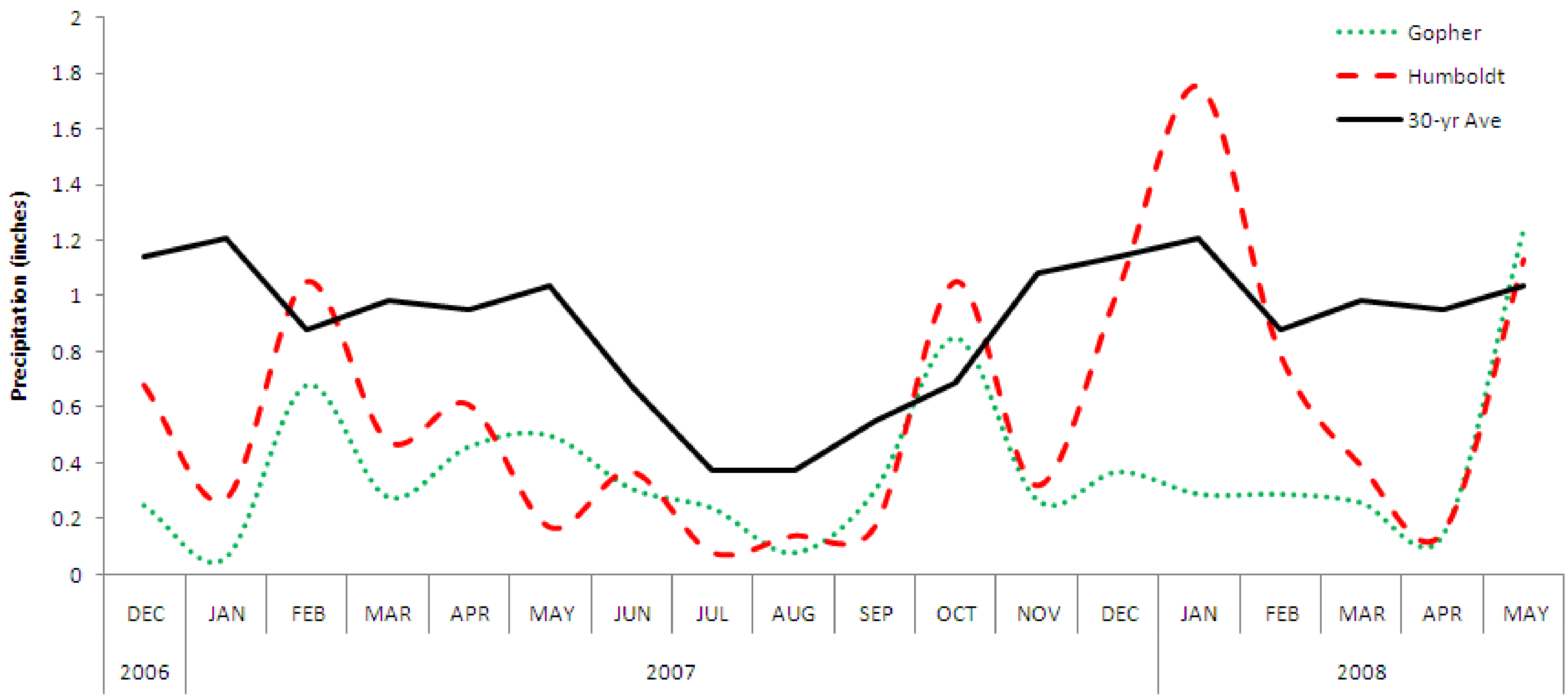


Seed Mix

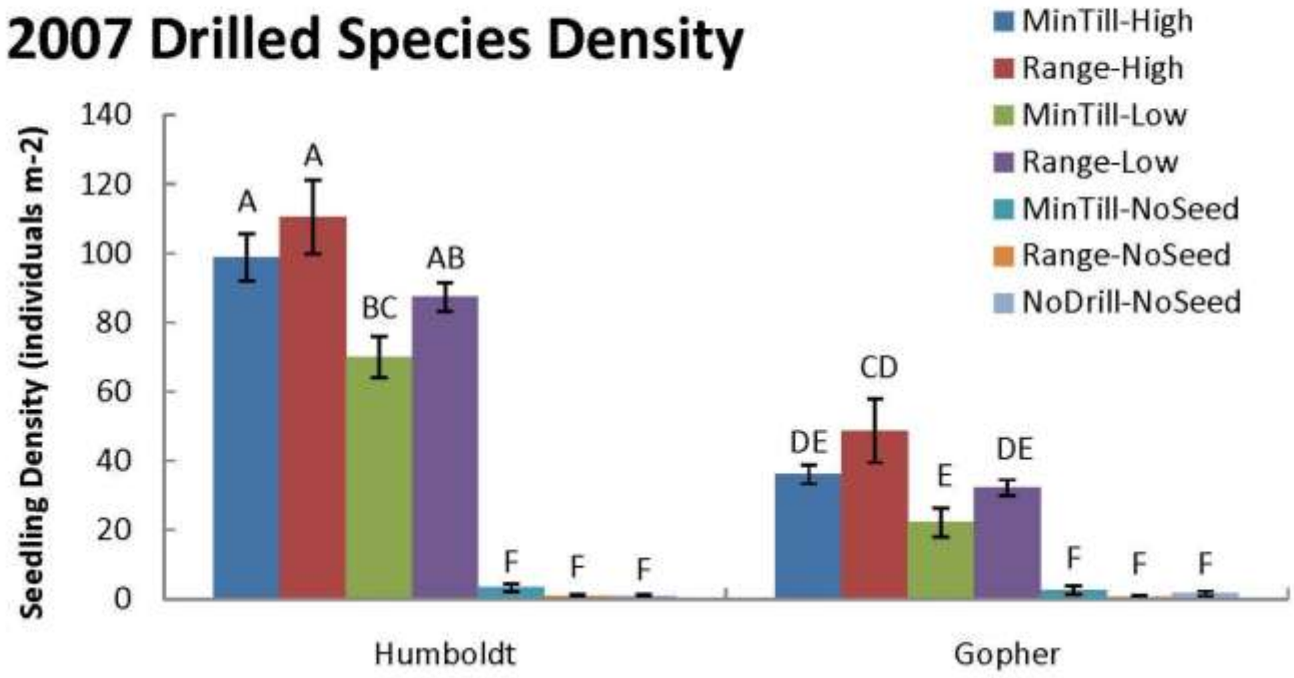
Drill mix
- Fourwing saltbush
- Blue flax
- Munro globemallow
- Bluebunch wheatgrass
- Bottlebrush squirreltail
- Indian ricegrass

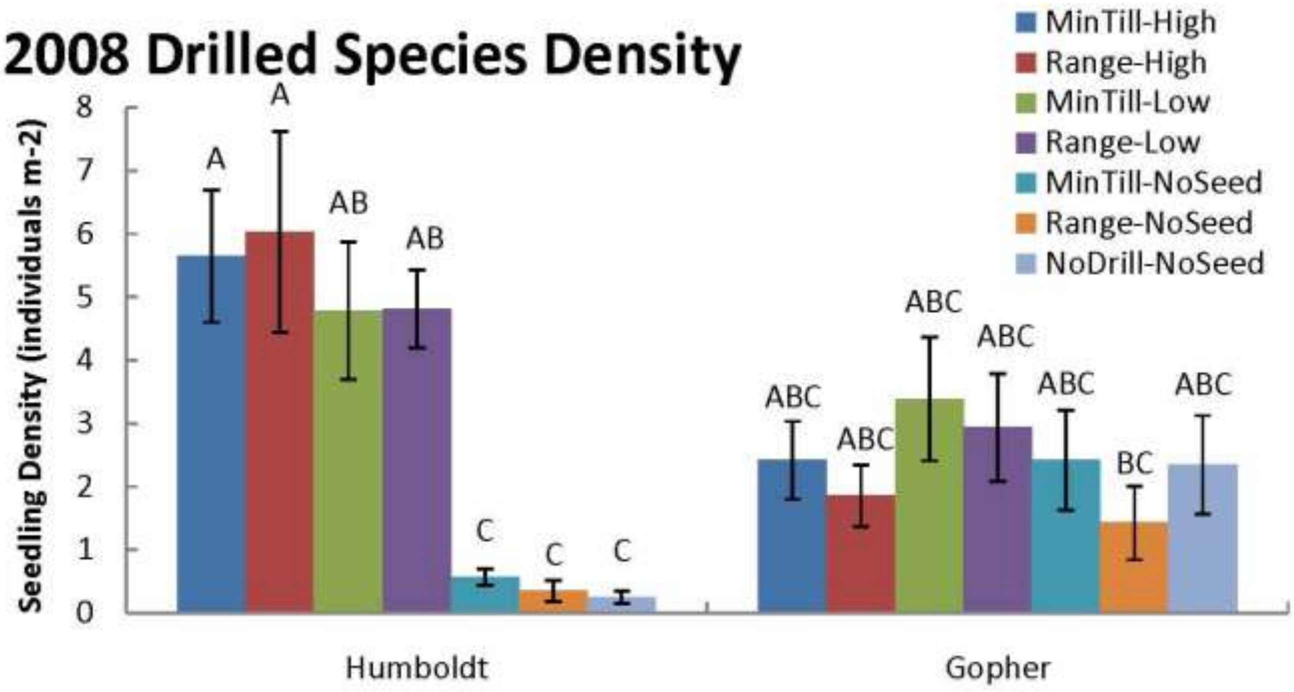
Broadcast
- Wyoming big sagebrush
- Rubber rabbitbrush
- Western yarrow
- Sandberg bluegrass

Precipitation



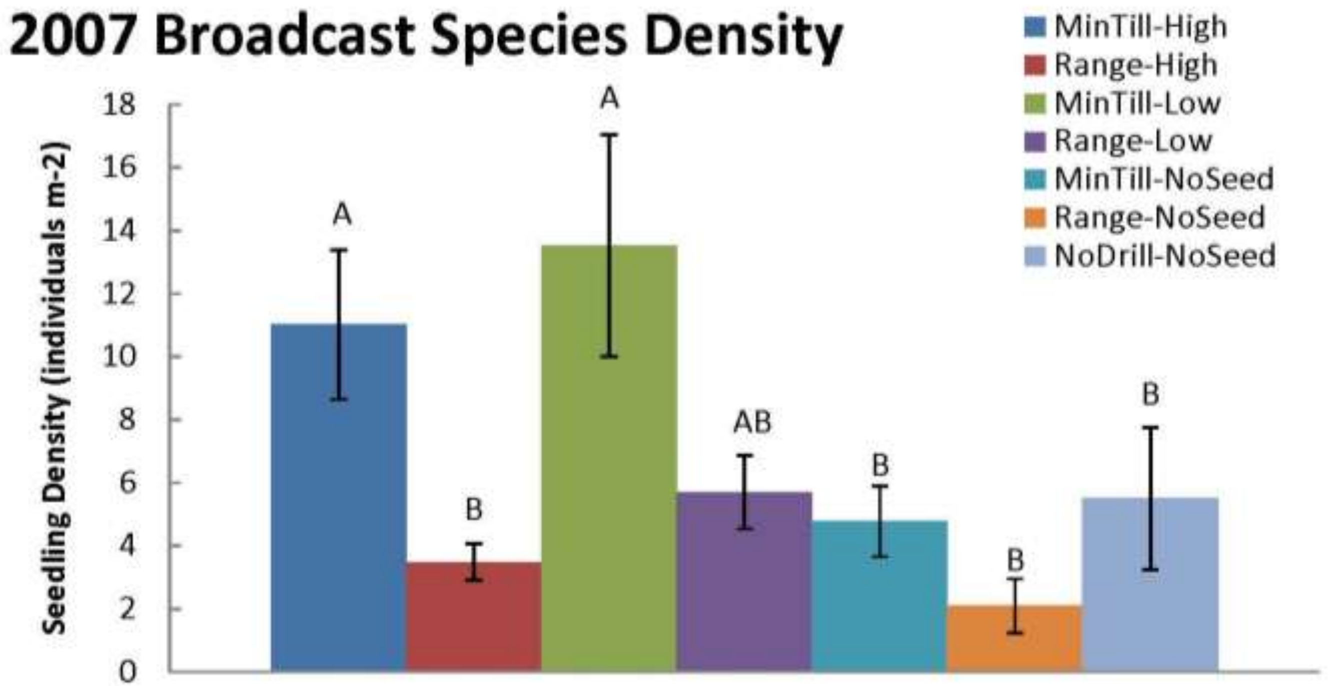
Results- Drilled Species Density

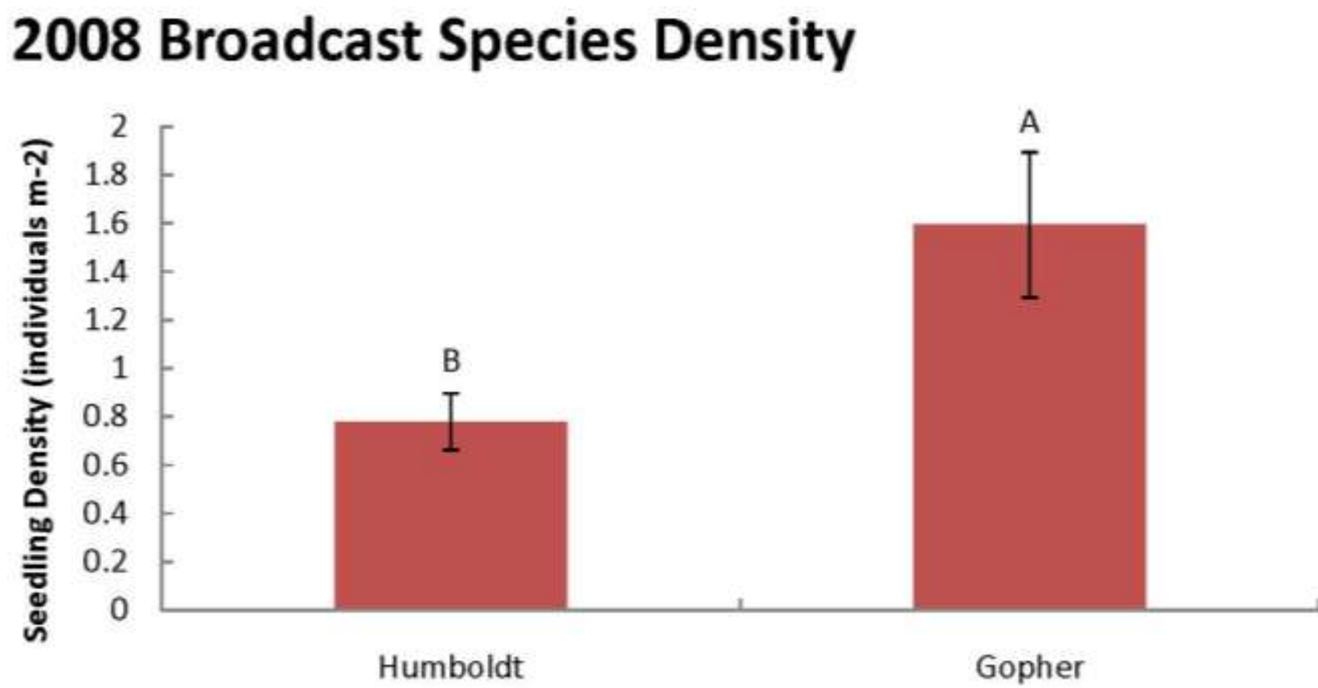




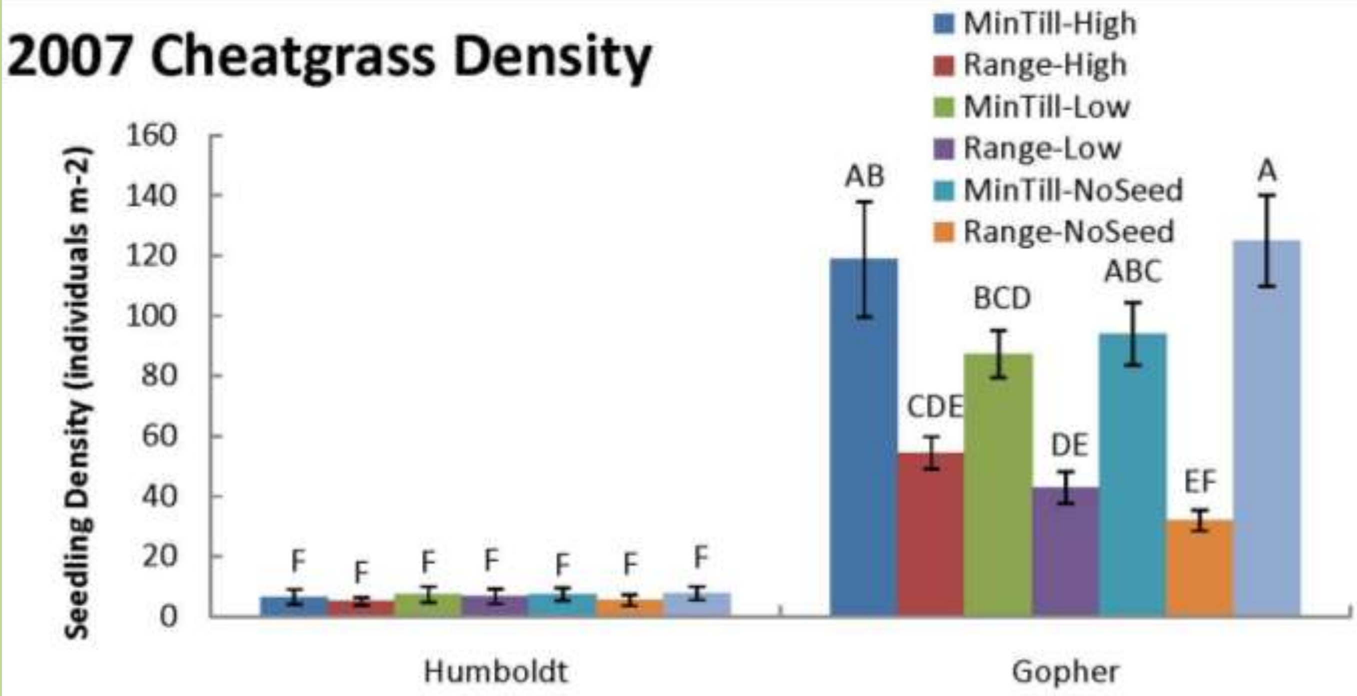
Results- Broadcast Species Density

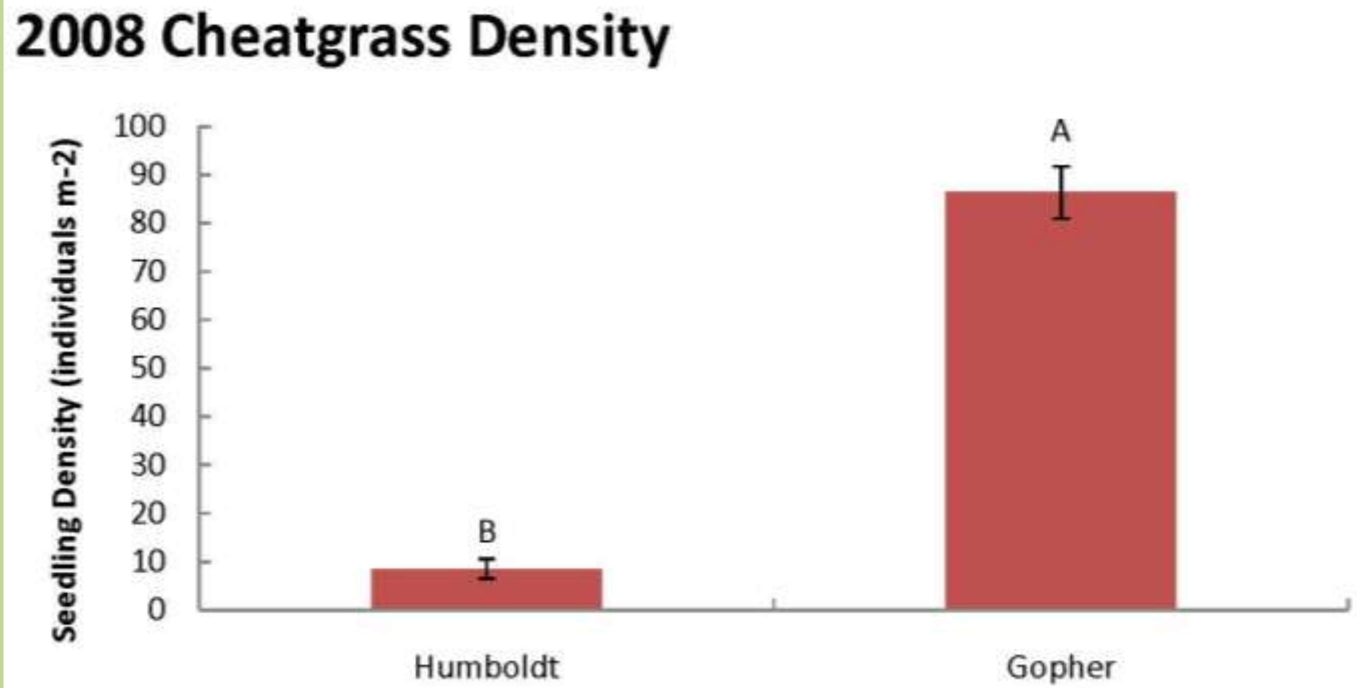
(no sage)





Results–Cheatgrass Density



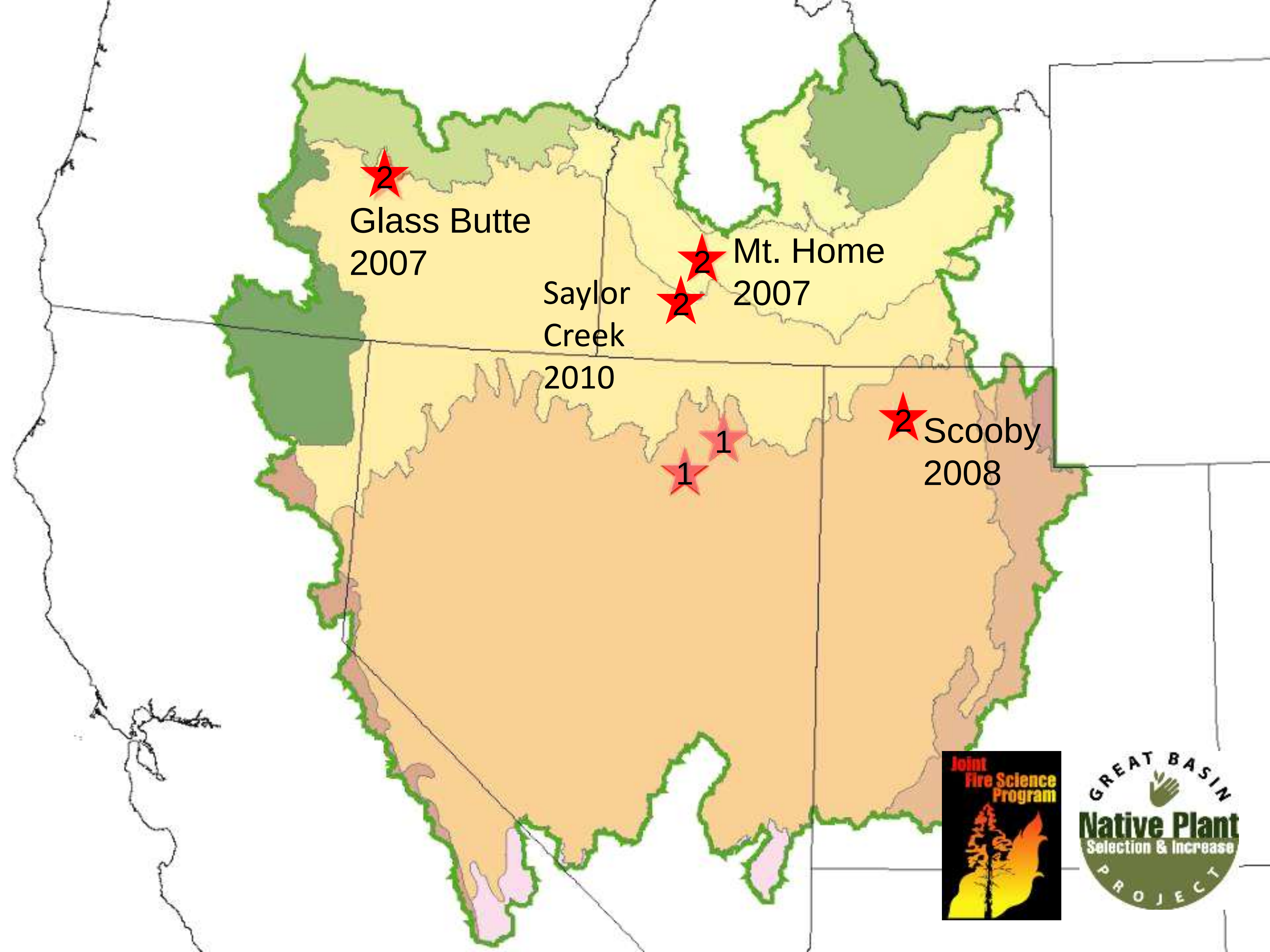


Conclusions

- Precipitation:
  - always a concern…!
- Seeding Technology:
  - Both drills successful with DRILLED seeds
  - Min-till drill more successful with BROADCAST seed
  - Rangeland drill reduced cheatgrass density the first year

Seeding Technology and Equipment for Reestablishing *Artemisia tridentata wyomingensis* Communities

- USDA FS Rocky Mountain Research Station, Boise and Provo
- USDA NRCS Aberdeen Plant Materials Center
- Texas Tech University
- Truax Co., Inc.
- USDI BLM, Idaho State Office
- USGS, Corvallis, Ecosystem Science Research Center
- University of Idaho
- University of Wyoming
- North Dakota State University


2
Glass Butte
2007
2
Mt. Home
2007
Saylor
Creek
2010
2
1
1
2
Scooby
2008
Joint
Fire Science
Program
GREAT BASIN
Native Plant
Selection & Increase
PROJECT

Treatments

Drill	Seeding Rates
No Drill	No Seed
Minimum-till	No Seed
	Standard
	5X ARTRW
	10X ARTRW
	Fall Hand Broadcast (5X)
	Winter Hand Broadcast (5X)
Rangeland	No Seed
	Standard
	5X ARTRW
	10X ARTRW
	Fall Hand Broadcast (5X)
	Winter Hand Broadcast (5X)

x 5

Seed Drills

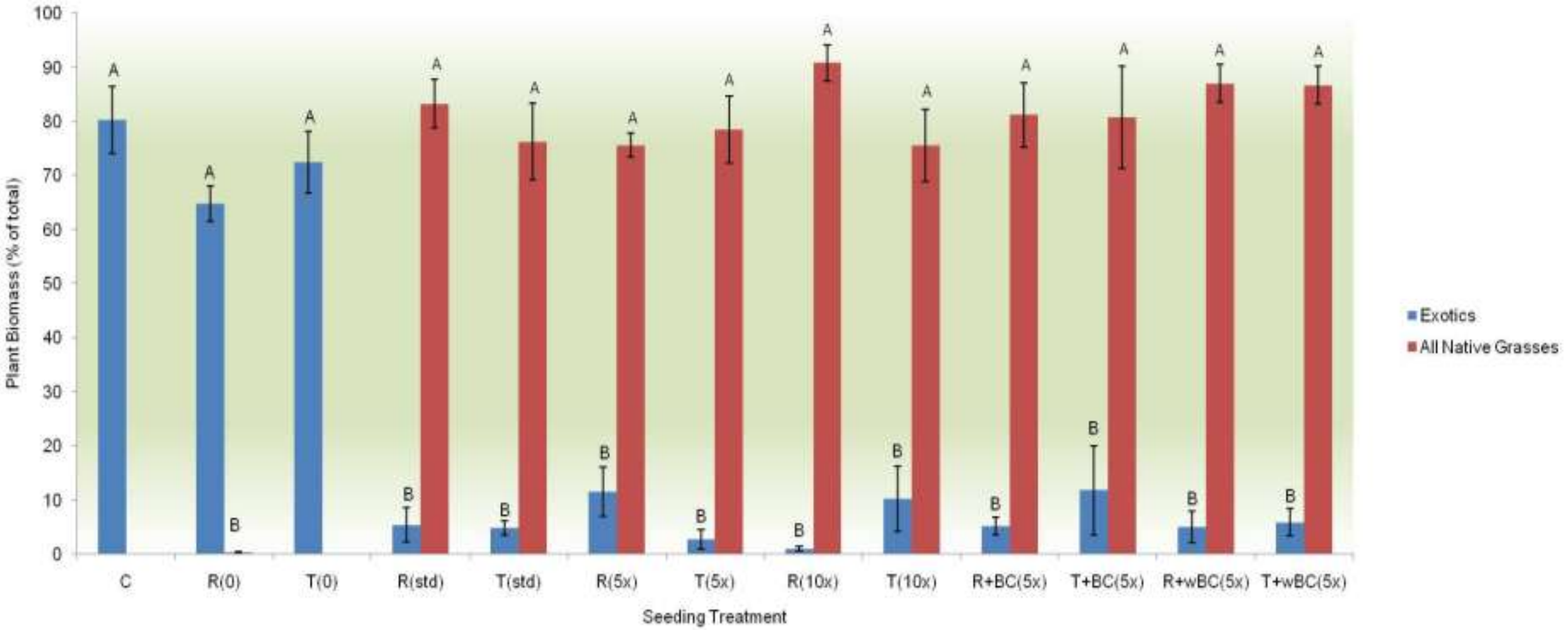
Rangeland

Minimum till

Scooby Seeding Mix Species	PLS lbs/ acre	PLS seeds/ft^2
Drill Mix		
Bluebunch wheatgrass	2.00	6
Indian ricegrass	1.00	5
Bottlebrush squirreltail	1.00	4
Munro globemallow	0.50	9
Sulphur-flower buckwheat	0.24	1
Total:	**4.74**	**25**
Broadcast Mix (Standard)		
Wyoming big sagebrush	0.10	5
Rubber rabbitbrush	0.50	8
Western yarrow	0.15	9
Sandberg bluegrass	0.40	9
Blue penstemon	0.09	7
Total:	**1.24**	**38**


Unseeded

Scooby Seeding 2010
Seeded Grasses and Invasive Density



The Role of Native Annual Forbs in the Restoration of Invaded Rangelands

Erin Goergen, Elizabeth Leger, Tara Forbis
University of Nevada, Reno
USDA ARS Reno, NV

Can we improve restoration success by more closely following natural successional patterns?

Disturbance → Annuals → Early seral perennials → Late seral perennials & shrubs




Annuals increase after disturbance!

- Native annual forbs have relatively low abundance in climax sagebrush communities.

- Underdown Canyon, Austin NV
  - 1 year after fire, native annual forbs increased by 70%
  - Cover stayed high even 3 years post-fire

Field Experiment

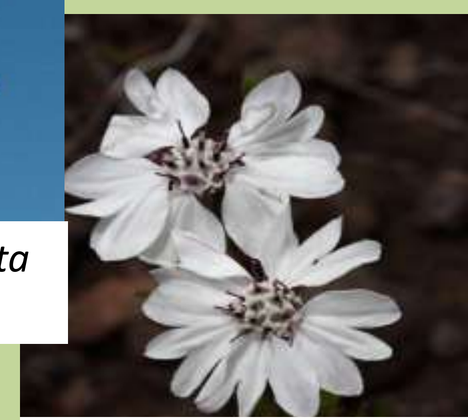
- Target *E. multisetus and B. tectorum*
  - grown alone, with single annual forb species, *B. tectorum*, or forb + *B. tectorum*.
- 5 Native forbs chosen:

Amsinckia intermedia
AMIN

Amsinckia tesellata
AMTE

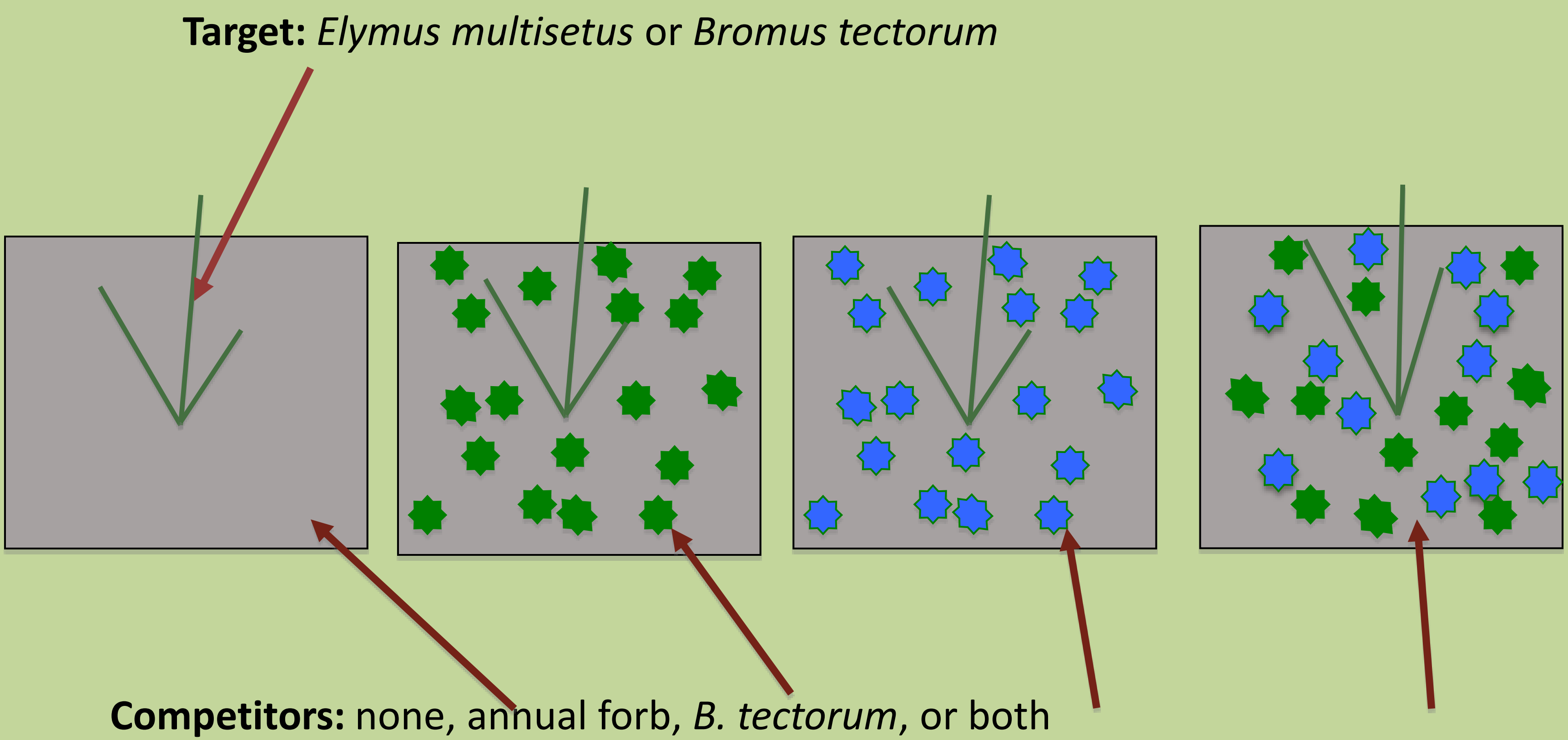
Mentzelia veatchiana
MEVE

Descurinia pinnata
DEPI

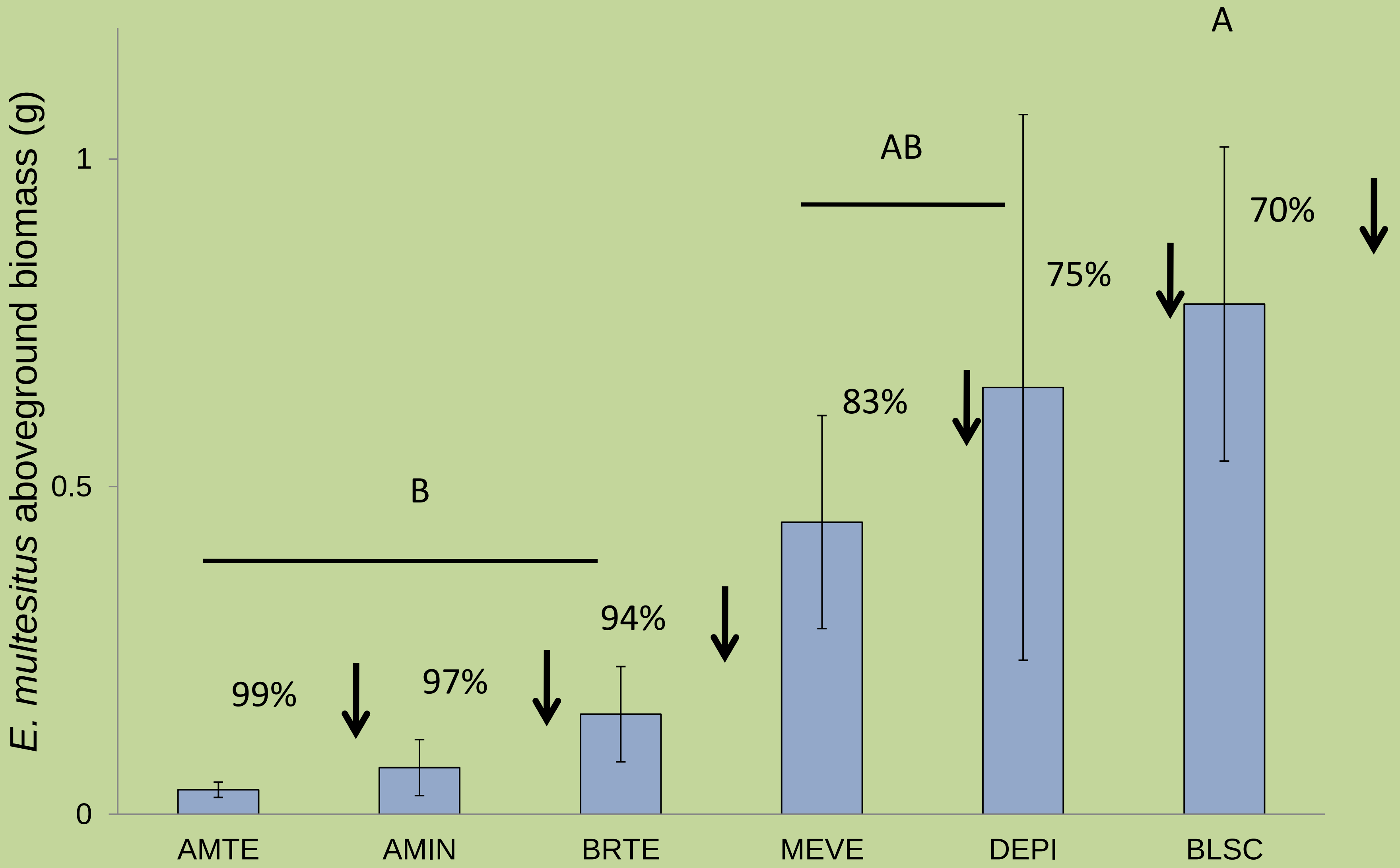


Blepharipappus scaber
BLSC

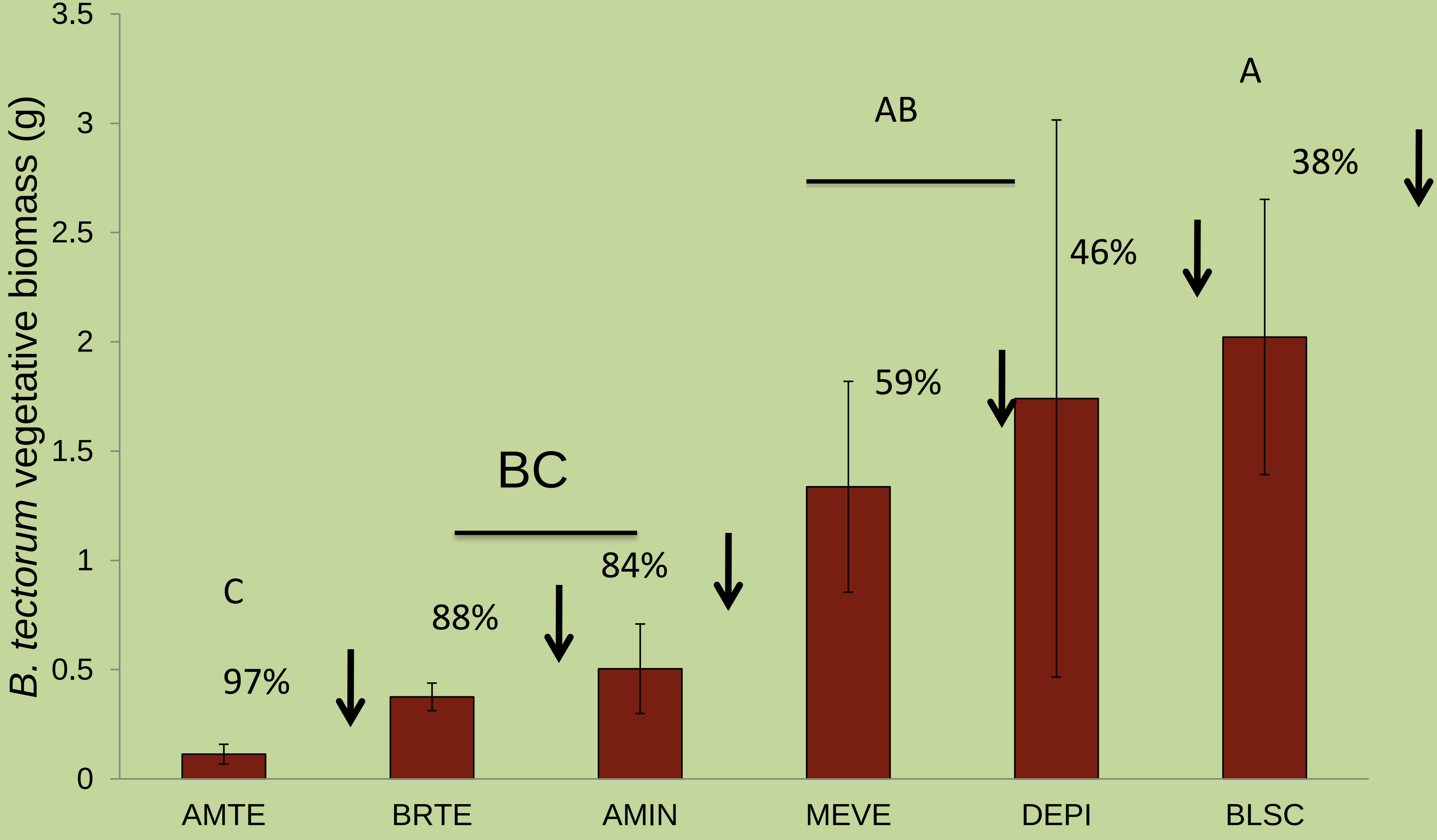
Experimental Design



1. ELMU grows best with BLSC, DEPI, and MEVE



1. Competitive pressure on BRTE is not equal!

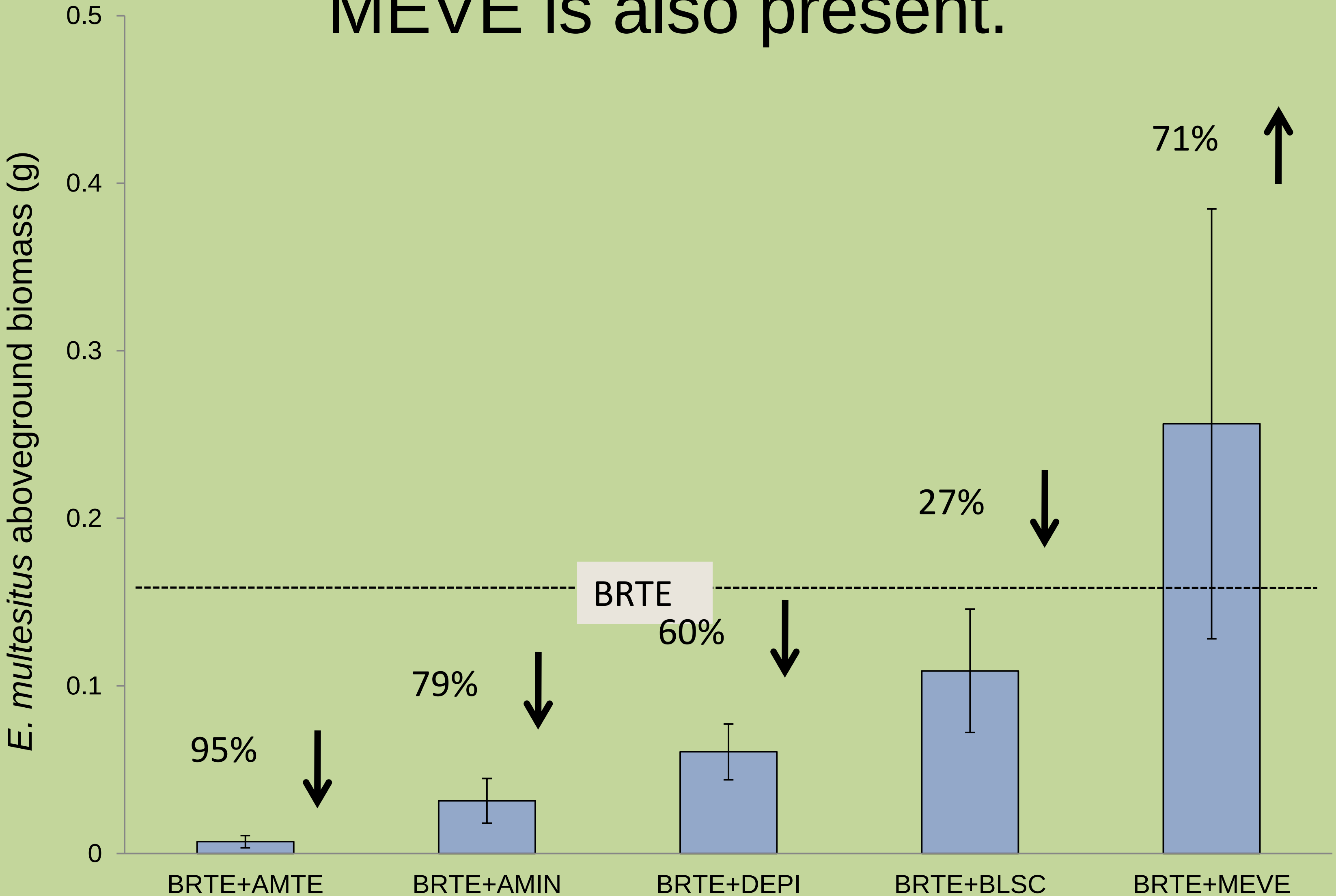


Questions

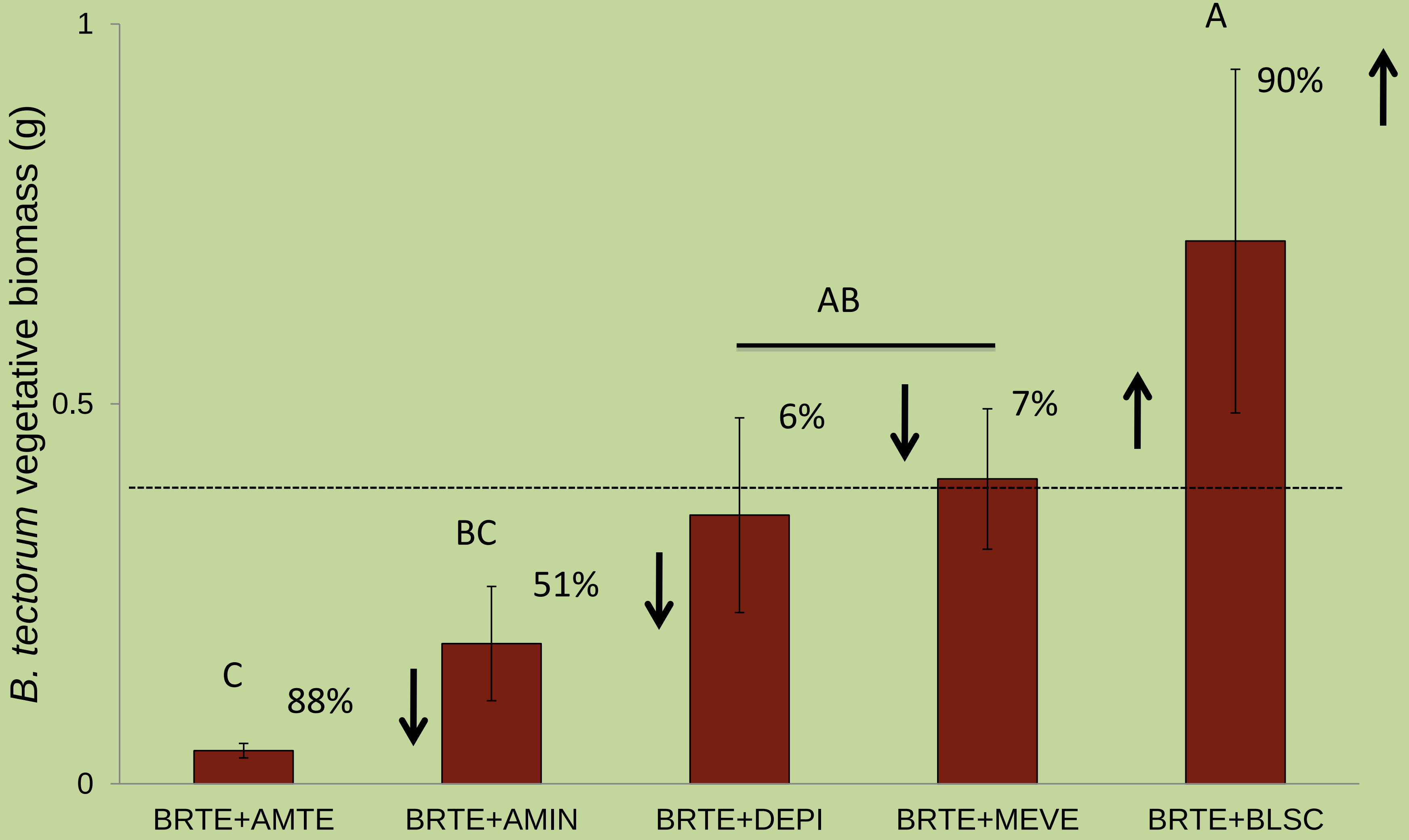
2. When grown in mixtures, what effect do annual forbs have on *Elymus multisetus* and *Bromus tectorum*?

MEVE and BRTE

2. When with BRTE, ELMU is larger when MEVE is also present.



2. BRTE is most impacted when grown with AMTE and AMIN.



Field summary

- *A. tesselata* and *A. intermedia* show promise as a good competitors against *B. tectorum.*

- *M. veatchiana* has the potential to facilitate establishment of *E. multisetus.*

Modeling Seedling Root Growth of Great Basin Species

Kert Young, Bruce Roundy, Darrell Roundy

GREAT BASIN Native Plant Selection & Increase PROJECT

BYU BRIGHAM YOUNG UNIVERSITY

Growth chamber

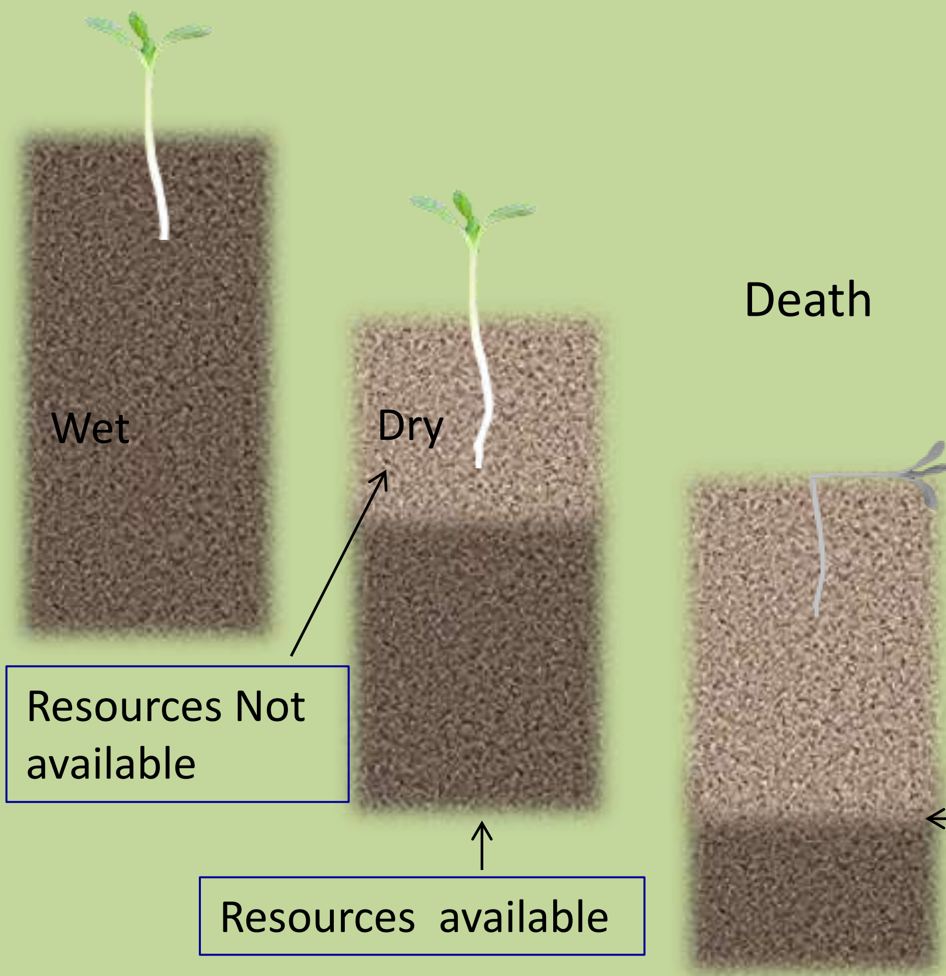
Goal

- Use thermal accumulation modeling
  - To predict which seeded species will successfully establish
    - Given
      - Site specific soil temperature and moisture patterns
      - Interspecies interference
    - Save $$$
      - Only planting species likely to establish
  - Pre-planting tool to screen plant materials based on growth chamber species performance

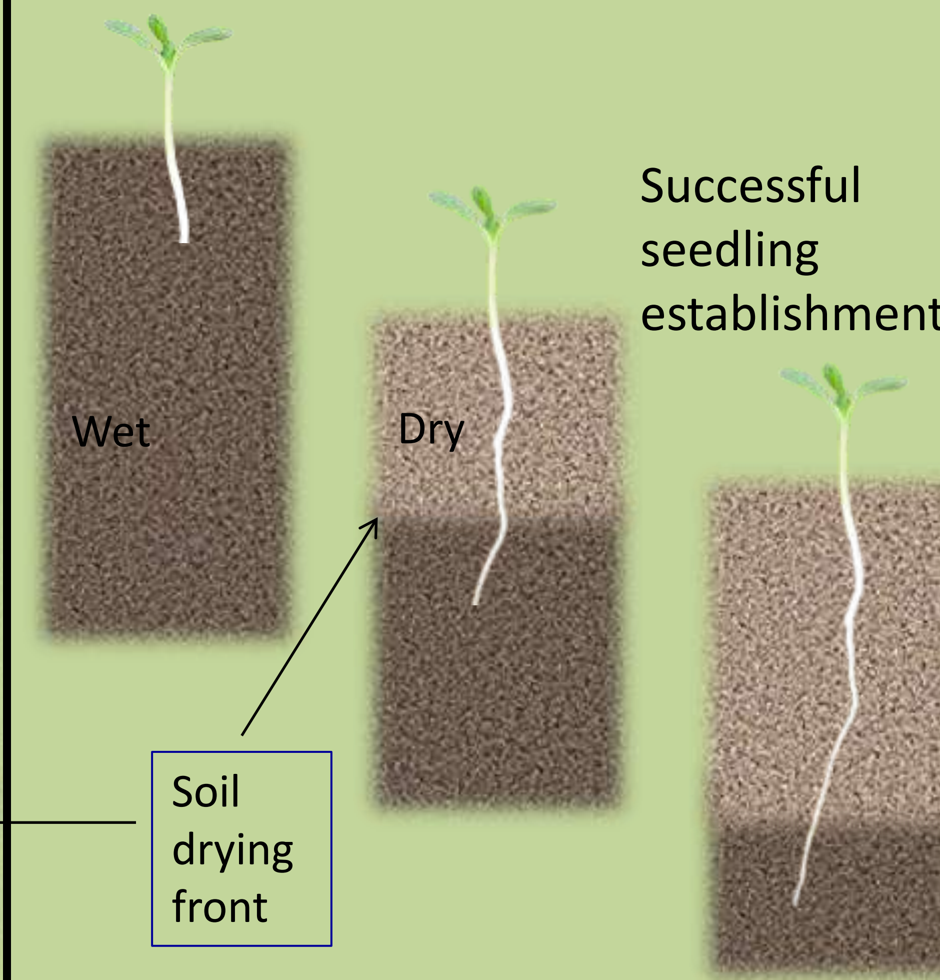
Overall Concept

Rate of root depth – vs – Rate of soil drying front in spring

Soil drying front faster than rate of root depth



Rate of root depth keeps up with drying front



Conclusions

- Thermal accumulation modeling
  - Accurately predicted rate of root depth for most species
- Life forms and life history strategies
  - Annual grasses put down roots fastest
    - Least thermal time required
  - Perennial grasses put down roots moderately fast
  - Forbs put down roots more slowly
    - Most thermal time required

Implications

- Thermal accumulation modeling
  - Tool for screening cultivars for site specific seedling establishment success
- Evidence of successful thermal accumulation modeling
  - Warrants additional research