INCREASING NATIVE PLANT DIVERSITY IN CRESTED WHEATGRASS STANDS: THEORY, PRACTICE AND PROBLEMS

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Sagebrush-grass Steppe Areas

- 50 million hectares in Western U.S.
- Open canopy of sagebrush with grass and forb understory
- Historically, fires occurred about every 30-70 years
- Fire played a local role in natural sagebrush areas
 - promoted patchiness
 - promoted diversity

Cheatgrass-altered Succession

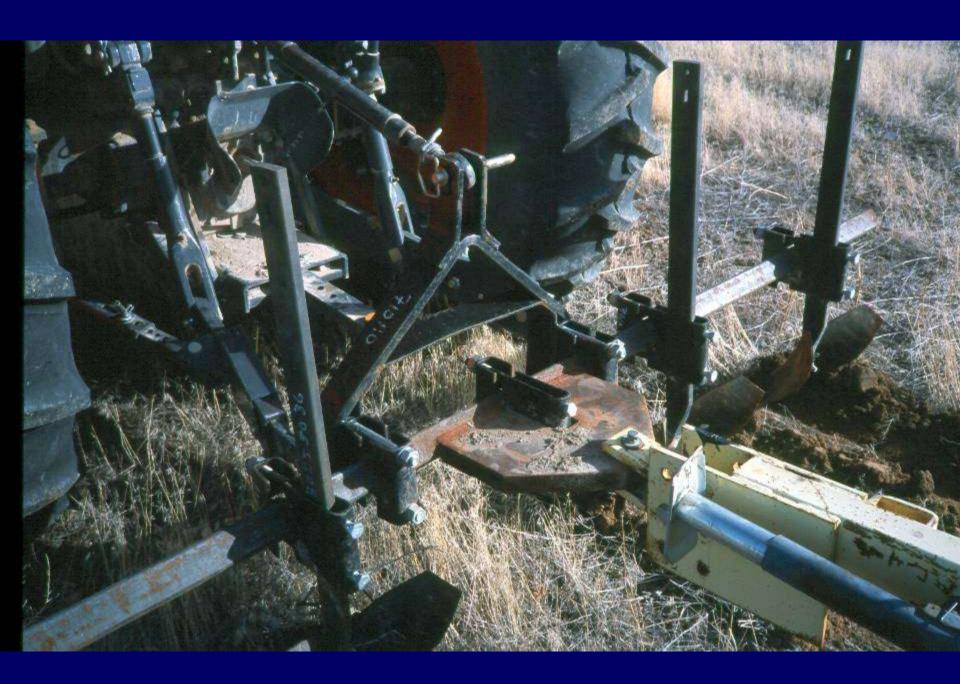
- Increase in fire frequency to 1 3 years
- Timing of competition for resources
 (preempted use of nutrients, light, water etc.)
- Succession is arrested at an annual stage





- Annuals such as cheatgrass affect sagebrush areas by:
 - Limiting the establishment of native seedings
 - Increasing the fire frequency
- Aggressive perennials such as Crested wheatgrass capture the site from cheatgrass and other annuals











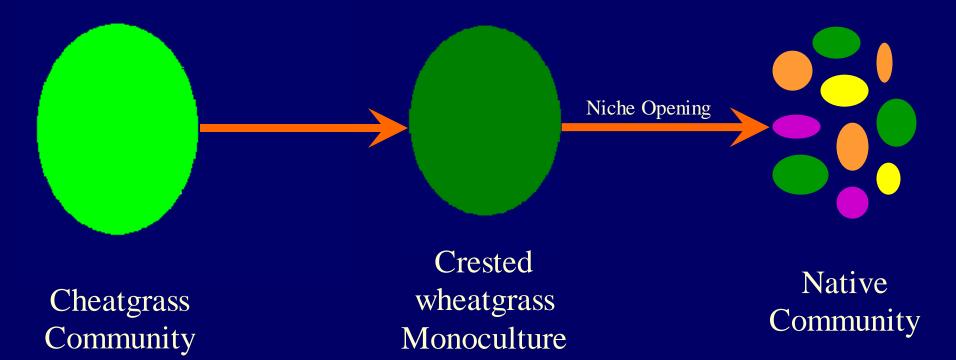


Hypothesis

- Reseeding of a sagebrush-grassland community will have significantly better establishment when seeded into a perturbated perennial monoculture rather than into an annual monoculture
- Sufficient buffer areas should be maintained for the perennial monoculture to avoid weed reinfestation of perturbated areas

Rationale for Project

 Assisted succession from annual monoculture, to perennial monoculture, to a more diverse community

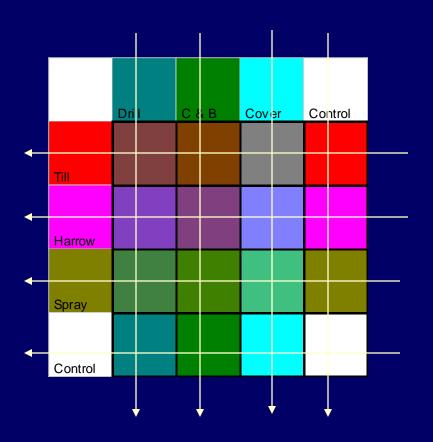


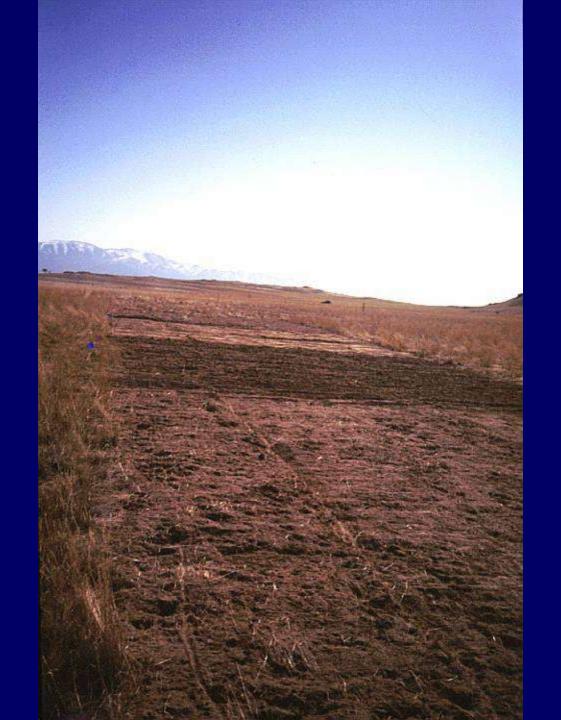
Species Seeded

	Rate, Kg/hectare,
Shrub Species	Pure Live Seed
Big sagebrush (<i>Artemisia tridentata</i> Nutt.)	0.3
Fourwing saltbush (Atriplex canescens [Pursh] Nutt.)	2.5
Rubber rabbitbrush (<i>Chrysothamnus nauseosus</i> [Pallas] Britt.)	0.2
Grass Species	
Bluebunch wheatgrass (<i>Elymus spicatus</i> [Pursh] Gould)	1.7
Galetta (<i>Hilaria jamesi</i> [Torr.] Benth.)	1.2
Needle and thread grass (Stipa comata Trin.& Rupr.)	1.1
Sandberg bluegrass (<i>Poa secunda</i> Presl)	1.1
Squirreltail (<i>Elymus elymoides</i> [Raf.] Swezey)	1.1

Plot Setup

- Strip Block
- Seedbed preparation treatments in strips across one direction
- Sowing treatments in strips across the other direction



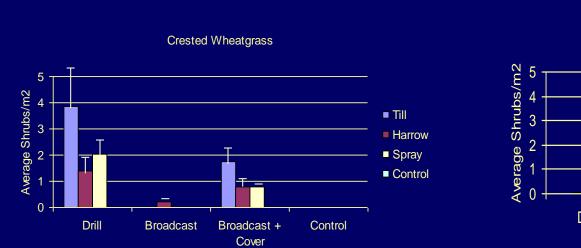


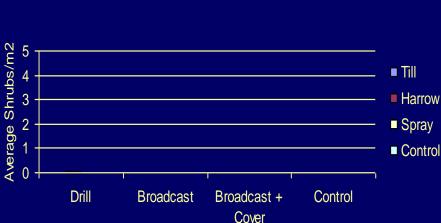


Native Grass Survival: site X soil treatment X seeding method (p=0.016)



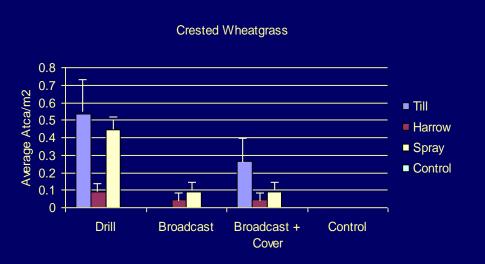
A. tridentata & C. nauseosus Survival: site X seedbed preparation X seeding method (p=0.001)

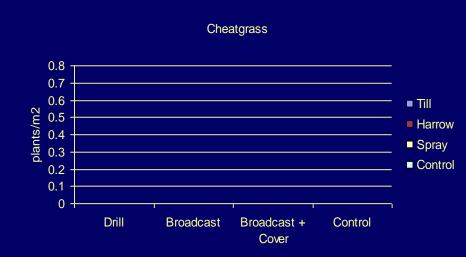




Cheatgrass

A. canescens Survival: site X seedbed preparation X seeding method (p=0.008)





Discussion

- Site Capture
 - Better establishment of natives
 - Reduce fire frequency
 - Establish perennial resource allocation patterns





Discussion

- Seedbed Preparation
 - Disruptions are necessary in crested wheatgrass to allow establishment of natives
 - Tilling vs Herbicide
- Seeding Method
 - Drilling vs Broadcasting or Broadcast/covering

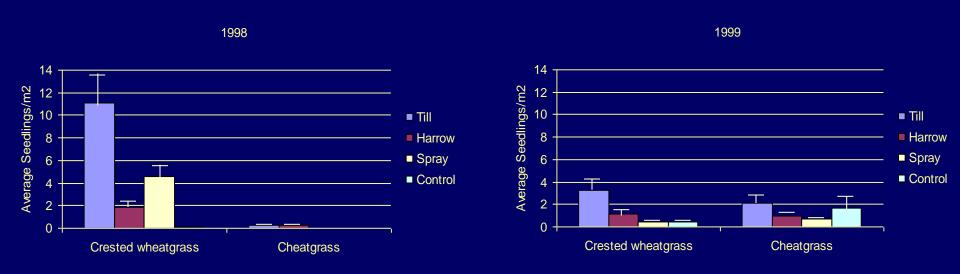
- Differing Responses in 1998 and 1999
 - Precipitation in February May
- ** Crested wheatgrass Control

• Till 83% 93%

• Harrow 67% 57%

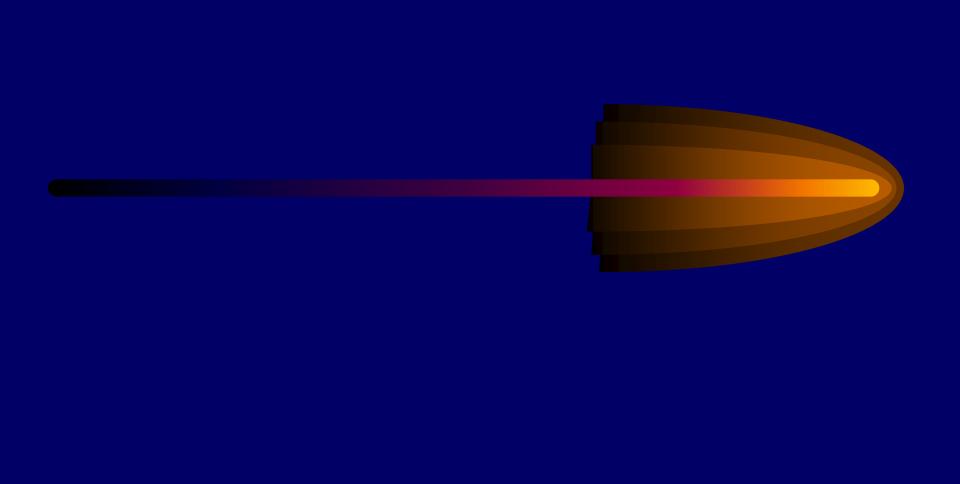
• Spray 67% 2%

Native Grass Emergence: year X site X seedbed preparation (p=0.001)

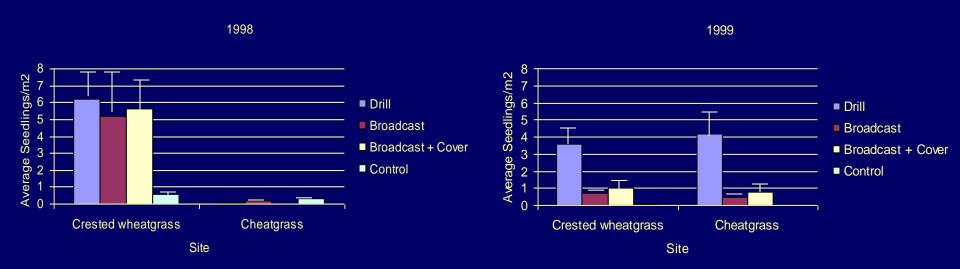


Recommendations

- Stepwise progression
 - Use "assisted succession" to establish native species
 - Site capture with aggressive perennials
 - Disrupt exotic perennial community
 - Diversify community with native species
 - Selective Bio Islands on highest potential sites
 - Focus on Crested wheatgrass areas first
 - 5 million hectares in N. America
 - Already primed for introduction of native species
 - Recapture additional weed infested acres for future conversion



Native Grass Emergence: year X site X seeding method (p=0.043)



Seed Mixes Native Low Seeding Rates (Lbs/Acre)

<u>Species</u>	<u>Drill</u>	<u>Aerial</u>	
Beardless Wheatgrass - Whitmar	2.0	4.0	
Bluebunch Wheatgrass - Goldar	2.0	4.0	
Western Wheatgrass - Rosana	1.0	2.7	
Indian Ricegrass - Nezpar	2.0	2.7	
Sandberg Bluegrass	-	1.3	
Wyoming Big Sagebrush	1.0	1.3	
Fourwing Saltbush	1.0	1.0	
Antelope Bitterbrush	1.0	1.0	
TOTAL	10.0	18.0	

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Seed Mixes Native High Seeding Rates (Lbs/Acre)

<u>Species</u>	<u>Drill</u>	<u>Aerial</u>	
Beardless Wheatgrass - Whitmar	2.0	4.1	
Bluebunch Wheatgrass - Goldar	2.0	4.1	
Western Wheatgrass - Rosana	2.0	2.7	
Indian Ricegrass - Nezpar	2.0	2.7	
Squirreltail - VNS	2.0	2.7	
Needle and Thread - VNS	2.0	2.7	
Basin Wildrye - Magnar	2.0	2.7	
Sandberg Bluegrass	2.0	2.7	
Wyoming Big Sagebrush	2.0	2.7	
Fourwing Saltbush	1.0	1.0	
Antelope Bitterbrush	1.0	1.0	
TOTAL	20.0	29.1	

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Seed Mixes BLM Seeding Rates (Lbs/Acre)

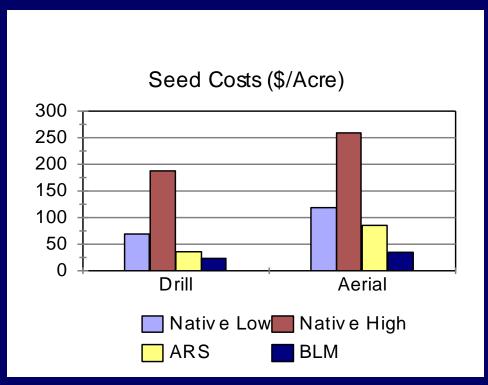
<u>Species</u>	<u>Drill</u>	<u>Aerial</u>	
Crested Wheatgrass - Hycrest	2.0	4.0	
Bluebunch Wheatgrass - Goldar	-	2.7	
Pubescent Wheatgrass - Luna	2.0	2.7	
Russian Wildrye - Bozoisky	2.0	2.7	
Smooth Brome - Lincoln	-	2.7	
Tall Wheatgrass - Alkar	2.0	2.7	
Western Wheatgrass - Aribba	1.0	-	
Alfalfa - Innoculated - Ladak	0.5	-	
Fourwing Saltbush	0.5	1.0	
Antelope Bitterbrush	-	1.0	
TOTAL	10.0	19.5	

Seed Mixes ARS Seeding Rates (Lbs/Acre)

<u>Species</u>	<u>Drill</u>	<u>Aerial</u>	
Siberian Wheatgrass - Vavilov	1.7	3.4	
Crested Wheatgrass - Hycrest CD II	1.6	3.3	
Russian Wildrye - Bozoisky	1.3	2.7	
Thickspike Wheatgrass - Critana	0.5	1.1	
Bluebunch Wheatgrass - Secar	1.1	2.3	
Western Wheatgrass - Rosana	1.1	2.2	
Indian Ricegrass - Rimrock	0.5	1.1	
Alfalfa - Rangelander	1.3	2.7	
Forage Kochia - Immigrant	0.3	0.7	
Fourwing Saltbush	-	1.0	
Antelope Bitterbrush	-	1.0	
TOTAL	9.4	21.5	

Seed Cost/Acre (1999)

Seed Mix	<u>Drill</u>	<u>Aerial</u>
BLM	\$23.39	\$34.85
ARS	\$35.77	\$85.48
Native High	\$187.63	\$259.07
Native Low	\$69.00	\$118.51



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Conclusions

Drill Seeding

- Native High, BLM, and ARS had similar successful establishment
- Natives can be successfully established at higher rates and higher cost
- Post fire rehabilitation required to avoid dominance by weeds or invasive annuals

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Treatments

- Crested wheatgrass vs Cheatgrass areas
- Seedbed preparation techniques
 - Early February each year
 - Till, Harrow, Herbicide, Control
- Seeding methods
 - 2-3 weeks after seedbed preparation
 - Drill, Broadcast, Broadcast/cover, Control

Treatment: Seedbed Preparation

Tilling

- Completely removes existing plant cover
- Creates nearly uniform soil surface

Harrowing

- Very irregular disturbance and soil surface
- Chemical herbicides
 - Leaves litter in place, little impact to soil
 - Applied Rounduptm according to mfg instructions (9.8ml/liter to cover 30 m²)

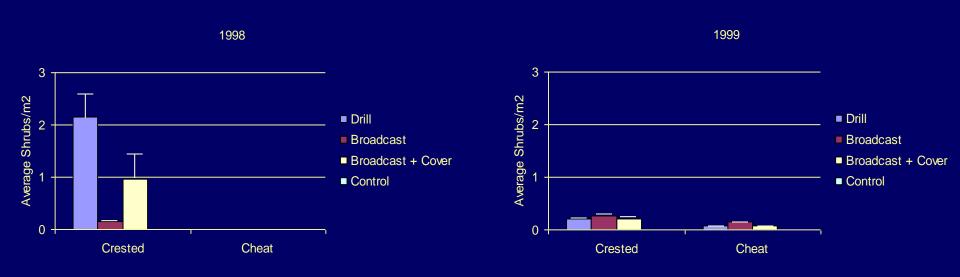
Treatment: Seeding Methods

- Drilling
 - Most recommended
 - Limited by terrain, area size
- Broadcasting
 - Used over rough terrain, large areas
 - Seeds exposed on the surface
- Broadcasting and then covering
 - Covered seeds are more successful

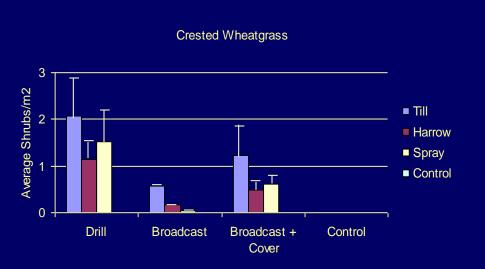
Plot Arrangement

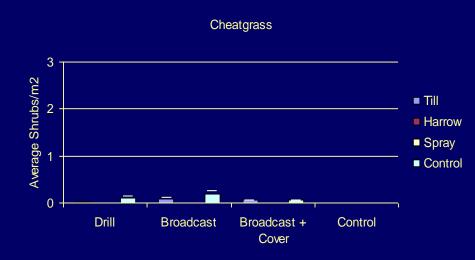
- 2 sites each year with 3 replications each
- Each block measures 40X40m, with 16 subplots of 10X10m each
- Conducted in 1998 and 1999

A. tridentata & C. nauseosus emergence: year X site X seeding method (p=0.001)

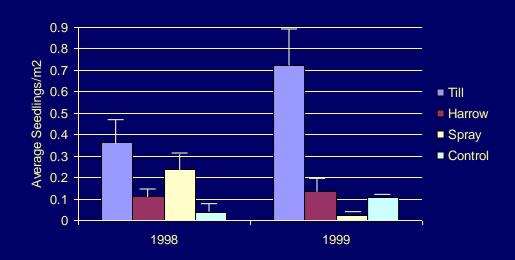


A. tridentata & C. nauseosus emergence: site X seedbed preparation X seeding method (p=0.044)

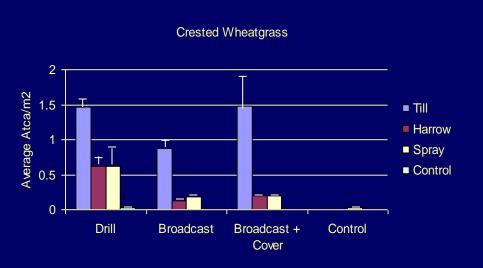


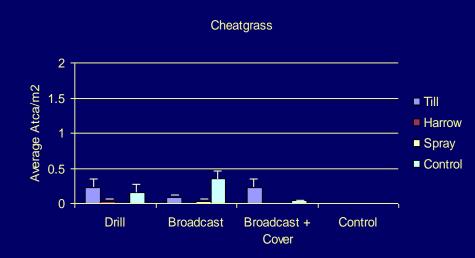


A. canescens emergence: year X seedbed preparation (p=0.003)



A. canescens emergence: site X seedbed preparation X seeding method (p=0.011)





Precipitation

