New Research to Manage Downy Brome (Cheatgrass)

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Downy brome (*Bromus tectorum*)

- Introduced, invasive grass
- Winter annual
- Prolific seed producer
- Germinates depending on temperature and rainfall
- Grows quickly and matures early
- Dominates millions of hectares in the western United States
- Negatively affects biodiversity, recreation, grazing

Other Invasive Annual Grasses

- Japanese Brome
- Medusahead
- Ventanata
- Feral Rye
- Jointed Goatgrass
- Red Brome
- Ripgut Brome
- Rattail Fescue

Annual Grass Impacts

Negative impacts to plant communities, wildlife, livestock, and economics

Reduced native herbaceous functional groups, large perennial grass and sagebrush cover, species richness and diversity

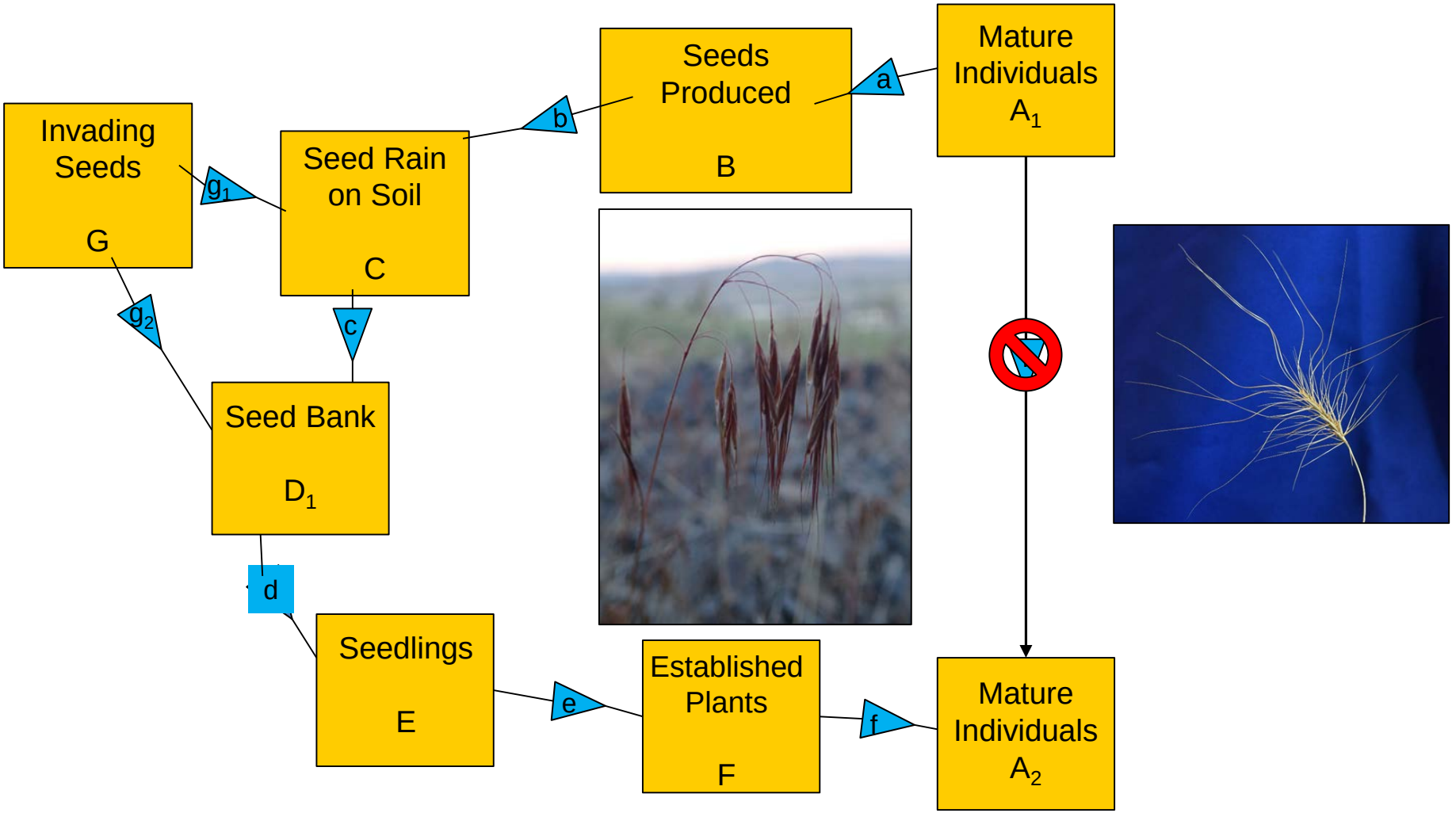
High silica content in medusahead and ventenata discourages grazing and allows heavy thatch buildup

Increases fire cycle

Opens native communities to secondary invasions

Integrated Management

Annual Grass Life Table – Points of Management



Considerations of Chemical Control of Annual Grasses

Two points of attack:

- Seed production
- Plant germination and establishment

Herbicides:

- Non-residual
- Residual

Herbicide Use Pattern:

- Knock out seed production
- Prevent seed germination
- Both

Site Condition:

Protection vs. Revegetation

Herbicides for Annual Grass Control

Herbicides

- Roundup
- Plateau
- Matrix
- Oust
- Landmark
- Milestone
- Esplanade

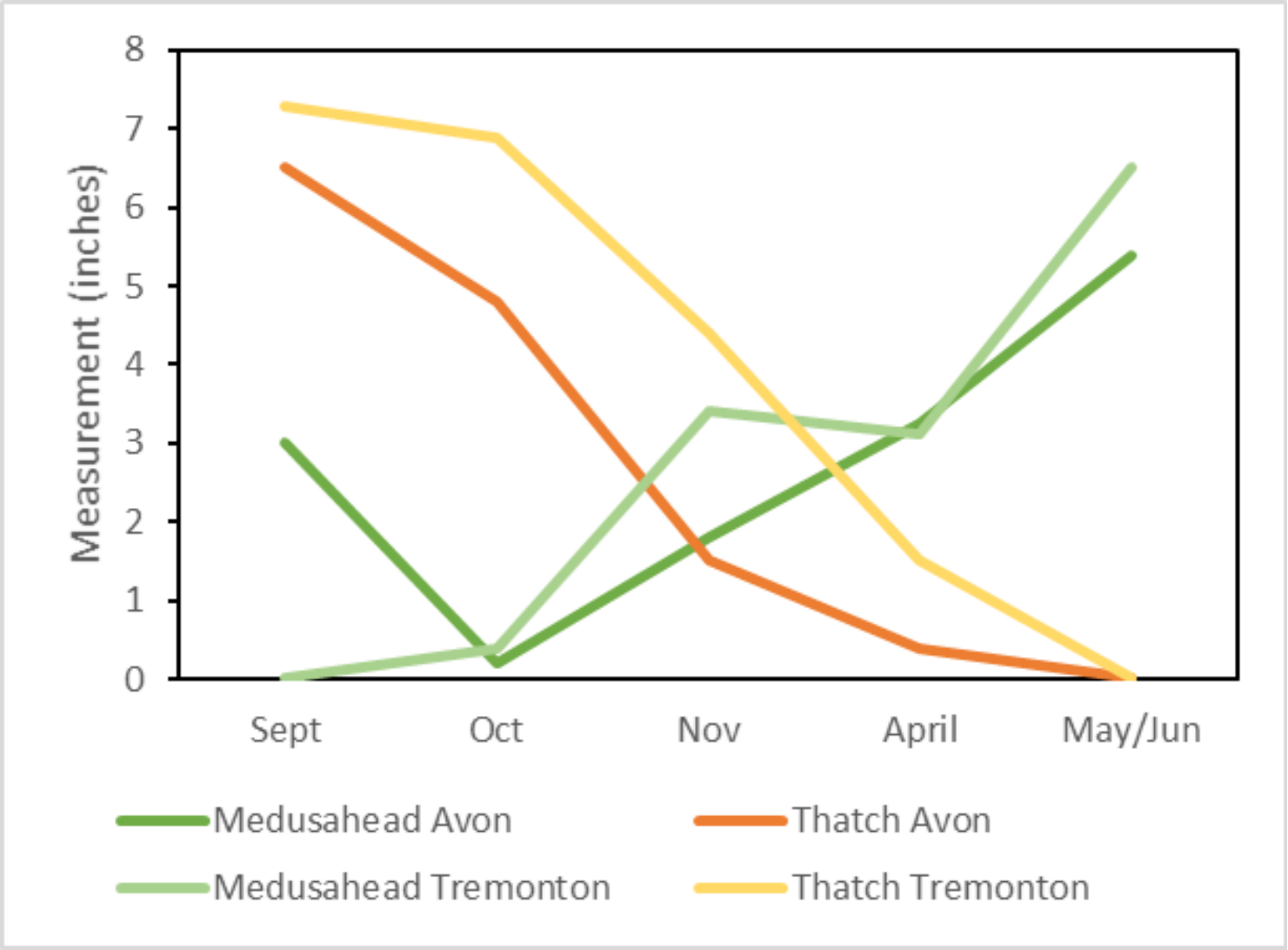
Timings

- PRE or POST
- Spring or Fall

Long Term Control

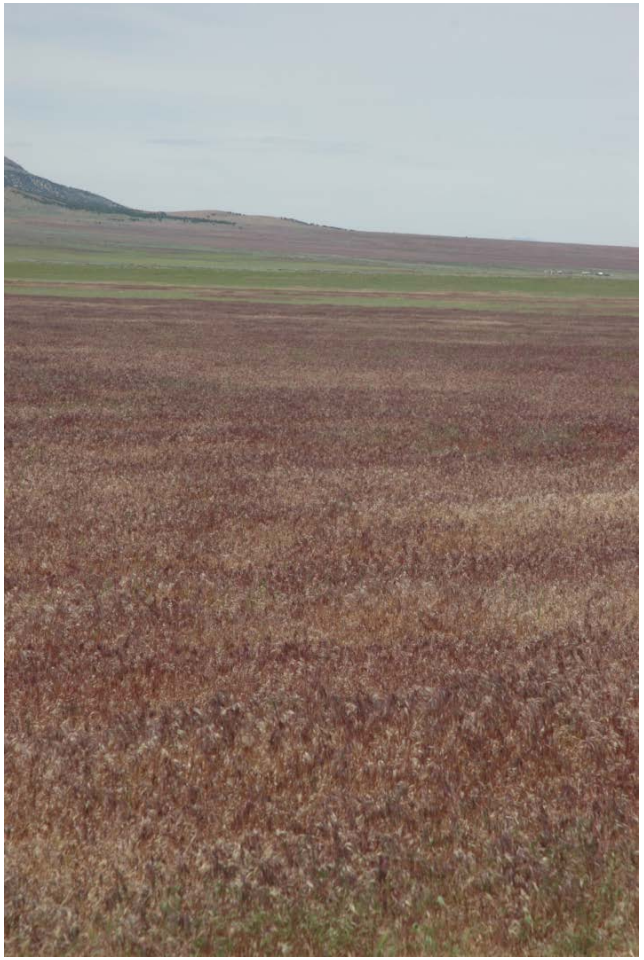
- Existing vegetation
- Site management

Medusahead Heights and Thatch Depths



Discussion Points – Annual Grass Management

- Seedling and established plant tolerance to herbicides
- Integrated and multiple intervention approaches
- Extending control with residual herbicides



Range Product Labels Specify Tolerance

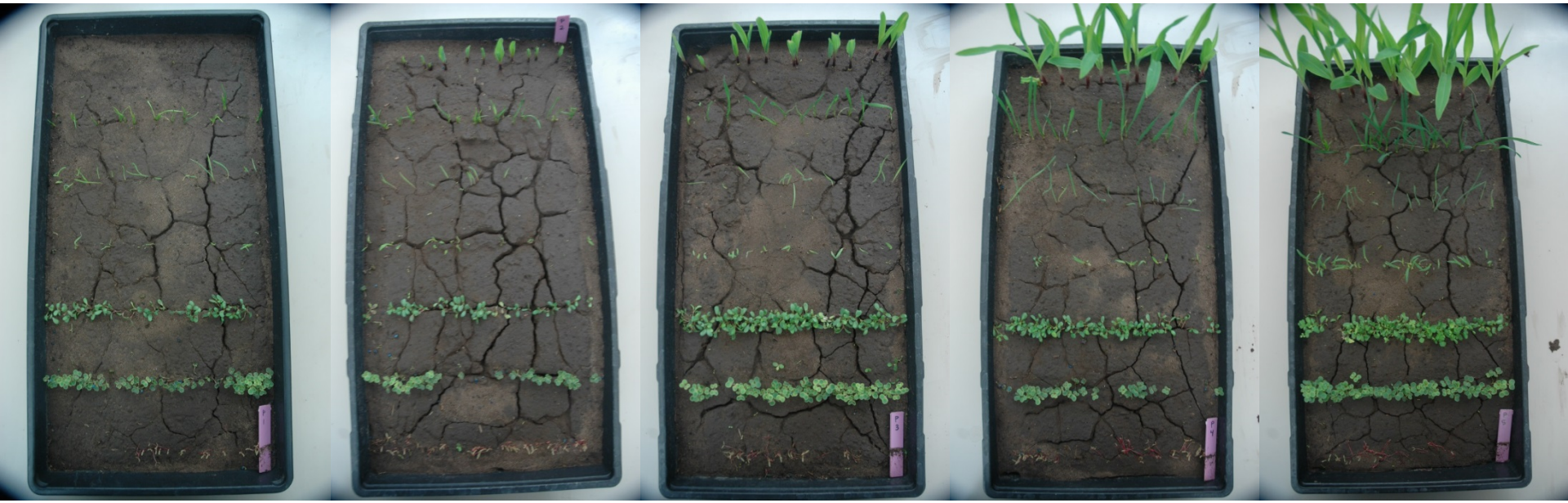
TOLERANT GRASS SPECIES[1]

Prairiegrass		Plateau Rate (oz/A)[2]	
Common Name	**Genus Species**	**New Seeding**	**Established**
Big Bluestem	*Andropogon gerardii*	2-12	2-12
Little Bluestem	*Schizachyrium scoparium*	2-12	2-12
Indiangrass	*Sorghastrum nutans*	2-12	2-12
Bushy Bluestem	*Andropogon glomeratus*	—*	2-12
King Ranch Bluestem	*Bothriochloa ischaemum*	—	2-12
Silver Beard Bluestem	*Bothriochloa saccharoides*	—	2-12
Broomsedge	*Andropogon virginicus*	—	2-12
Fingergrass, Rhodes grass	*Chloris* spp.	—	2-12
Needlegrass	*Stipa* spp.	—	2-12
Needleandthread	*Stipa comata*	—	2-12
Kearny (Plains) Threeawn	*Aristida longespica*	—	2-12
Prairie Threeawn	*Aristida oligantha*	—	2-12
Prairie Sandreed	*Calamovilfa longifolia*	—	2-12
Smooth Bromegrass	*Bromus inermis*	—	2-12
Kentucky Bluegrass	*Poa pratensis*	—	2-12[4]
Sandberg's Bluegrass	*Poa sandbergii*	—	2-12
Wheatgrasses	*Agropyron* spp.	—	2-12
Bottlebrush Squirreltail	*Sitanion hystrix*	—	2-12
Russian Wild Ryegrass	*Elymus junceus*	2-6[2]	2-12
Sideoats Grama	*Bouteloua curtipendula*	2-8[3]	2-8
Blue Grama	*Bouteloua gracilis*	2-8[3]	2-8
Buffalograss	*Buchloe dactyloides*	2-4	2-8
Eastern Gamagrass	*Tripsacum dactyloides*	2-6[3]	2-8

Seedling Wildflower and Legume Tolerance to Plateau (4 oz/A)[1] in Mixed Grass/Forb Stands.

Common Name	Genus Species	PRE	POST
Alfalfa	*Medicago sativa*	No	Yes
Aster, New England	*Aster novae angliae*	No	Yes
Aster, Prairie	*Aster tanacetifolius*	No	Yes
Baby Blue Eyes	*Nemophila menziesii*	No	Yes
Beggar ticks	*Bidens frondosa*	No	Yes
Bird's Eyes	*Gilia tricolor*	No	Yes
Bishop's Flower	*Ammi majus*	No	Yes
Blackeyed Susan	*Rudbeckia hirta*	Yes	Yes
Blanketflower	*Gaillardia aristata*	No	Yes
Bundleflower, Illinois	*Desmanthus illinoensis*	Yes	Yes
Catchfly	*Silene armeria*	No	Yes
Chicory	*Cichorium intybus*	Yes	Yes
Clover, Crimson	*Trifolium incarnatum*	Yes	Yes
Clover, White	*Trifolium repens*	No	Yes
Coneflower, Purple	*Echinacea purpurea*	Yes	Yes
Coneflower, Upright Prairie	*Ratibida columnifera*	Yes	Yes
Coreopsis, Dwarf Red Plains	*Coreopsis tinctoria* var. Gay Feather	Yes	Yes
Coreopsis, Lance Leaved	*Coreopsis lanceolata*	Yes	Yes
Coreopsis, Plains	*Coreopsis tinctoria*	Yes	Yes
Cornflower	*Centaurea cyanus*	No	Yes
Cosmos, Garden	*Cosmos bipinnatus*	Yes	Yes
Cosmos, Yellow	*Cosmos sulphureus*	Yes	Yes
Daisy, Ox-eye	*Chrysanthemum leucanthemum*	Yes	Yes
Daisy, Shasta	*Chrysanthemum maximum*	Yes	Yes
Five Spot	*Nemophila maculata*	No	Yes
Flax, Blue	*Linum perenne*	No	Yes
Indian Blanket	*Gaillardia pulchella*	No	Yes
Indigo, Blue False	*Baptisia australis*	Yes	No
Johnny Jump-ups	*Viola cornuta*	Yes	Yes
Lemon Mint	*Monarda citriodora*	No	Yes

Plateau Half Life (Persistence)

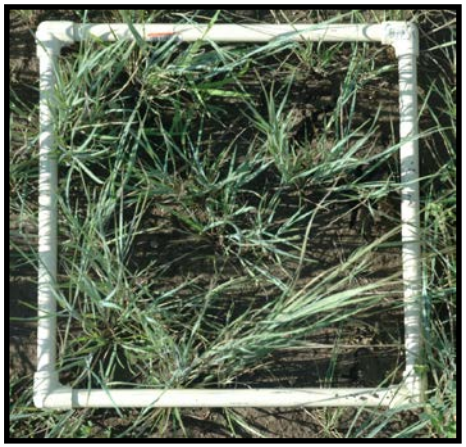


4 oz/acre **2 oz/acre** **1 oz/acre** **0.5 oz/acre** **0.25 oz/acre**

Seedling Grass Tolerance to Herbicides

Untreated

Outrider
(0.75 oz/A)

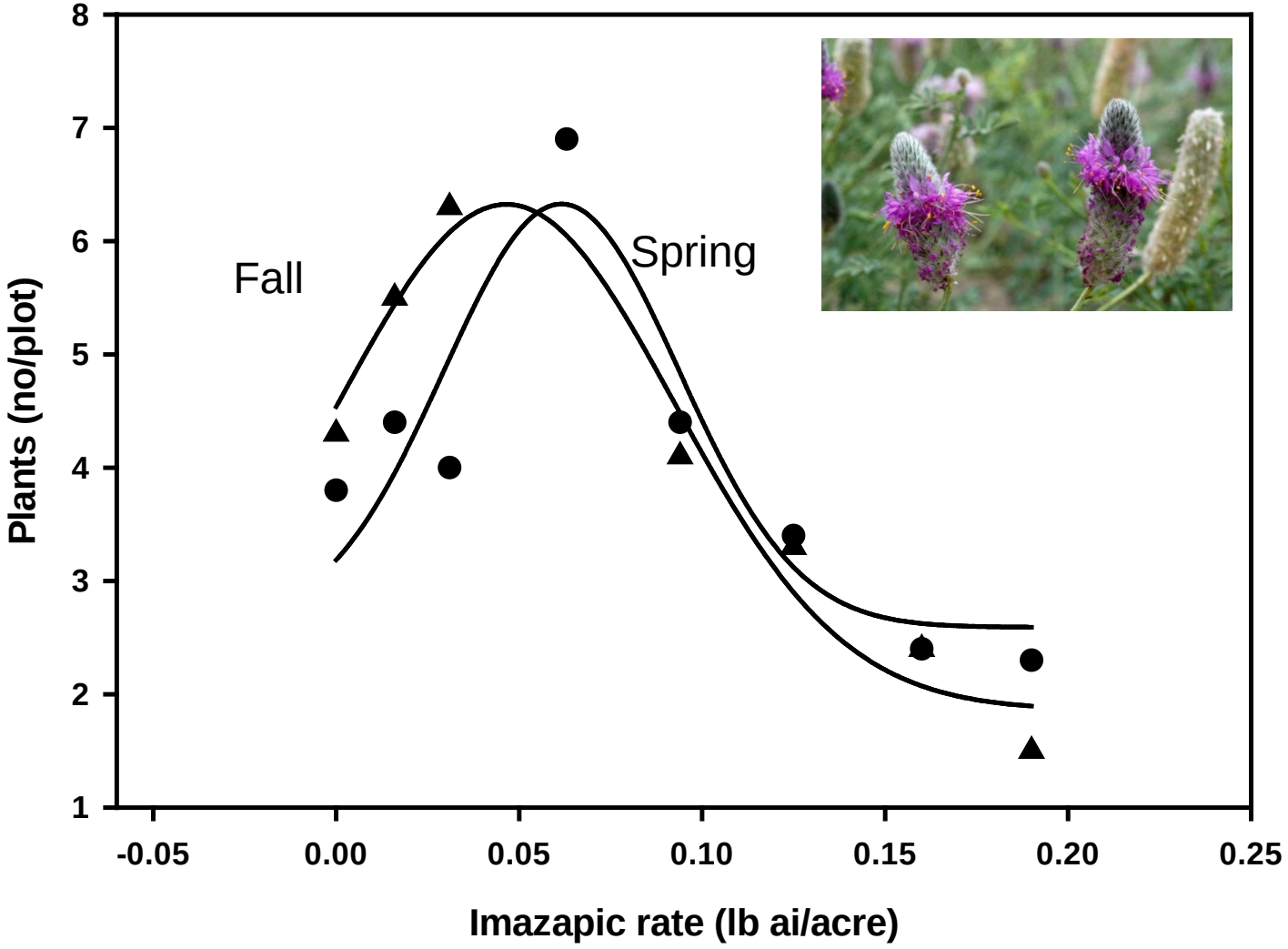


Plateau
(6 oz/A)

Milestone
(7 oz/A)

‘Anatone’ bluebunch wheatgrass response to herbicide treatments.

Basalt Milkvetch Establishment



Plant Tolerance to Herbicides - Conclusions

- Herbicides do not “know” the difference between good and bad plants

- Selectivity can be species specific, based on plant lifecycle and growth stage, or herbicide application timing

- Few plants establish if weeds are not controlled

Discussion Points – Annual Grass Management

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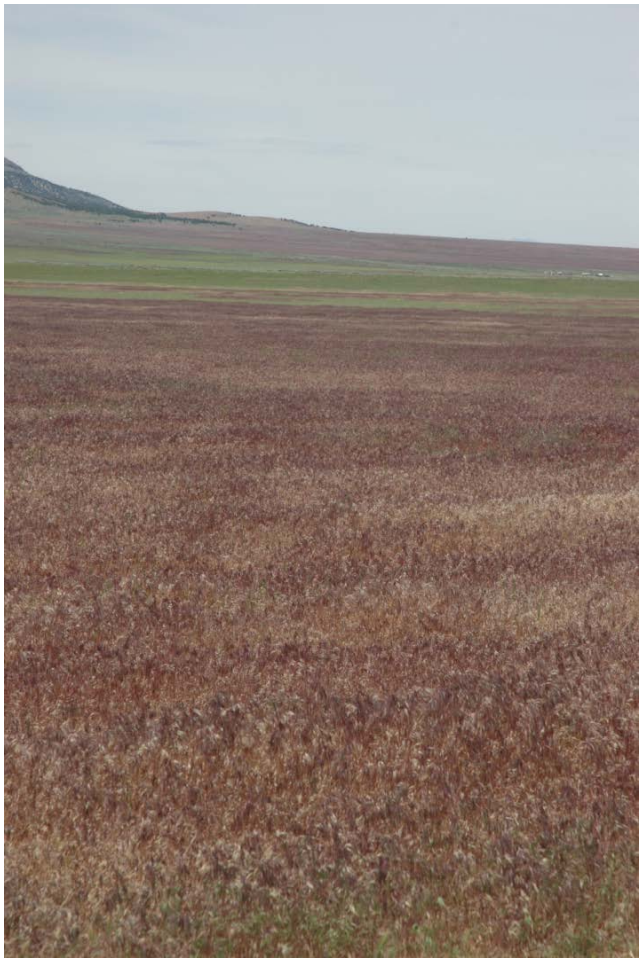
- Integrated and multiple intervention approaches
- Extending control with residual herbicides



Downy Brome Trial, 2001-2002

Factors

Burn vs. Unburned

Plateau Rates

2, 4, 6, 8, 10, 12 oz/acre

PRE vs. POST-Planting

Seeding of 5 Species

Valvalov – Siberian Wheatgrass

Goldar – Bluebunch Wheatgrass

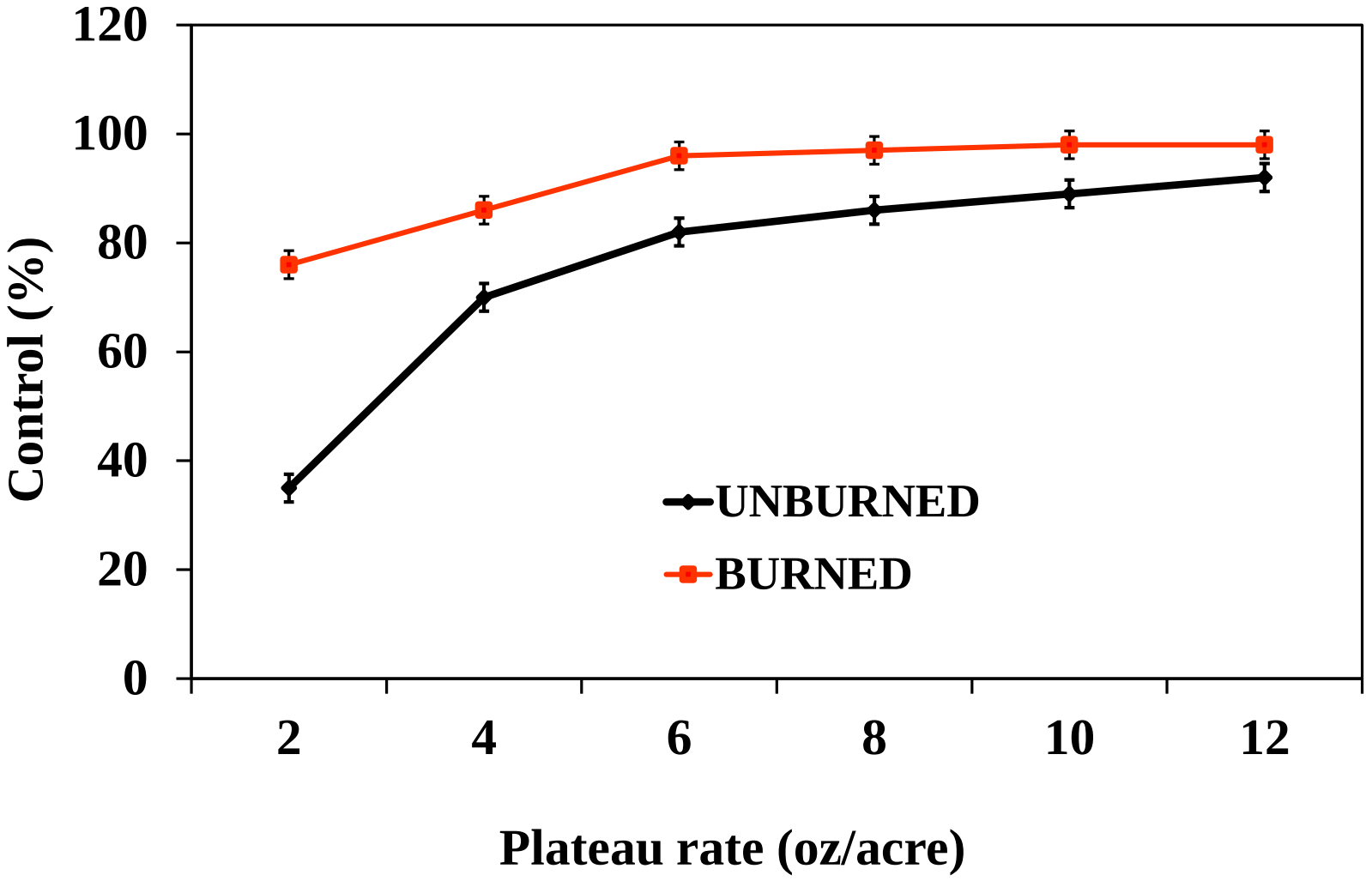
Western Yarrow

Magnar – Great Basin Wild Rye

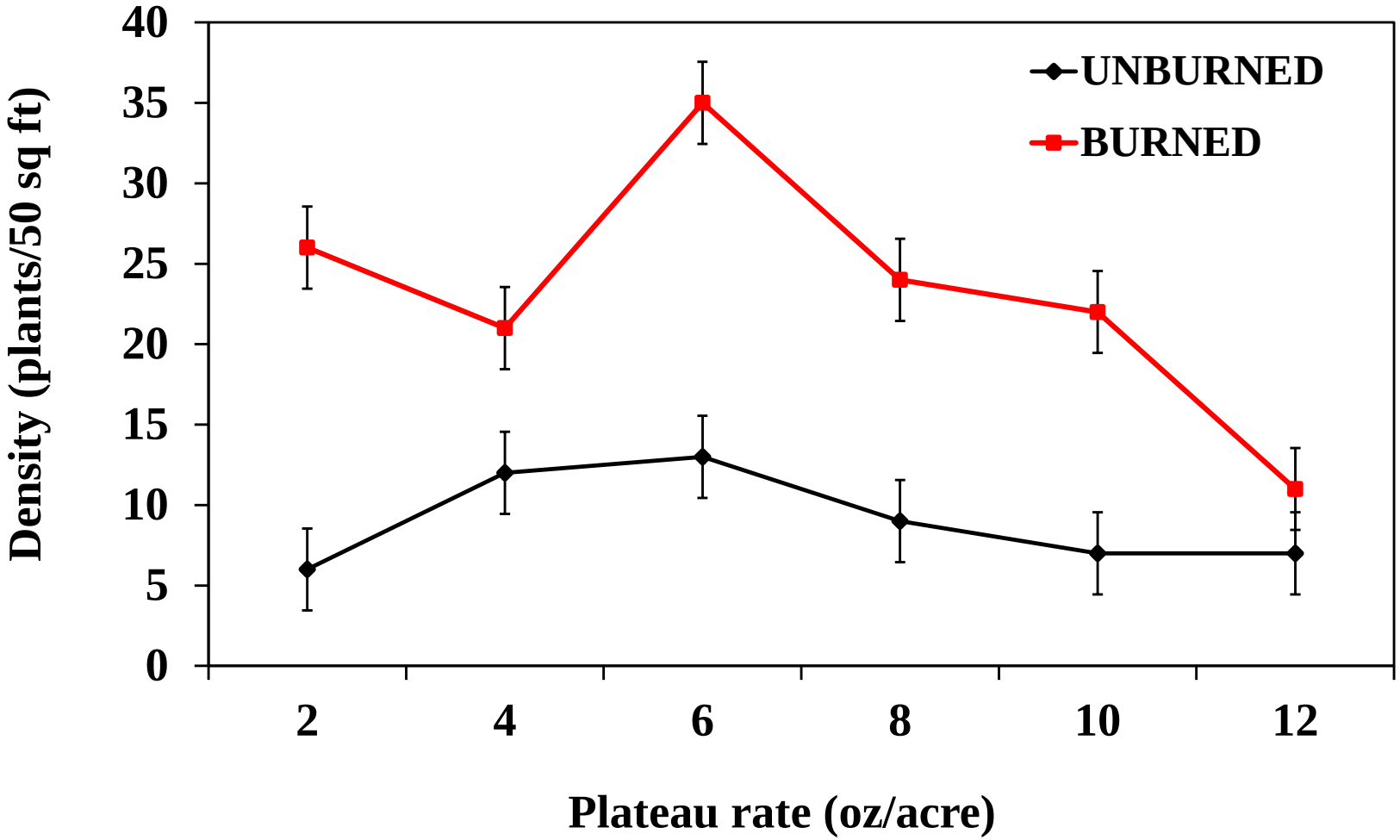
Bozoisky – Wild Rye

Downy Brome Trial, 2001-2002

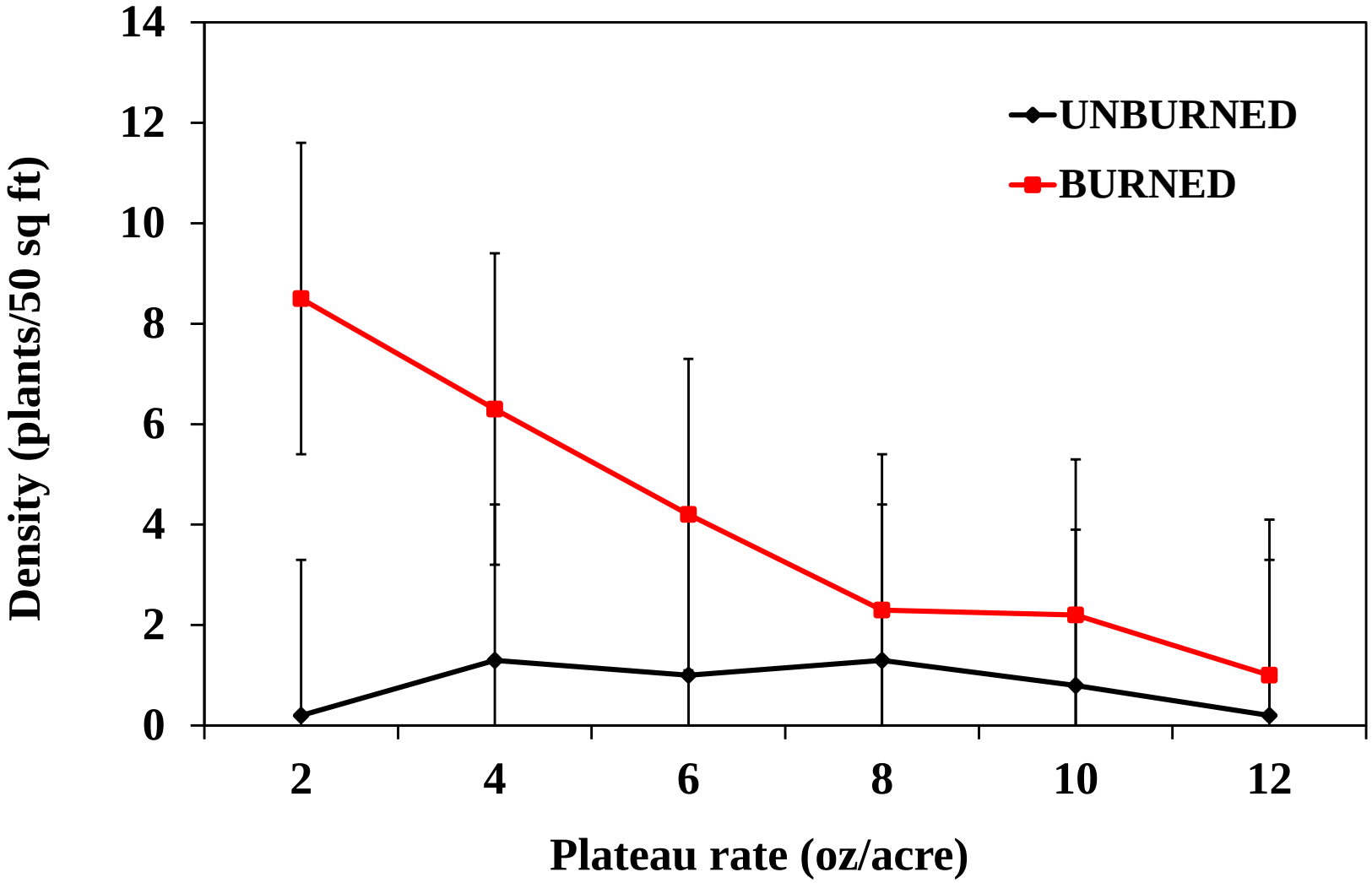
Downy Brome Control, Oregon, 2002



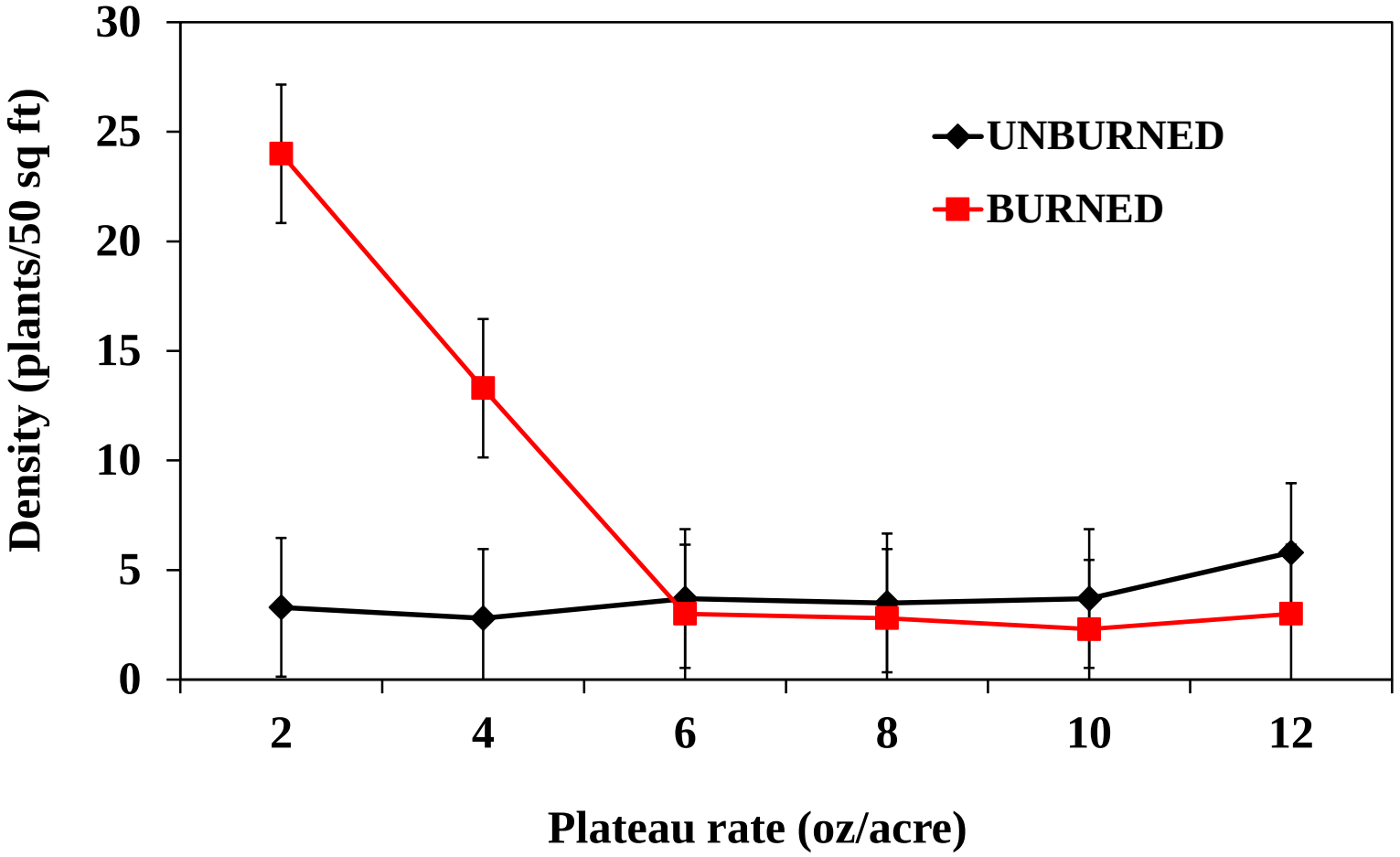
Siberian Wheatgrass, 2002



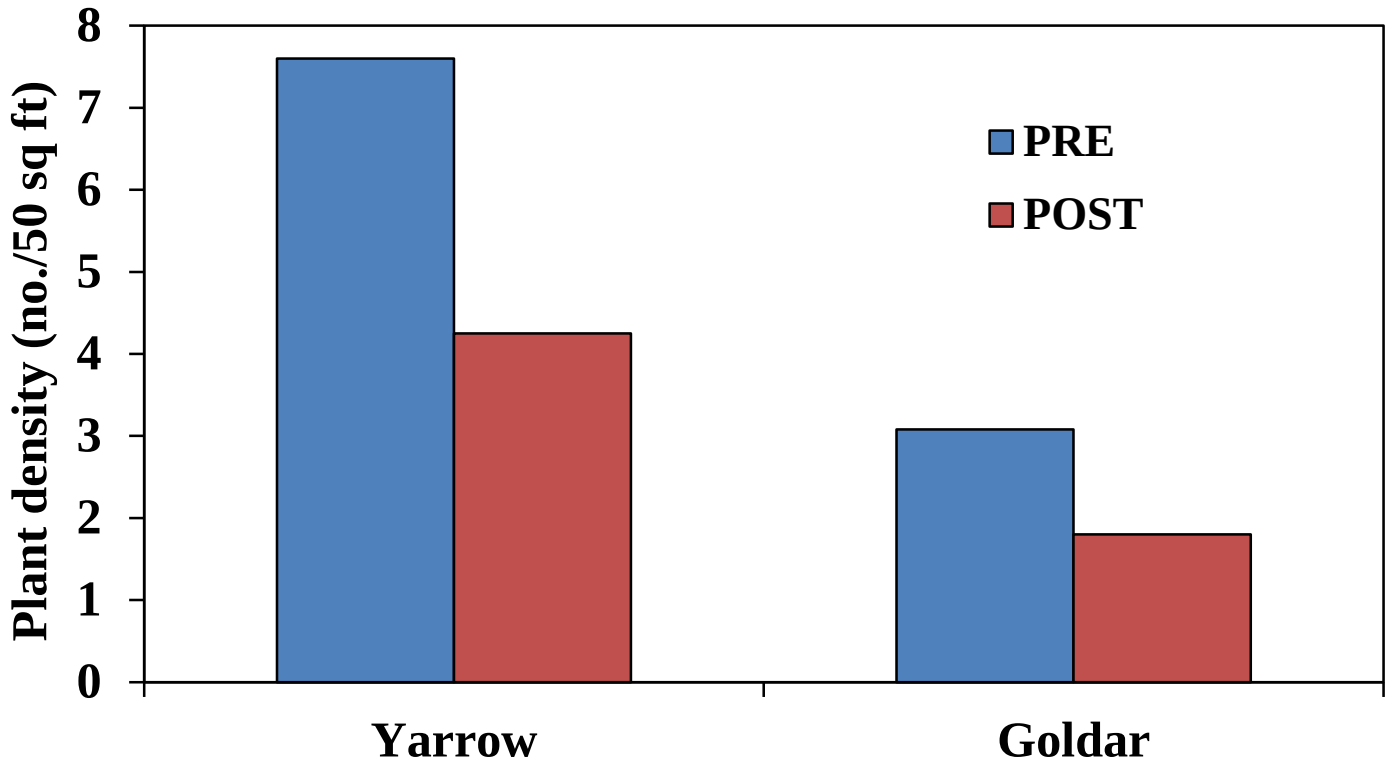
Bluebunch Wheatgrass, 2002



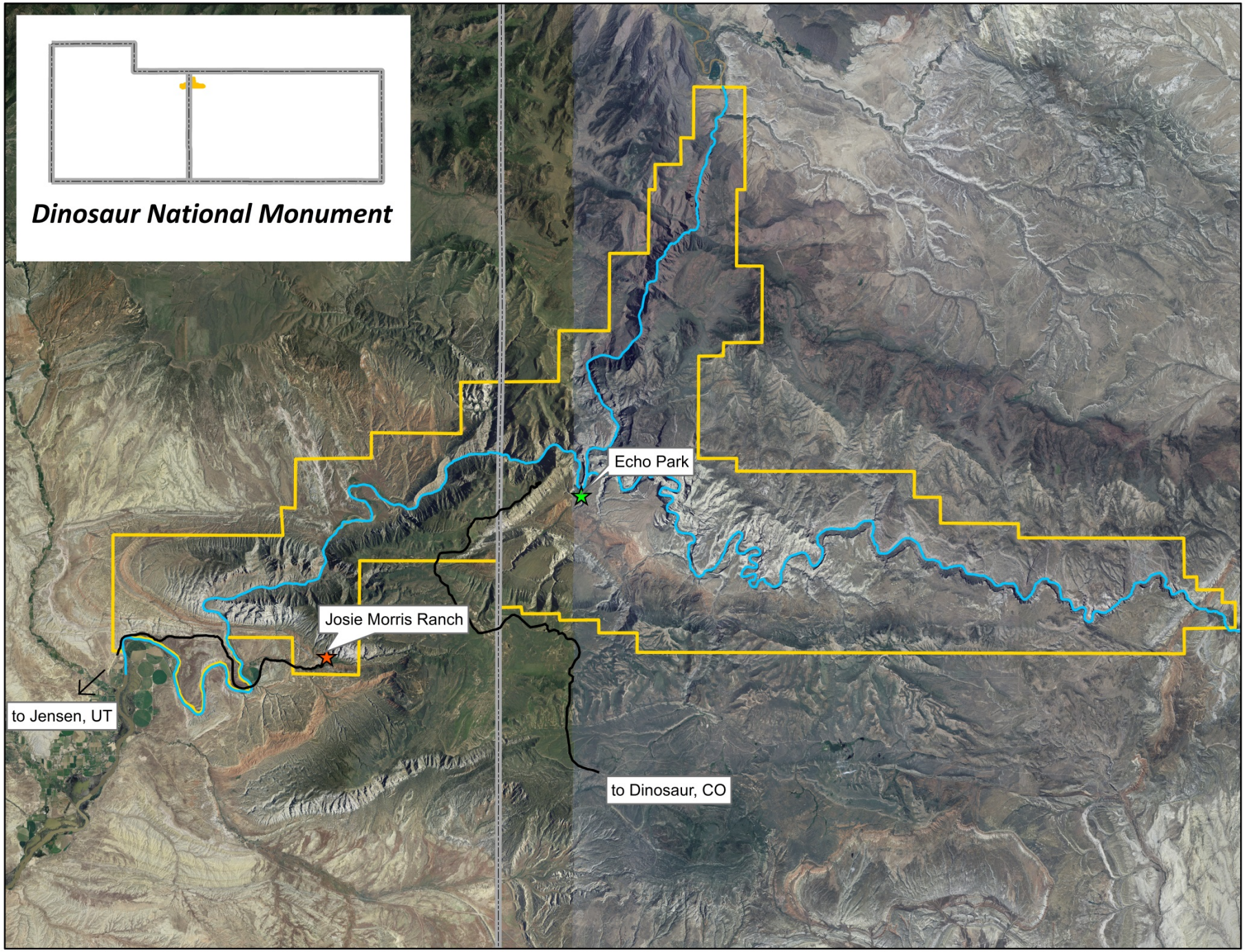
Western Yarrow, 2002



Plant Response to Application Timing, 2002



Cheatgrass Trials at Dinosaur National Monument, 2009-2015


Dinosaur National Monument
Echo Park
Josie Morris Ranch
to Jensen, UT
to Dinosaur, CO

Downy Brome Trials

Josie Morris Ranch

Echo Park

- Conducted at Josie's Ranch and Echo Park
  - -Trial initiation spring of 2010 for both sites
- Split-plot design with 4 replications
  - -Main plots = seed reduction (prevention) (24 x 9m)
  - -Sub plots = preemergence herbicide treatments (3 x 9 m)

Main Plot – Seed Reduction

Josie Morris Ranch

Echo Park

Main plots = Seed reduction

- Untreated control
- Mowing - sicklebar mower 5 cm from ground, late May 2010
- Glyphosate at 193 g ai ha^{-1}, mid-April 2010

Sub Plot Herbicide Treatments

- Sub plots = Preemergence treatments applied mid-October 2010
  - Untreated
  - Plateau: 4, 6, 8, 10, 12 fl oz/A
  - Outrider: 1.33 oz/A
  - Matrix: 3.0 oz/A
- Applications using CO_2-pressurized backpack sprayer
- Evaluation included: visual injury, density, cover, and biomass
- Analyzed using Repeated Measures ANOVA, transformed where needed and means separated using Fisher's LSD ($P \leq 0.05$)

Materials and Methods

- Cover evaluations (point transect), biomass harvest, density counts in 2010, 2011, 2012

- Cover evaluations (point transect), biomass harvest 2013

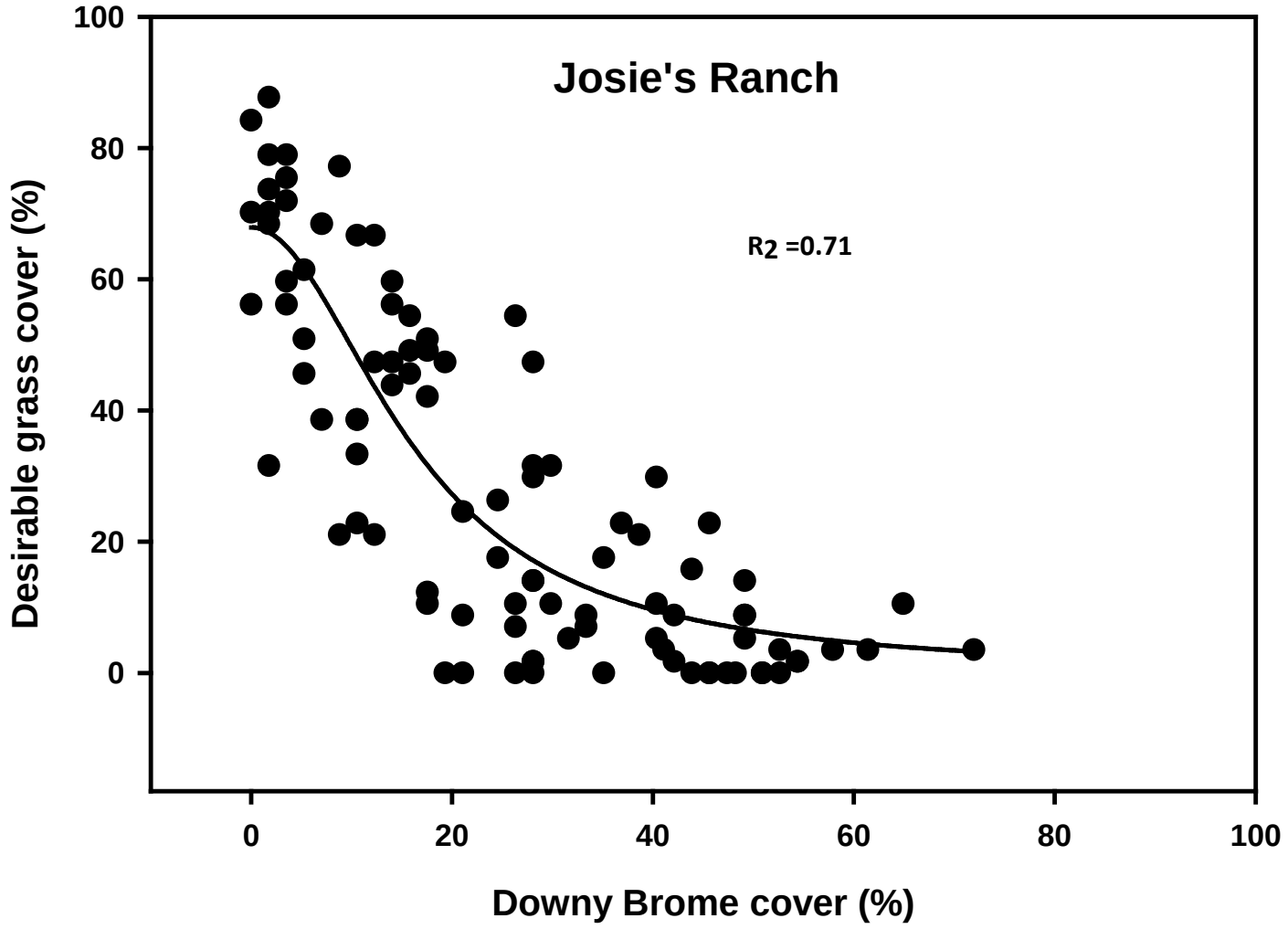
Results: Downy brome cover 1 YAT, Echo Park

		Downy brome cover		
Preemergence treatments	Rate	Untreated	Mowing	Glyphosate
	oz/acre	%		
Untreated	--	40.75 a	17.25 b	15.25 b
Plateau	4	7.50 bc	1.00 d	1.75 d
Plateau	6	2.50 cd	3.75 c	0.50 d
Plateau	8	0.50 d	0.00 de	0.00 de
Plateau	10	1.00 d	0.00 de	0.00 de
Plateau	12	0.50 d	0.50 d	0.50 d
Outrider	1.33	1.50 d	0.00 de	0.00 de
Matrix	3	0.00 de	0.00 de	0.00 de
P value		<0.0300		

Results: Downy brome cover 2 YAT, both sites

		Downy brome cover, 2 YAT		
Preemergence treatments	Rate	Josie Morris Ranch		Echo Park
	oz/acre	——— % ———		——— % ———
Untreated	--	11.17 a		0.00
Plateau	4	8.75 ab		0.00
Plateau	6	7.25 abc		0.00
Plateau	8	8.58 abcd		0.00
Plateau	10	7.92 abcd		0.00
Plateau	12	3.50 bcd		0.00
Outrider	1.33	1.58 d		0.00
Matrix	3	1.17 cd		2.17
P value		0.0309		0.4626

Relationship Between Downy Brome and Grass Cover



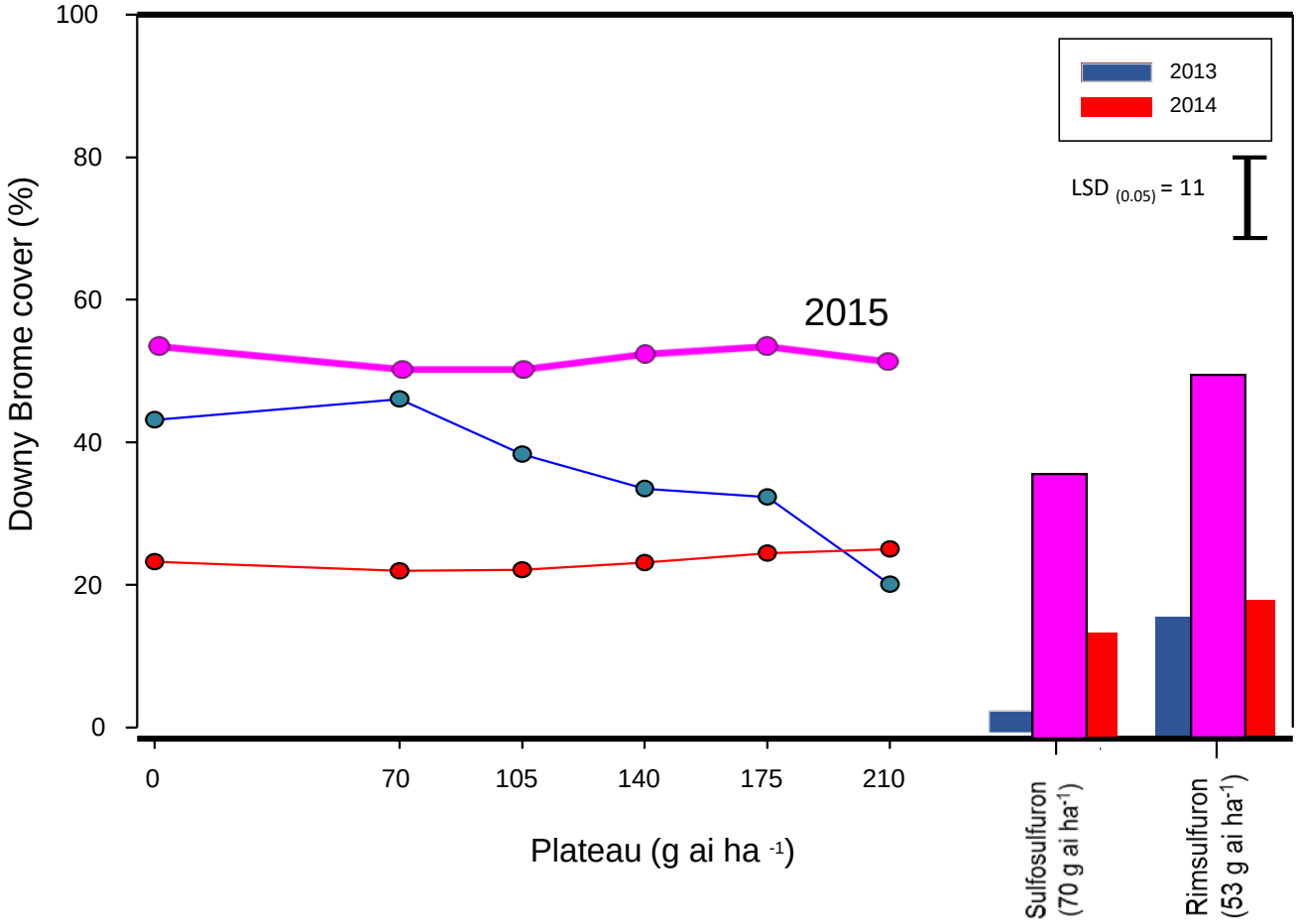
Initial Results

- Herbicide subplot treatments exhibited high levels of downy brome control in 2011
- 2012 was a drought year; there was minimal downy brome presence
- Main plot treatments had minimal effect on downy brome cover

Additional Main Plot Treatments 2013

- Mowing main plots:
  - Roundup 4 oz/A + Plateau at 8 oz/A in October 2013
- Glyphosate main plots:
  - glyphosate at 4 oz/A in April 2013
  - glyphosate at 4 oz/A + Milestone 8 oz/A in October 2013
- Applications made with CO_2-pressurized backpack sprayer
- Evaluations and analysis the same as previously mentioned

Downy Brome Cover – Josie's Ranch, Year by Herbicide



Downy Brome Cover, 2013-2014

Year by Main Plot						
	Josie's DB Cover			Echo DB Cover		
Main Plot	2013	2014	Change	2013	2014	Change
	% Cover					
1-Untreated	37	63	↑	29	55	↑
2- Fall Roundup + Plateau	35	0	↓	13	0	↓
3-Spring Roundup fb fall Roundup + Milestone	16	2	↓	9	1	↓
LSD $_{(0.05)}$	6.6			6.3		

Desirable Grass Cover, 2013-2014

Year by Main Plot						
	Josie's DG Cover			Echo DG Cover		
Main Plot	2013	2014	Change	2013	2014	Change
	% Cover					
1-Untreated	22	3		27	30	
2- Fall Roundup + Plateau	27	24		33	22	
3-Spring Roundup fb fall Roundup + Milestone	28	42		21	53	
LSD $_{(0.05)}$	4.3			6.3		

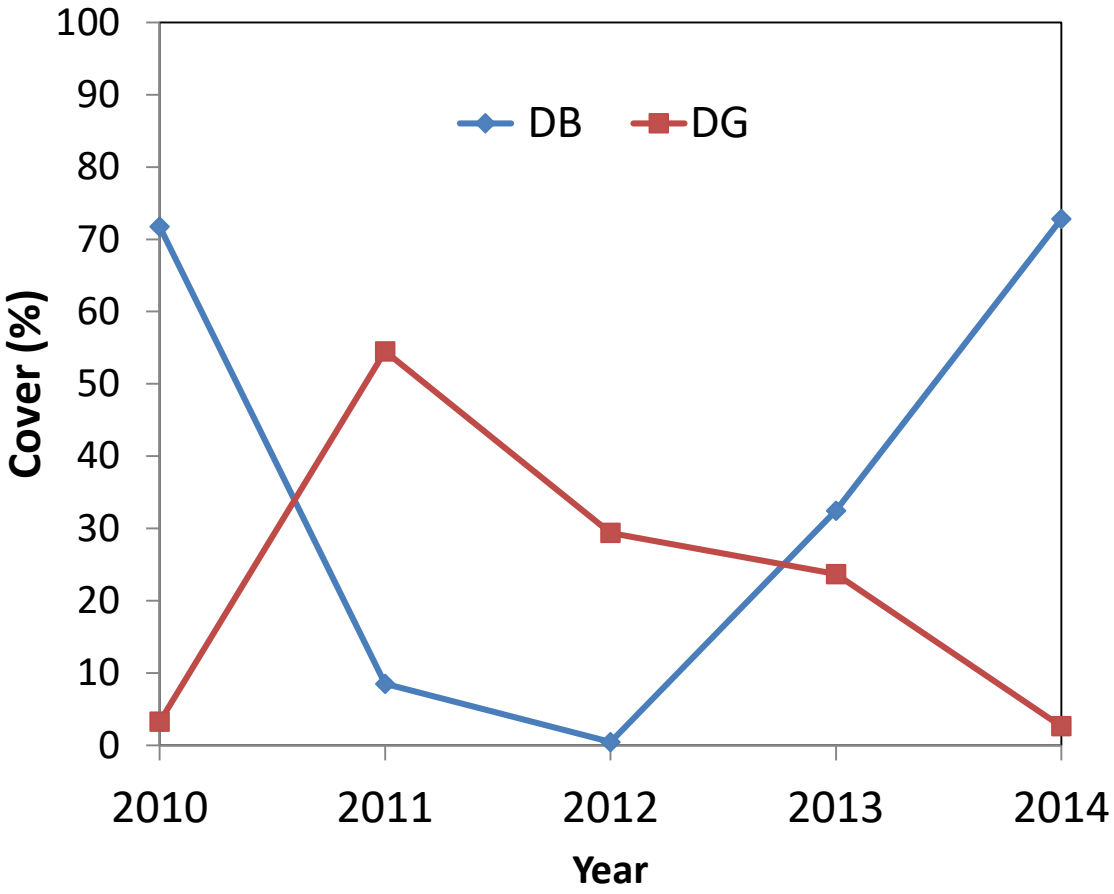
Downy Brome Cover, 2014-2015

Year by Main Plot						
	Josie's DB Cover			Echo DB Cover		
Main Plot	2014	2015	Change	2014	2015	Change
	% Cover					
1-Untreated	63	59	–	55	40	↓
2- Fall Roundup + Plateau	0	41	↑	0	21	↑
3-Spring Roundup fb fall Roundup + Milestone	2	47	↑	1	15	↑
LSD $_{(0.05)}$	7.3			6.3		

Desirable Grass Cover, 2014-2015

Year by Main Plot						
	Josie's DG Cover			Echo DG Cover		
Main Plot	2014	2015	Change	2014	2015	Change
	% Cover					
1-Untreated	3	7	–	30	33	–
2- Fall Roundup + Plateau	24	8	↓	22	34	↑
3-Spring Roundup fb fall Roundup + Milestone	42	19	↓	53	50	–
LSD $_{(0.05)}$	8.5			6.2		

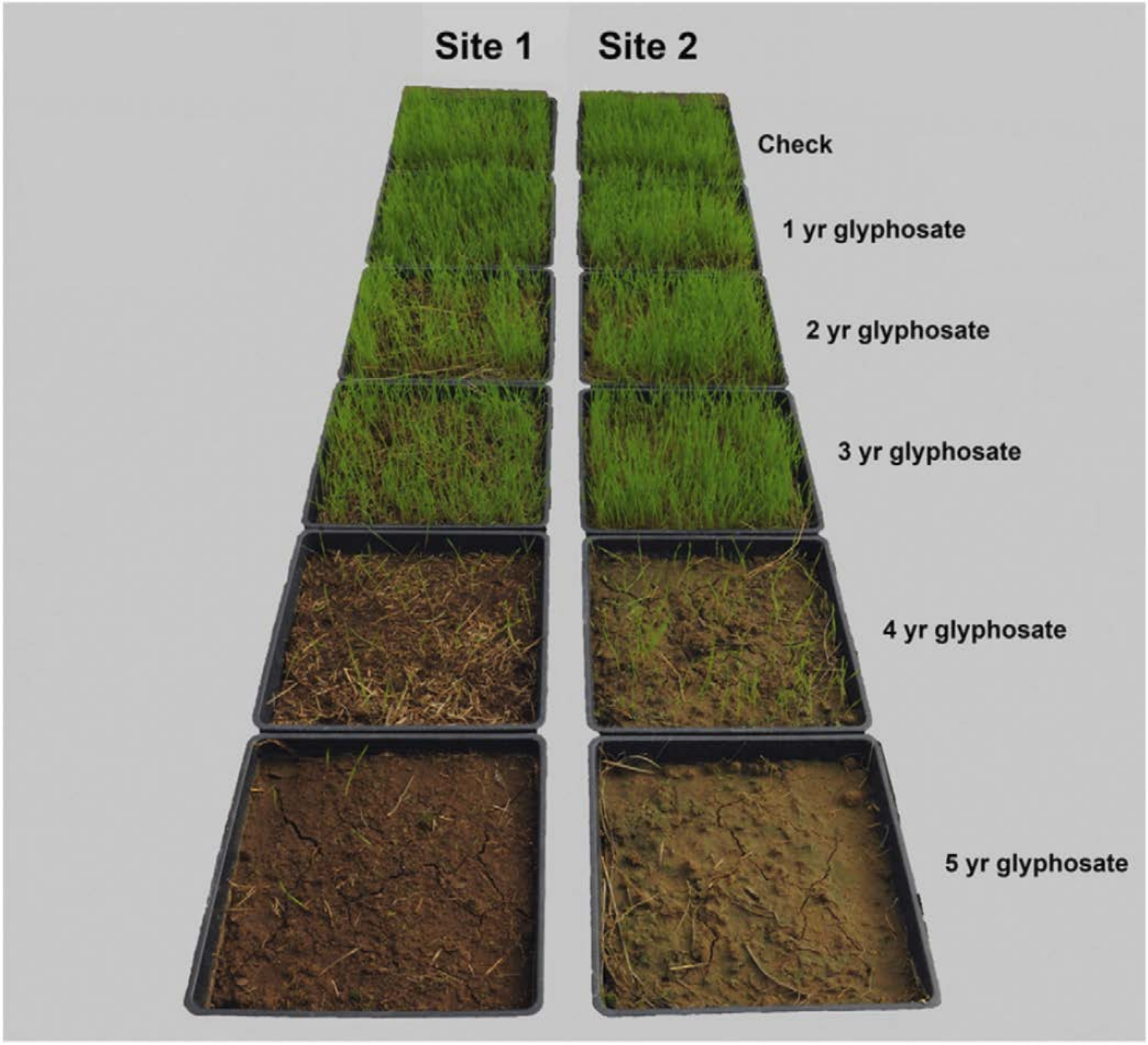
Reliance on the Herbicide Alone



Change in cover in the Plateau at 10 oz/A-subplot of the untreated main block across all years of the study at the Josie Morris site

Conclusions – Integrated Approaches

- Integrating different management approaches can increase and maintain annual grass control
- While Plateau effects can be seen for 3 to 4 years after application, the seedbank can persist longer
- Selectivity of Plateau and other herbicides is dependent on rate, species, growth stage, and application timing
- Long term restoration efforts will require multiple approaches to effect long-term changes
- Environmental conditions are a large driver of these systems



Sebastian et al. 2016. Seed Bank Depletion: Key to long-term downy brome management. Rangeland Ecology and Management

Discussion Points – Annual Grass Management

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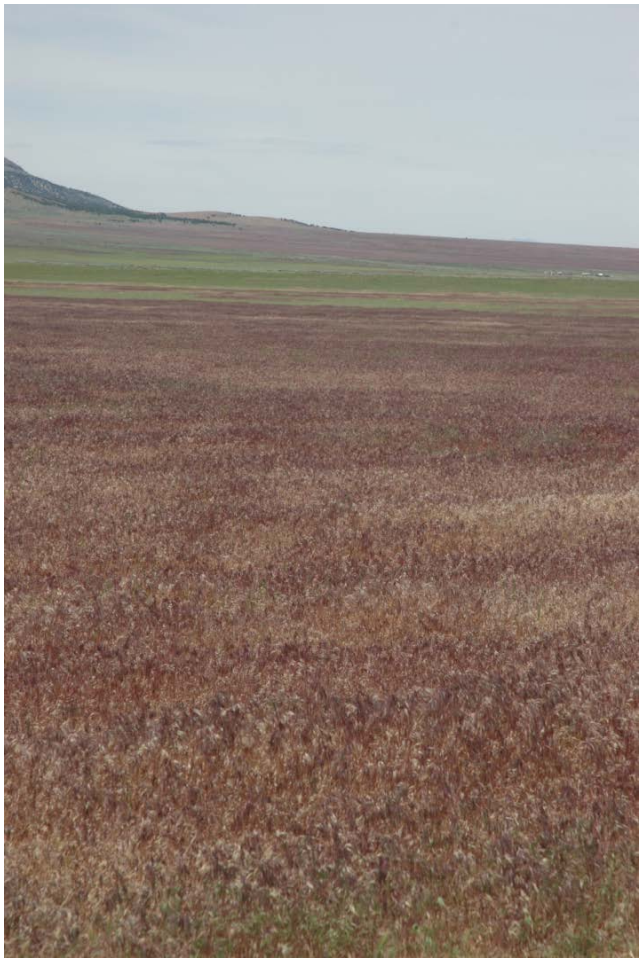


A New Option for Protecting Existing Vegetation

Treatments

Various herbicides alone and combined with Esplanade

Applications:

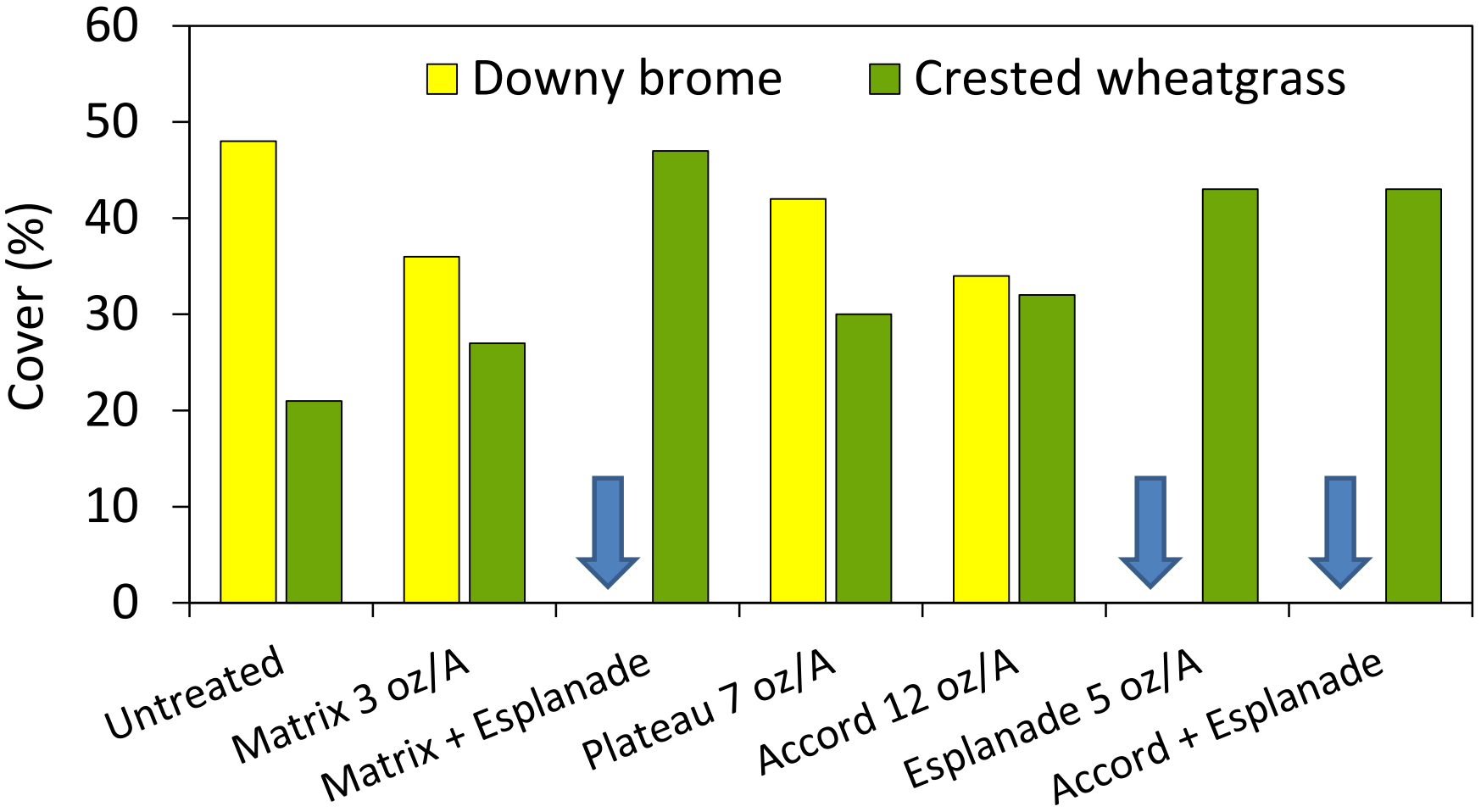
- Nov. 7 2015

- April 7, 2016

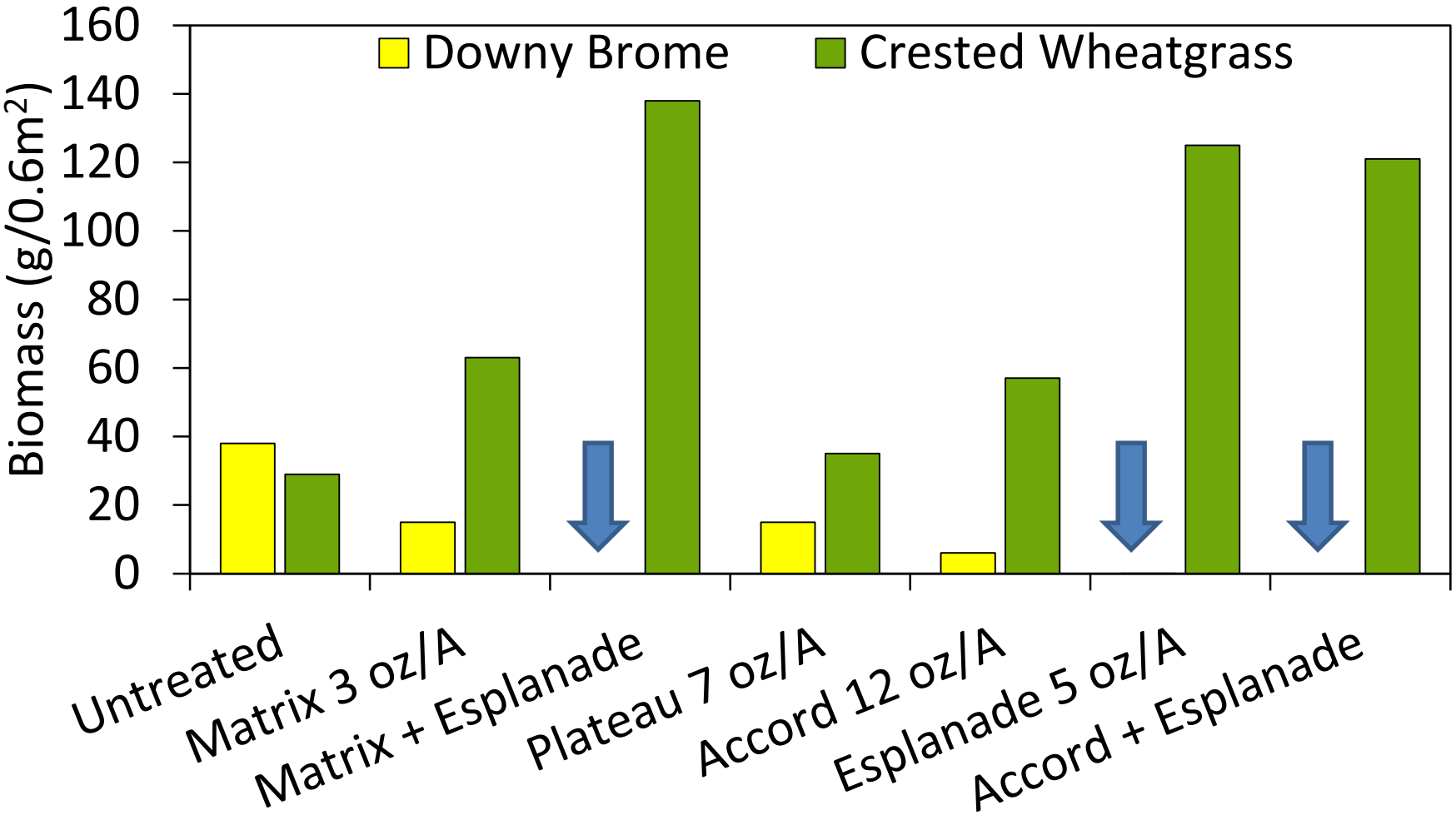
Only select fall applied treatments will be presented

Esplanade – No Grazing!

Species Cover (2YAT)



Species Biomass (2YAT)



Conclusions

- The ability to manage the seed bank is critical to successful long-term control of invasive annual grasses

- Esplanade provides opportunity to protect or reclaim non-grazed areas with remnant perennial vegetation

Summary

As we gain more management tools, we need more information on how to integrate the tools in order to manage invasive annual grasses and restore or protect invaded lands

Aren’t we there yet!!


Questions?

Thanks to: Tamara Naumann, Dinosaur National Monument

Acknowledgements

- Corey Ransom, Major Professor
- Tamara Naumann, DNM, USNPS
- Heather Olsen, Technician
- Bill Mace, Technician
- Andrew Swain, Graduate Student
- Tyler Swain, Student Worker

Support: Great Basin Native Plant Selection and Increase Project


6/2015

Invasive Annual Grass Management

Corey Ransom

UtahStateUniversity
DEPARTMENT OF PLANTS, SOILS, & CLIMATE

Medusahead Biology

Taeniatherum caput-medusae
= Elymus caput-medusae

Winter annual grass - up to 2 ft

Densities upward of 500/ft^2

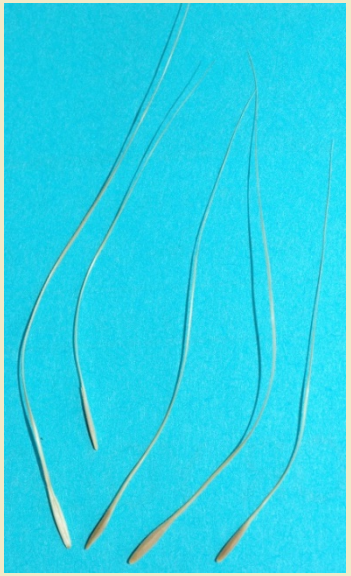
Narrow leaves (1 to 3 mm), with fine hairs

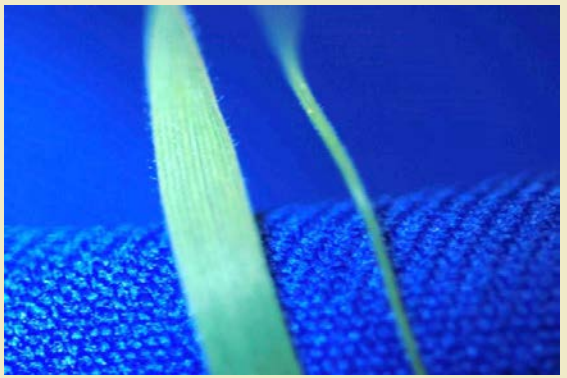
Light green color, especially with seed heads

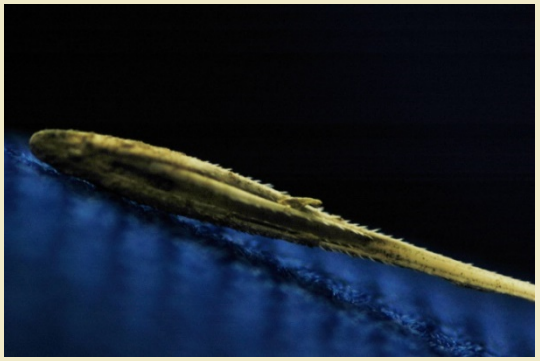
Flower head 0.6 to 2 inch long producing 8 to 15 seeds per spike

Awns 1 to 3 inch, straight when green and twisting as they dry, barbed

Stiff florets remain attached to head after seed shatter







Medusahead Look-Alikes

Medusahead

Bottlebrush Squirretail

http://www.webpages.uidaho.edu/west/plantid.htm

Foxtail Barley

Medusahead Herbicide Timing Trials, 2012-13

Two Trials in Cache Valley

Applications: September, October, November, April, May/June of 2012-13

<u>Treatments:</u>

Plateau at 10.0 fl oz

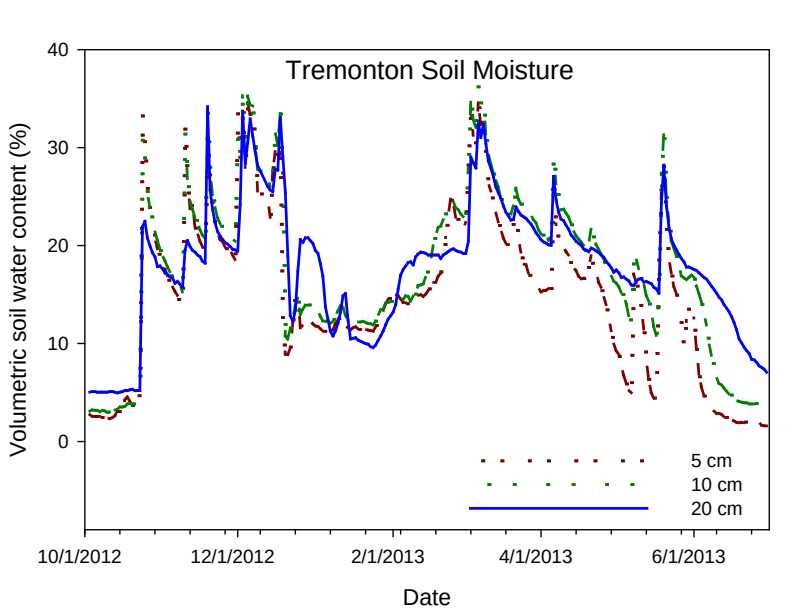
Matrix at 4.0 oz

Plateau + Roundup at 10 + 6 oz

Matrix + Roundup at 4 + 6 oz

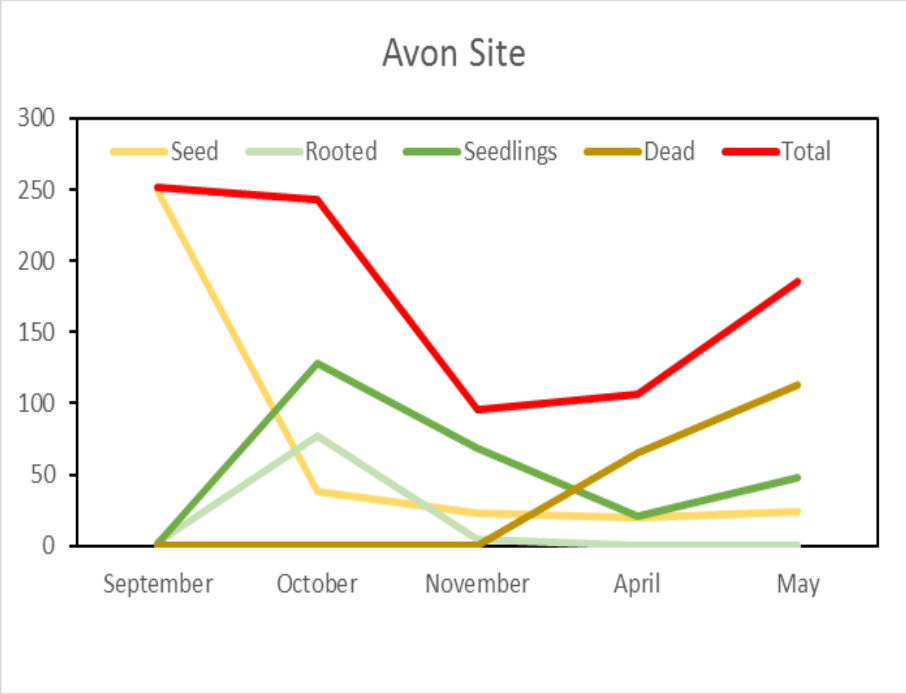
Roundup ProMax at 6 oz

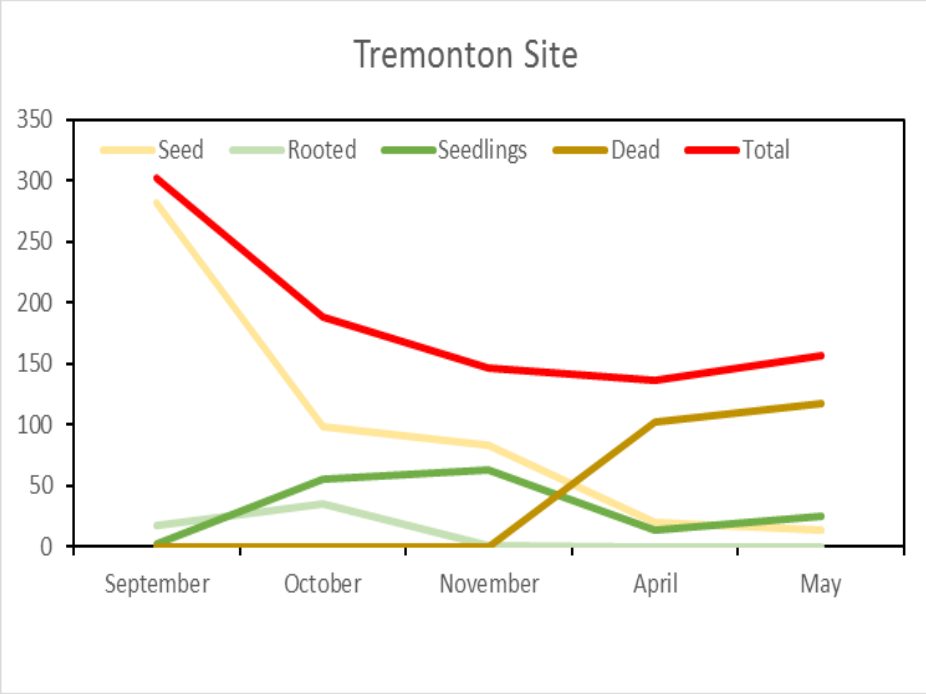
Recorded environmental conditions, thatch depth, seedling numbers, seedling height, seed location and stage



Early Management is Critical

Medusahead Seed and Seedling Numbers from Small Soil Cores





Medusahead Control in Response to Herbicides and Application Dates

		Medusahead control				
Treatment*	Rate	Sept	Oct	Nov	April	May/Jun
	oz/acre	——————————%——————————				
		Avon				
Plateau	10	59	68	93	100	45
Matrix	4	97	100	94	100	56
Plateau + RU	10 + 6	29	81	99	100	81
Matrix + RU	4 + 6	97	98	100	100	72
Roundup ProMax	6	11	9	61	85	84
LSD (0.05)				19.0		
		Tremonton				
Plateau	10	69	74	91	98	69
Matrix	4	98	99	98	99	76
Plateau + RU	10 + 6	69	86	97	99	76
Matrix + RU	4 + 6	100	98	100	100	71
Roundup ProMax	6	0	38	63	63	89
LSD (0.05)				13.8		

*All treatments included ammonium sulfate (AMS) at 8.5 lb/100 gal. Plateau and Matrix treatments also included methylated seed oil (MSO) at 1.0% v/v.

Inconsistent Control with Aerial Applications

Medusahead Gallonage Trial, 2014-15

Greenhouse and Field Trials

Field Application: April, 2014

Treatments:

Plateau at 10.0 fl oz + MSO

Plateau at 10.0 fl oz + MSO + AMS

Spray Volumes:

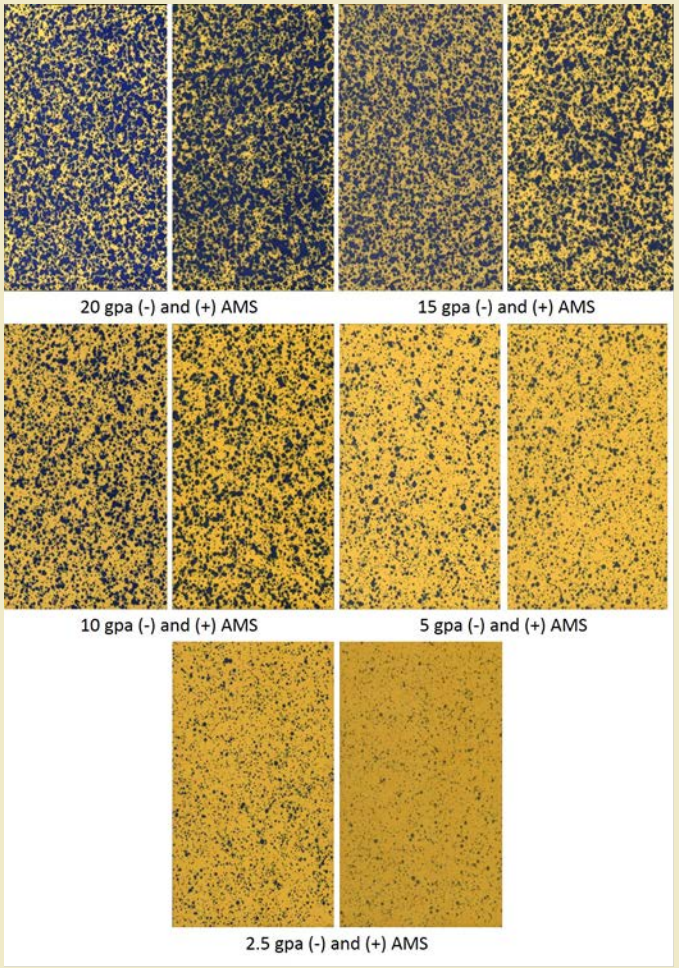
20 gpa

10 gpa

5 gpa

2.5 gpa

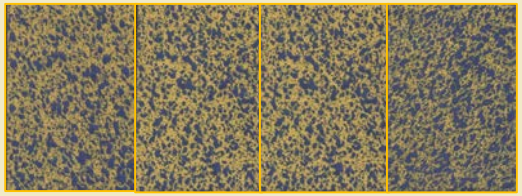
Spray volume had little effect on medusahead control!



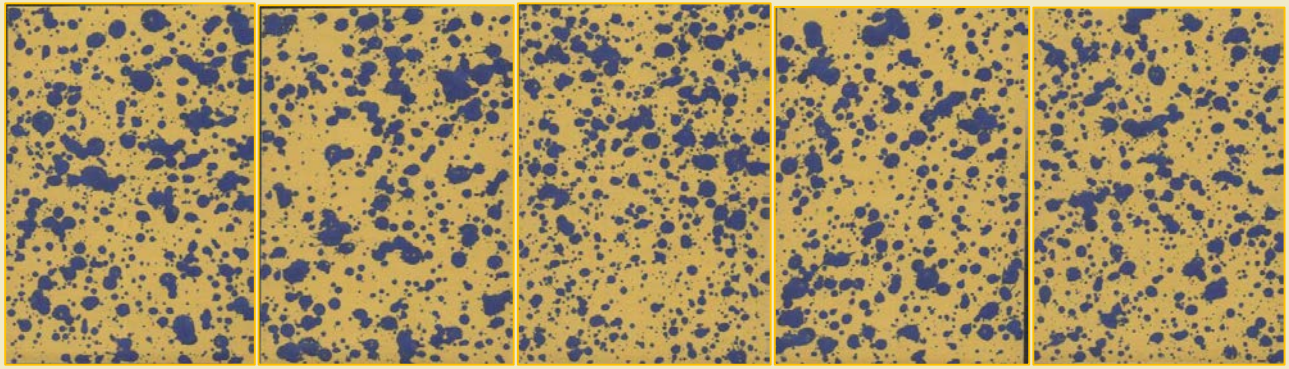
Coverage?

Sprayer Droplet Patterns

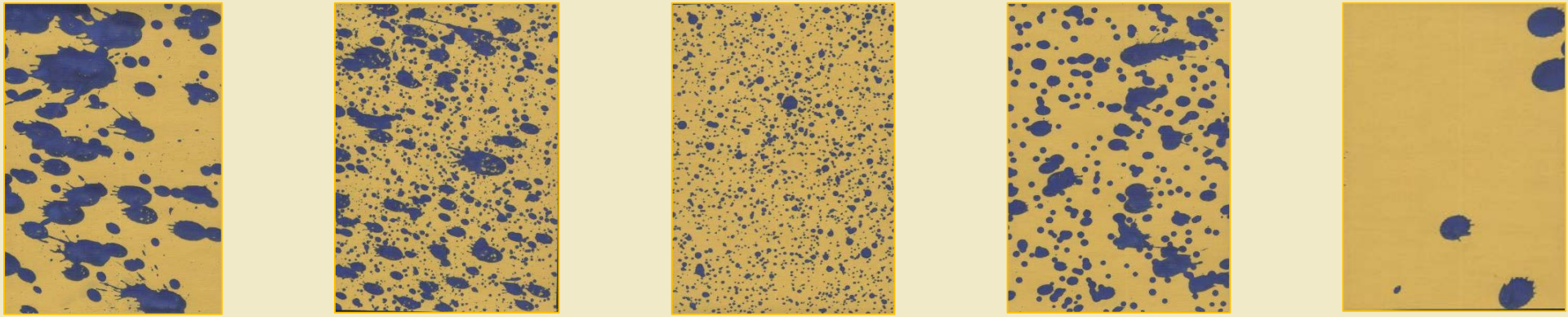
Target Volume 20 gpa



Backpack (2, 4, 6, 8 Feet)



Boom (2, 6, 10, 15, 18 Feet)



Boom Buster (2, 9.5, 15, 21.5, 28 Feet)

Using Milestone to Control Medusahead, 2015

Applications:

April 10, 2015 – 3-leaf

August 11, 2015 - Preemergence

Treatments:

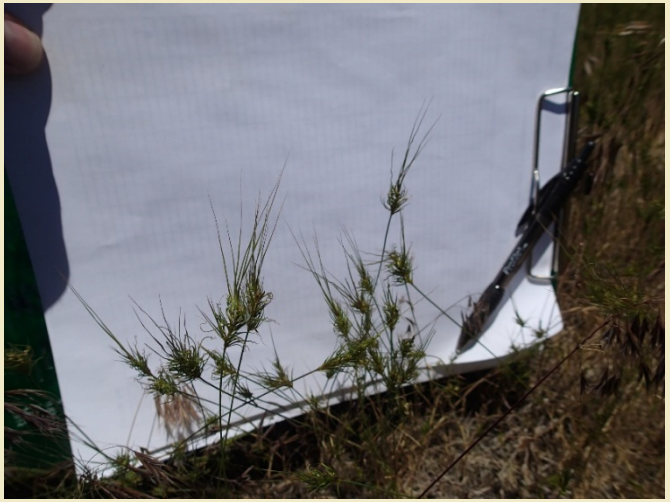
Milestone 7 or 14 fl oz/acre

Opensight 3.3 or 6.6 oz/acre

Plateau 10 fl oz/acre

Spray Volume:

18 gpa



Using Milestone to Control Medusahead, 2015

Herbicide	Rate	Timing	Medusahead		
			Seedheads	Germination	Shoots
	oz/a		no/ft^2	–%–	no/ft^2
Milestone	7	April	275 b	0.01 b	18 c
Milestone	14	April	170 b	0 b	29 c
Opensight	3.3	April	219 b	0 b	23 c
Opensight	6.6	April	218 b	0 b	32 c
Plateau	10	April	204 b	23 b	2 c
Milestone	7	August	-	-	227 b
Milestone	14	August	-	-	77 c
Opensight	3.3	August	-	-	97 c
Opensight	6.6	August	-	-	70 c
Plateau	10	August	-	-	14 c
Untreated	-	-	441 a	77 a	495 a

Herbicides for Medusahead Control, Summary

- ✓ **Herbicides can effectively control medusahead, for two or more years.**
- ✓ **Early spring applications can reduce seed numbers and or viability, but sufficient seeds remain to warrant using a soil active herbicide.**
- ✓ **Herbicide application timing is critical, possibly due to coverage issues or discontinuous germination, or both.**
- ✓ **Selectivity to desirable vegetation is herbicide and timing dependent.**
- ✓ **Integration of herbicides with vegetation recovery or establishment will be key to long term control.**

Support: UDAF ISM, USU AES, Chemical Companies