Evaluating the Revegetation Success of Foothills Fescue Grassland

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Can Native Fescue Grassland Make a Comeback?

- Fescue grassland – late seral and long lived perennial forage providing important habitat for rare/uncommon plant species and several endangered wildlife species
- Currently only in remnants remaining
- Can be permanently altered by heavy grazing
- Threatened by invasion of non-native forage species
- Difficult to restore once disturbed
- Poor and erratic seed production behaviour

Outline

- Fescue grassland revegetation research
- Challenges
- Findings & future work plan
- When is reclamation success achieved – using the 2010 Reclamation Criteria

Can Native Fescue Grassland Make a Comeback?

2010

2011

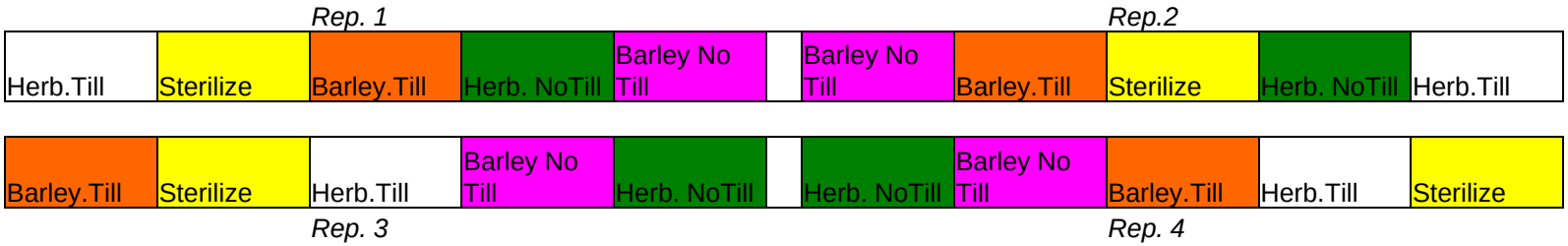
Study Design

Site 1: Mac Blade

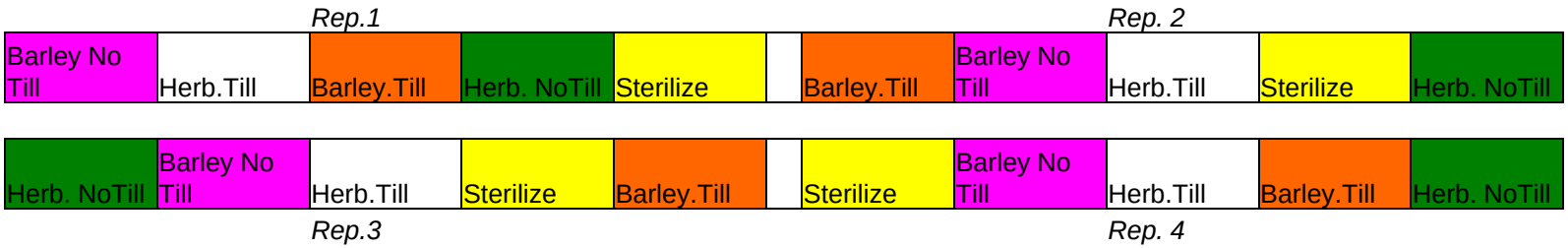
Five pre-seed treatments. Control is referenced from outlying areas.

Herbicide (Round-up Weathermax) Zero-till
Herbicide (Round-up Weathermax) conventional till
Barley zero till
Barley conventional till
Soil fumigation

*mostly smooth brome grass



Site 2: Chattaway



*mostly Timothy grass

Foothills Fescue Establishment near Longview

Foothills Fescue Revegetation in 2010

Foothills rough fescue - 57%
Rocky Mountain fescue -15%
June grass - 5%
Hairy wild rye -10%
Slender wheatgrass – 5%
Green needle grass - 3%
Idaho fescue - 5%

What Grew on the Sites?

Germination Test of Seed Used in Study

Latin Name	Seed Source	% Germination
Elymus trachycaulus ssp subsecundum	Breeder2005	91
Nassela viridula	Common 2010	14
Festuca idahoensis	Breeder 2010	41
Leymus innovatus	Common 2009	49
Koeleria macrantha	Breeder S2 2003	90
Festuca campestris	M.D. of Ranchlands, 2011	30
Festuca saximontana	“Plateau” Brett-Young 2011	60

Soil Characterization

		Topsoil					Subsoil		
Location	**Treatment**	**Topsoil Depth (cm)**	**Color**	**Texture**	**Consistence**	**Structure**	**Texture**	**Consistence**	**Structure**
Mac Blade	Undisturbed Native Fescue	11	10yr 3/2 very dark grayish Brown	SiL	Soft	Subangular blocky-Fine	SiL	V. Friable	Subangular blocky fine to Granular
Mac Blade	Forage	13	10yr 2/1 Black	SiL	Soft	Subangular blocky-Fine	SiL	Soft	Subangular Blocky Fine - Medium
Mac Blade	Test Site	13	10yr 2/1 Black	SiL	Firm	Subangular blocky-Fine	SiL	Friable-Firm	Subangular Blocky Medium
Chattaway	Undisturbed Native Fescue	12	10yr 2/2 very Dark Brown	SiL	Soft	Subangular blocky to amorphous	SiL	Soft	Subangular blocky fine to medium to amorphous
Chattaway	Forage	15	10yr 2/1 Black	SiL	Firm	granular-med.	SiL	Hard	Subangular blocky f.-med.
Chattaway	Test Site	10	10yr 2/1 Black	SiL	Firm	Subangular blocky fine	Clay	Hard	Subangular blocky f.-med.

Microbial Diversity

Site	Treatment	Time	Total Bacterial (µg/g)	Total Fungal (µg/g)	Flagellates	Amoebae	Ciliates	Total Nematodes #/g	Plant available N Supply
Chattaway	Forage	Spring	349	149	64949	11729	196		110-150
Chattaway	Forage	Summer	336	14.5	16702	8387	69	0.23	100-150
Chattaway	Forage	Fall	154	442	6719	8130	50	0.06	75-100
Chattaway	Native	Spring	318	257	788	379	8		<25
Chattaway	Native	Summer	76.7	180	903	462	15	0.03	<25
Chattaway	Native	Fall	188	309	928	513	31	0	<25
Chattaway	Test site	Spring	316	118	1857	616	371		50-75
Chattaway	Test site	Summer	509	60	1008	697	7	0.02	<25
Chattaway	Test site	Fall	70	107	1837	1670	0	0	<25
Mac Blade	Forage	Spring	195	74.3	2183	436	0	0.05	<25
Mac Blade	Forage	Summer	156	114	570	212	53	0.01	50-75
Mac Blade	Forage	Fall	170	432	580	704	54	0.32	50-75
Mac Blade	Native	Spring	310	252	1825	757	7		<25
Mac Blade	Native	Summer	173	76.3	667	1608	97	0.02	50-75
Mac Blade	Native	Fall	317	381	3087	5128	85	0.13	50-75
Mac Blade	Test site	Spring	802	231	2194	438	132		50-75
Mac Blade	Test site	Summer	101	108	1733	1733	17	0.03	<25
Mac Blade	Test site	Fall	323	512	5701	2862	57	0.15	50-75

Both sites have high microbial count, which can influence plant community dynamics.

More available N in the non-native forage area, but not on Mac Blade site

Nutrient Profile

Site	Vegetation Type	Ca	K	P	Mg	Nitrate Nitrogen	Ammonia nitrogen	S	Cu	Fe	Mn	PH	Conductivity (dS/m)
Chattaway	Forage	3736	13	451	681	0	10.4	12	6	4	13	7.69	0.09
	Forage	4128	17	214	520	6.1	14.5	26	0	5.6	0	7.31	0.07
	Native	5325	63	202	842	0.69	11	11	13	5	46	7.8	0.1
	Native	3901	25	333	855	12.3	14.3	52	0	6	0	6.81	0.05
	Test site	5542	24	192	669	4.4	40.5	8	12	4	23	7.88	0.12
	Test site	5738	38	182	495	43.7	13	3	0	5.3	0	7.75	0.15
Mac Blade	Forage	5037	16	314	1090	0.15	10.8	10	11	4	29	8.11	0.2
	Forage	5119	26	343	879	3.8	11	16	0	5.3	0	7.28	0.11
	Native	3736	14	432	533	0.38	9.4	7	9	5	15	8	0.11
	Native	4128	87	257	1412	19	13	17	0	6.6	0	7.28	0.09
	Test site	5532	20	251	1189	4.1	9.8	14	14	4	19	8.33	0.15
	Test site	5676	51	335	557	73.6	9.4	49	0	4.5	0	7.55	0.66

Nutrients measured in ppm

Greater number of nitrifying bacteria, converting NH_4 to NO_3

Organic Matter Content

Location	Treatment	% OM
Mac Blade	Undisturbed Native Fescue	9.1
Mac Blade	Forage	17.1
Mac Blade	Test Site	17.7
Chattaway	Undisturbed Native Fescue	13.5
Chattaway	Forage	13.3
Chattaway	Test Site	13.5

Potential Allelopathic Effect

- Allelopathic substances accumulate in plants and soils
- Allelopathic activity of plant spp., their varieties/genotypes and response of their seedlings to chemical interactions affects the compatibility and durability in plant communities
- Causes structural changes in plant communities

Literature Search

- Field testing for pollen allelopathy - A review. Sep 2000. Journal of Chemical Ecology, Vol 26 Issue 9

- Inhibitory effects of smooth brome leachates on leafy spurge.Willard L. Koorkkari and David D. B iesboer. *Department of Botany, University of Minnesota, St. Paul, MN 55108*.

- Allelopathic Evidence in the Poaceae. The Botanical Review 69(3): 300–319.

- Polyphenol oxidase activity in the roots of seedlings of Bromus (Poaceae) and other grass genera. Claus Holzapfel, Pouyan Shahrokh, David Kafkewitz American Journal of Botany (2010), Volume: 97, Issue: 7, Pages: 1195-1199

- Reduced seed set in *Elytrigia repens* caused by allelopathic pollen from *Phleum pratense.* Stephen D. Murphy, Lonnie W. Aarssen Canadian Journal of Botany, 1995, 73:(9) 1417-1422, 10.1139/b95-154

F. Campestris Test for Potential Allelopathy

Growth Chamber Study

Treatment	Percent Germination			
	Rep 1	Rep 2	Rep 3	Average
Fescue original seed	76	80	76	77
Fescue with lemma and palea sanded off	100	94	94	96
Slender wheat original	94	92	91	92
Slender wheat grass placed in dish with fescue seeds intact	76	88	84	83

Field study @ Vegreville - Emergence recorded after 21 days.

Treatment	Percent Germination			
	Rep 1	Rep 2	Rep 3	Average
Seeds de-hulled	39	46	24	36
Seeds intact	71	57	67	65

Greenhouse Study

Seed mix species planted in trays, containing soil obtained from the test sites compared to a greenhouse soil, showing emergence 18 days after seeding

What's next?

- Determine if fall seeded (2011) species will yield better results
- Monitor the site in 2012
- Possibly, soil needs a longer rest after cultivation to allow possible allelopathic chemical to degrade prior to seeding
- If no growth in 2012, plan to grow 4,000 plugs for transplanting onto sites

Conclusion

These sites were not the ideal site for the study: influence of non-native forages

2011 fall seeding will do better

Forbs and legumes appear to withstand the effects from the tame forages better that the native grasses

Experiences have shown that it is possible to re-establish fescue grassland

Conclusion

Fescue hay, 5 years (2009) after spreading on a gravel pit, Milk River Ridge

When is reclamation success achieved, using the 2010 Reclamation Criteria as a guide?

Objectives:

- When is reclamation success achieved and how is it achieved?
- Can the 2010 criteria reliably predict ecosystem succession and health
- If reclamation is achieved, what is the time period before a reclamation certificate is obtained?

Results

- Site age is a large factor in success rate
- For certain sites, a 5 yr. period after reclamation may not be enough time to seek a certificate
- Criteria imposes minimum requirements for successful reclamation, based on physical and inter-species factors
- Most failures will be due to soil compaction and problem weeds

Issues with Some Sites

Good Reclamation

Sandy soils – near Metiskow

Cenovus site – near Brooks

Issues

- Learning curve, can be time consuming
- Know your plants and soil
- Knowing if a sample point fails- step-outs, a laptop will be useful to have on hand
- Litter – other factors in line but not enough litter
- Non-routine application – some sites can be easily passed with minor attention
- Soil consistency
- Grazing response- bases species selection on grazing, not based on diversity, may restrict seed mixes used

Thank you