

Cover crops and reclamation



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Talk outline

- Previous research results on cover crops
- Follow-on experiment
- Evidence to support using a cover crop cocktail
- Experiment planted in interim reclaims at Ft Berthold
- Preliminary results



Research results -

Annual oat simultaneous with perennial grass

- Oat only competed with perennials on farm soil under controlled conditions
- Stressful soil in pipeline meant competition was not important
- Oats did not persist to year 2
- No grazing restriction, narrow water pipeline



Espeland and Perkins 2013

Questions for 2014 experiment



- Do oats reseed themselves in absence of grazing?
- Do oats compete with perennial grasses in interim reclaims?
- Does an oat cover crop reduce weeds?

Revegetation often occurs on structureless soils



Can we use cover crop cocktails to speed soil-building?



How cover crops build soil health



Roots build soils

- carbon feeds microbes
- exudates build aggregates
- roots make pores



+ carrot, turnip, radish



Periodic table of cover crops

Grass

Grass

Broadleaf

Legumes

A Barley										A Pearl millet
A Oat	A Phacelia							A Amaranth	A Foxtail millet	
A/P Ryegrass	A Flax							A Buckwheat	A Proso millet	
A Wheat	A Spinach	B Turnip	A Field pea	A Berseem clover	A/P Medic	A Chickpea	A Sunflower	A Sudan grass		
A Cereal rye	A Kale	A Radish	A Lentil	B/P Red clover	P Birdsfoot trefoil	A Cowpea	A Safflower	A Teff		
A Triticale	A/B Canola	B Beet	A Lupin	P White clover	P Sainfoin	A Soybean	A Squash	A Grain sorghum		
A Annual fescue	A/P Mustard	A/B Carrot	A/B Vetch	A/B Sweetclover	P Alfalfa	A Mung bean	P Chicory	A Corn		

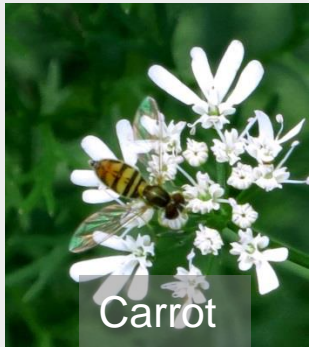
mixing species exploits more below-ground available space

ND NRCS cover crop cocktail recommendations

Insect benefits

- Pollinators, butterflies, and natural enemies that attack crop pests

Open Flower : Nectar available to a wide variety of pollinators and natural enemies



Carrot

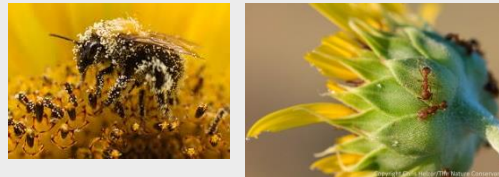


Buckwheat



Canola

Extrafloral Nectaries & Pollen

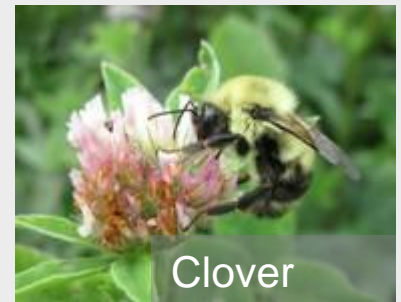


Sunflower

Closed Flower: specialized pollinators (bumble/honey bees)



Pea



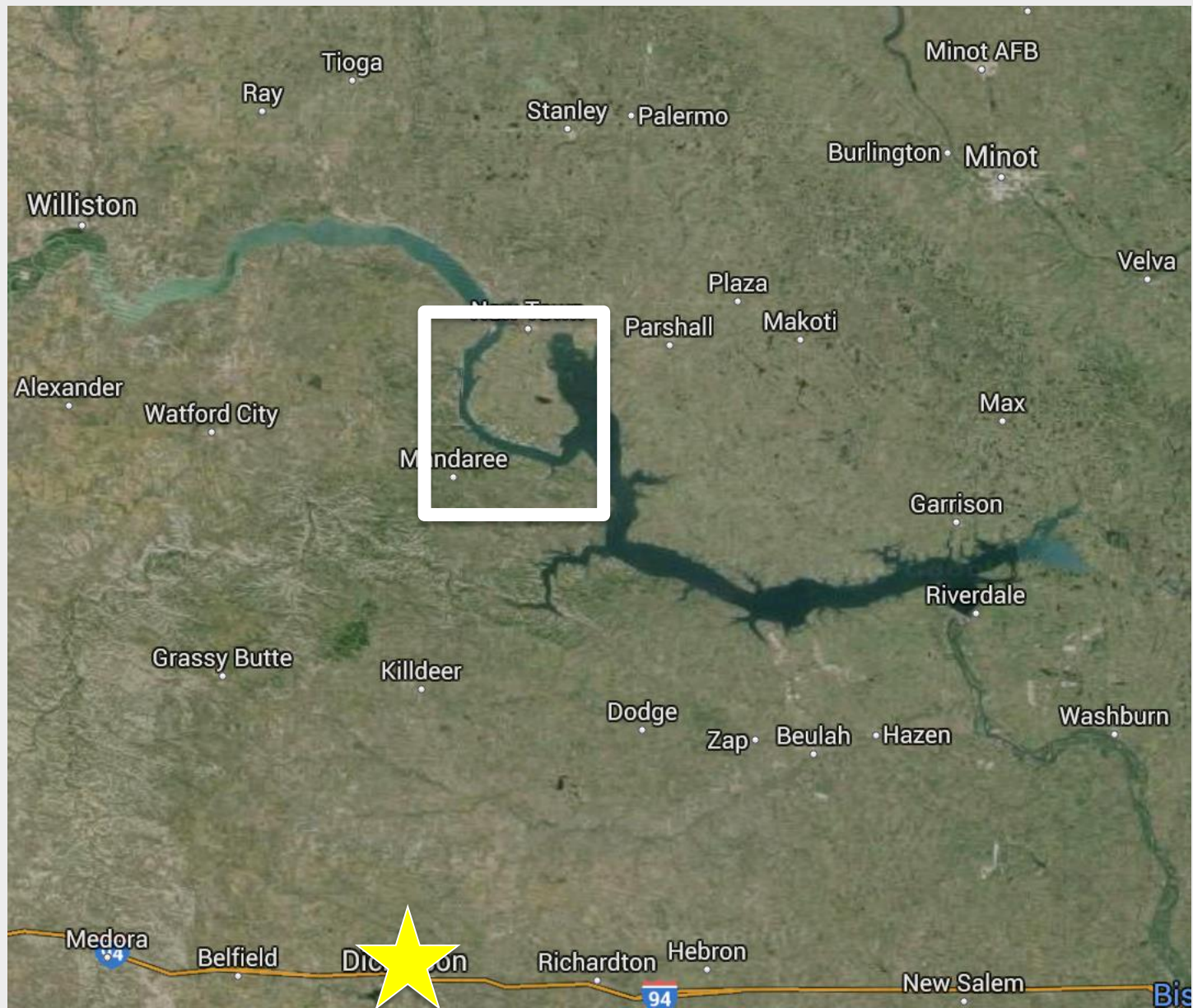
Clover

Questions to answer in cover crop cocktail study

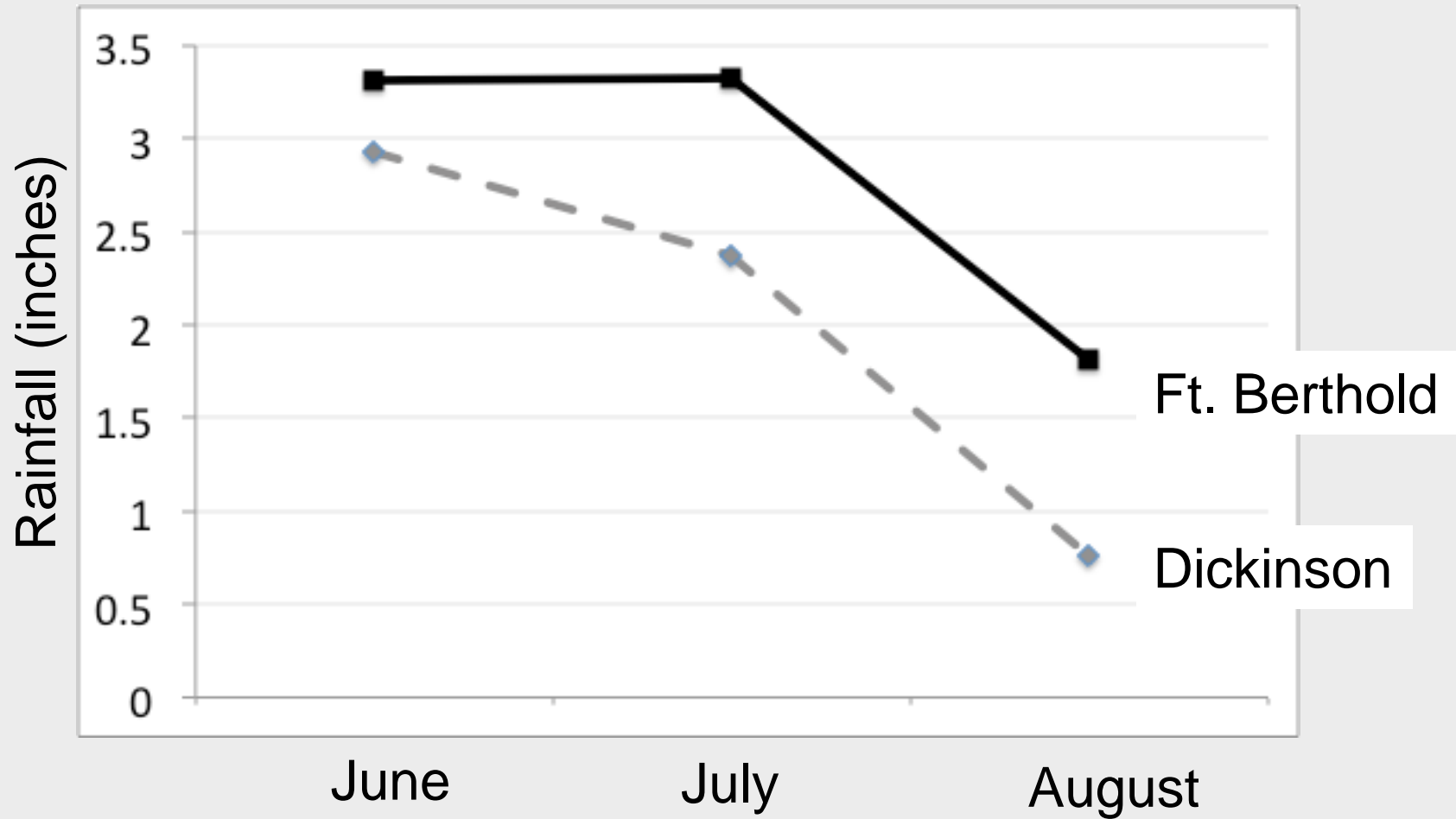
- Grow at harsh reclamation sites?
- Reduce perennial grass establishment?
- Reduce weeds?
- Provide services to pollinators and beneficials?
- Reduce erosion?
- Build soil aggregation?



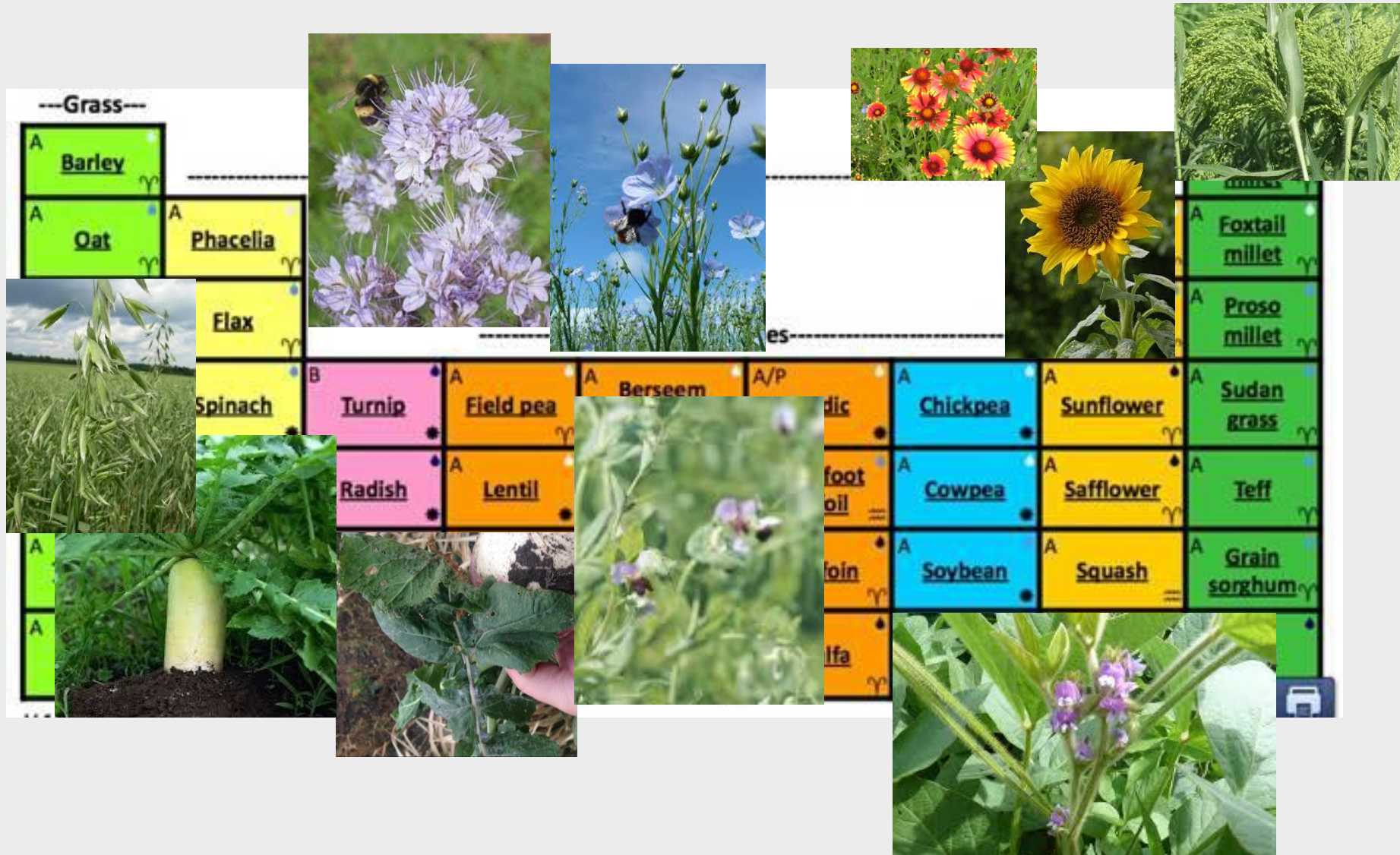
Ft. Berthold location



2015 growing season rainfall



oat, phacelia, flax, radish, turnip, field pea, soybean, sunflower,
blanketflower, millet



2014

of sites

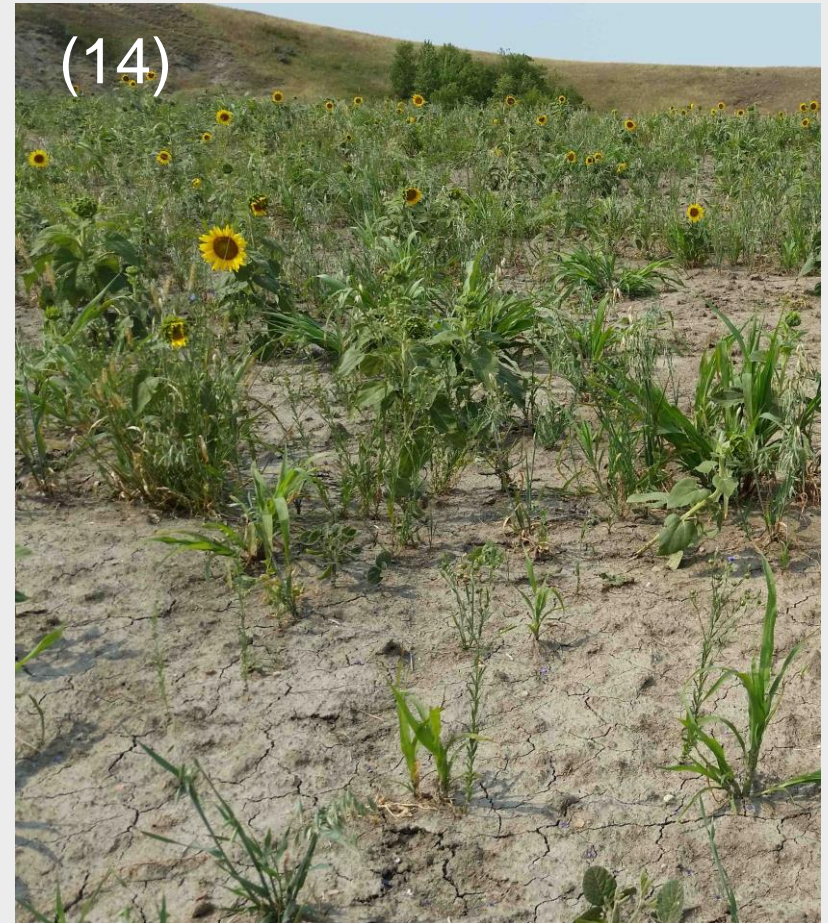
2015



Oat vs. no oat

N= 2

N= 6



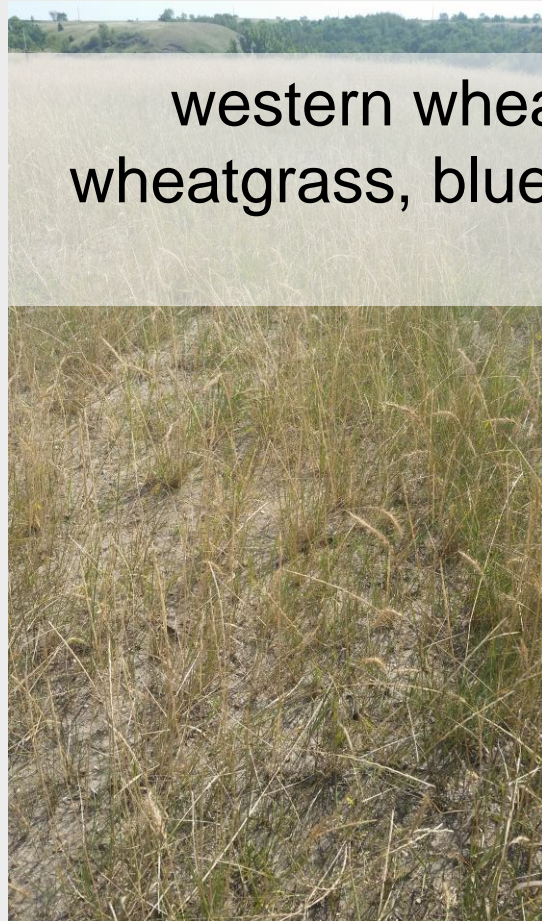
Oat vs. CCC (cover crop cocktail)

N= 3

N= 3

Seed costs

2014

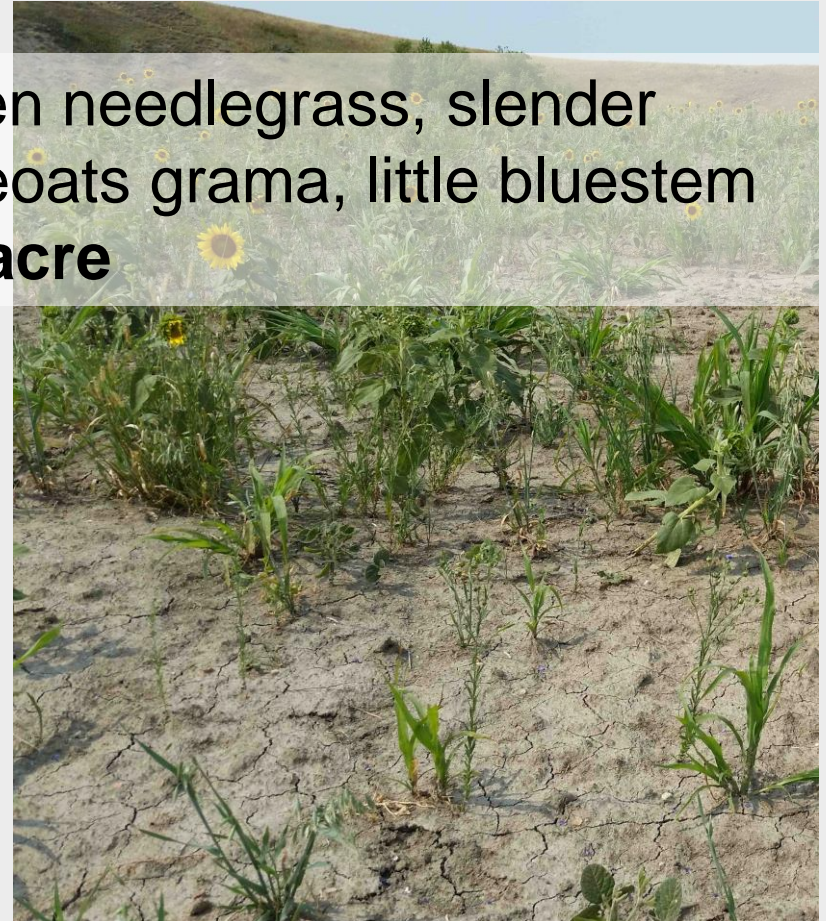


western wheatgrass, green needlegrass, slender
wheatgrass, blue grama, sideoats grama, little bluestem
\$100/acre

Oat
\$3.40/acre

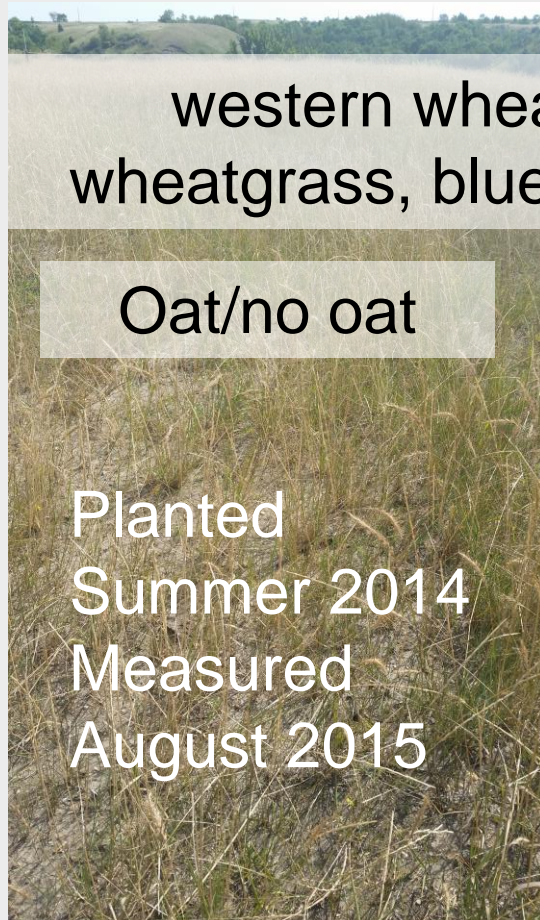
CCC
\$7/acre

2015



Planting and measuring dates

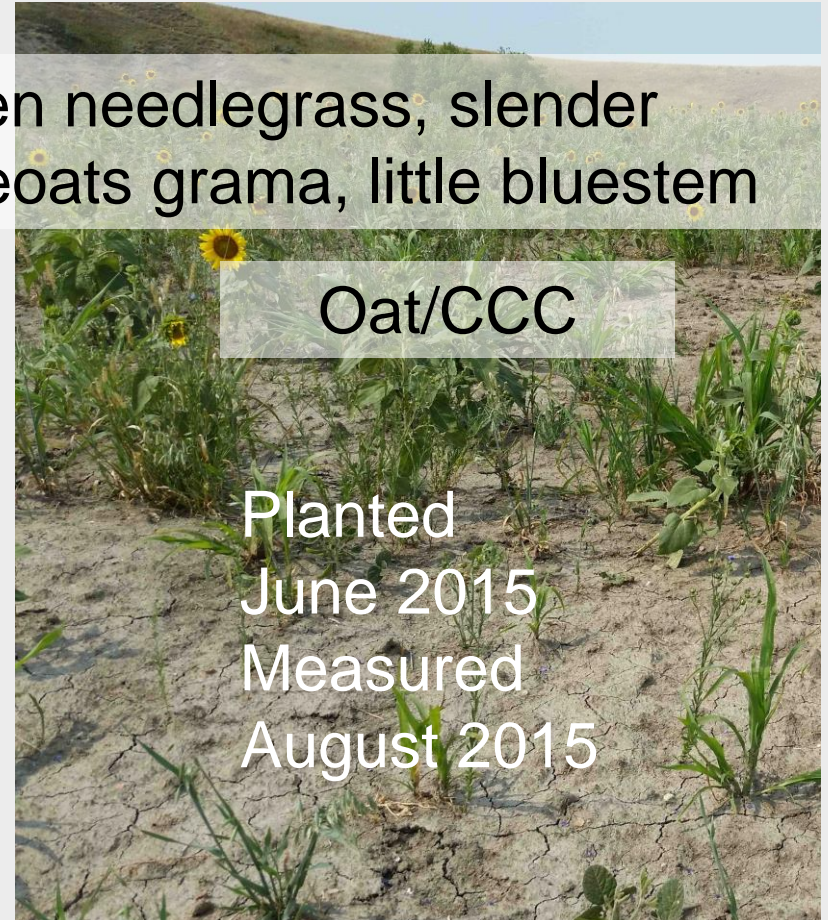
2014



Oat/no oat

Planted
Summer 2014
Measured
August 2015

2015



Oat/CCC

Planted
June 2015
Measured
August 2015

Cover crop establishment

2014

Oat: some persistence to 2015
20-40% frequency

2015

Phacelia, Sunflower, soybean,
radish, turnip, blanketflower,
flax, field pea, oat, millet
all established at all sites
Oats 100% frequency



Perennial grass establishment

2014

28 (± 7) plants/m² no Oat

30 (± 6) with Oat

2015

21 (± 7) plants/m² Oat only

17 (± 7) CCC

No difference between cover crop treatments

Weeds

2014



No Oat: 2.9 (1.0)

With Oat: 3.0 (0)

0 (none)
4 (high)

2015



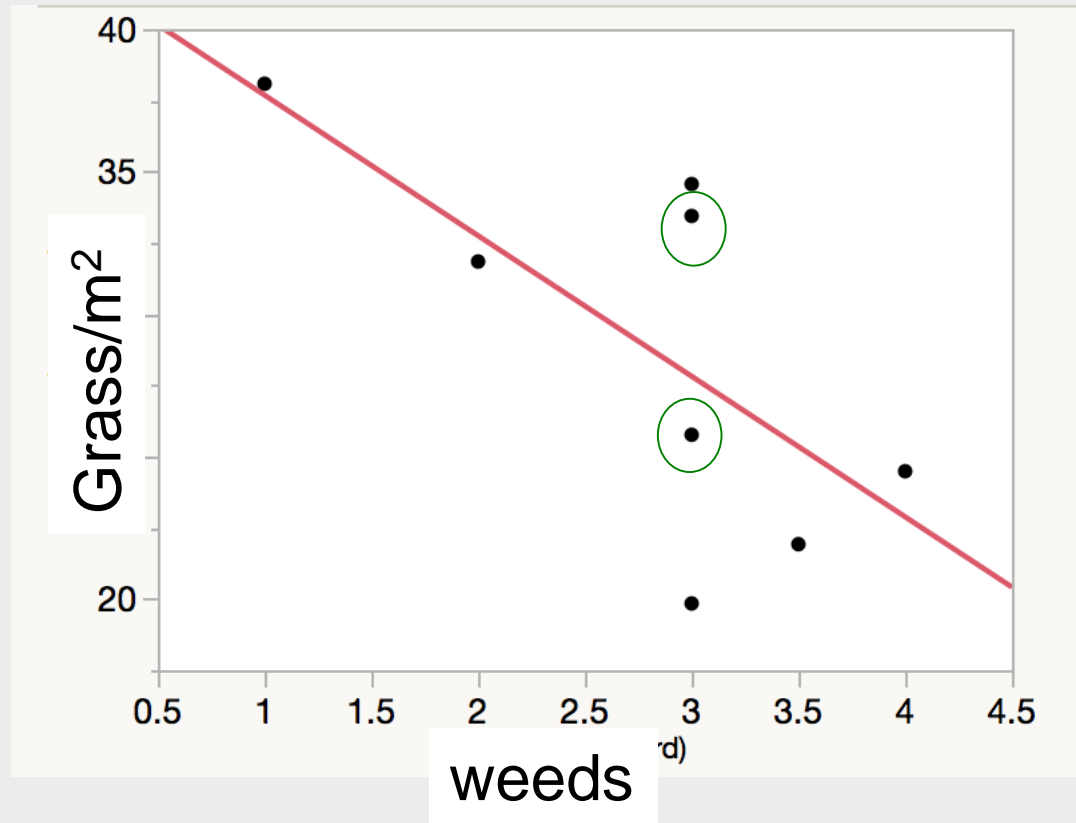
Oat: 1.4 (1.7)

CCC: 1.7(1.5)

2014: more weeds means less grass

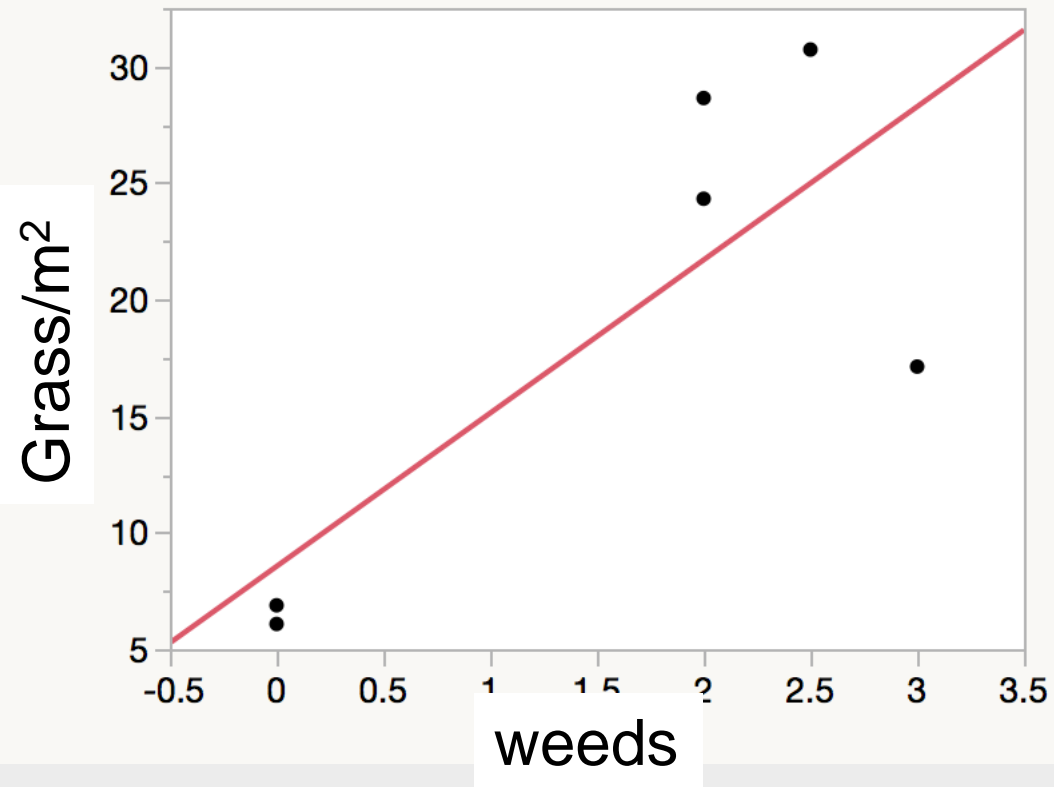


(No cover crop)



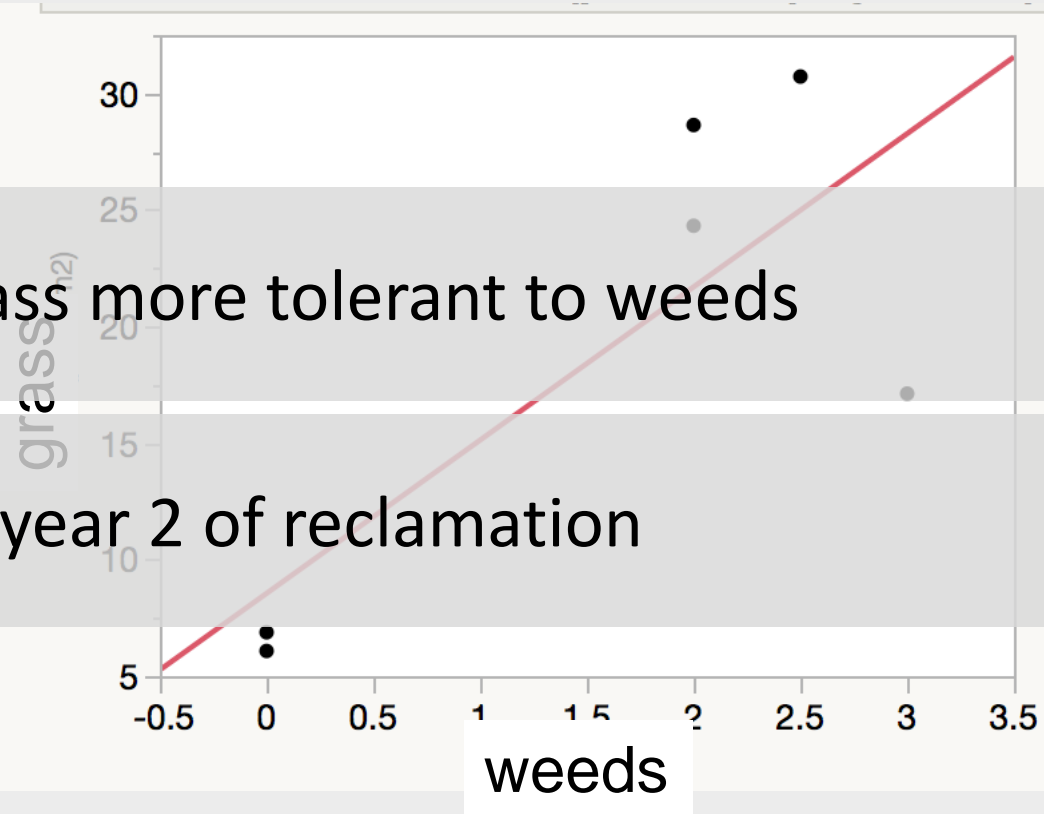
2015: more weeds = more grass

(All cover crop)



2015: more weeds = more grass

(All cover crop)



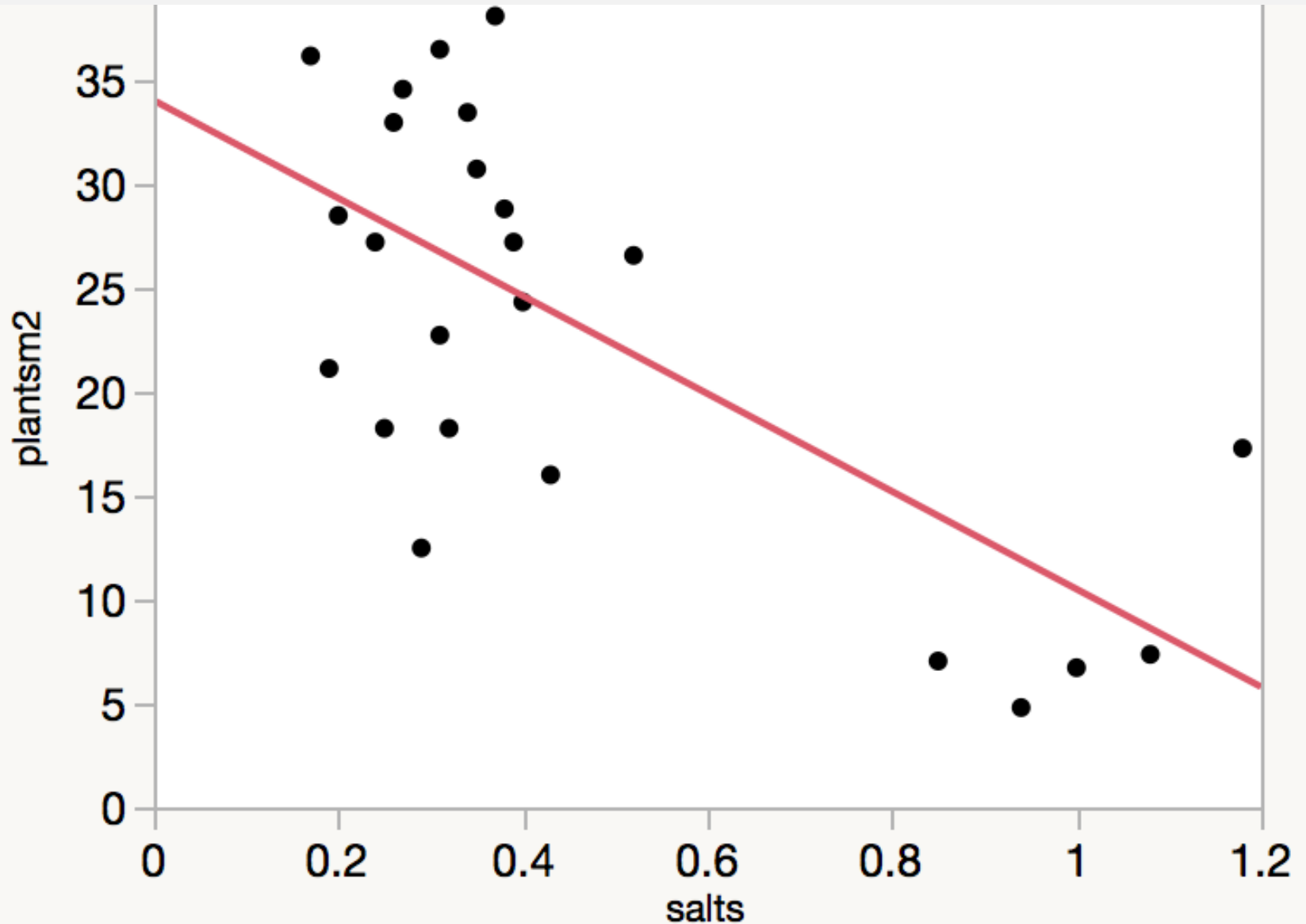
Cover crops may make grass more tolerant to weeds

Weeds cause mortality in year 2 of reclamation



***What determines perennial
grass establishment?***

Plants respond strongly to soil



Weeds and perennial grasses respond the same to soil

- Significant decreases in abundance with increased stress
 - Salts (0.17 - 1.18) [Soluble Salts 1:1 mmho/cm]
 - Copper (0.21 - 3.56) [Copper DTPA, ppm Cu]
 - Sulfur (6 - 150) [Sulfate Ca-P, ppm S]
 - Sodium (36 – 514) [Sodium NH₄OAc, ppm Na]
- Not driven by nutrition

Do we need a higher CCC density?



The Hollywood version



Our version

Can we afford a higher density?

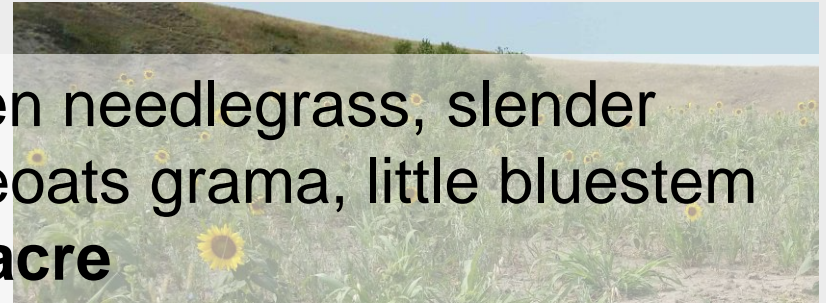


western wheatgrass, green needlegrass, slender
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\$100/acre



Oat
\$3.40/acre

CCC
\$7/acre



Summary of early results: Oat



- Do oats reseed themselves in absence of grazing?
YES (20-40%)
- Do oats compete with perennial grasses in interim reclaims? NO
- Does an oat cover crop reduce weeds? NO

2014

Summary of early results: CCC

- Grow at harsh reclamation sites? YES
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- Build soil aggregation?



picture courtesy of Clarence Chavez, NRCS

2015

Under investigation:

- Increase cover crop density?
- Is soil chemistry always most important?
- How do weeds affect grasses?



- Soil improvement over time
- Perennial grass growth over time
- Measure pollinators/ beneficials



Can we make milder soils?



Acknowledgements



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