

Salinity, Soil, Water, & Biology



Caley Gasch

School of Natural Resource Sciences

NDSU NORTH DAKOTA
STATE UNIVERSITY

caley.gasch@ndsu.edu @ckgasch



Soil & Soil Water Workshop
Jan. 22, 2020

Not Saline

Moderately Saline

Severely Saline



Managing Salinity with Cover Crops: A Whole System Response (2017 – 2021)



4 Fields

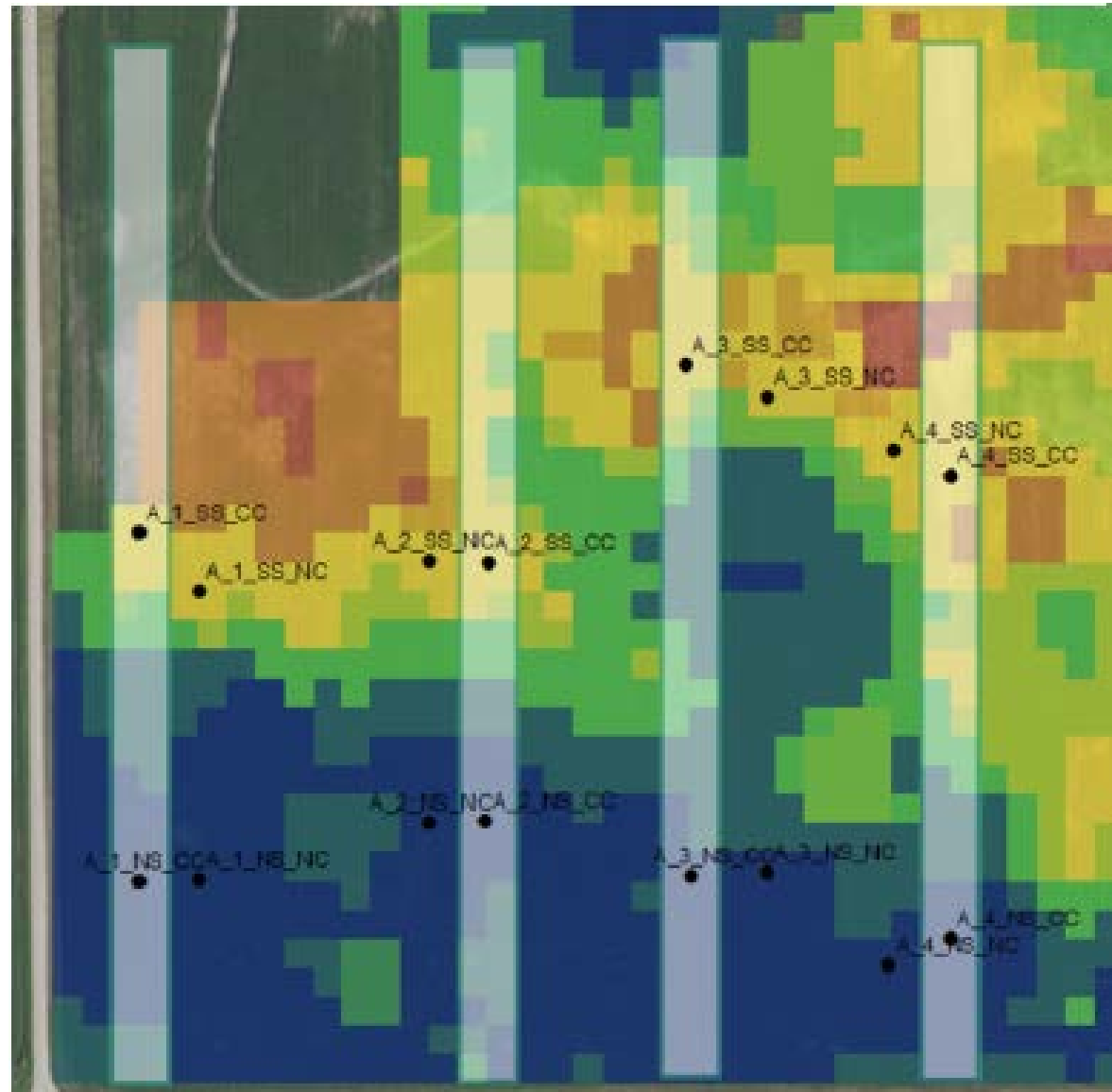
2 salinity categories ($EC_{1:1}$)

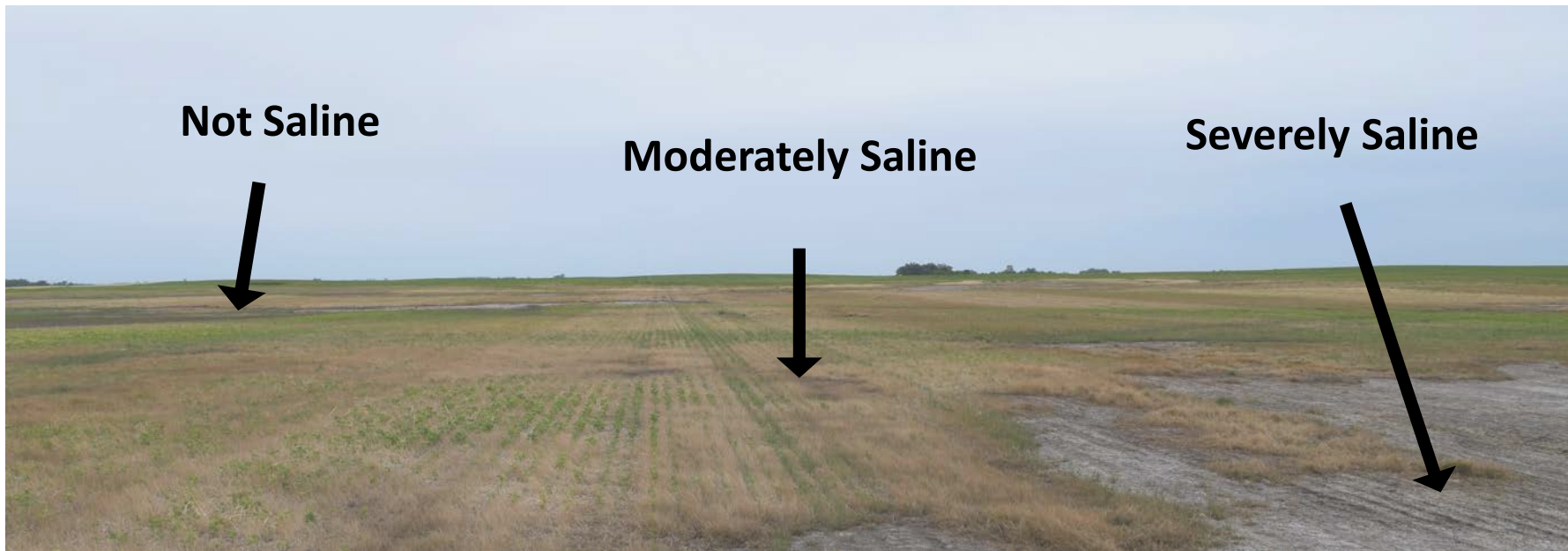
- < 1 dS/m (low)
- 2-4 dS/m (moderate)

2 cover crop treatments

- + or -

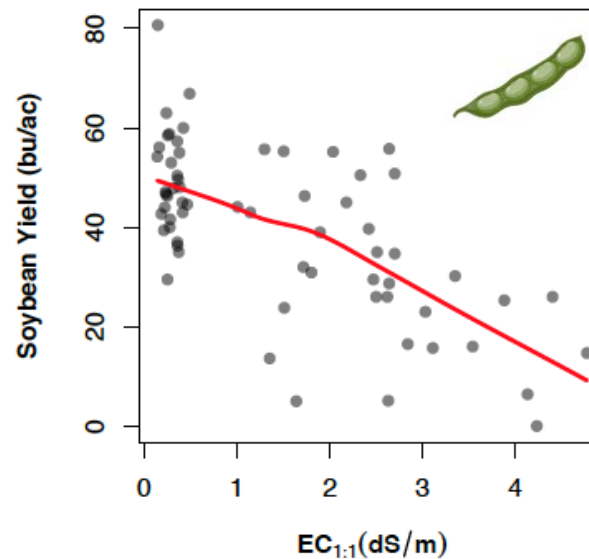
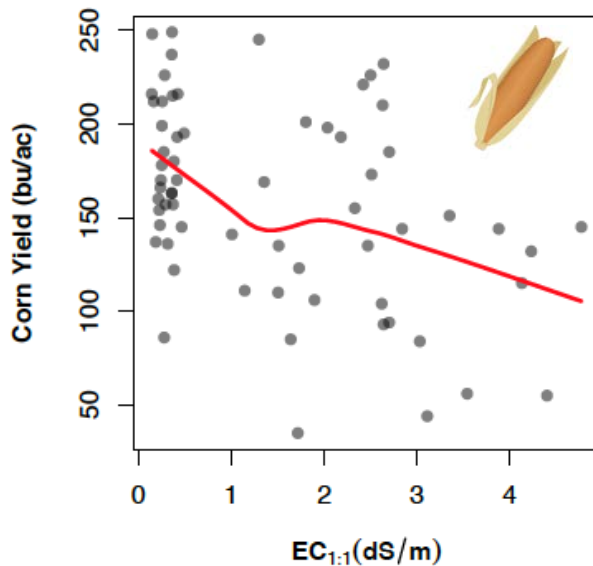
4 plot-level replicates





Salt content

Crop productivity



SF1087 (revised September 2019)



Managing Saline Soils in North Dakota

David Franzen, Extension Soil Science Specialist, Professor

Caley Gasch, Assistant Professor of Soil Health

Christopher Augustin, Extension Soil Health Specialist, North Central REC

Thomas DeSutter, Professor, School of Natural Resource Sciences, Soil Science

Naeem Kalwar, Extension Soil Health Specialist, Langdon REC

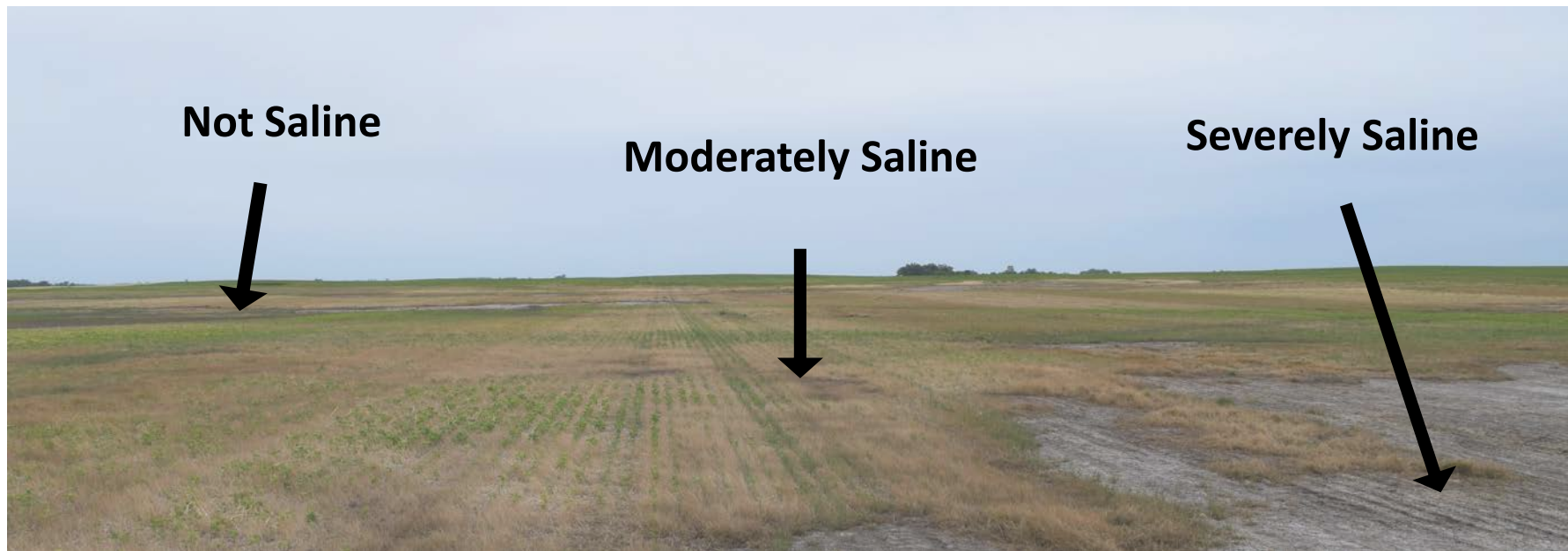
Abbey Wick, Extension Soil Health Specialist, Associate Professor, Soil Science

NDSU photo

Saline Soils

Saline soils contain salts in great enough abundance that crop yields suffer and sometimes makes successful crop

(magnesium sulfate, or $MgSO_4$) and glauber salts (sodium sulfate, or $NaSO_4$) are salts. Calcium chloride ($CaCl_2$),



Salt content

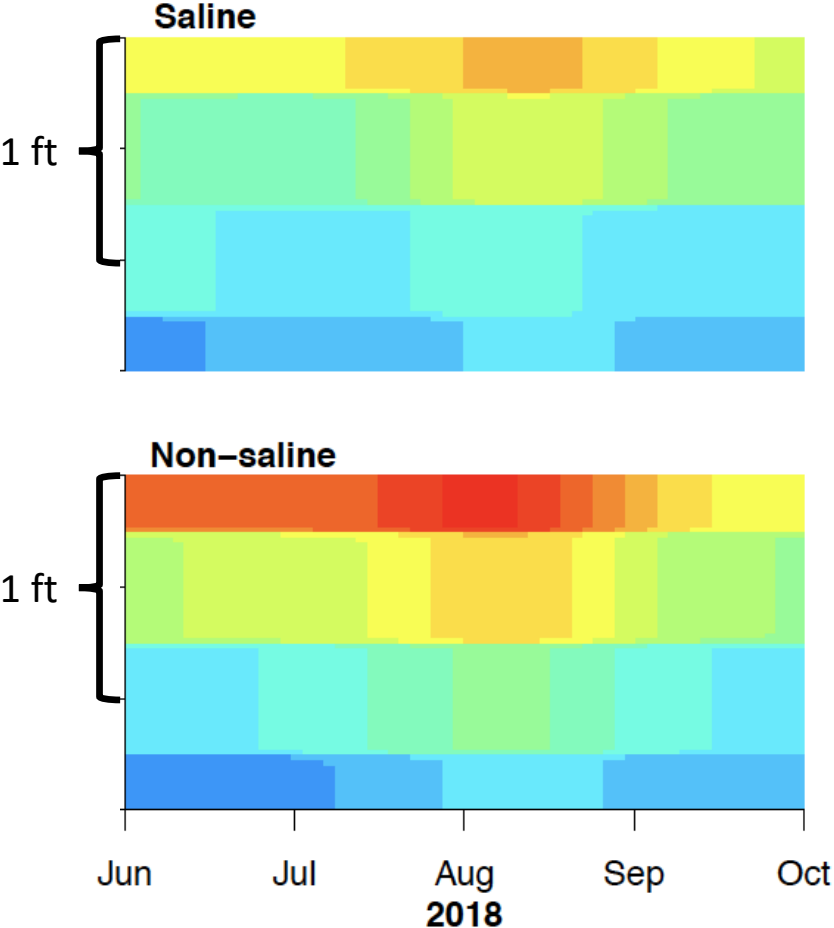
Crop productivity

In 3 years of the study, the cereal rye has not caused yield reduction for either corn or soybean.

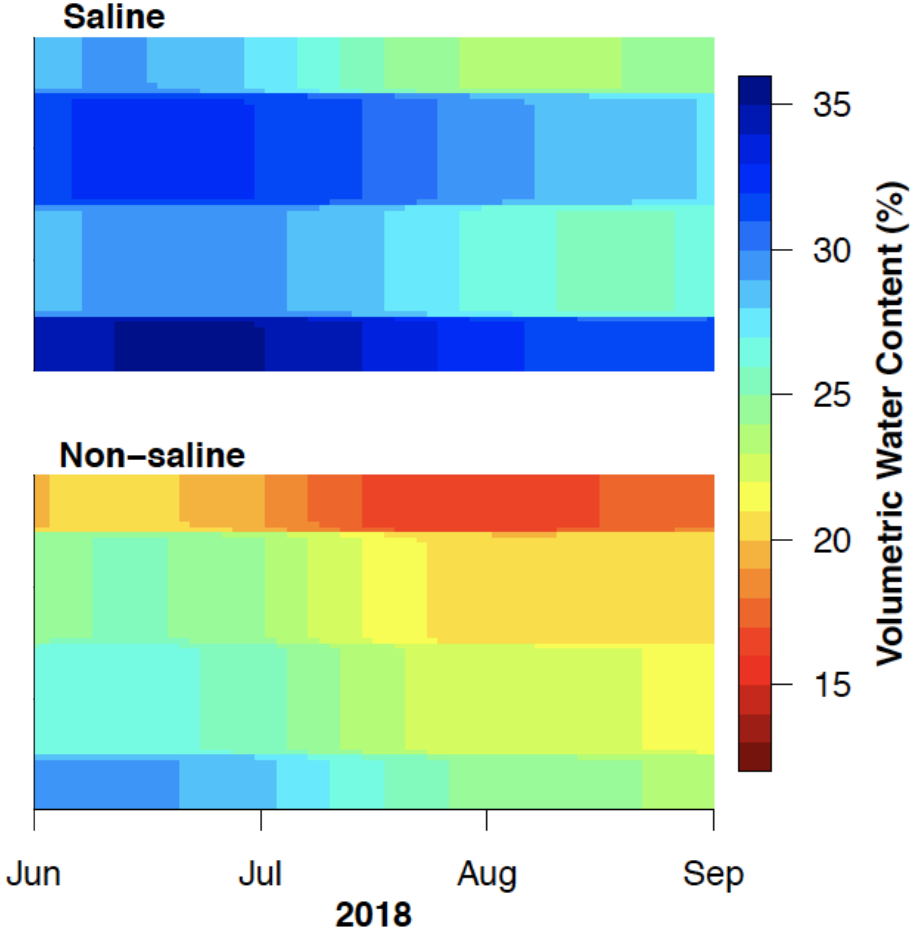


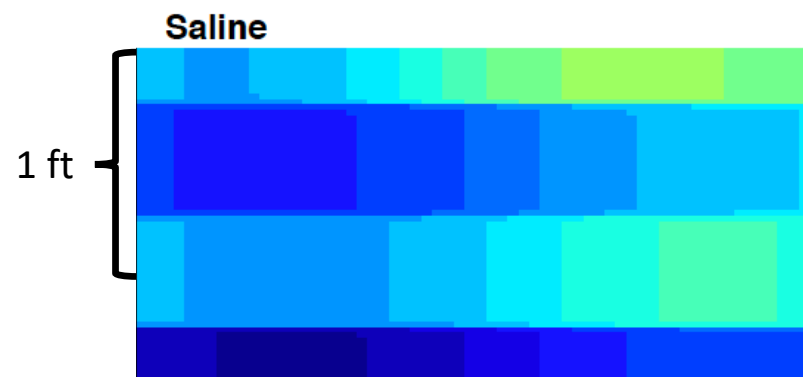
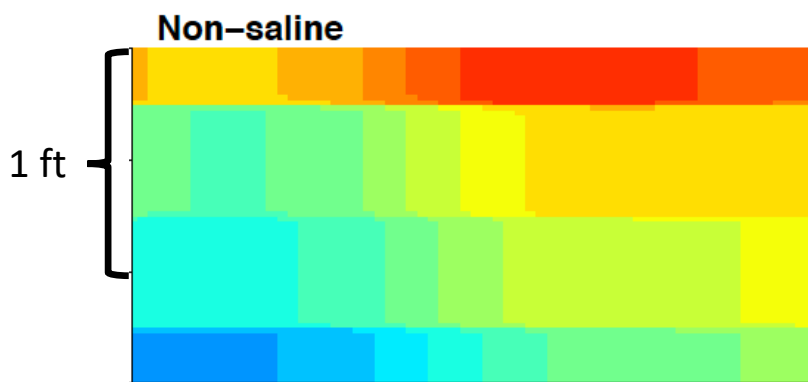
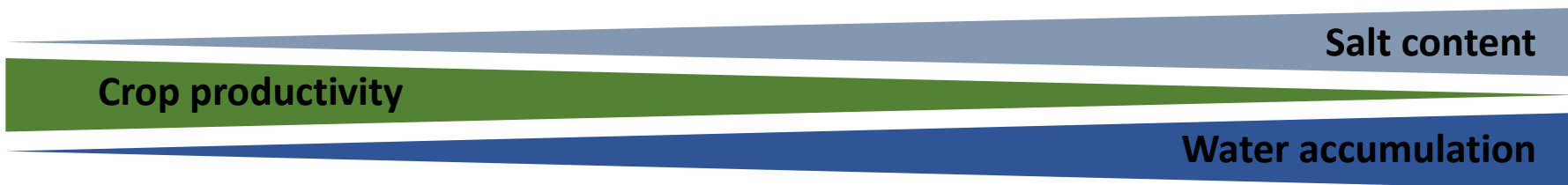
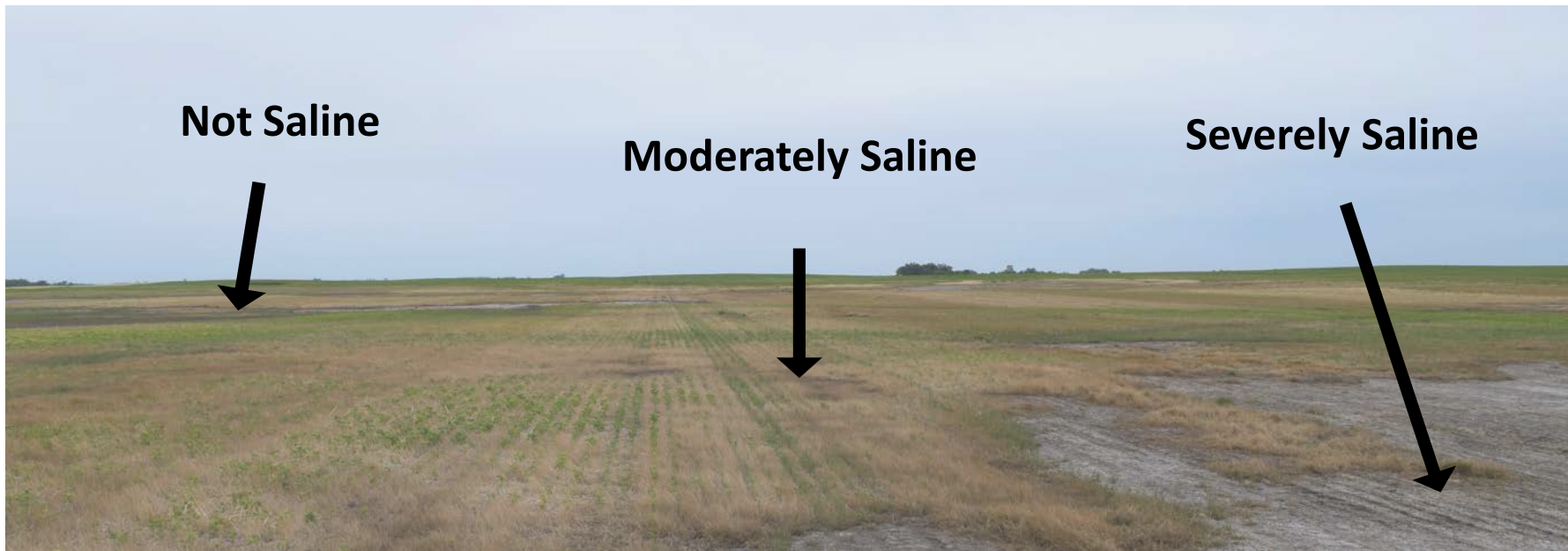
Saline soils hold more water for longer

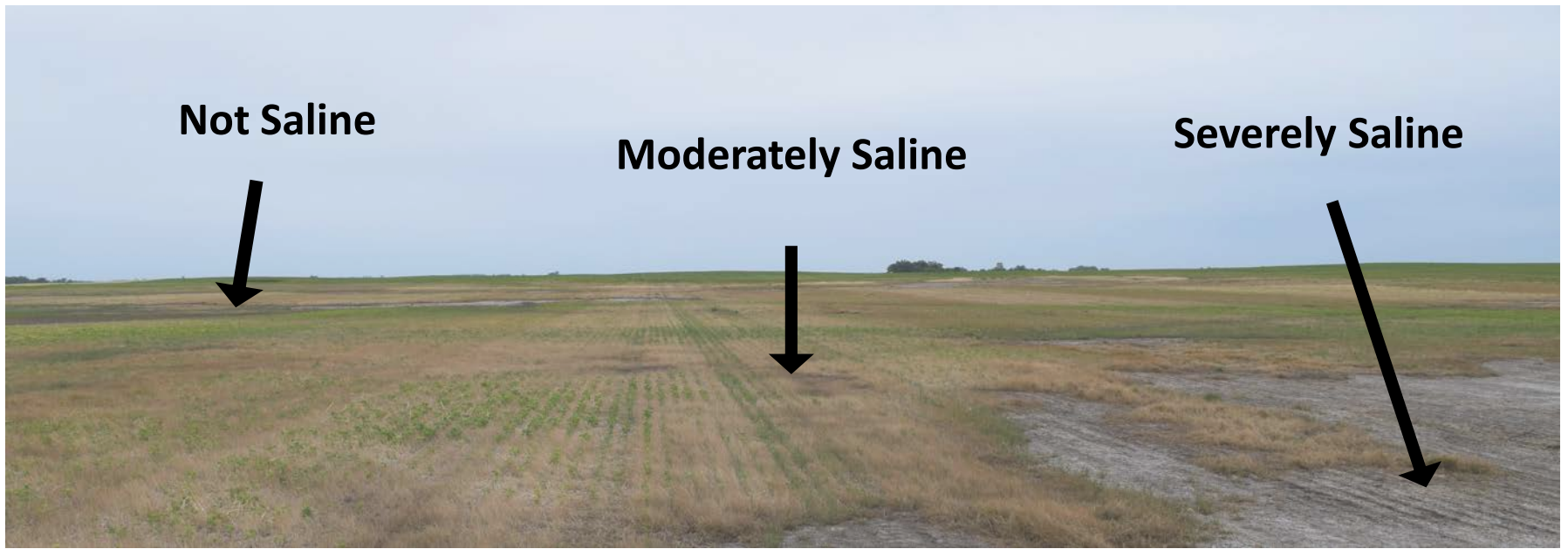
Soybean



Corn





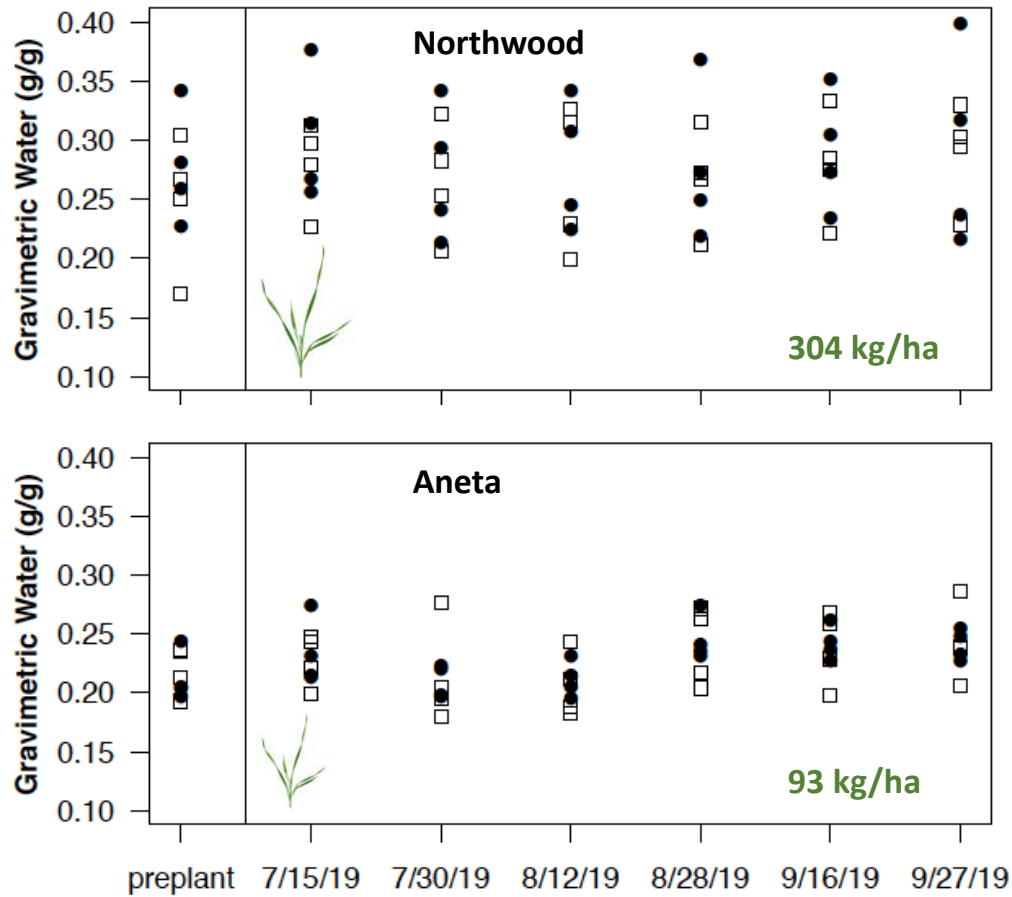


2017 & 2018: 40 lb/ac cereal rye broadcast
2019 & 2020: 80 lb/ac cereal rye broadcast

Does cereal rye dry out the soil?



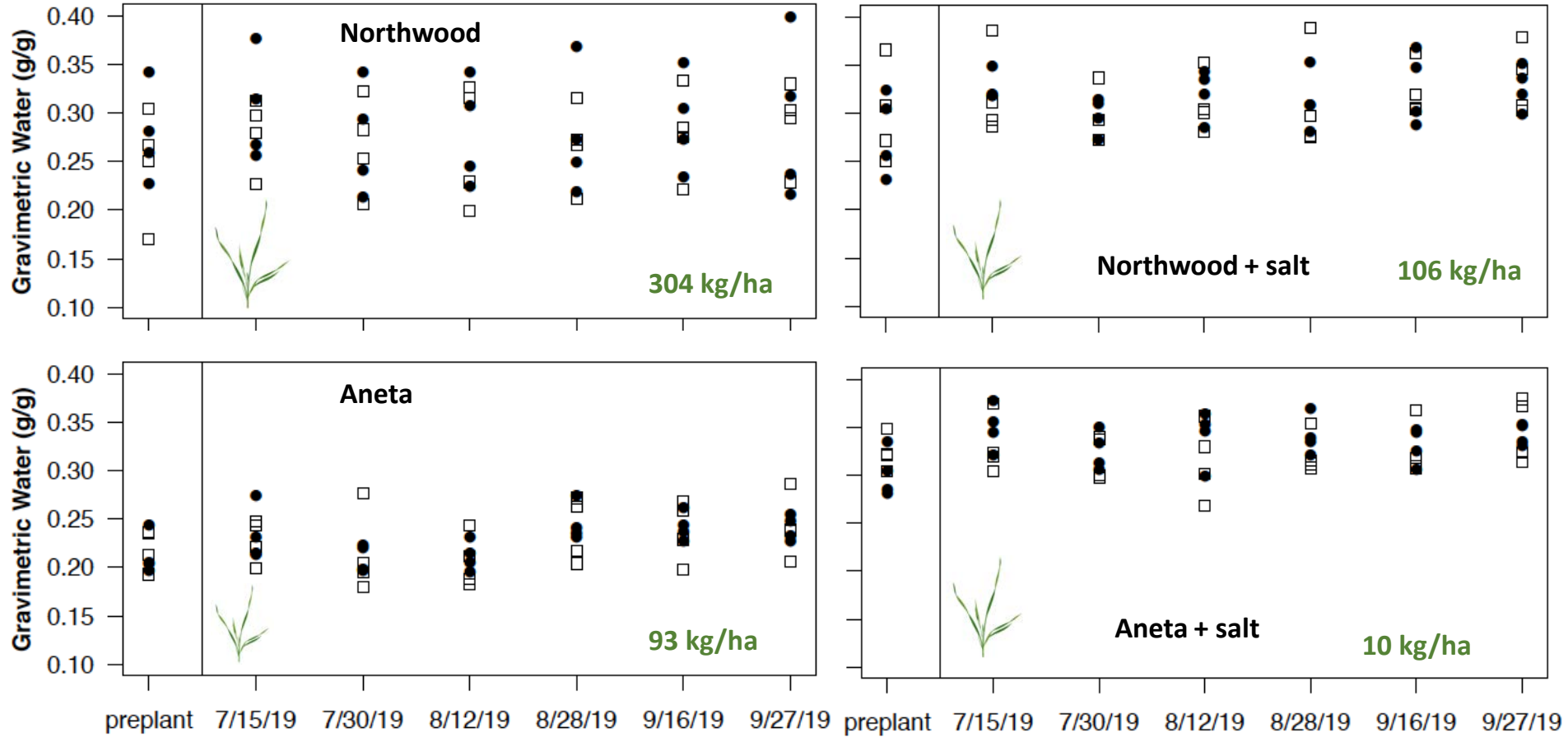
0-6" depth



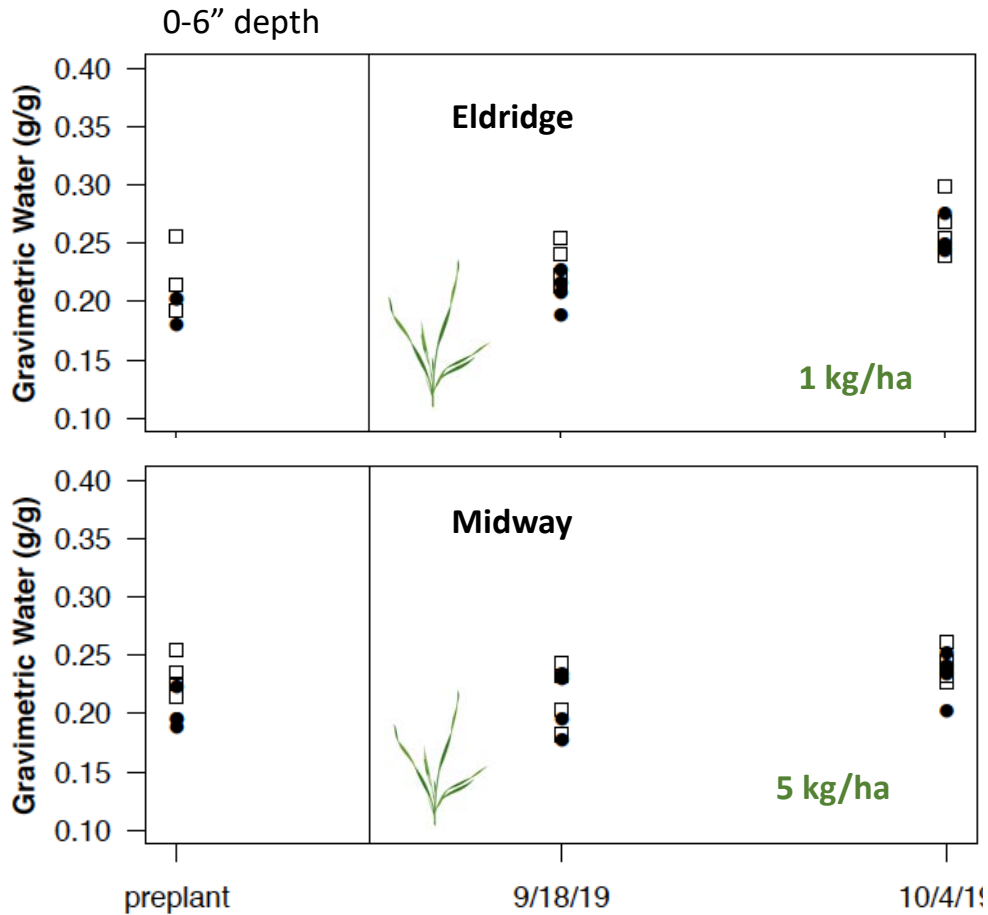
Does cereal rye dry out the soil?



0-6" depth

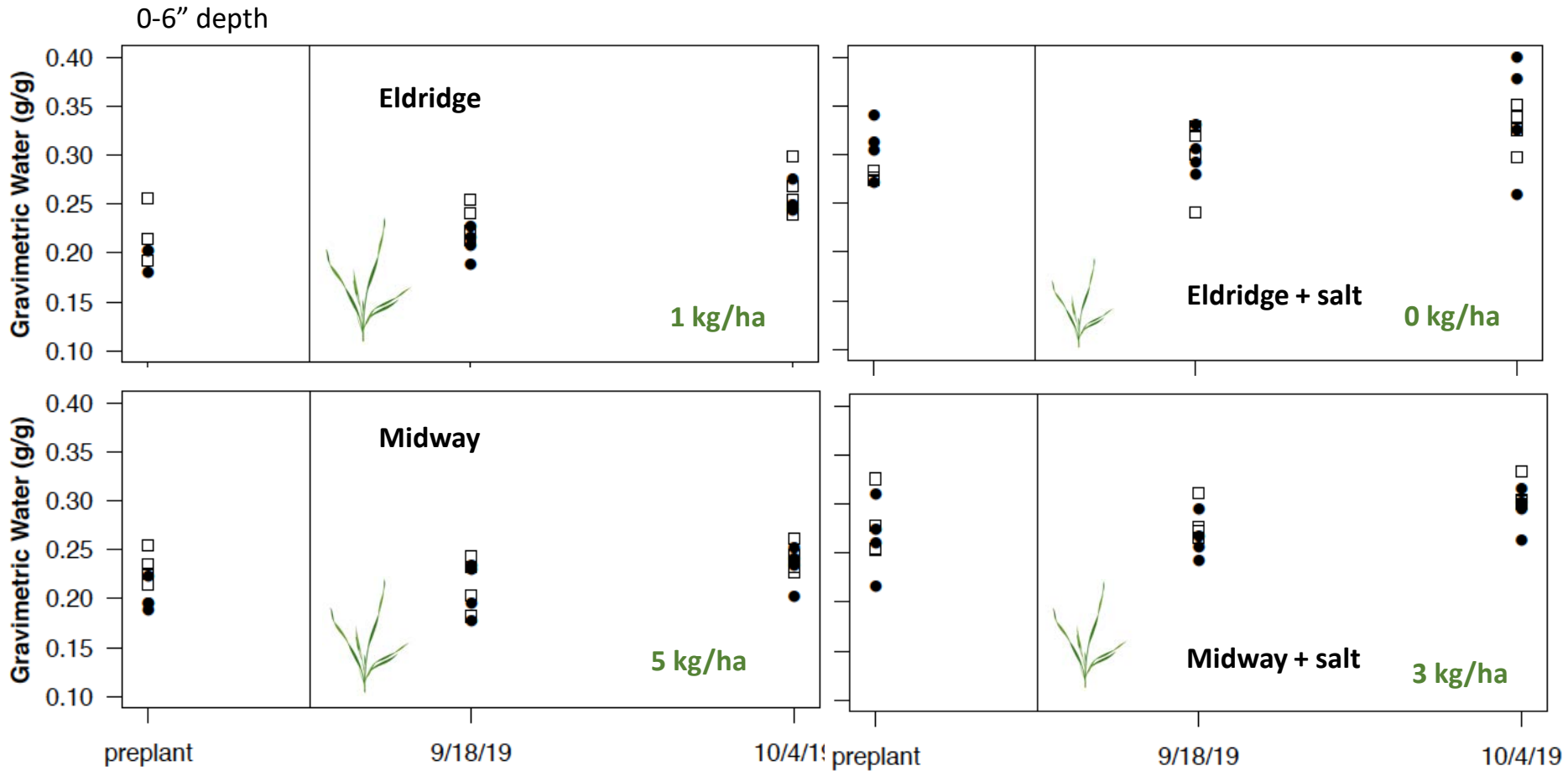


Does cereal rye dry out the soil?



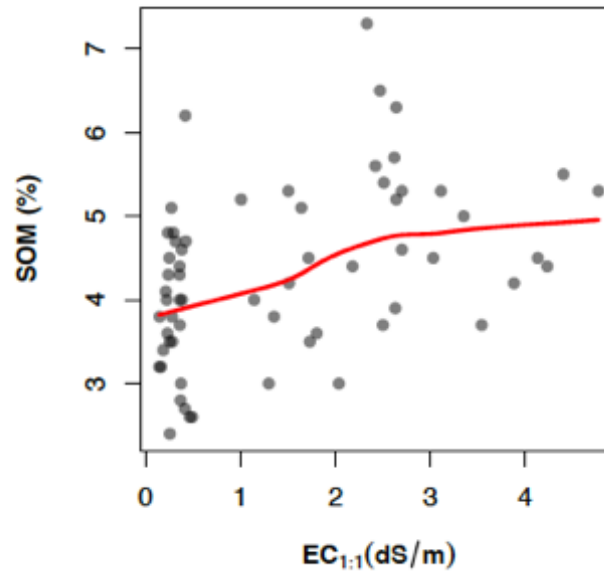
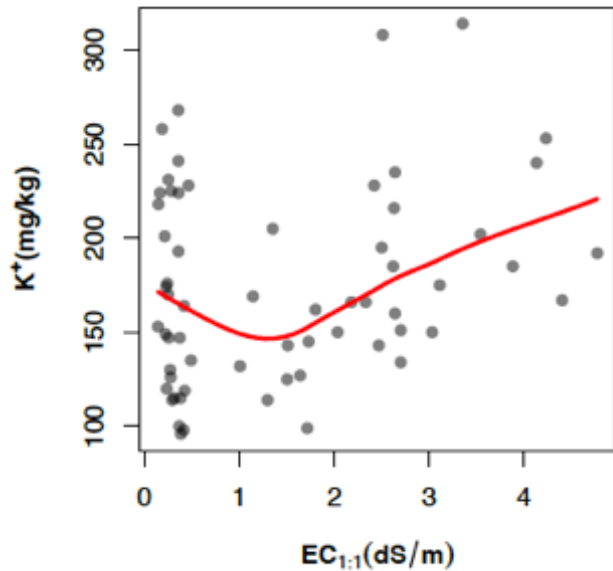
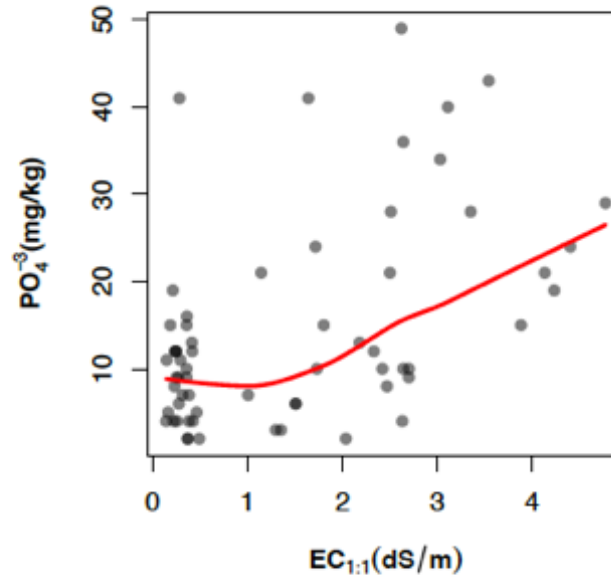
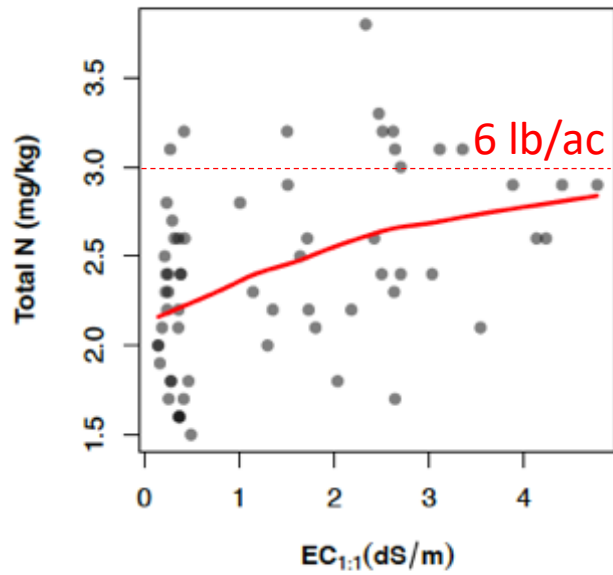
● No Cover □ Cereal Rye

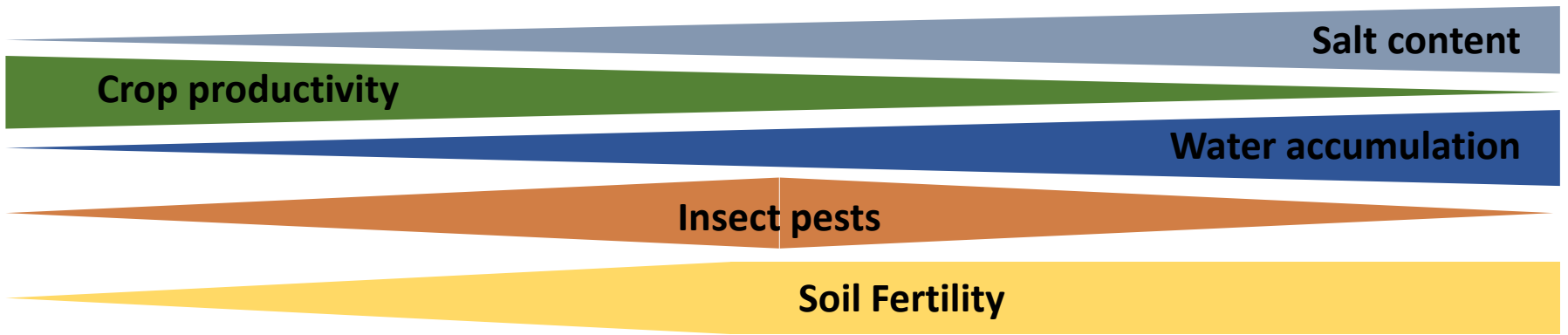
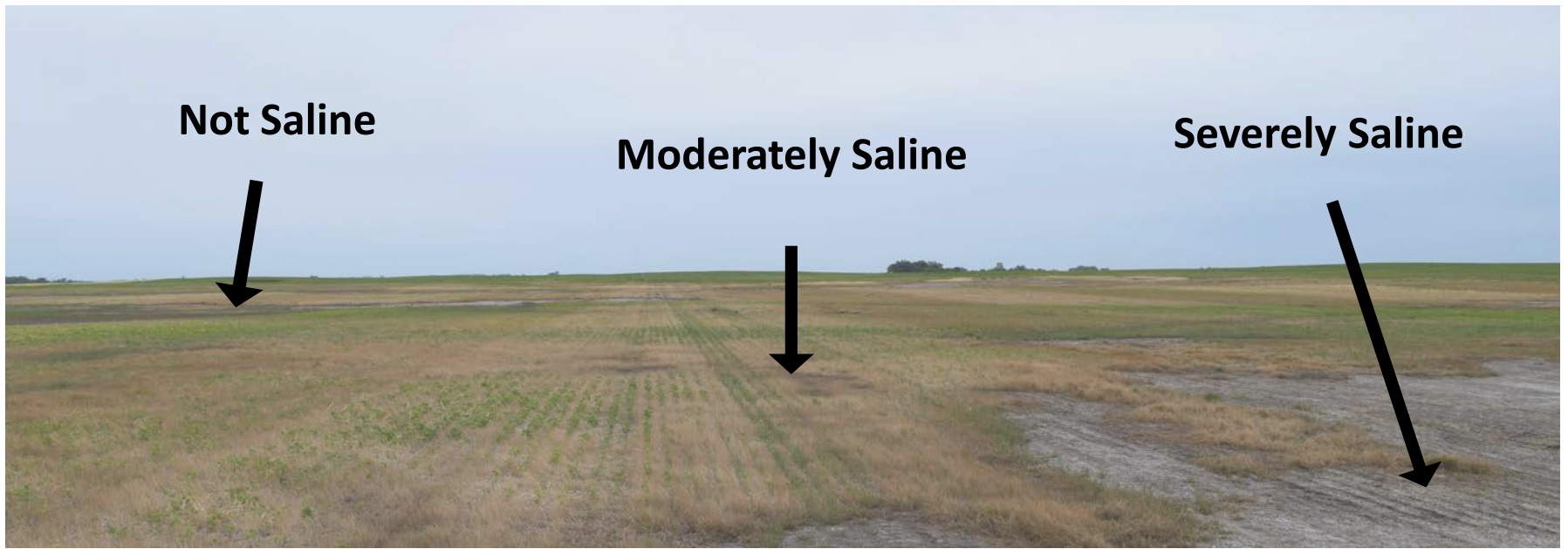
Does cereal rye dry out the soil?



● No Cover □ Cereal Rye

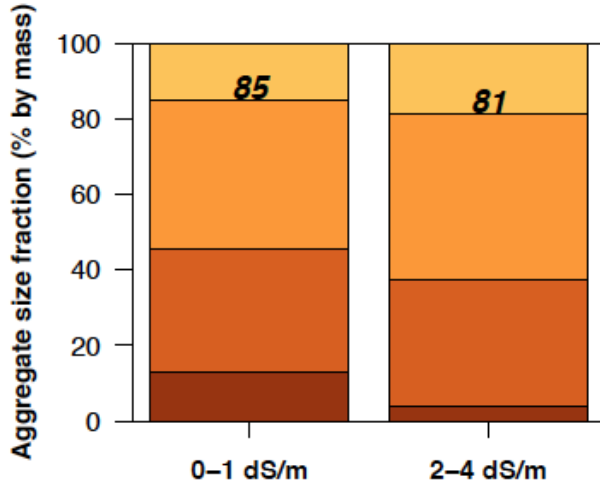
Saline soils have higher fertility (0-6")



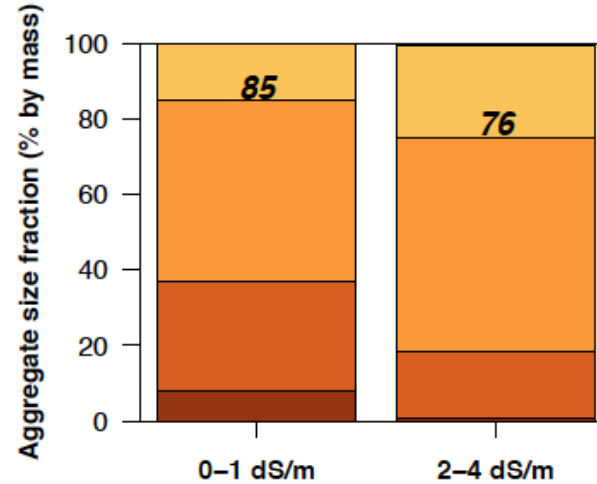


Saline soils do not have as much structure (0-6")

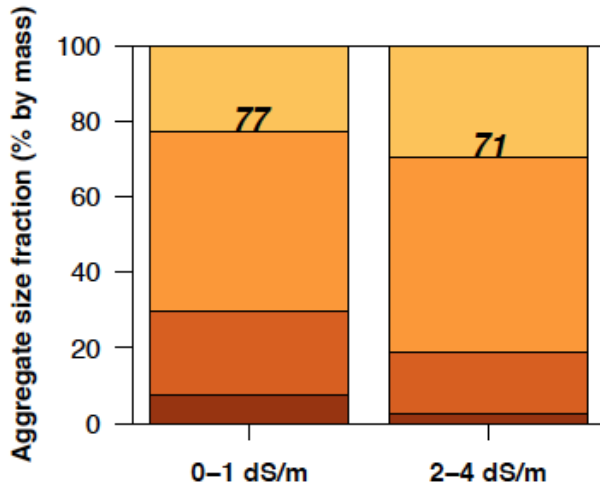
Aneta (0-6 in.)



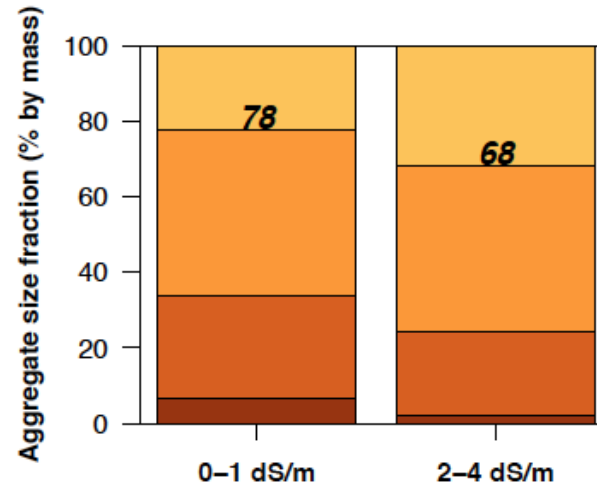
Eldridge (0-6 in.)



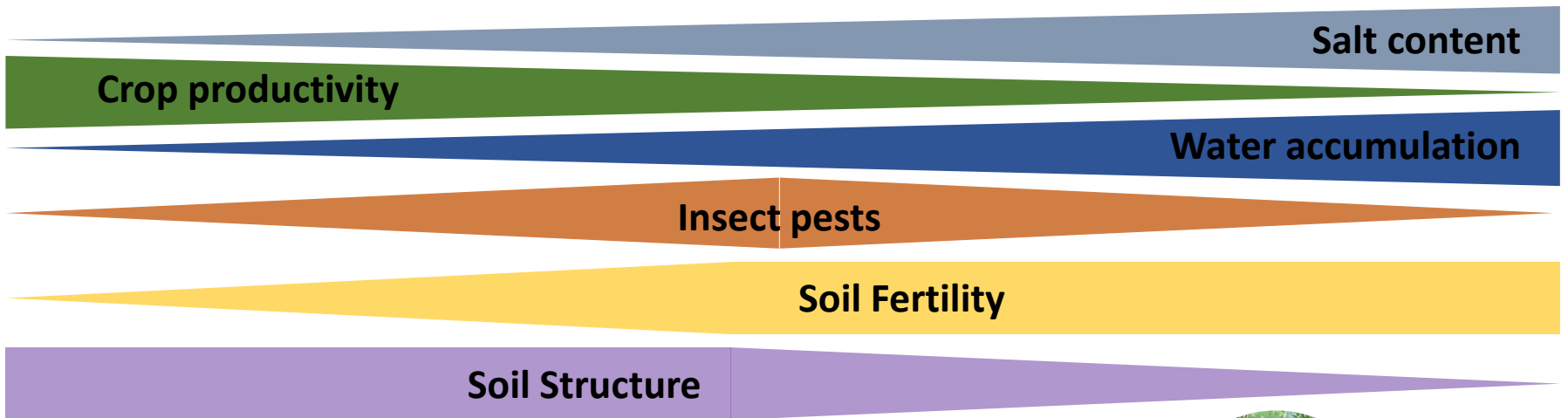
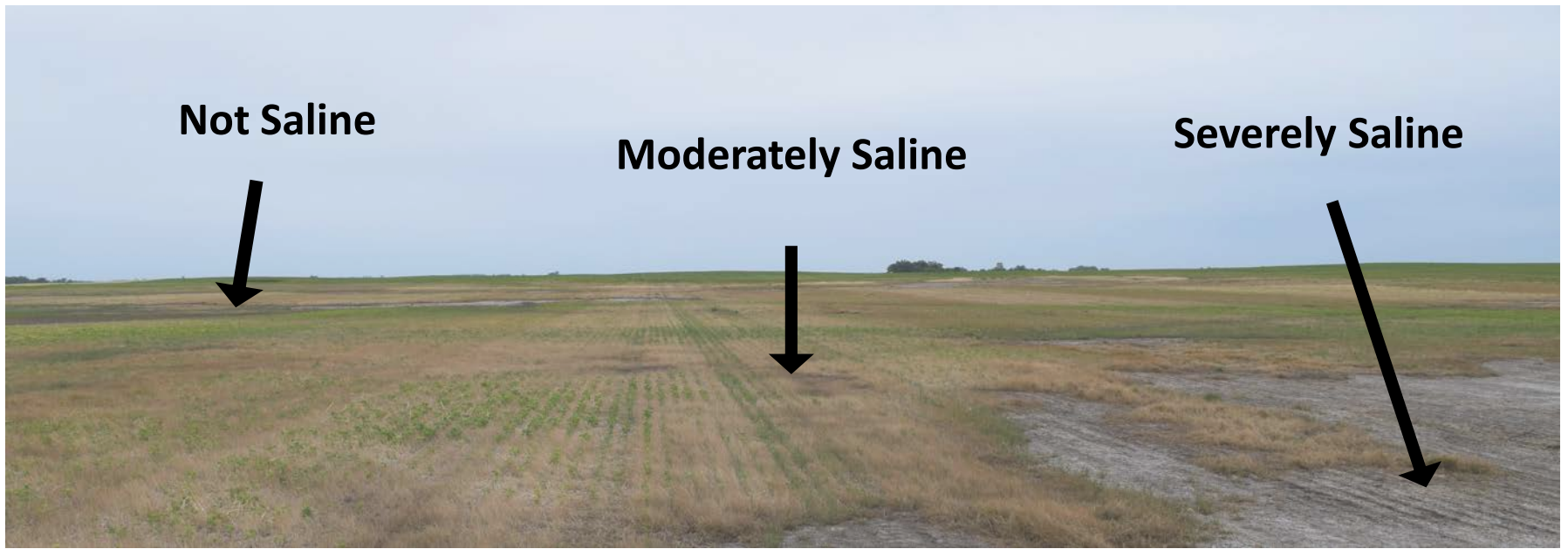
Midway (0-6 in.)



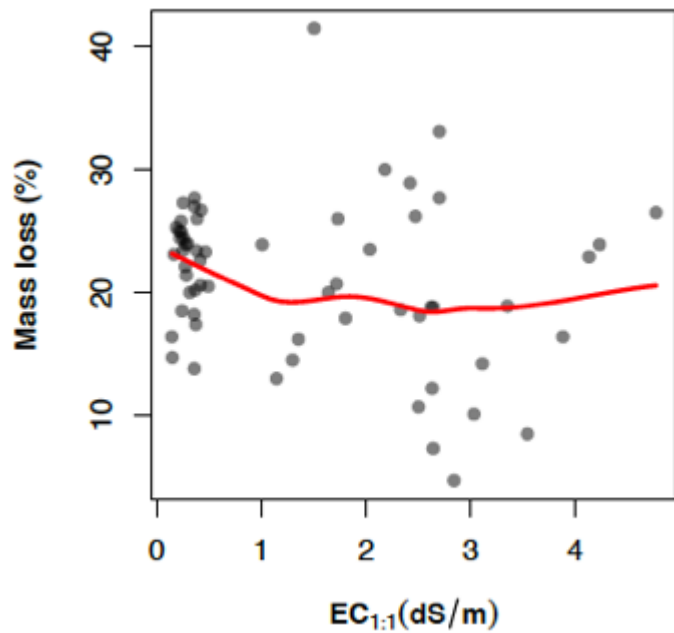
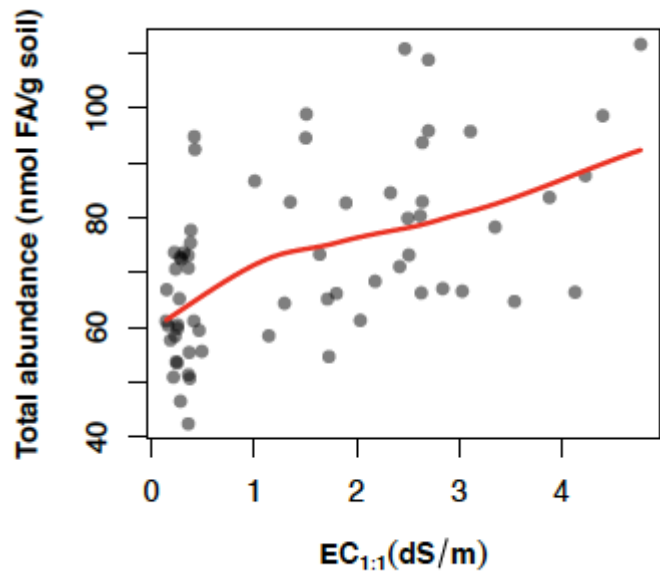
Northwood (0-6 in.)



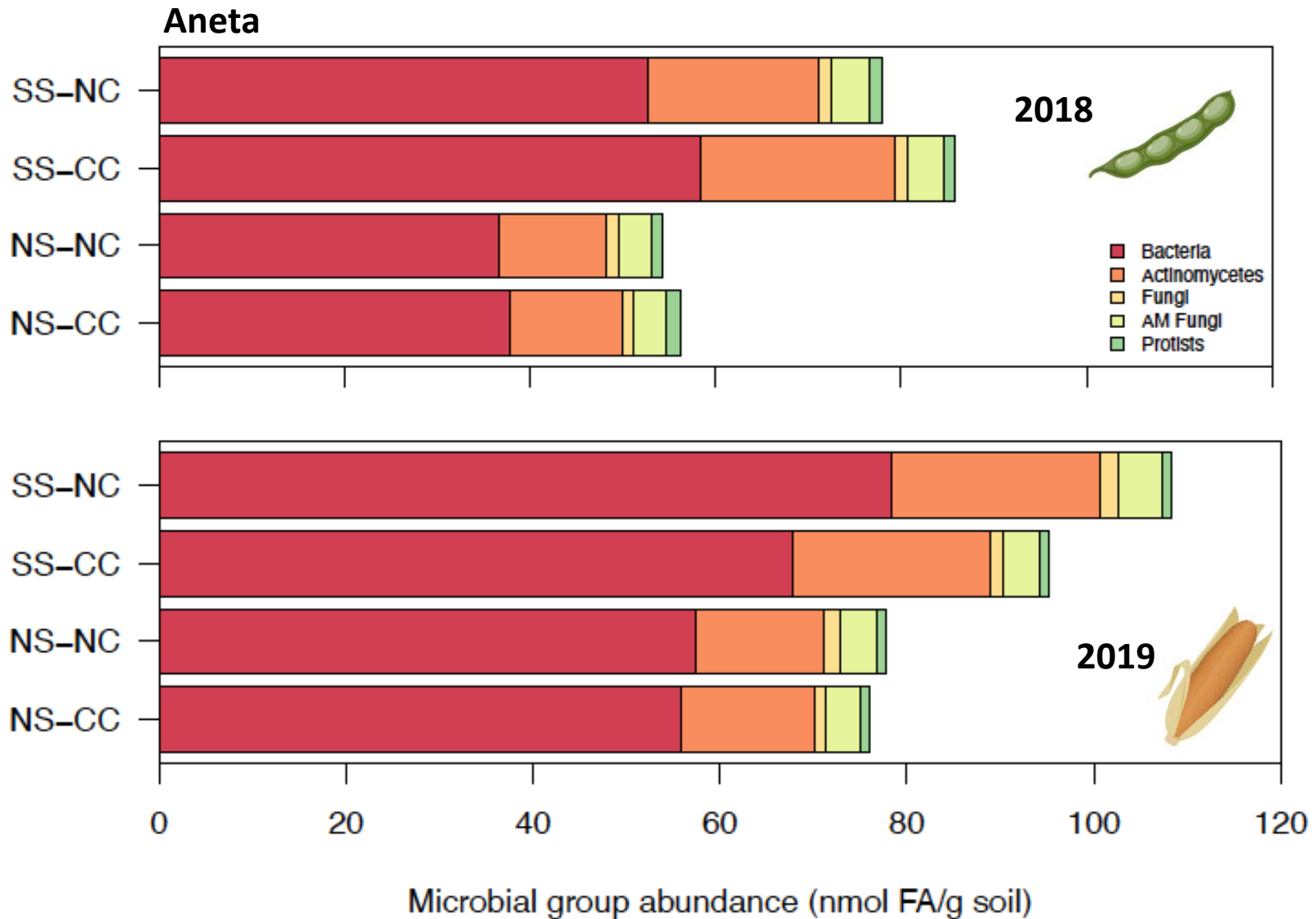
- > Macro
- Macro
- Micro
- Free particles

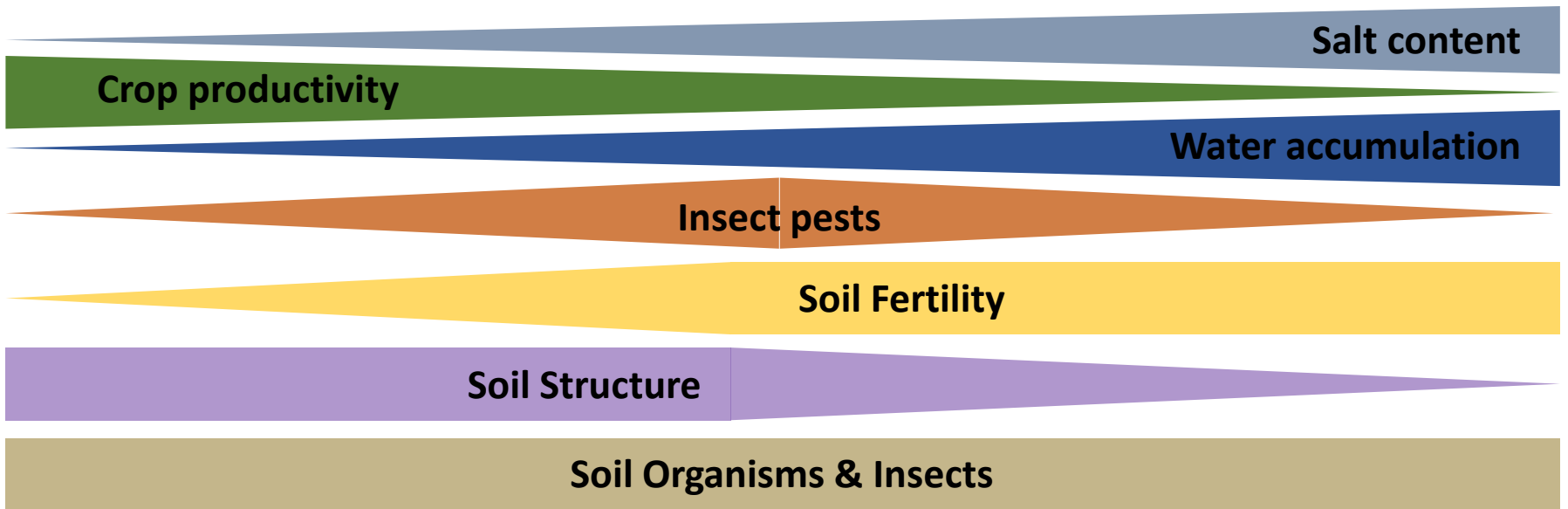


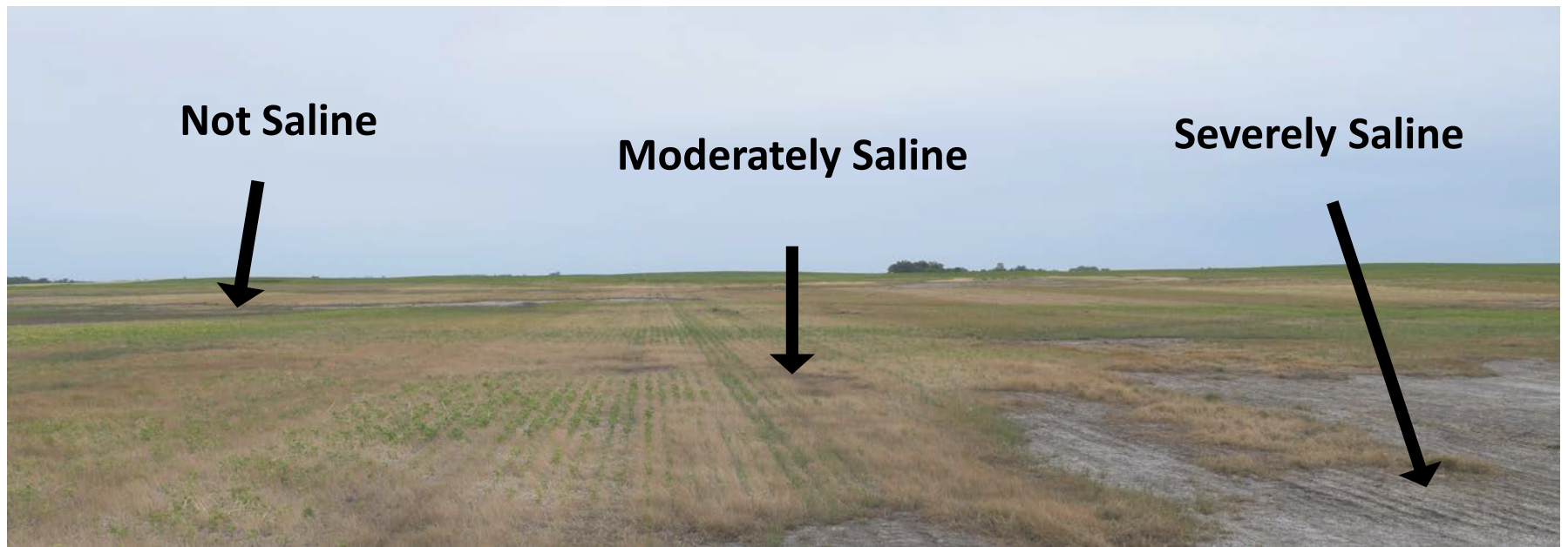
Saline soils are not dead!



Saline soils are not dead!







It isn't just about the salt...

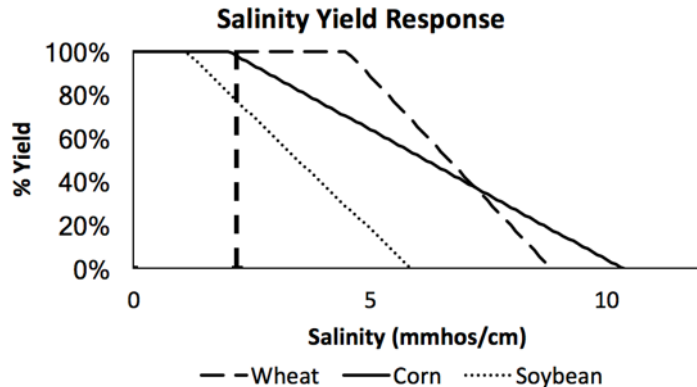
- Saline soils have chemical, physical, & biological differences than non-saline soils.
- How do these differences influence salinity management approaches?



- Left un-managed, salinity can spread and will continue to consume seed, fertilizer, and input costs – it reduces field-level profitability.
- This issue provides the perfect opportunity for zone management of salt-affected fields.

Salt economics

Dave Ripplinger



Salinity	2.2
Price of N (¢/lb)	43
N Credits	40

	<u>Baseline</u>		
	Corn	Soybean	Wheat
Price (adjustable)	\$3.30	\$8.18	\$5.71
Yield (adjustable)	145	48	58

	<u>Salinity-Adjusted</u>		
	Corn	Soybean	Wheat
Price	\$3.30	\$8.18	\$5.71
Yield	142	37	58
Revenue	\$467.02	\$301.94	\$331.18
Direct Costs	\$322.66	\$147.54	\$166.65
Cash Returns	\$144.36	\$154.40	\$164.53

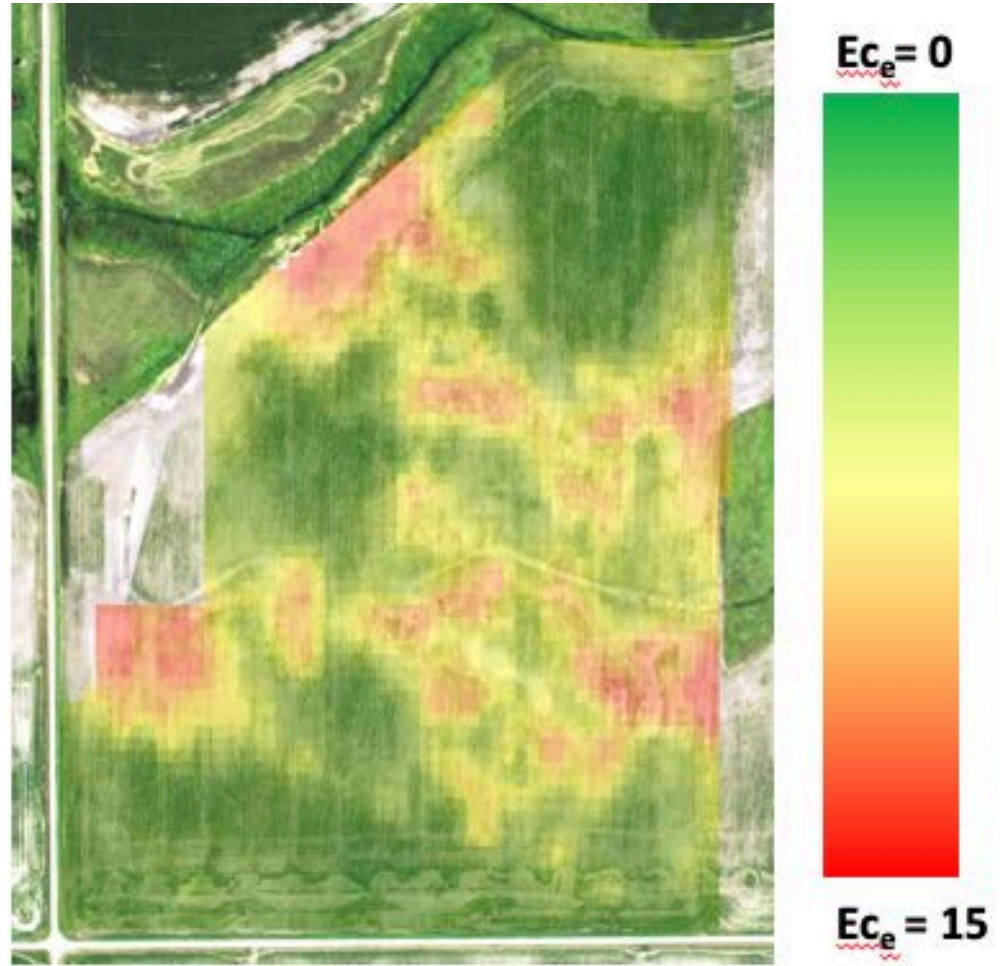
Other than Land	\$70.86	\$43.19	\$45.51
Land	\$95.00	\$95.00	\$95.00

Returns to Labor and Management	-\$21.50	\$16.21	\$24.02
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Gross N	150		185
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Access the tool: www.ag.ndsu.edu/bioeconomics/Library/tools/salinity-economics-tool/view

Salt economics



We applied the salinity-yield tool across each 10 m x 10 m grid cell of an electrical conductivity map (Veris cart + ground truth).

Salt economics

The tool estimates cash returns for each grid cell, for each crop.

From the output, we can calculate field-level profits and delineate zones based on cash returns

Corn



Area profit: 18 ha (57%)
Area loss: 14 ha (43%)
Area net return: \$86

Soybean



Area profit: 16 ha (50%)
Area loss: 16 ha (50%)
Area net return: \$1,895

Wheat



Area profit: 22 ha (70%)
Area loss: 10 ha (30%)
Area net return: \$3,047

Management of saline zones

1. **STOP** putting seed and fertilizer in un-productive areas.
2. Select salt-tolerant plants
3. Separate un-productive zones and begin remediation – use **plants** (& **pipes**) to move **water**

Tall wheatgrass

Slender wheatgrass

Western wheatgrass

Green wheatgrass (AC saltlander)

Russian wild rye

Alfalfa

Barley

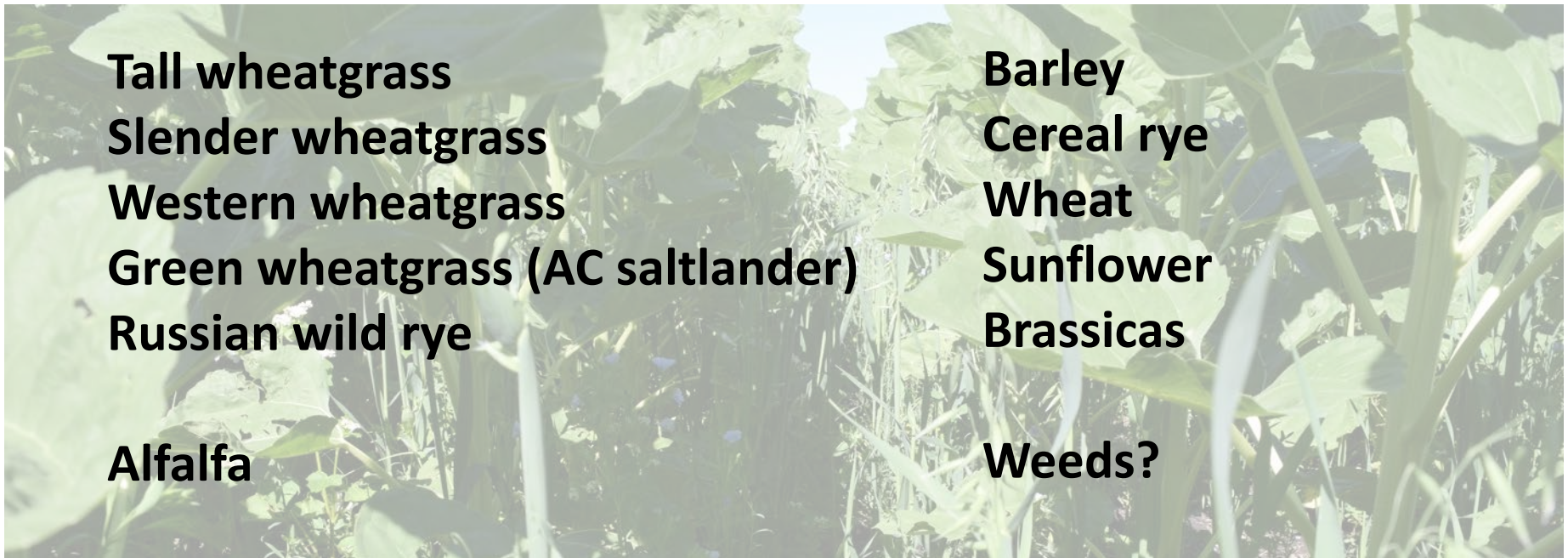
Cereal rye

Wheat

Sunflower

Brassicas

Weeds?





Funding:

ND Corn Council

ND Soybean Council

ND Department of Health

ND Agriculture Experiment Station

Farmer cooperators!

People:

Joel Bell

Jaclyn Eichele-Nelson

Brooke Rockentine

Alec Deschene

Mackenzie Ries

Rebecca Hebron

Kari Olson

Chandra Langseth

Luke Ressler

Nate Derby

Jason Harmon

Tom DeSutter

Abbey Wick

Dave Ripplinger

Erik Hanson

Salinity Improves Performance and Alters Distribution of Soybean Aphids

Jaclyn Eichele-Nelson,¹ Thomas DeSutter,² Abbey F. Wick,² Erin L. Harmon,¹ and Jason P. Harmon^{1,3}

¹Department of Entomology, North Dakota State University, NDSU Dept. 7650, PO Box 6050, Fargo, ND 58108-6050, ²Department of Soil Science, North Dakota State University, NDSU Dept. 7680, PO Box 6050, Fargo, ND 58108-6050, and ³Corresponding author, e-mail: jason.harmon@ndsu.edu



Subject Editor: Christopher

Received 15 February 2018; Edit

The Effects of Salinity on the Herbivorous Crop Pest *Tetranychus urticae* (Trombidiformes: Tetranychidae) on Soybean and Corn

Jaclyn L. Eichele-Nelson,¹ Abbey F. Wick, Thomas M. DeSutter, and Jason P. Harmon

Department of Entomology, North Dakota State University, 1300 Albrecht Blvd, Fargo, ND 58102 (jaclyn.eichele@ndsu.edu; Abbey.Wick@ndsu.edu; Thomas.DeSutter@ndsu.edu; jason.harmon@ndsu.edu), and ¹Corresponding author, e-mail: Jaclyn.Eichele@ndsu.edu

Subject Editor: Yasmin Cardoza

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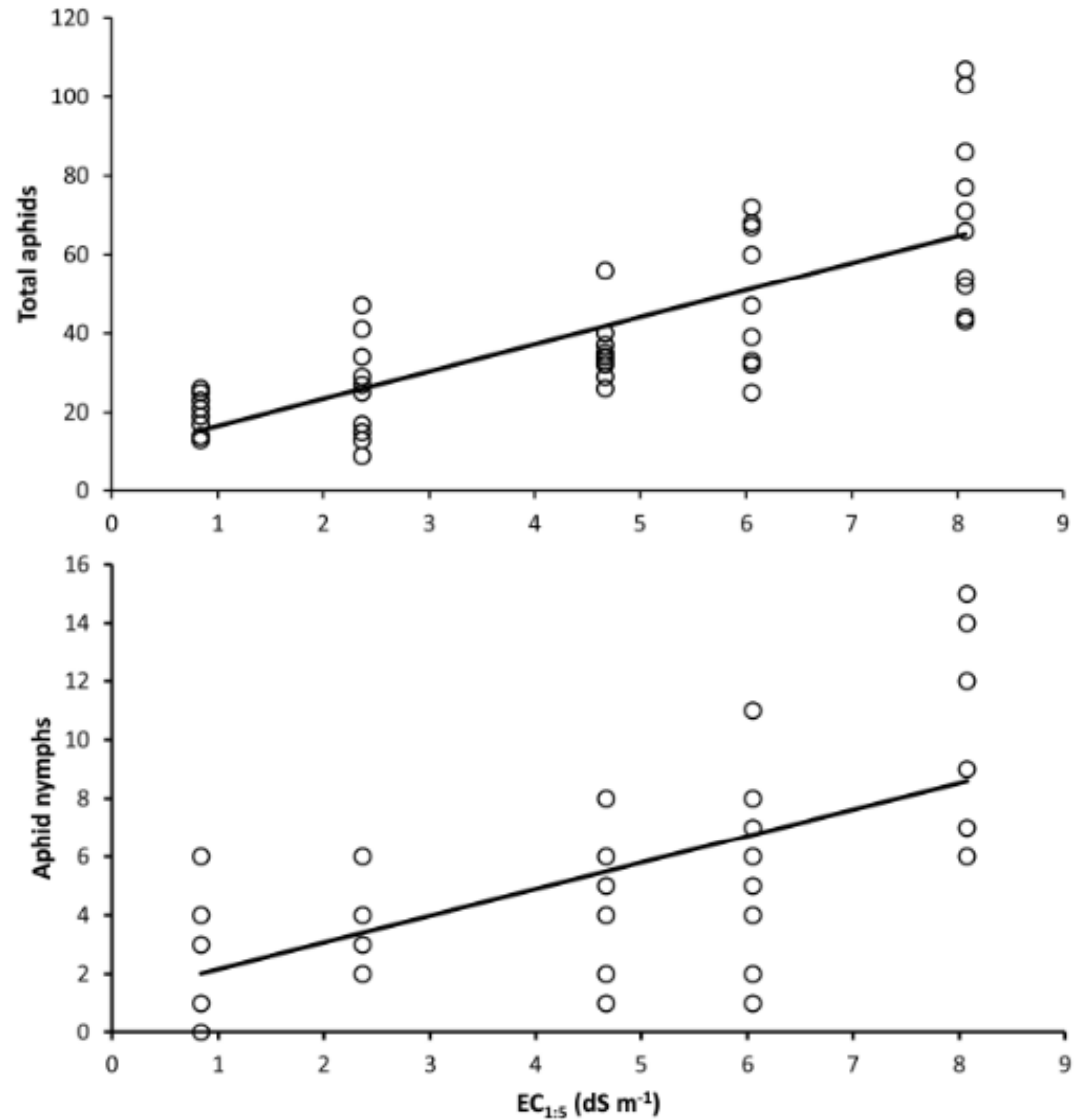




Soybean Aphids

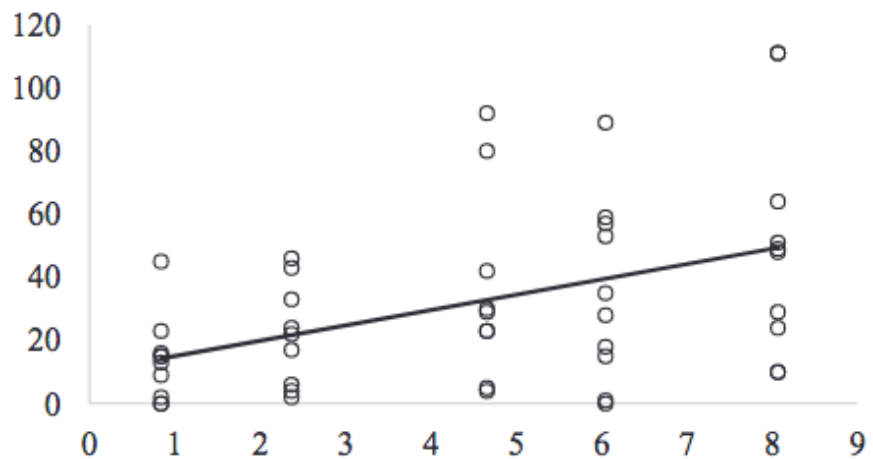
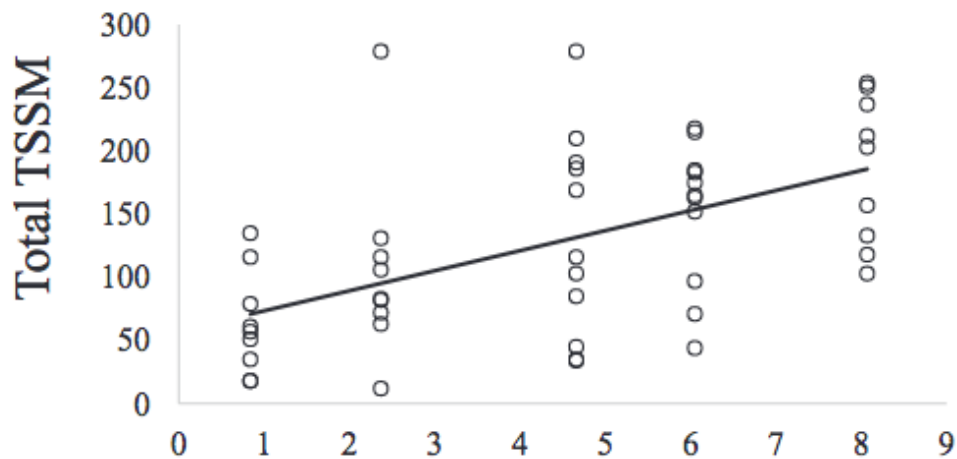
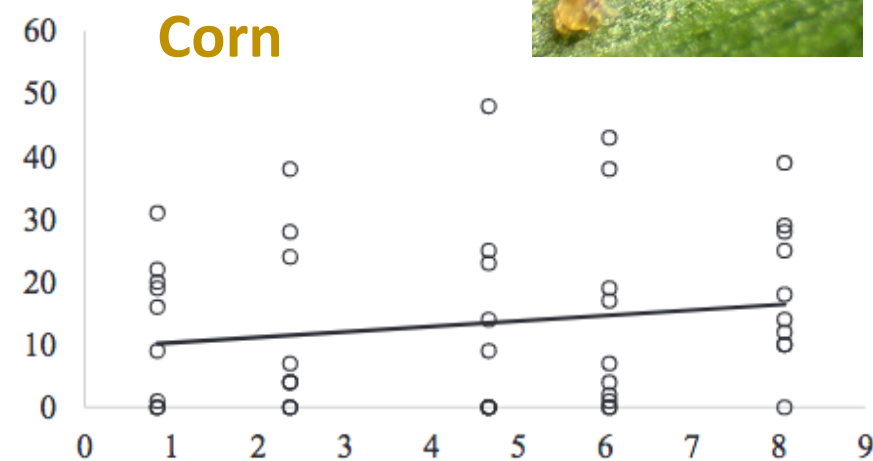
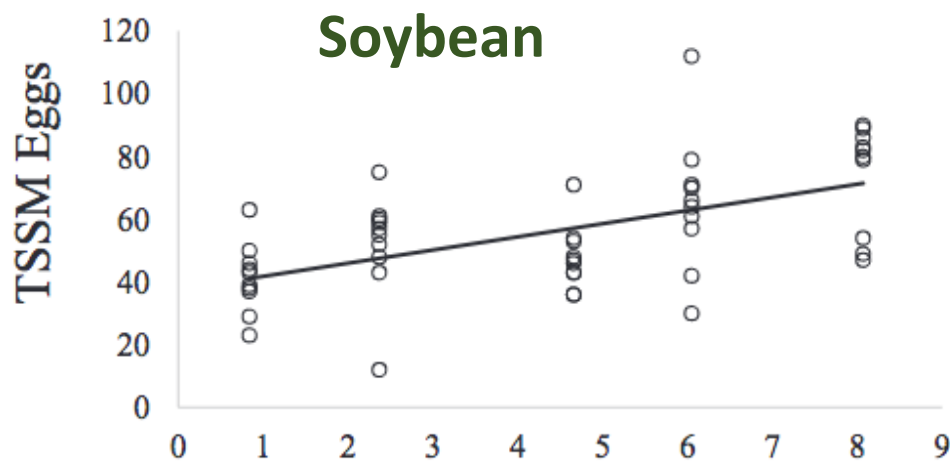
Pot experiments

- Population growth
- Fecundity (3 days)
- Lifetime fecundity (47 days)
- Plant choice

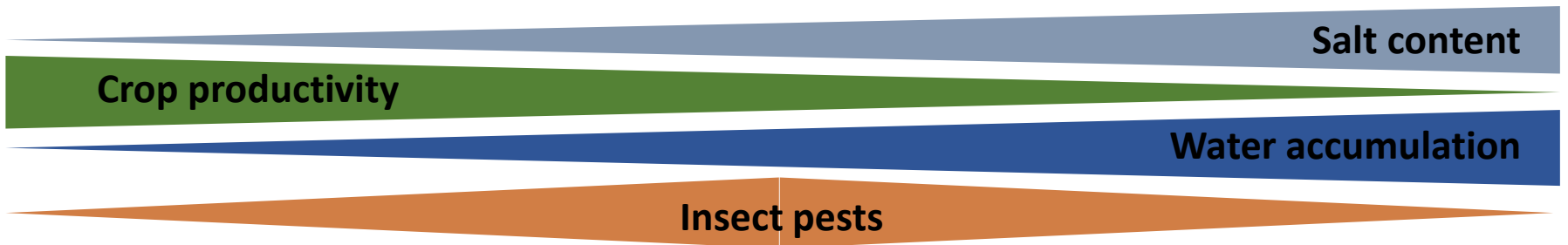
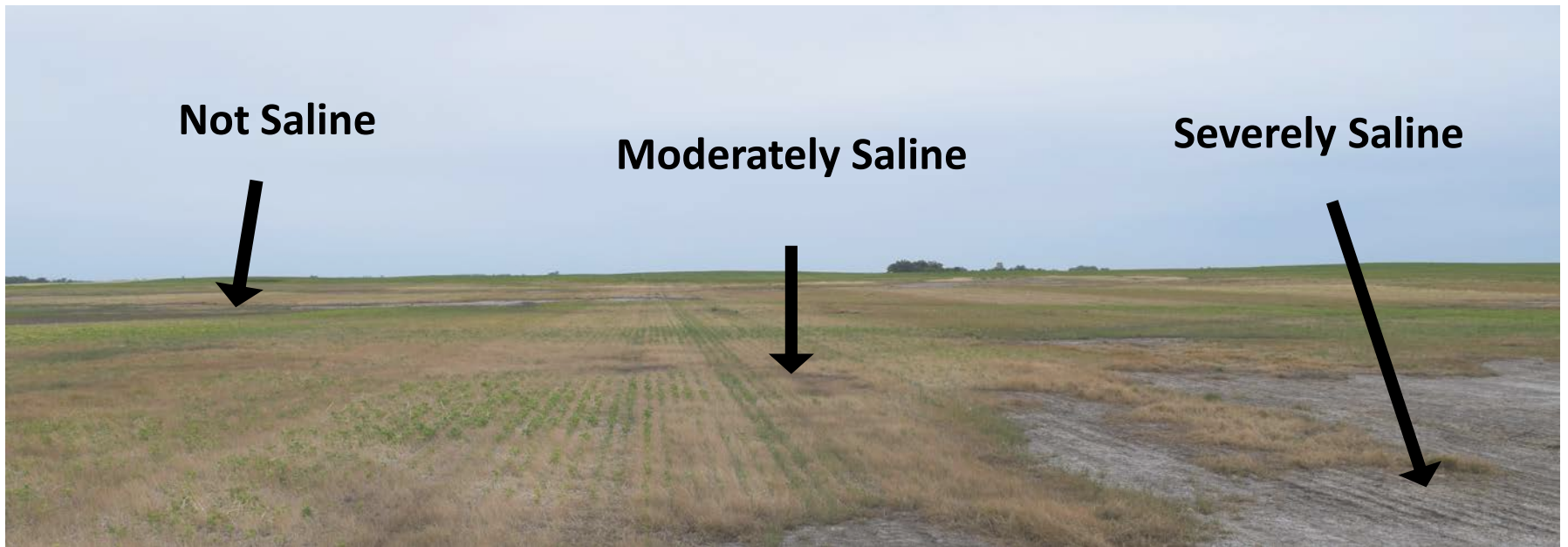


(Eichele-Nelson et al., 2018. *Environmental Entomology*, 47: 875)

Twospotted Spider mite

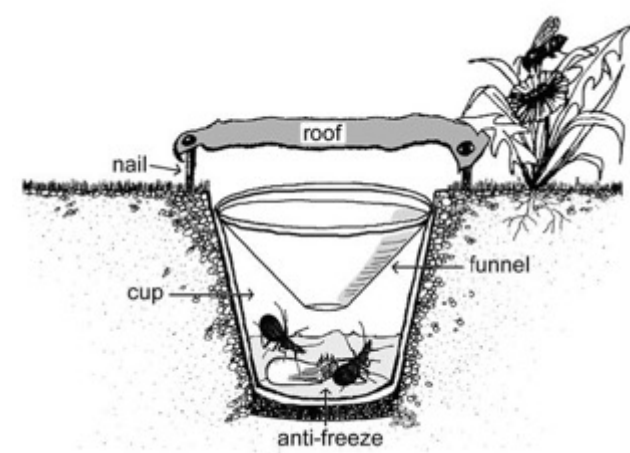


EC_{1.5} (dS m⁻¹)



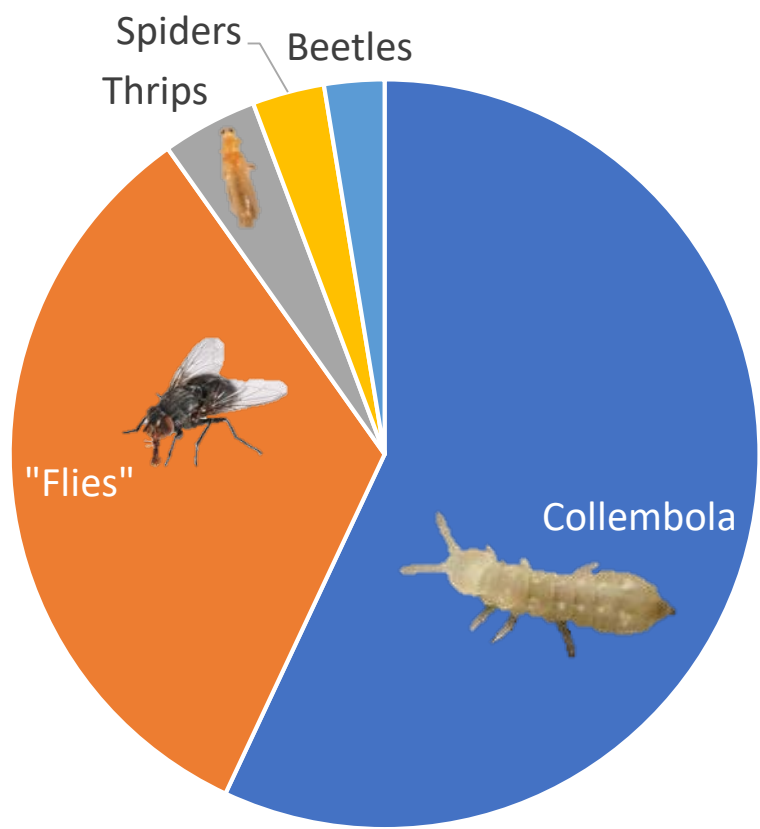
How do insect groups respond to cereal rye?

Jason Harmon, Brooke Rockentine

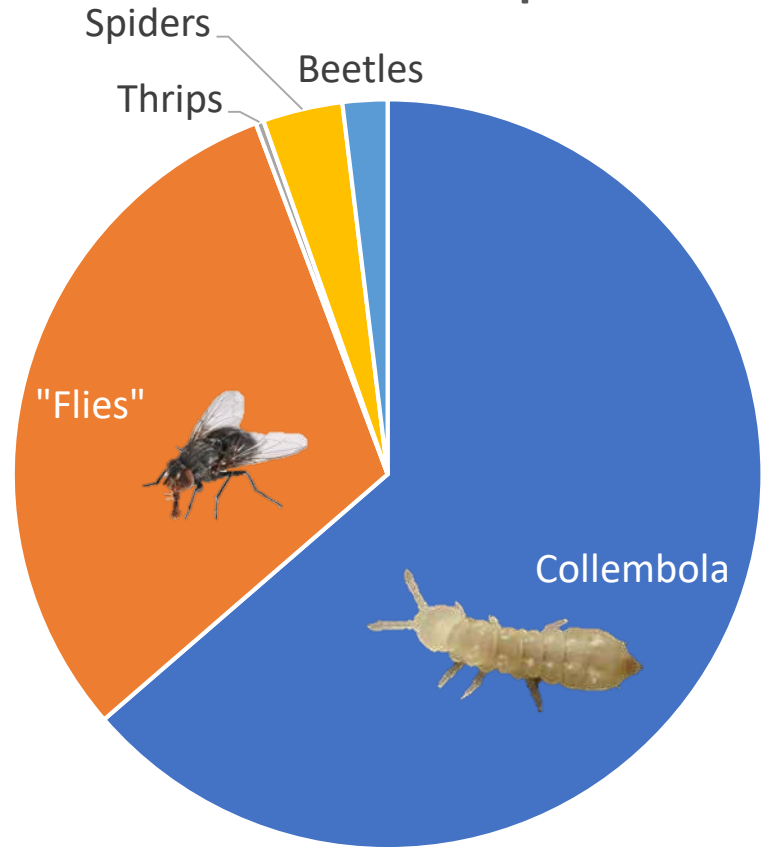


aphidsrus.wordpress.com

Cover Crop

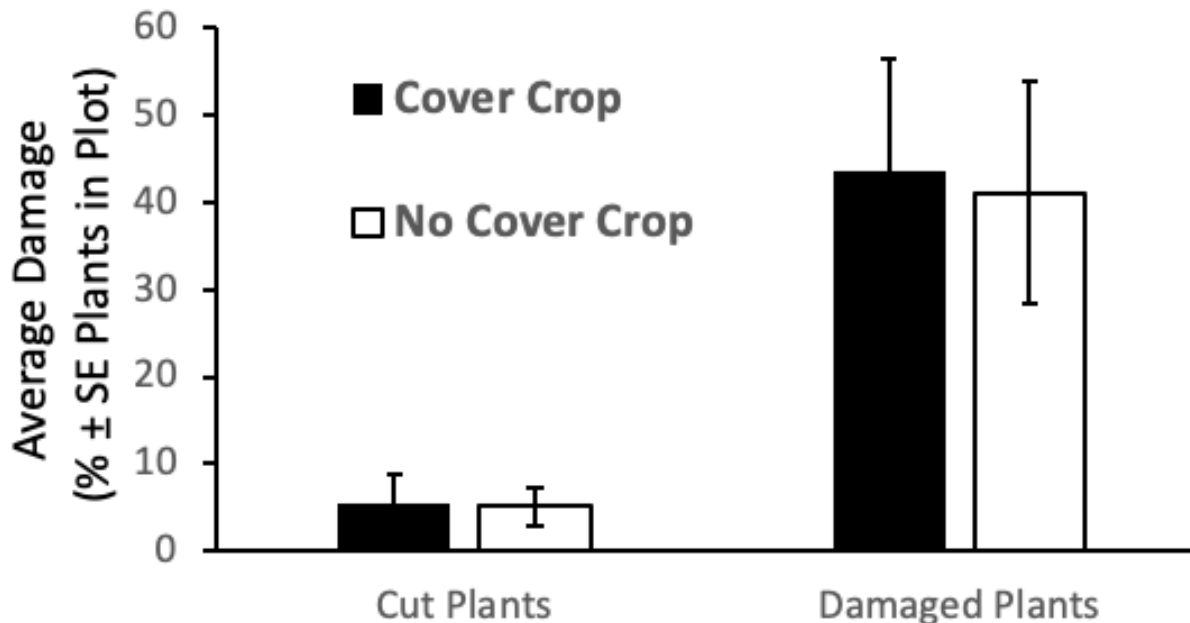


No Cover Crop

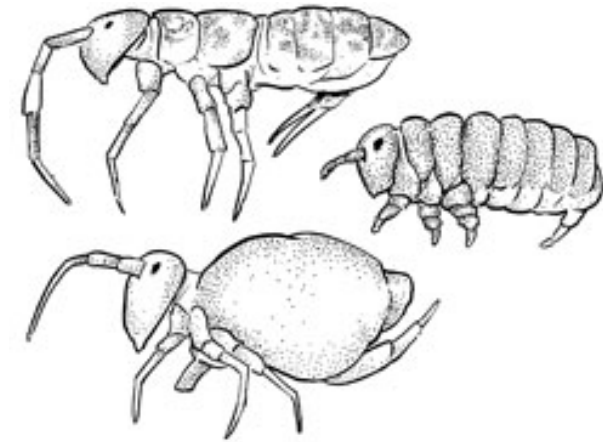


2018 cutworm surveys

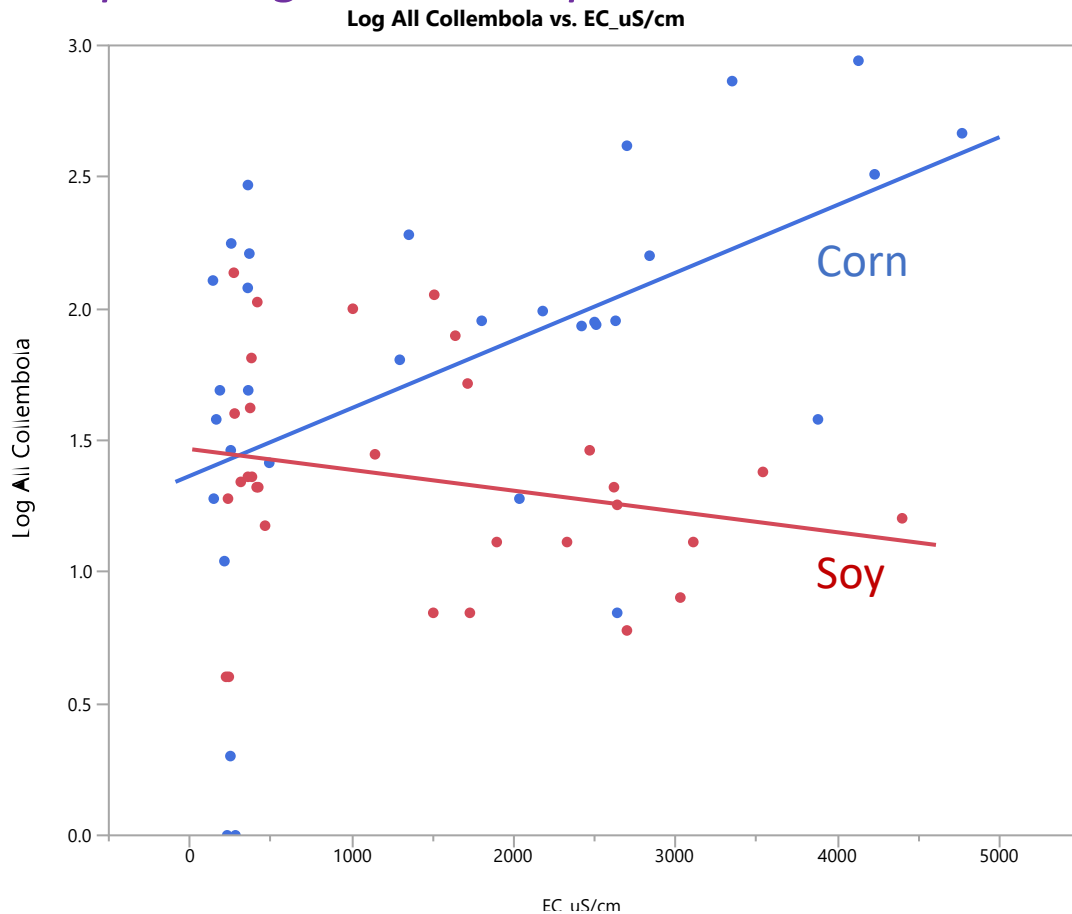
- 3 of our 4 fields had little evidence of cutworms
- One soybean field had more signs of damage (53 damaged plants and 9 cut off plants out of 135)
- However, no differences seen in cover crop plots vs no cover crop plots (also no effect of salinity)



How does salinity modify collembola & the food web?



Collembola respond to salinity, but differently depending on the crop.



Jason Harmon, NDSU
Brooke Rockentine