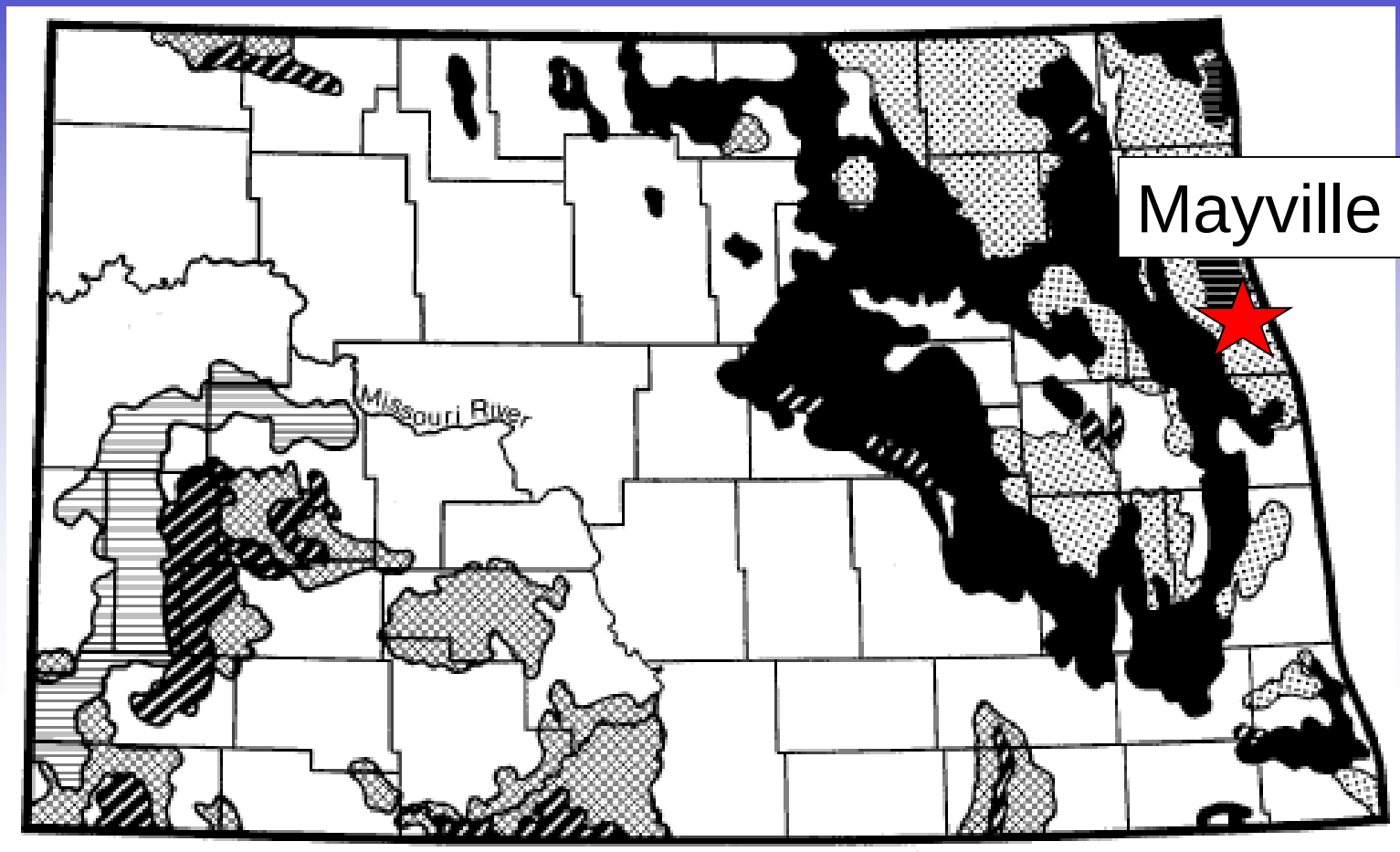
Saline/Sodic Soil Demonstration Project 2009 – 2015

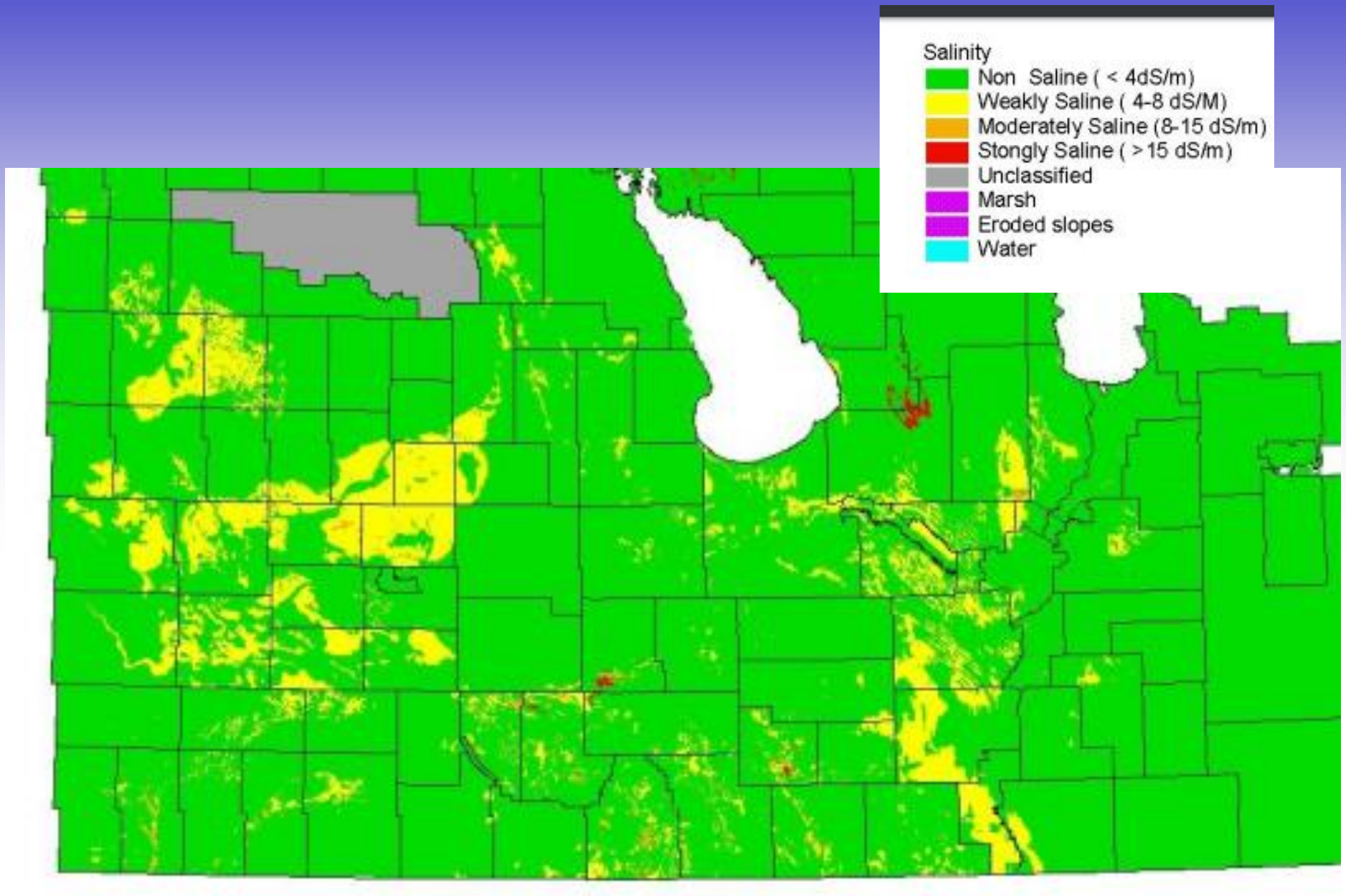
- Tile Drained - 2007
  - Most Acres : Low salt and low sodium
  - Some acres: Saline (High salt) and low sodium
  - Some acres: Saline (High salts) and Sodic (High sodium)

Saline and Sodic Soils in North Dakota

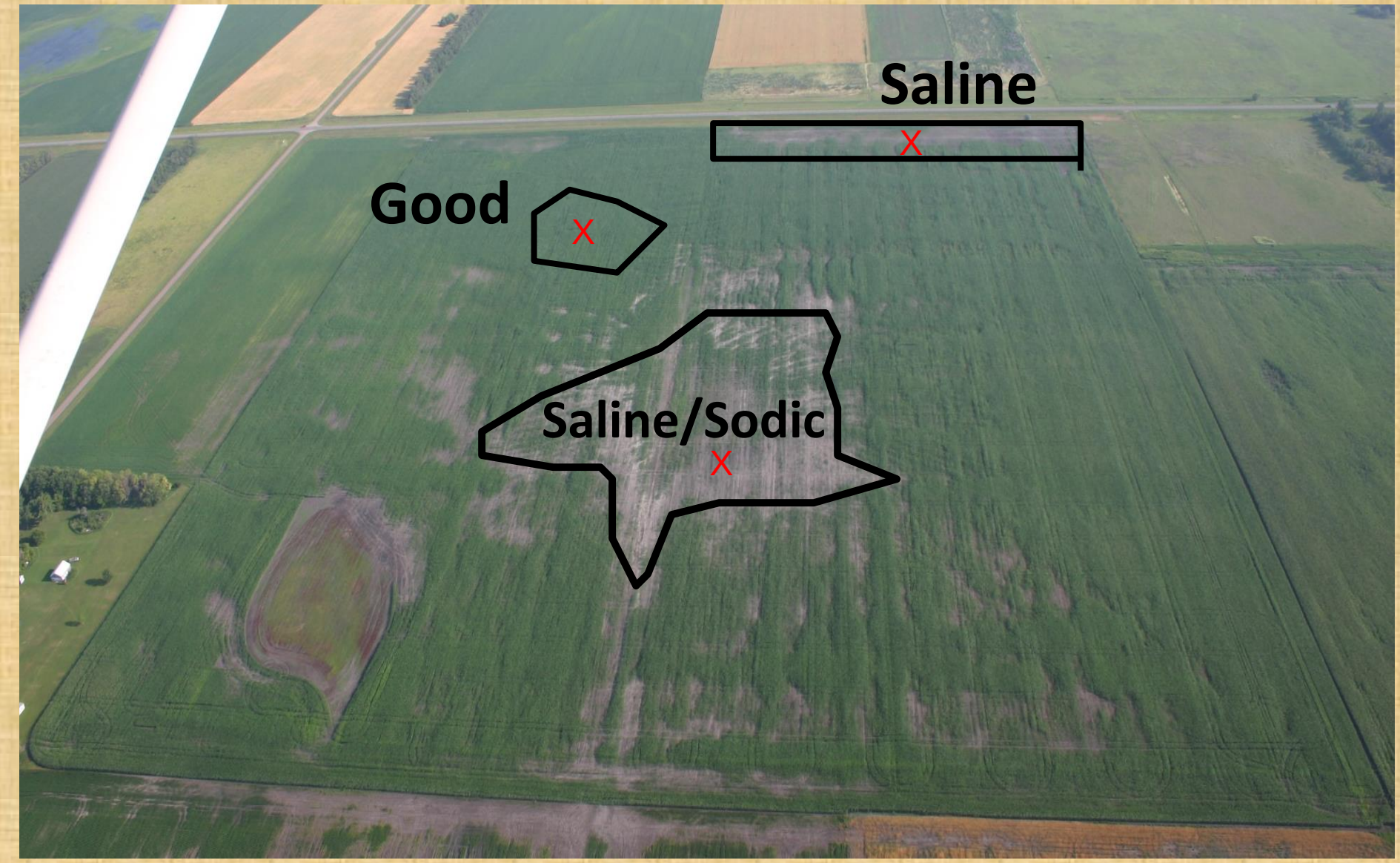


ISE LABORATORIES

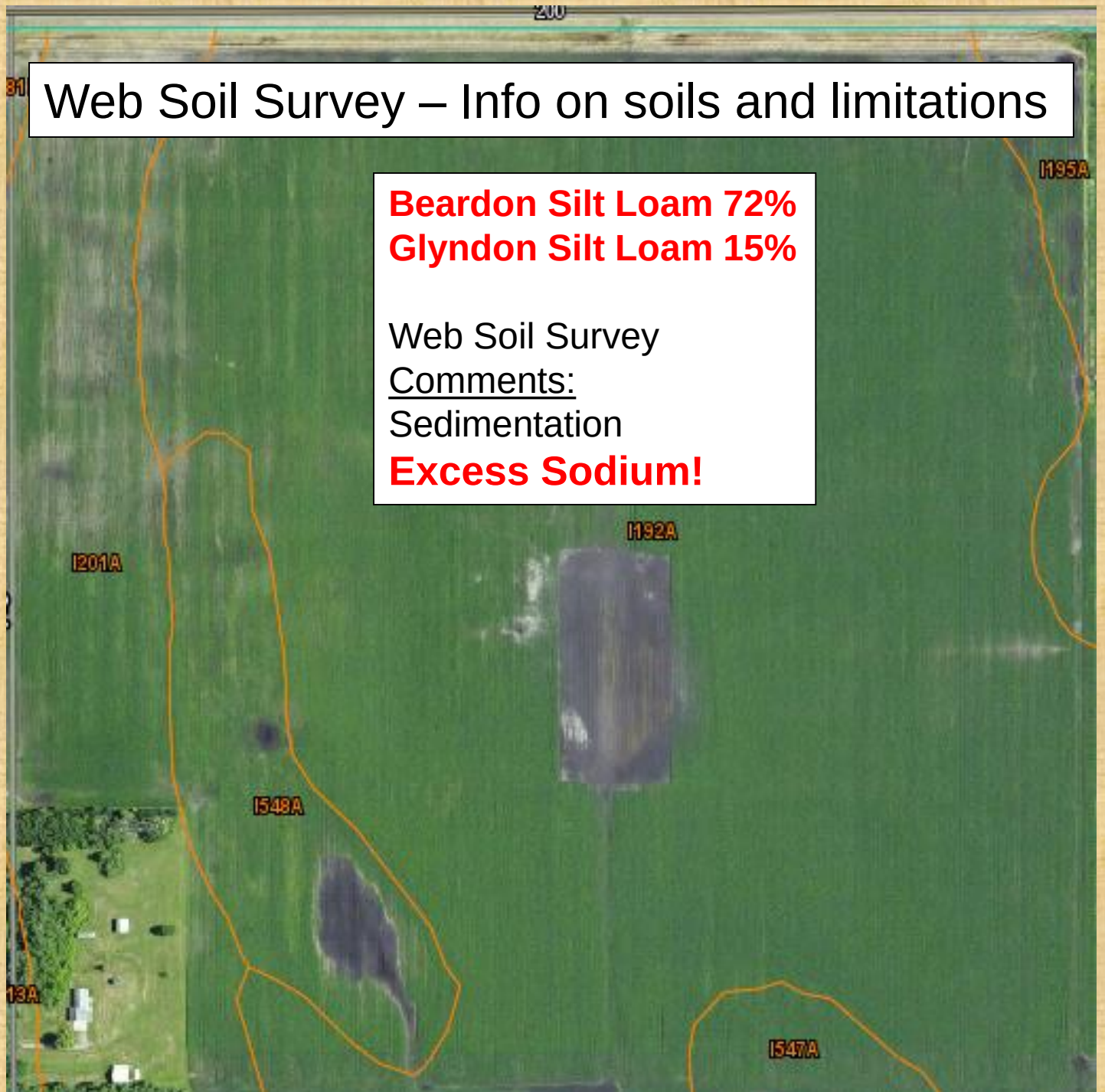
Saline Soils in Manitoba



Greg Riedman – Consultant Mike Kozojed – Farmer



Web Soil Survey – Info on soils and limitations



Beardon Silt Loam 72%
Glyndon Silt Loam 15%

Web Soil Survey
Comments:
Sedimentation
Excess Sodium!

Saline (salts)= Good Structure

- Saline Soil has e.c. (salts) >2.0 (routine 1:1 test)
  - Low sodium (Low %Na/SAR)
- Caused by high water table all or part of the year (wicks water up to surface, evaporates and leaves salts behind)
- Good structure due to bonds of Ca++ and Mg++ salts
- Salts reduce crop yield due to limiting water to plants (osmotic)
- Continuous cropping with long season crops lowers water table
- Salinity (soluble salts) can be leached lower in the profile over many years with tile drainage (and good surface drainage!)

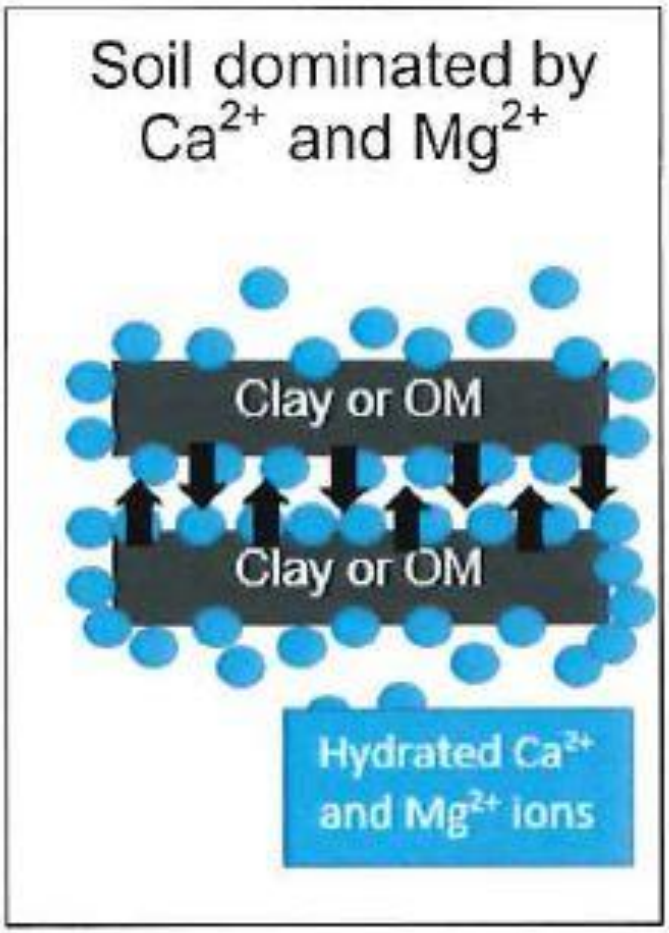
Sodic Soil = Poor soil structure! (Swelling and Dispersion)

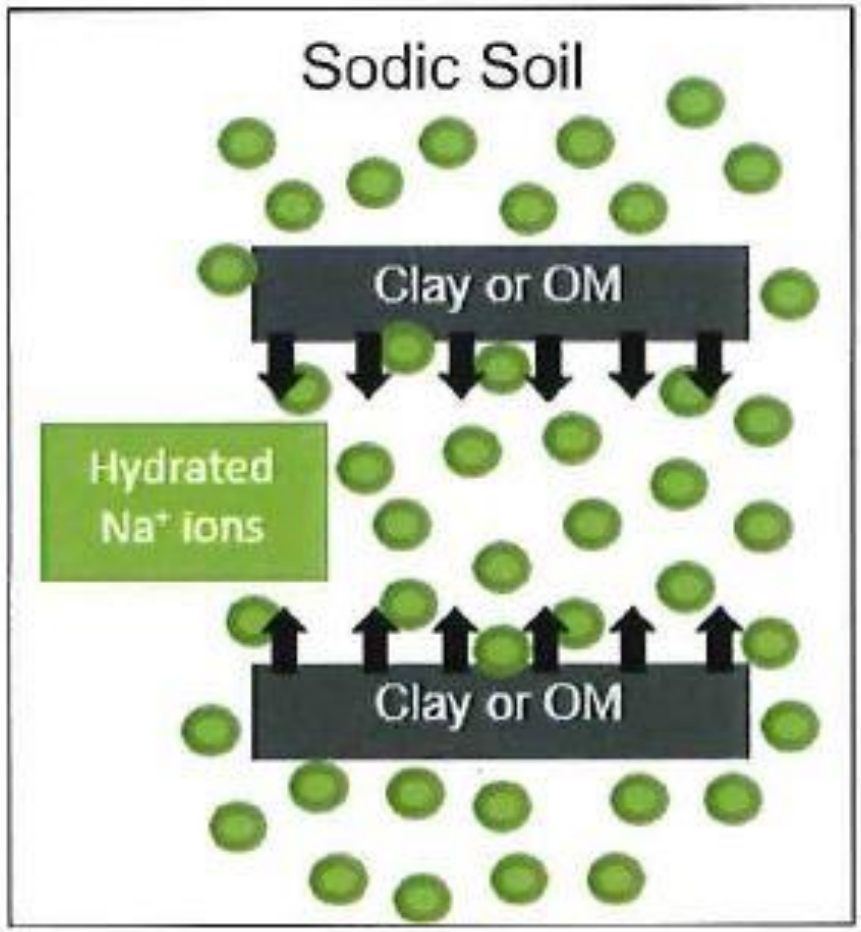
- Soils with >15% Sodium/SAR are defined as Sodic
  - (Low total salt/e.c)
- High sodium causes soil to swell when wet. The clay particles move apart and separate (disperse).
- High sodium causes soil aggregates to break apart closing off soil pores (reduced water flow)
- Reducing sodium requires amendment like gypsum ($CaSO_4$) and good drainage so sodium can be moved away.
- When the %Sodium is greater than 5-7% issues can start

Saline and Sodic Soil Good Structure?

- Saline and Sodic Soil has >2.0 e.c. (salt) and >15% Sodium/SAR
- Salts > 2.0 makes structure good (even with >15% sodium)
- Tile can leach salts away over many years (wet years required)
- If salts leave too quickly, remaining sodium will dominate soil properties and cause swelling and dispersion (poor structure)
- Reducing sodium requires amendment like gypsum ($CaSO_4$)
- Amendment like gypsum needed before salts get lower than 2.0

Ca++ and Mg++ = good structure
Na+ = swelling and dispersion (bad!)

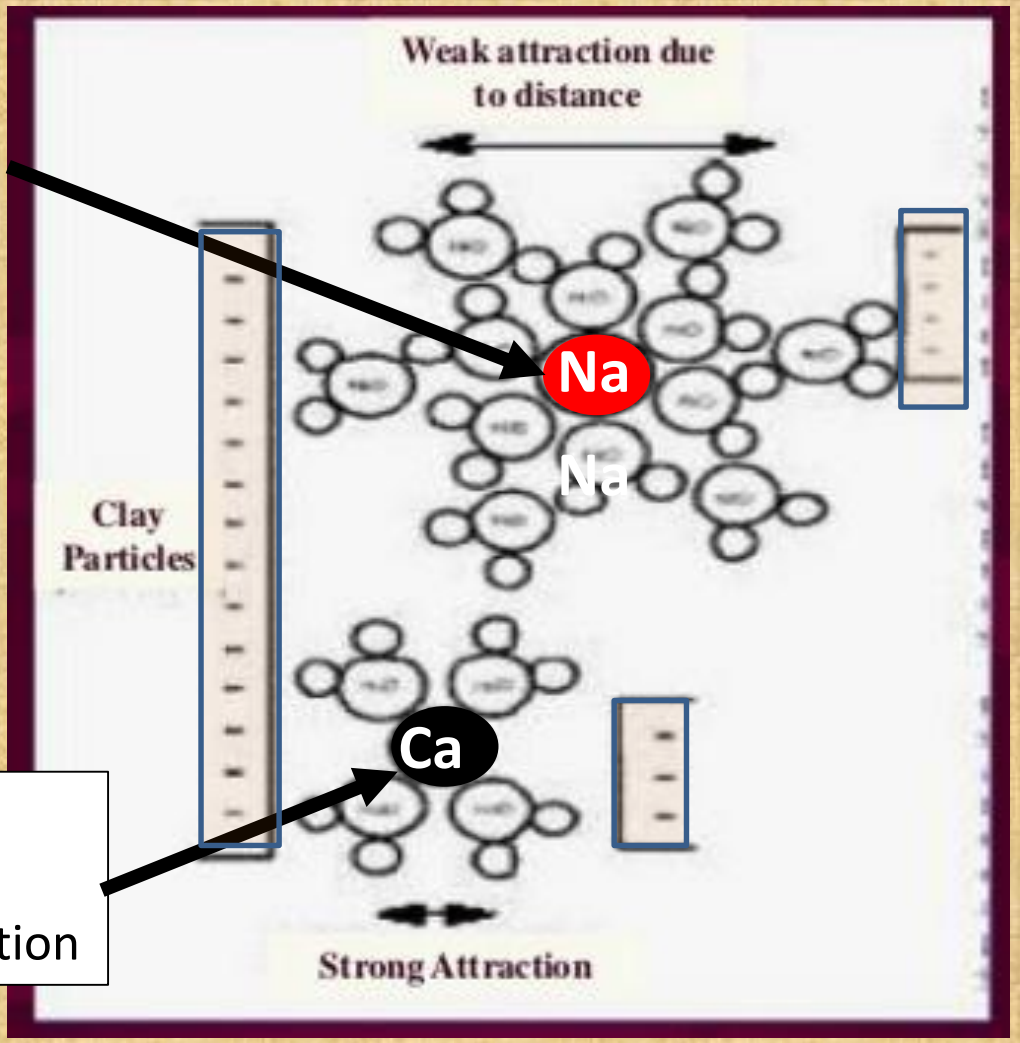




M. Breker, NDSU Soil Health. Adapted from Brady and Weil, 2010"

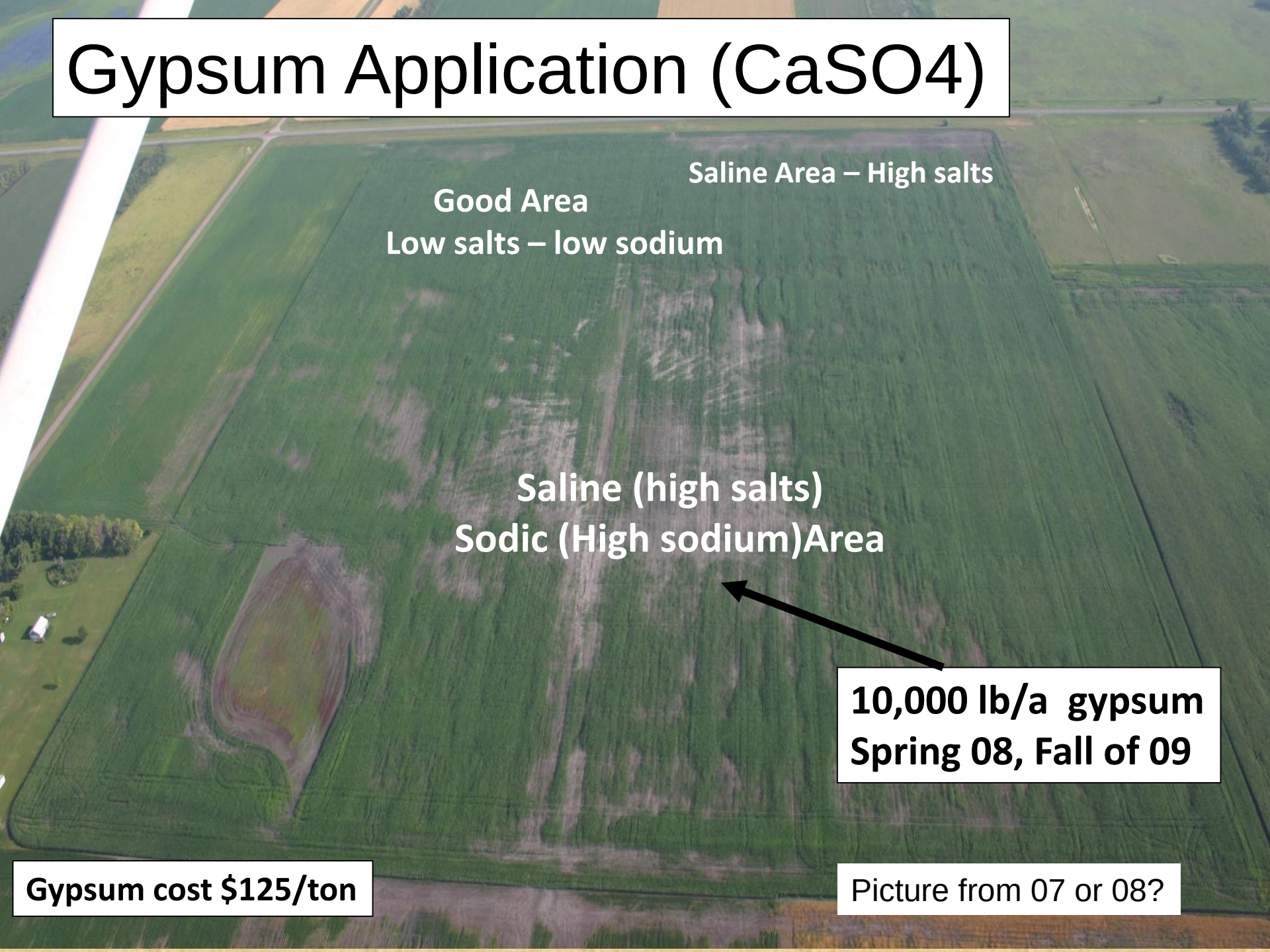
Sodium forces clay particles apart (weaker attraction)

Hydrated Sodium pushes the clay particles Further apart resulting in weaker attraction



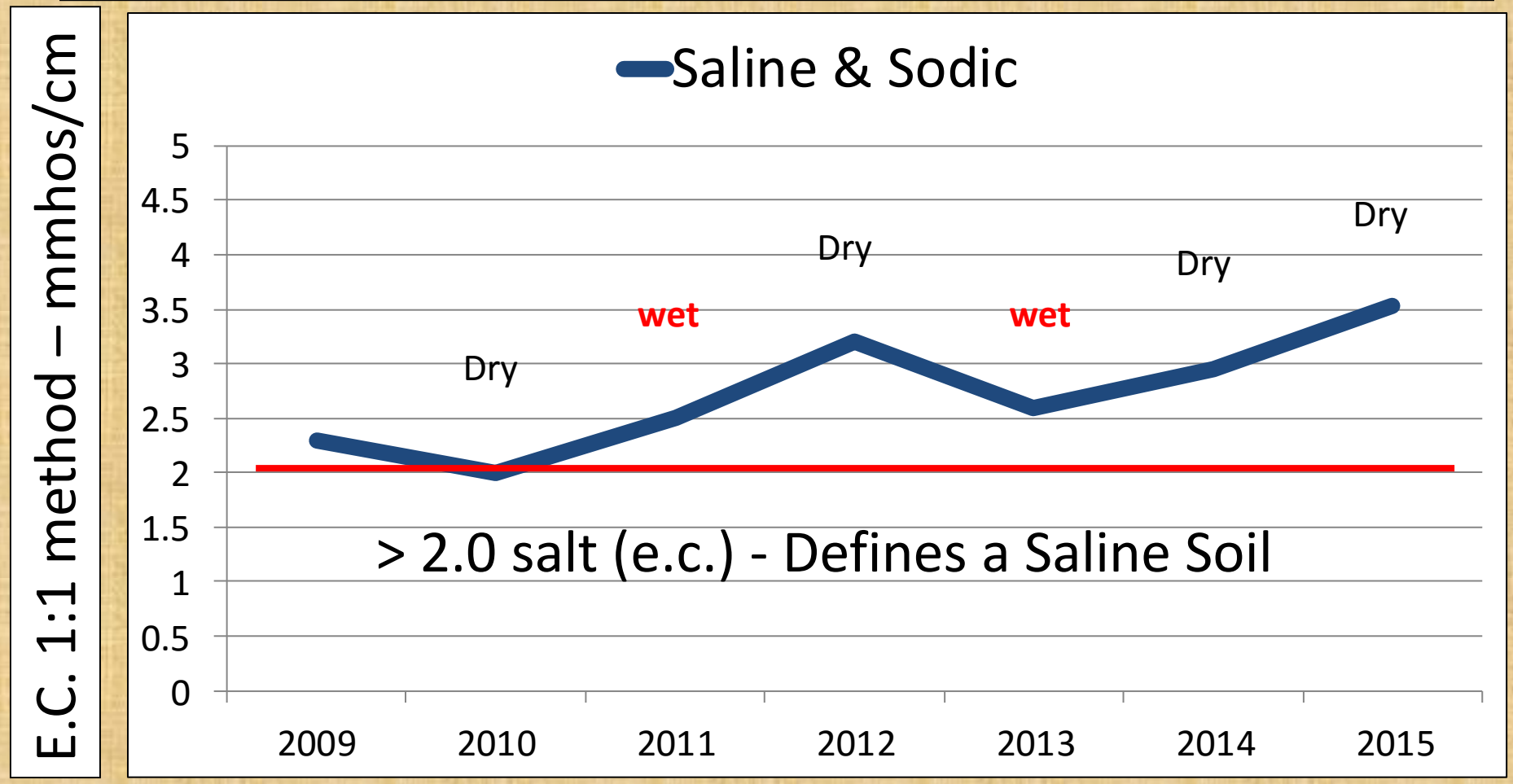
Calcium is smaller with two charges and Allows clay particles to be closer resulting in Stronger attraction

Gypsum Application (CaSO4)



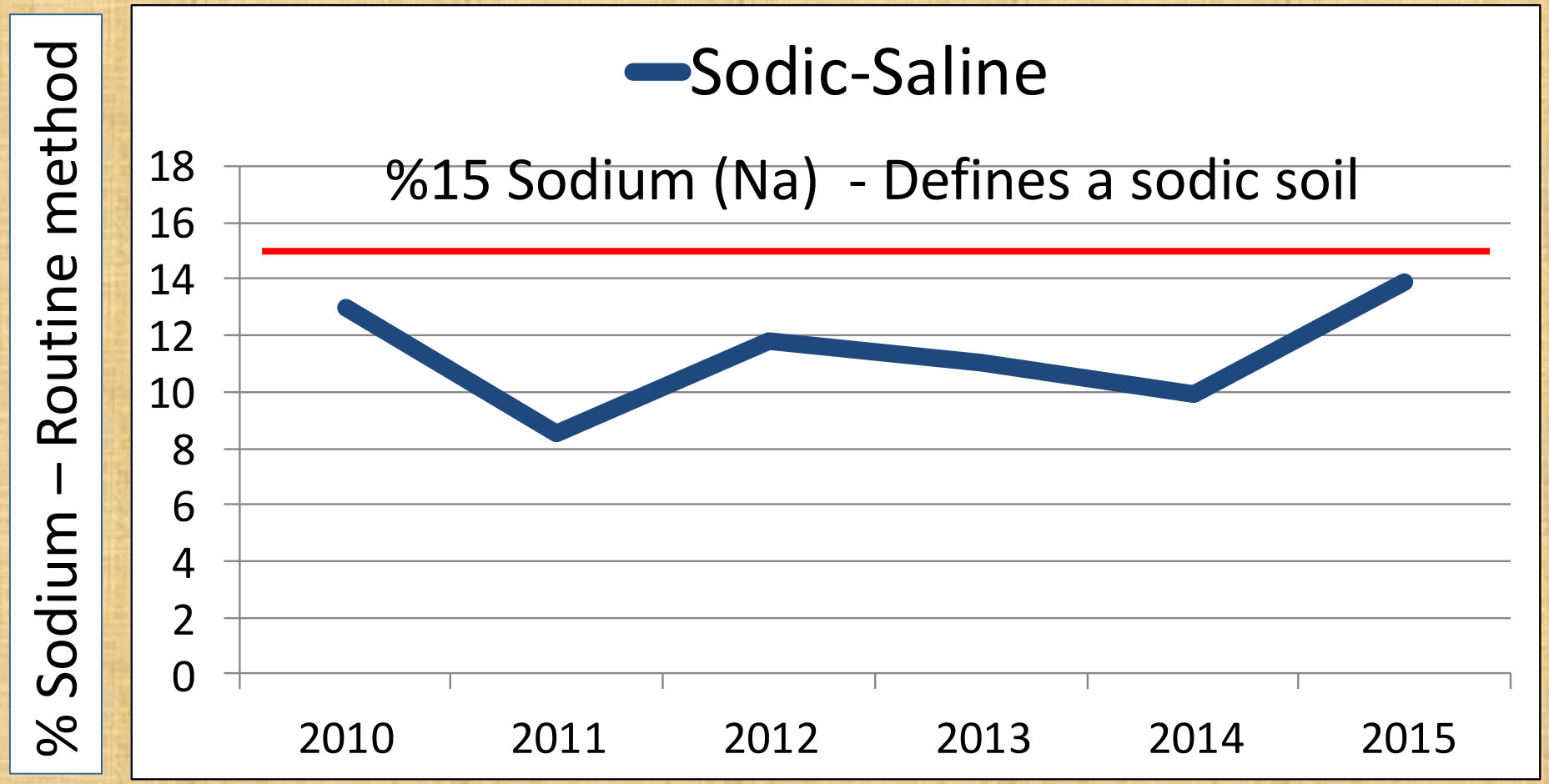
Topsoil Salinity 2009-2015

Routine salt (e.c.) method 1:1



Decrease in salinity will be slower on soils with finer texture (excessive rainfall required)

Topsoil 2010 - 2015
%Sodium = (SAR)



<u>Question:</u> Will sodium in this soil accumulate lower in profile and cause dispersion (restrict water flow) in parts of the soil profile once the salts are leached away?

- Gypsum ($CaSO_4$) applied in topsoil dissolves slowly and calcium replaces sodium on soil exchange site.
- Sodium must then be leached down through the soil profile and out the tile (wet years required).
- Gypsum applied to the surface can only influence soil to some depth?
- Over many years, salts concentration at all depths will eventually decrease in the soil profile. If salts are removed and sodium remains high in one layer of soil, swelling and dispersion (loss of structure) will occur and water movement will be restricted in that part of soil profile.

What has happened in the Soil Profile so far in "Saline & Sodic area? (Sampled every 6" down to tile)

Thanks to GK Technolgy and Ellingson Drainage

Saline/Sodic Soil - Testing Above Tile
Is salt decreasing and sodium increasing?

Sample depth	Routine Salt (E.C.) (1:1 method) Mmhos/cm	%Na Routine method
0-6”	2.7	10.4
6-12”	2.8	12.3
12-18”	2.1	12.2
18-24”	2.9	13.4
24-30”	1.6	14.5
30-36”	2.5	12.5
36-42	2.3	11.4

Samples collected July 2015 – Saline/Sodic area with total of 10,000 lb/a of gypsum applied in 2008-09

Routine % Na = SAR paste method
Published Research – NDSU and AGVISE 2015

Sample depth	%Na Routine Summation method Inexpensive & fast ($7.80)	%SAR (Sodium Adsorption Ratio (Paste Method) Expensive & slow ($17.45)
0-6”	10.4	9.0
6-12”	12.3	12.7
12-18”	12.2	13.3
18-24”	13.4	13.2
24-30”	14.5	13.3
30-36”	12.5	12.4
36-42	11.4	10.4

Just Ask for Ca, Mg, Na, K and we will calculate the %Na

Crumb Test (Visual Effect of Sodium!)

- Make 1” cube of moist soil suspected of sodic issues
- Put in DI water and watch for symptoms caused by sodium
  - Symptoms of swelling & dispersion are clouds of small soil particles
- Shows what will happen if salts are leached before sodium
- Salty water will stop Na symptoms (dispersion)
- Shows what will happen if salt is kept above 2.0 while gypsum helps move the sodium down in soil profile.

Sodic Soil – 20% Na, Salt (e.c.) 1.15 mmhos/cm, pH 8.9

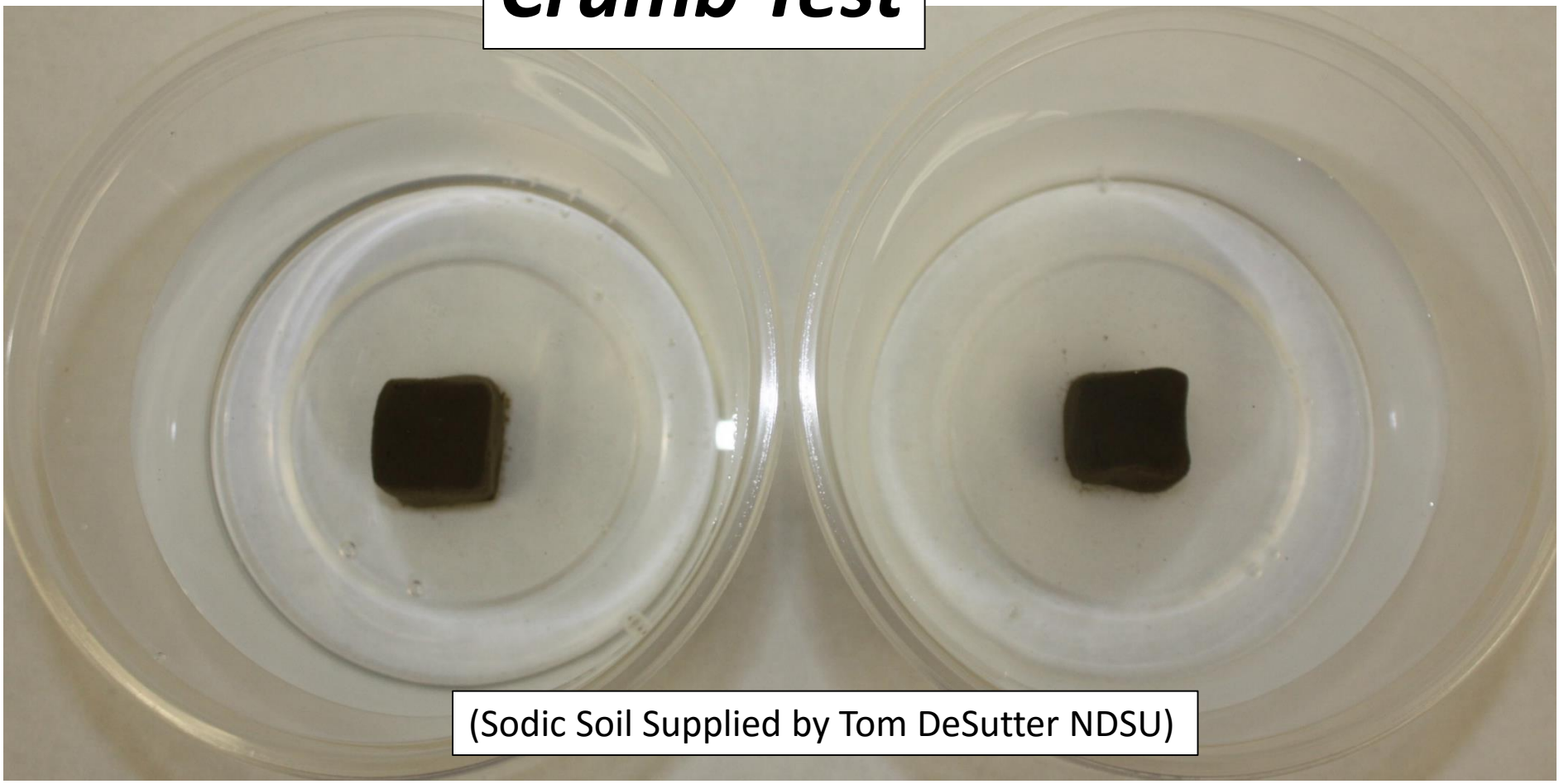
DI water (low salts)

0 minutes

Gypsum Solution (salt 2.5)

0 minutes

Crumb Test



(Sodic Soil Supplied by Tom DeSutter NDSU)

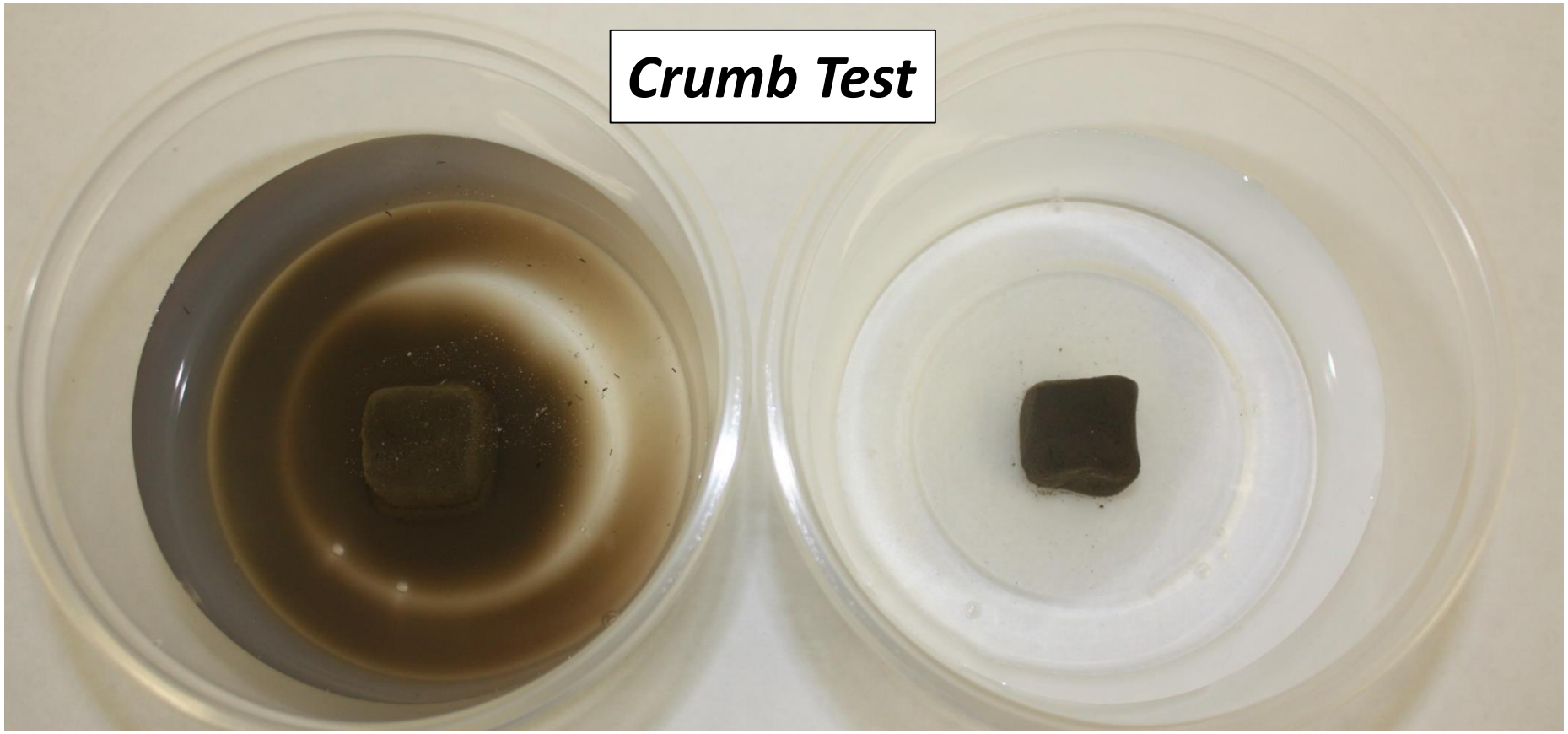
Sodic Soil – 20% Na, Salt (e.c.) 1.15 mmhos/cm, pH 8.9

DI water (low salts)

15 minutes
Dispersion happening fast

Gypsum Solution (salt 2.5)

15 minutes – No Dispersion



Sodic Soil – 20% Na, Salt (e.c.) 1.15 mmhos/cm, pH 8.9

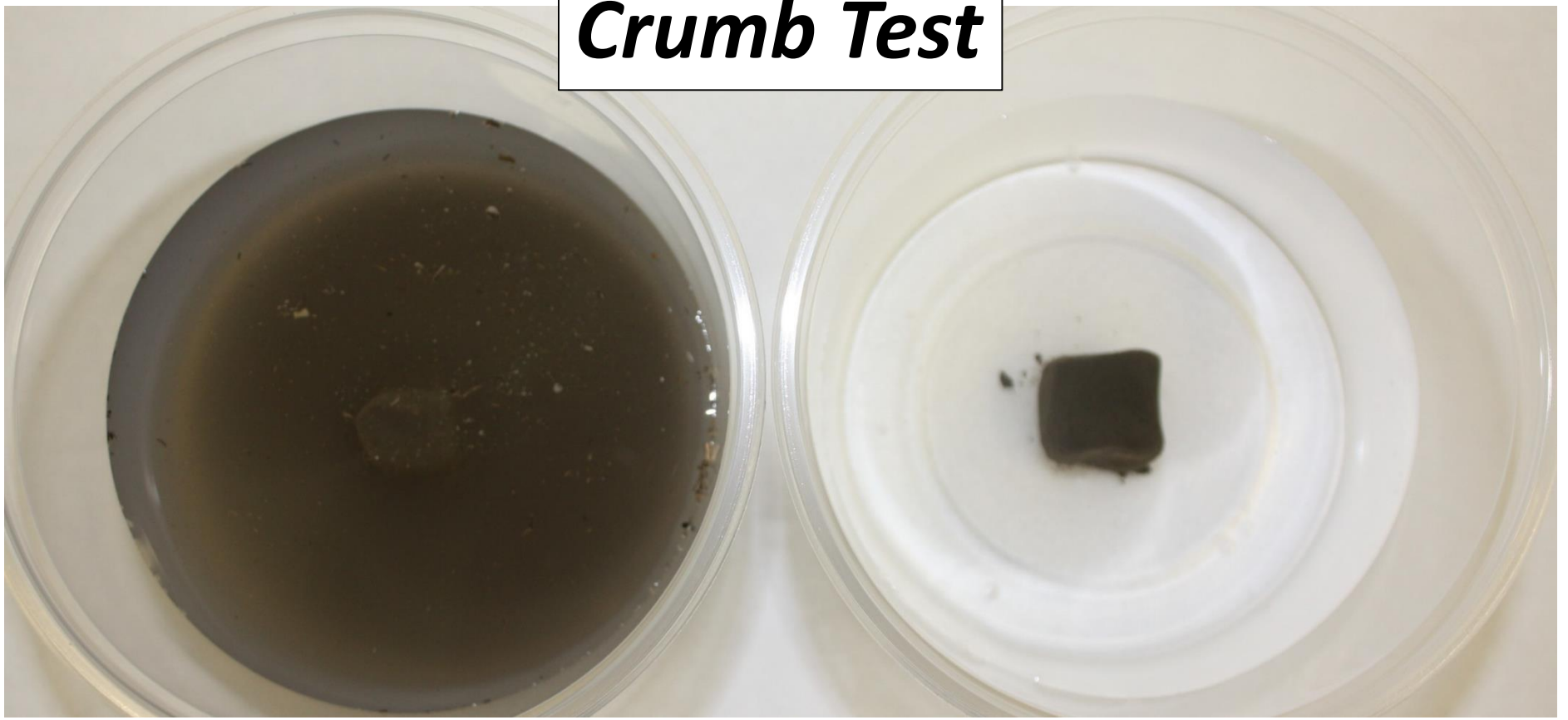
DI water (low salts)

90 minutes
Dispersion happening fast

Gypsum Solution (salt 2.5)

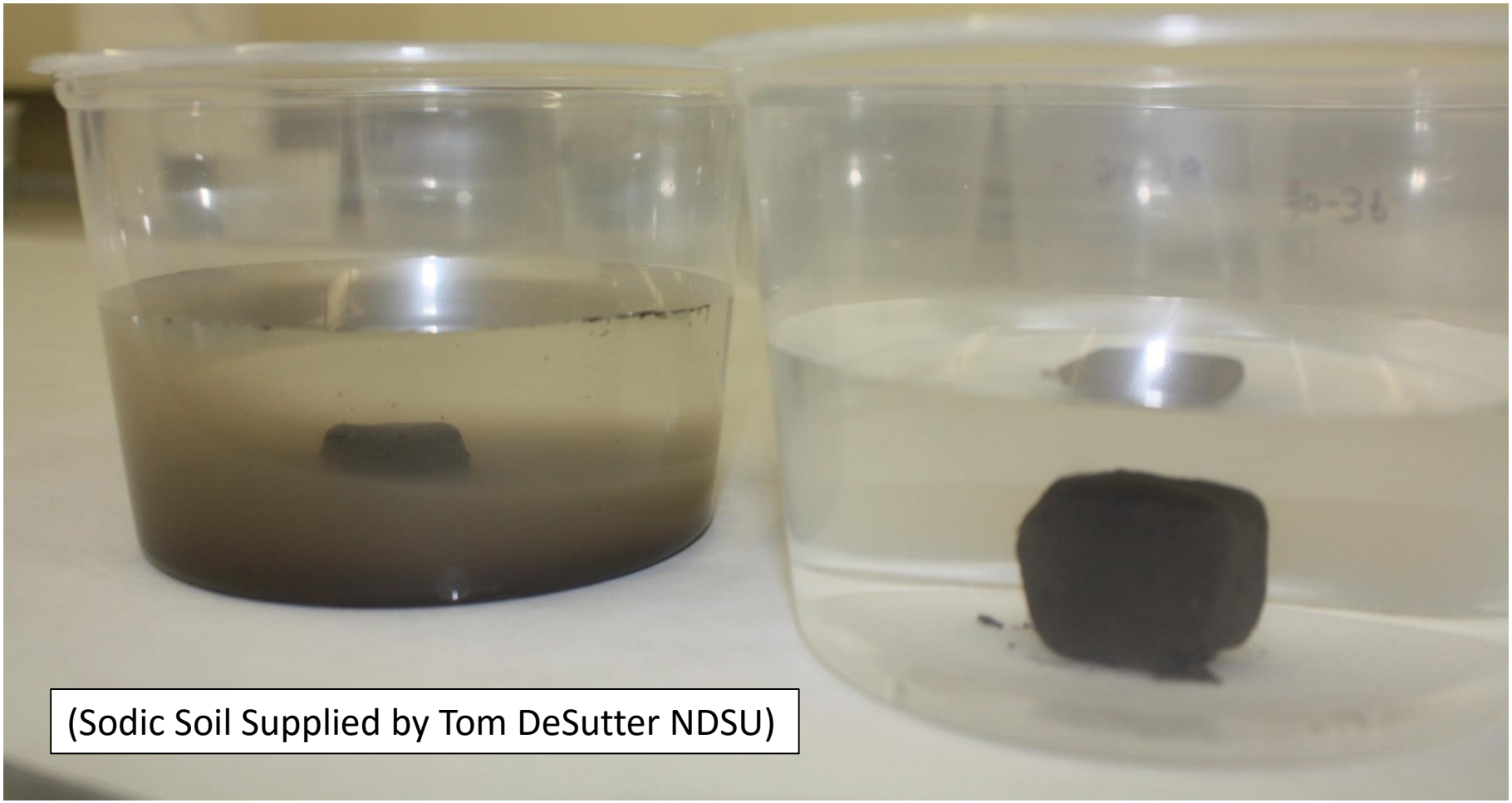
90 minutes
No Dispersion

Crumb Test



Sodic Soil – 20% Na, Salt (e.c.) 1.15 mmhos/cm, pH 8.9

Look for the cloud of dispersed soil particles

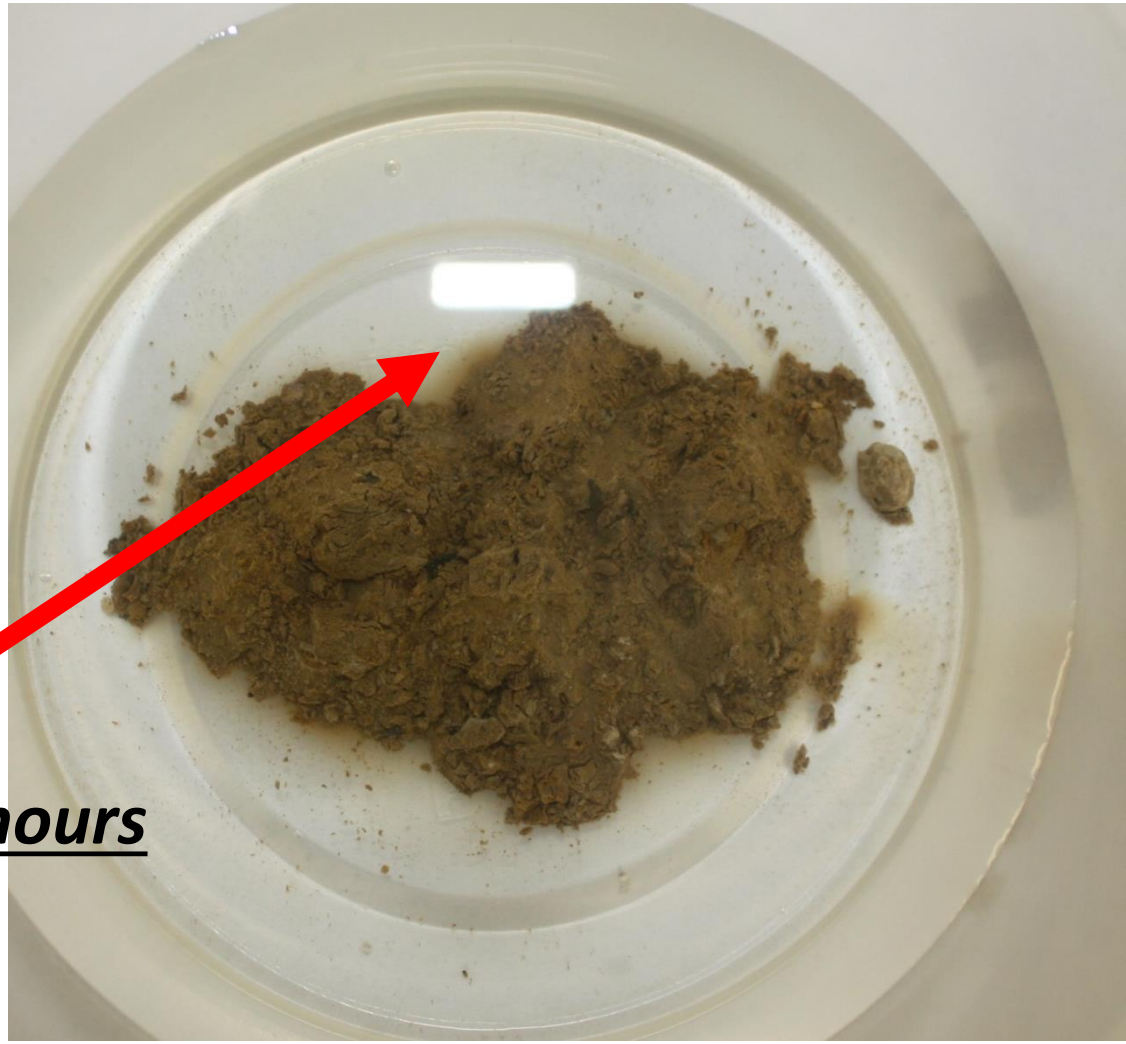


Crumb test

(Putting soil in DI water Simulates dispersion That will occur if salts were leached away)

Saline & Sodic area
24-30” Soil Profile

Salt (e.c.) - 1.6,
Sodium – 14%
pH 8.2



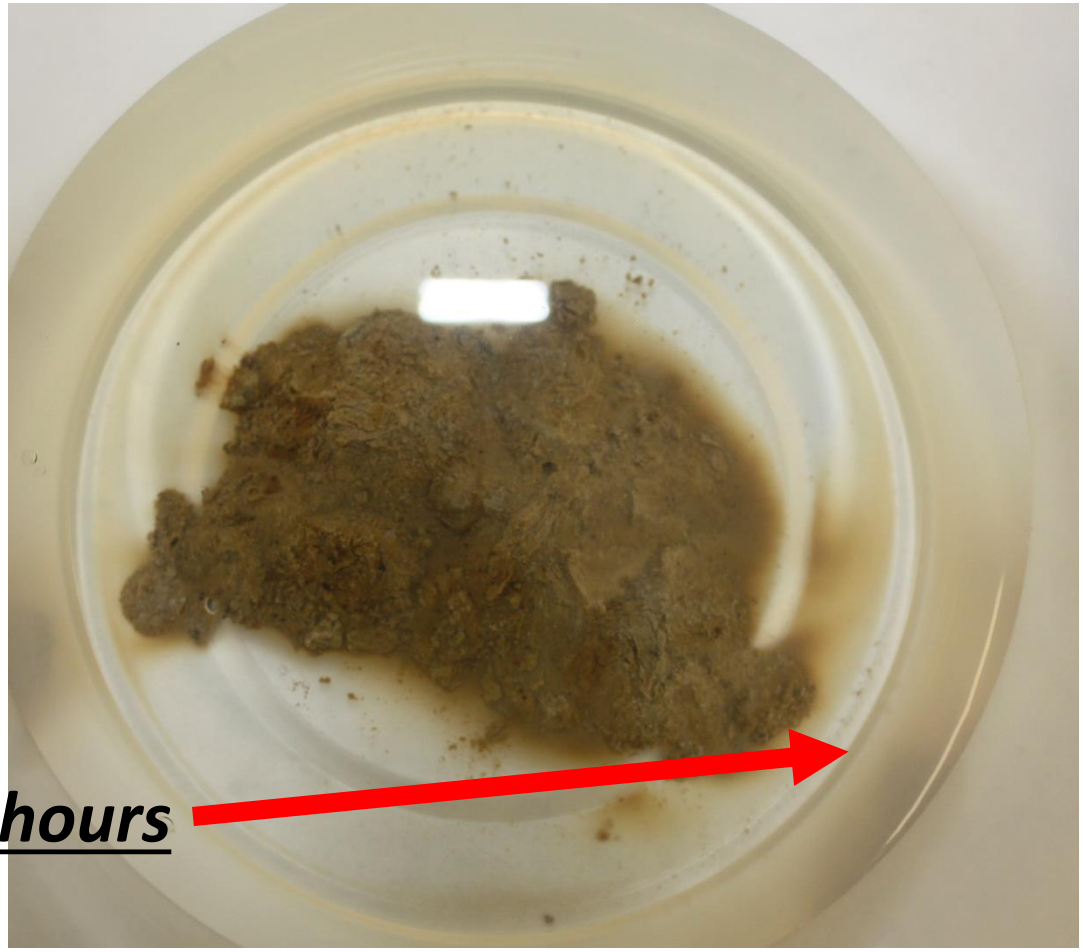
Slight dispersion after 6 hours

Crumb test

(Putting soil in DI water Simulates dispersion That will occur if salts were leached away)

Saline & Sodic area
30-36" Soil Profile

Salt (e.c.) – 2.5,
Sodium – 12.5%
pH 8.2



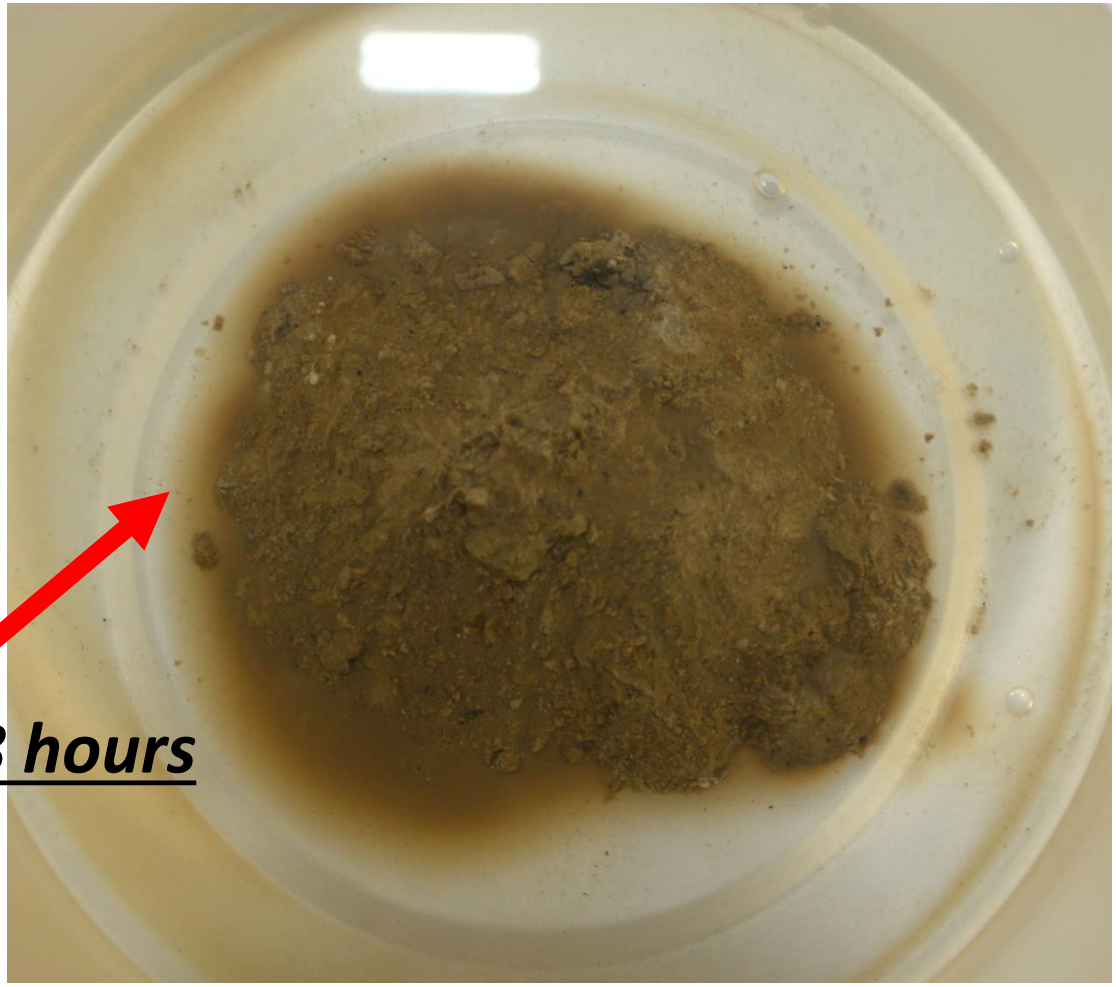
Slight dispersion after 18 hours

Crumb test

(Putting soil in DI water Simulates dispersion That will occur if salts were leached away)

Saline & Sodic area
36-42” Soil Profile

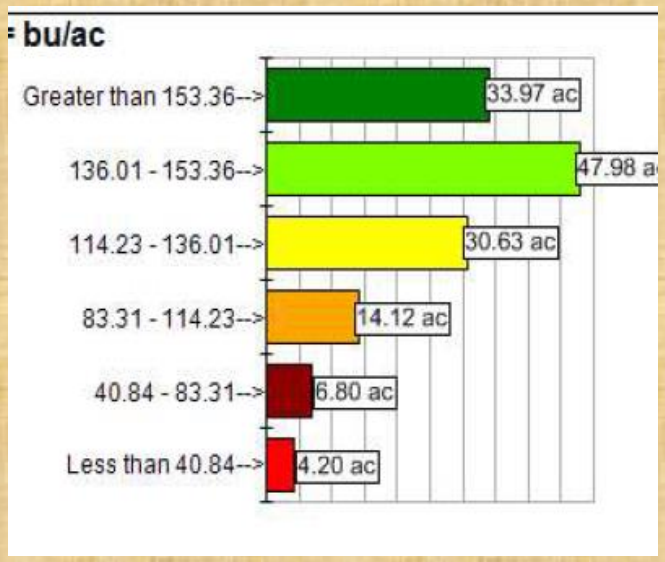
Salt (e.c.) – 2.3,
Sodium – 11.4%
pH 8.2

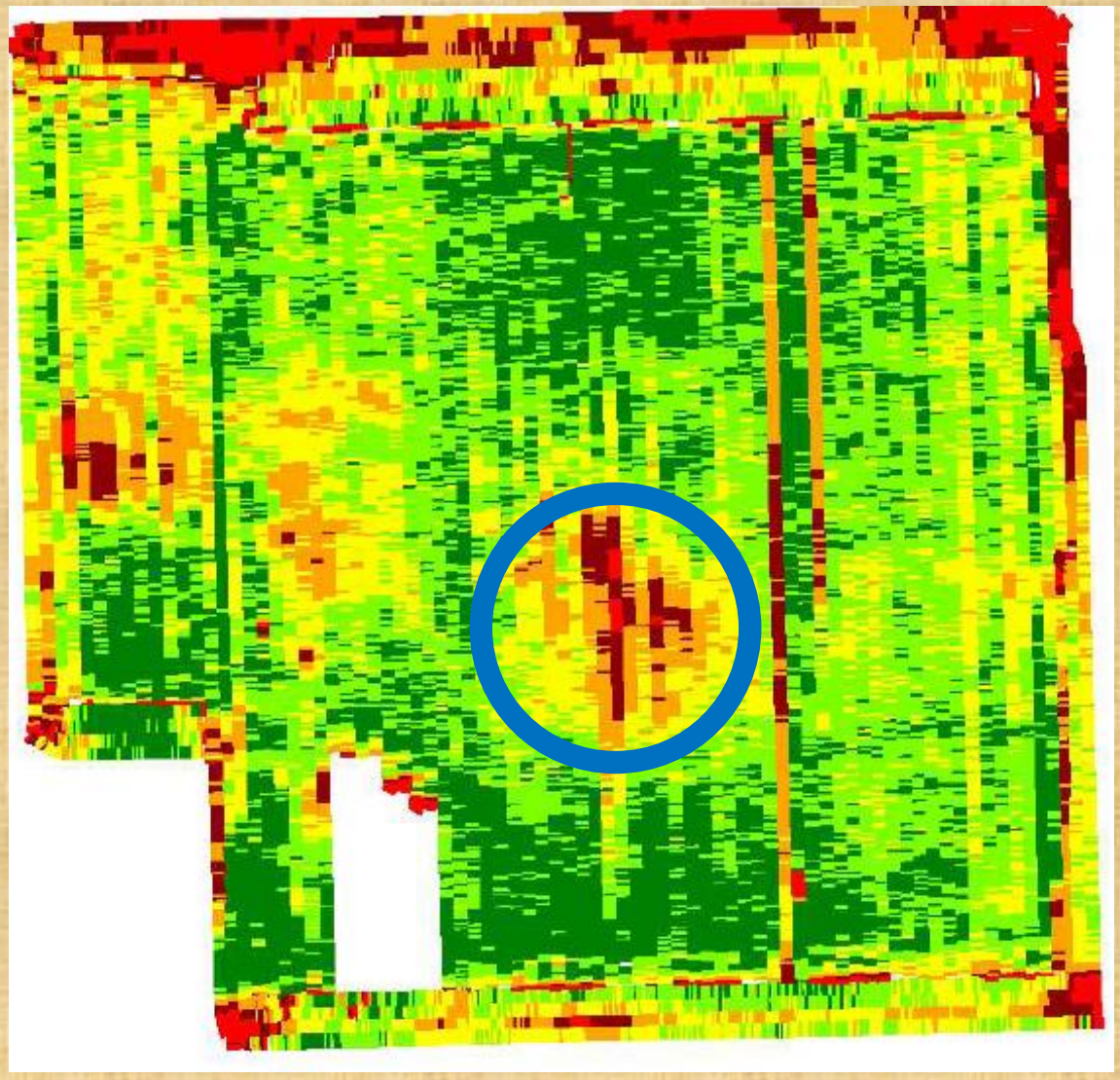


Slight dispersion after 18 hours

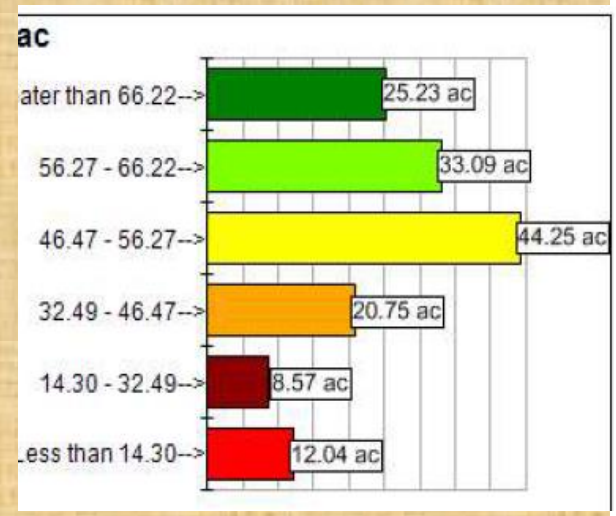
Corn Yield 2014

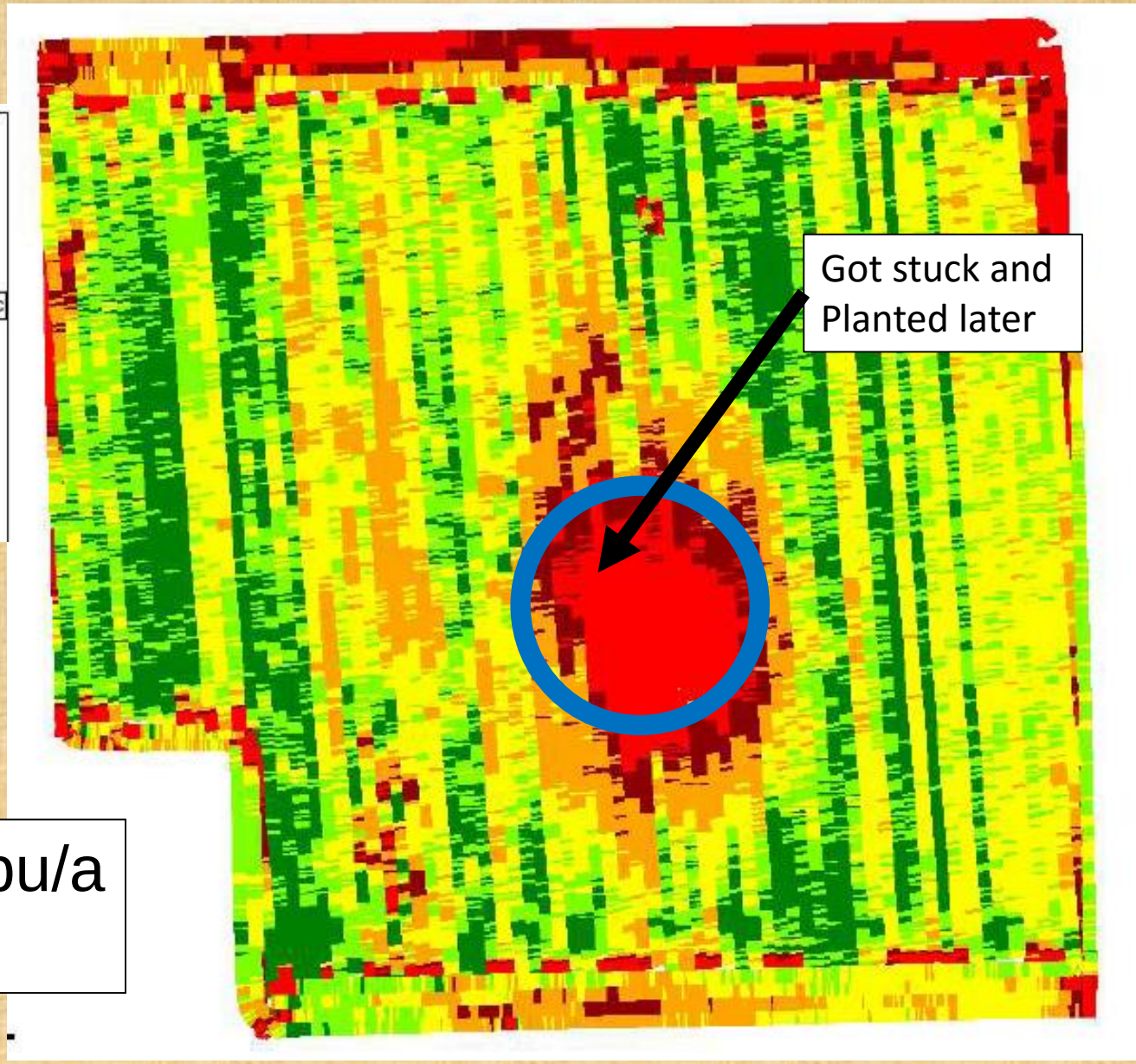
Averaged 133 bu/a
Dry corn





Soybean Yield 2015





Averaged 50.4 bu/a
Soybean

Saline & Sodic Area

- *Salts will eventually be leached from the profile*
- *When salts get below 2.0 anywhere in profile, effects of sodium may start showing (dispersion, restricted water flow)*
- *Gypsum application has reduced/prevented dispersion issues from sodium close to the surface.*
- *Sodium lower in the profile may cause issues with water flow as salt level decrease in future.*

Should Fields With Small Areas of Saline & Sodic Soil Be Tiled?

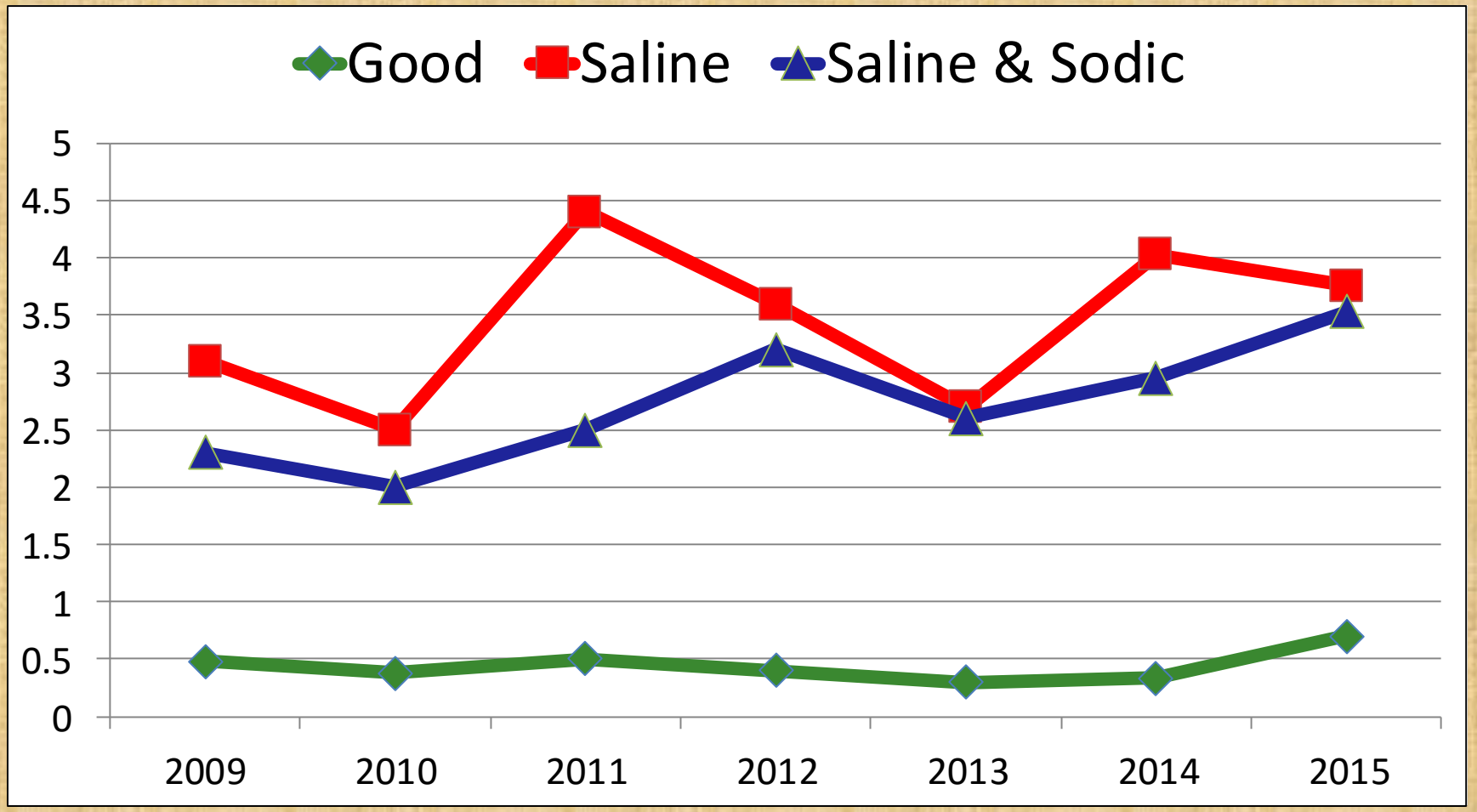
- *Tile drainage keeps salt affected area from getting larger*
- *Salts will leave the profile over many years*
- *Sodium removal will require gypsum some time in future (may not be needed right away)*
- *Once salt level decreases to about 2.0, gypsum should be added (may be many years down road)*
- *Until salt level decreases, seed affected area to salt tolerant grass or Round-Up alfalfa (Stop $ losses)*
- *Soil test area periodically to monitor salt and sodium*

"Daddy, Is this - Soil or Dirt?"


Questions

Topsoil Salinity 2009-2015

Routine salt (e.c.) method 1:1



ecrease in salinity will be slower on soils with finer texture (excessive rainfall required)

Topsoil 2010 - 2015
%Sodium = (SAR)