

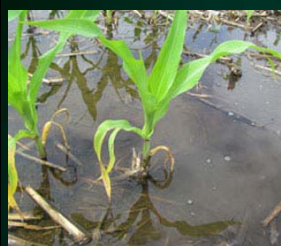
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MANAGING SALINITY WITH TILING
Hans Kandel, Extension Agronomist

STUDENT FOCUSED • LAND GRANT • RESEARCH UNIVERSITY



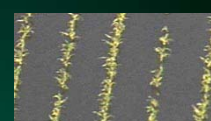
Farmland Drainage Needs
Spring or Summer in Minnesota and
North Dakota



Figures 1 (left) and 2. Corn growing in flooded or saturated soil is more likely to develop disease problems now and later in the season. (Left photo courtesy of Jae Behn, UNL).

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**Impact of water
logged conditions
on yield of corn**



- Yield reductions are significant even after 2 days

Days Water Logged	Percent Yield Reduction	Date of Planting	Percent Yield Reduction
0	0%	By 5/1	0%
2	-25%	5/2-5/10	-7%
5	-45%	5/11-5/25	-13%
8	-80%	5/26-6/1	-24%

- Crop may look like it recovered and still have a yield reduction

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Why do water logged conditions after planting cause crop damage?

- Under water-logged conditions, the availability of oxygen is decreased

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Why do water logged conditions after planting cause crop damage?

- When roots are subjected to low oxygen conditions, changes occur in the plant that generally decreases yield
- Root growth is restricted

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Drained conditions after planting

- When roots have oxygen available, plants generally respond with increase yield
- Root growth is not restricted

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Canadian Example

Crop	Un-drained bu/a	Drained bu/a	Increase in yield in %
Soybean	31	38	23
Wheat	45	61	36
Corn	88	123	40

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Pro Drainage Farm Drainage Contractors, Ontario
www.drainage.org/factsheets/fs11.htm

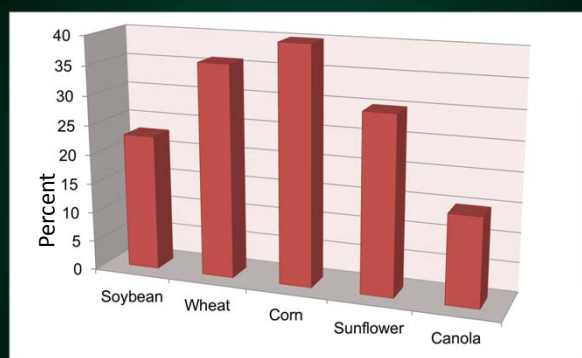
Canadian Example

Crop	Un-drained lb/a	Drained lb/a	Increase in %
Sunflower	1091	1418	30
Canola	1350	1554	15

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Pro Drainage Farm Drainage Contractors, Ontario
www.drainage.org/factsheets/fs11.htm

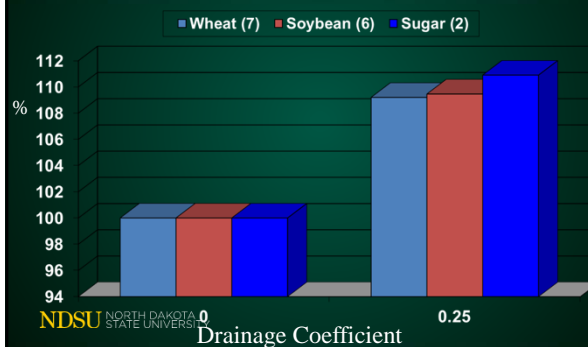
Crop Yield Tiled vs Untiled in %



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Average Wheat, Soybean, and Sugar Yield In % of non-tiled 2001-04



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Drainage Coefficient

2012 NDSU Fargo Saturated-soil, neutral pH, Roundup Ready Soybean					
			Dryland	Saturated soil	Dry-Wet average
Company	Entry	Maturity date	Yield* Bu/A	Yield** Bu/A	Yield Bu/A
Seeds 2000	2051RR2Y	12-Sep	43.1	31.7	37.4
REA Hybrids	65G22	13-Sep	39.9	29.0	34.4
Legend Seed	LS03R2	12-Sep	37.5	44.6	41.0
REA Hybrids	66G22	13-Sep	34.6	42.3	38.4
Proseed	P2 20-90	18-Sep	37.3	39.0	38.1
Average		14-Sep	32.4	27.3	29.8
LSD(0.05)		5	11.7	10.7	11.2

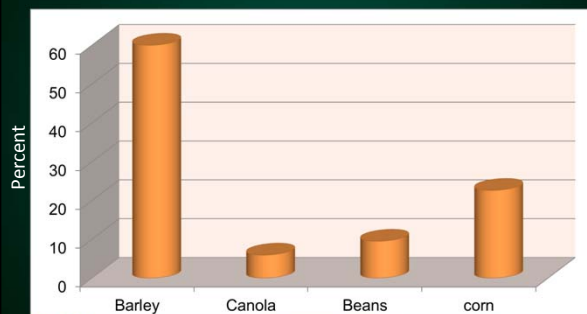
19 % yield loss due to excess water

Salts in ND

- Salts found in North Dakota soils are of three types: sulfates (SO_4); carbonates (CO_3); and chlorides (Cl).



Crop Yield in Salt Area as % of Yield in non Salt Area



Seed germination with salt concentration



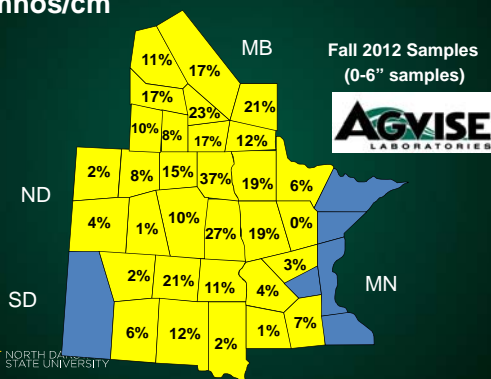
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Soybean Response to Salt



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% Soil Samples with Salts greater than 1.0 millimhos/cm



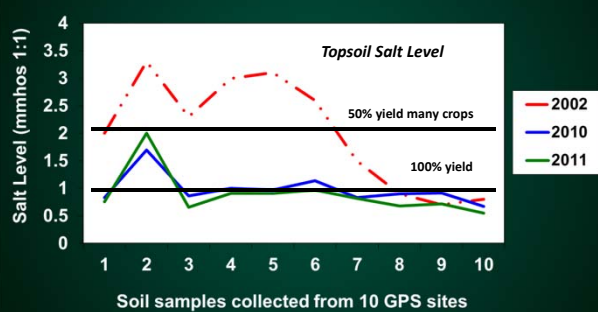
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Management Options

- 1) Crop Selection (short-term)
- 2) Breeding (long-term)
- 3) Tillage and seed placement (short-term)
- 4) Sub-surface drainage

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Tile Drainage – Topsoil Soluble Salts Demonstration Project (2002, 2010, 2011)



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(Tile installed summer 2002)



Soybean 2003

Soybean 2007

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Managing Saline Soils

- The only way to remove salts is to leach them out or remove salts in crop biomass.
- Tile drainage permanently lowers the water table and provides an outlet for excess water.
- Time required to reduce salt levels depends on:
 - Soil characteristics
 - Amount of water removed through tile

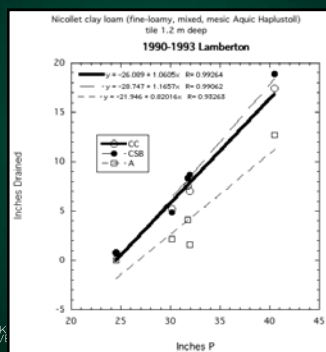
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Tile Drainage Results

- Topsoil salt levels have decreased a lot.
- Several crops now produce good yields
 - Corn, soybeans, sunflowers
- Subsoil salt levels take longer to be decreased
- High subsoil salt levels do not affect yield as much as high topsoil salt levels
 - Seedling salt sensitivity vs. general salt sensitivity

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Annual tile drainage vs. Precipitation for continuous corn, corn-soybean and alfalfa at Lamberton



2002 publication by Gabe Rasmussen

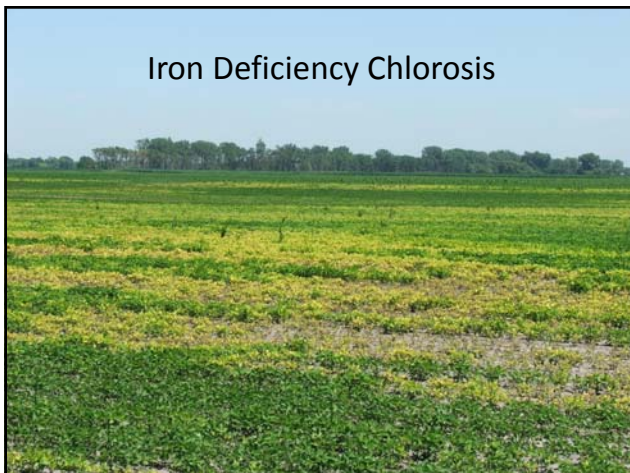
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Photo of sample bottles from Red Lake County Monitoring sites.



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Iron Deficiency Chlorosis

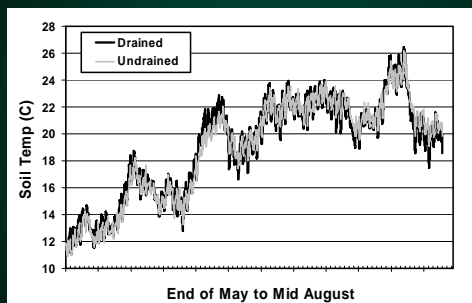


Factors "Known" to Increase Potential for Iron Deficiency Chlorosis

- Soluble Salts
- Excessive water
- Cool Temperatures
- Carbonates

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Spring Soil Temps at Brooks MN

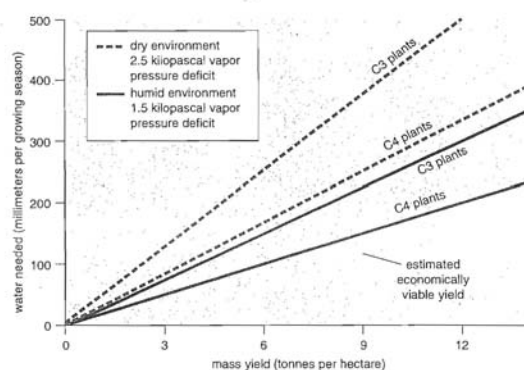


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Grygla 2005



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Location of tile research site



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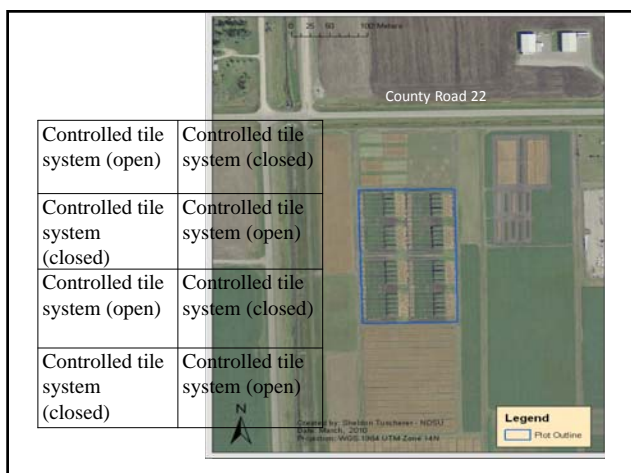
Soybean Intensive Management Study, Fargo, 2011



Research Location NW 22

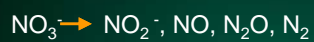


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Denitrification (anaerobic)

13 different bacteria:



Nitrate to gaseous forms of N
(nitrite, nitric oxide, nitrous oxide, N gas)



Can lose up to 2-4 pounds/acre/day

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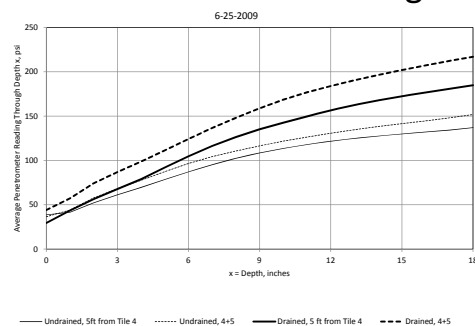
Penetrometer Readings



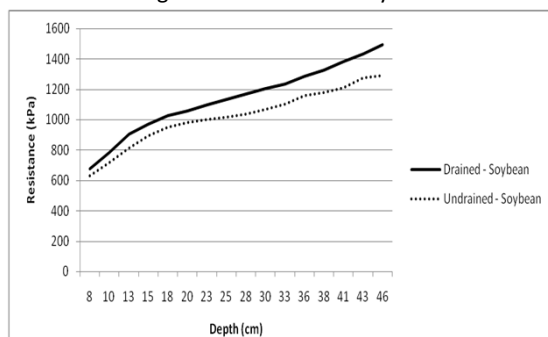
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Penetrometer Reading



Resistance values for depths 8-46 cm on drained and undrained ground seeded into soybean.



Drainage Effects on Corn Yields – Ohio, 13 Year Study

Treatment	Bu/A	C.V.%
Undrained	60	46
Surface	92	33
Subsurface	116	18
Combination	121	17

(Source: G.O. Schwab, 1984)

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