

IDC Soybean Demonstration Project 2016 (Iron Deficiency Chlorosis)

Objective: Soil sample IDC areas and adjacent areas to determine soil properties which contribute to IDC

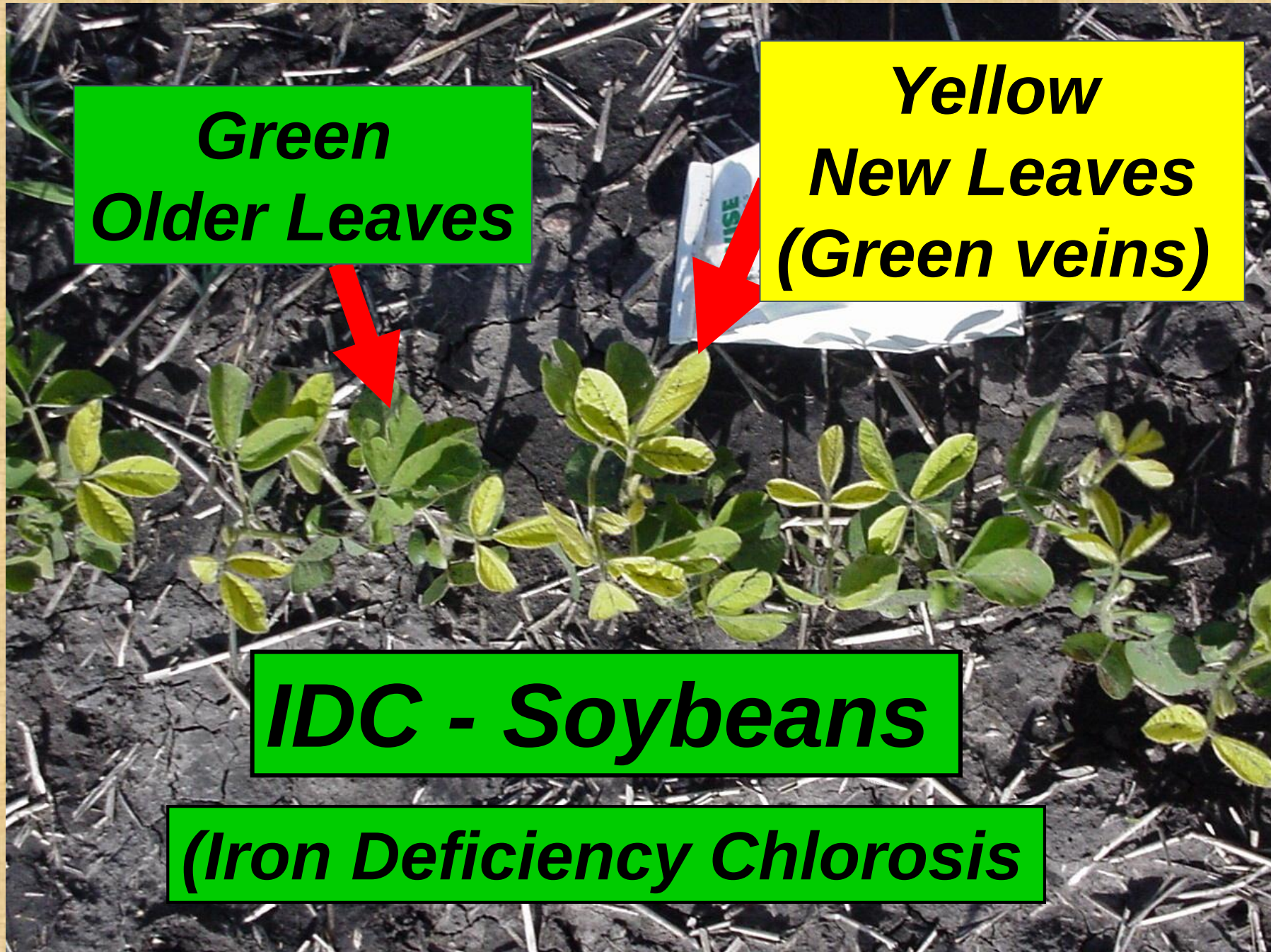
- 1. Carbonate (CCE) (Calcium Carbonate Equivalent)**
- 2. Salts (e.c. 1:1)**
- 3. Nitrate-N**
- 4. SCN????????????????????**

***Green
Older Leaves***

***Yellow
New Leaves
(Green veins)***

IDC - Soybeans

(Iron Deficiency Chlorosis)



Iron is Important!

- Iron Functions in Plants
 - Photosynthesis
 - Chlorophyll formation
 - Nucleic acid synthesis
 - Enzyme transformations

How Grasses Get Iron

- Most Grass plants (Iron chlorosis very rare!)
 - Secrete phytosiderophores (siderophores)
 - Chelate all forms of iron around the root
 - Ferric (Fe^{3+}) and Ferrous (Fe^{2+}) Iron brought into plant
 - Reduction of iron happens *Inside* the plant

How Soybeans Get Iron

- Soybeans
 - Try to acidify the area around the root zone
 - Soybean root pumps out H^+ (acid)
 - Ferric (Fe^{3+}) is reduced to Ferrous (Fe^{2+})
 - Reduction of iron happens **outside** the plant
 - Soil Properties and soil chemistry affect this process

IDC - Iron Chlorosis Factors

- **Cool Temperature**

- Reduces iron solubility a little
- Reduces root activity

- **Water logged/Poor Aeration**

- Increases CO_2 = more HCO_3^- (bicarbonate)
- Slower root development
- Decreased nutrient uptake

IDC- Iron Chlorosis Factors

- ***High Soluble Salts (Salinity)***

- Reduces total nutrient uptake
- Reduces water uptake
- Reduces root growth/length
- Competing nutrient effects

- ***Excessive soil nitrate (NO_3)***

- Increases IDC

IDC - Iron Chlorosis Factors

- **Carbonates (CCE – Calcium Carbonate Equivalent)**

- CCE range in cornbelt (0-5%)
- CCE in northern region (0-20%)

- Chemical Reaction



 **BAD!**

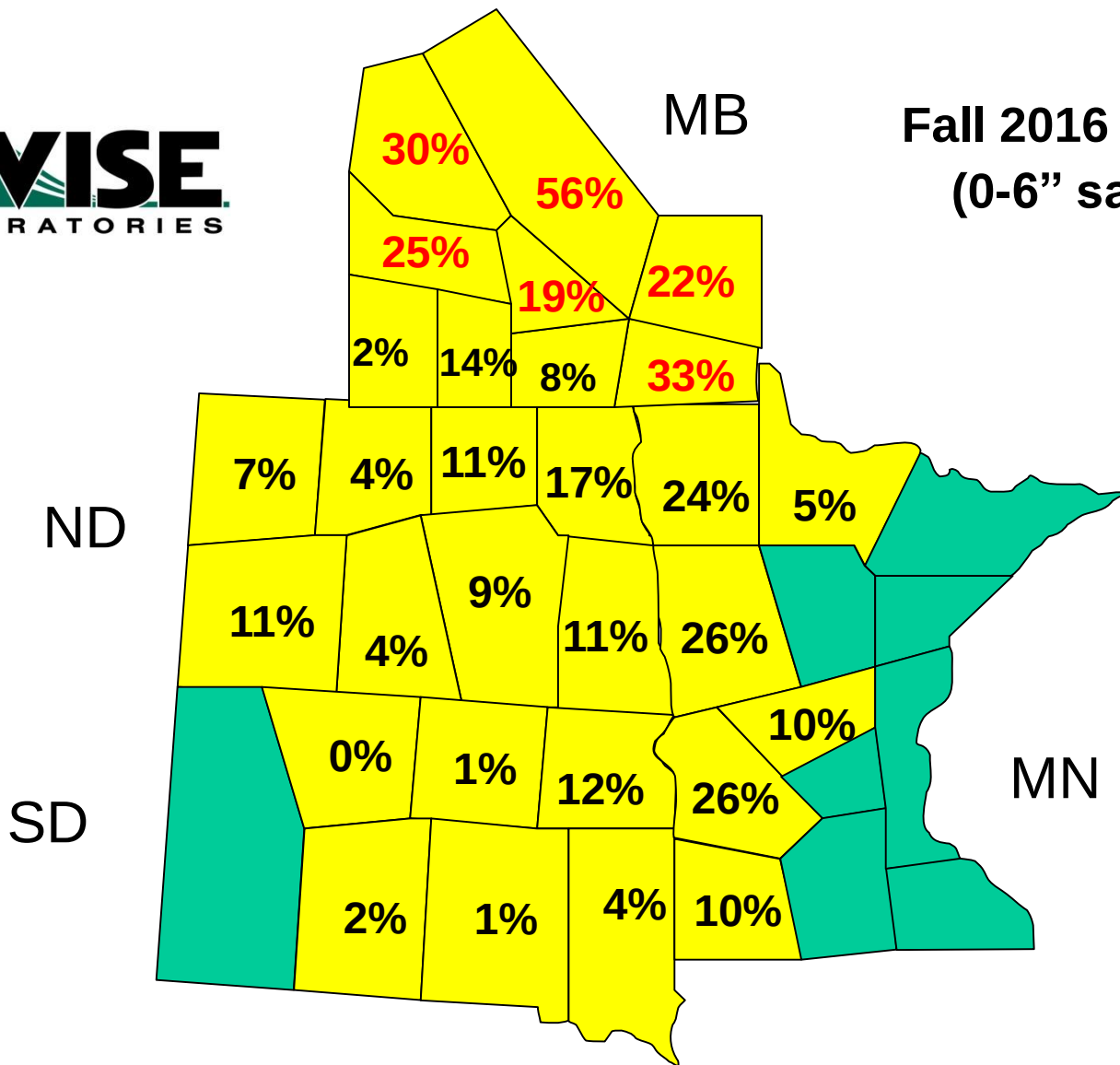
- Bicarbonate neutralizes acid put out by roots (less iron can be taken up)

- Soil pH higher than 7.4 may have carbonates (test to know) lower than 7.4 no carbonates

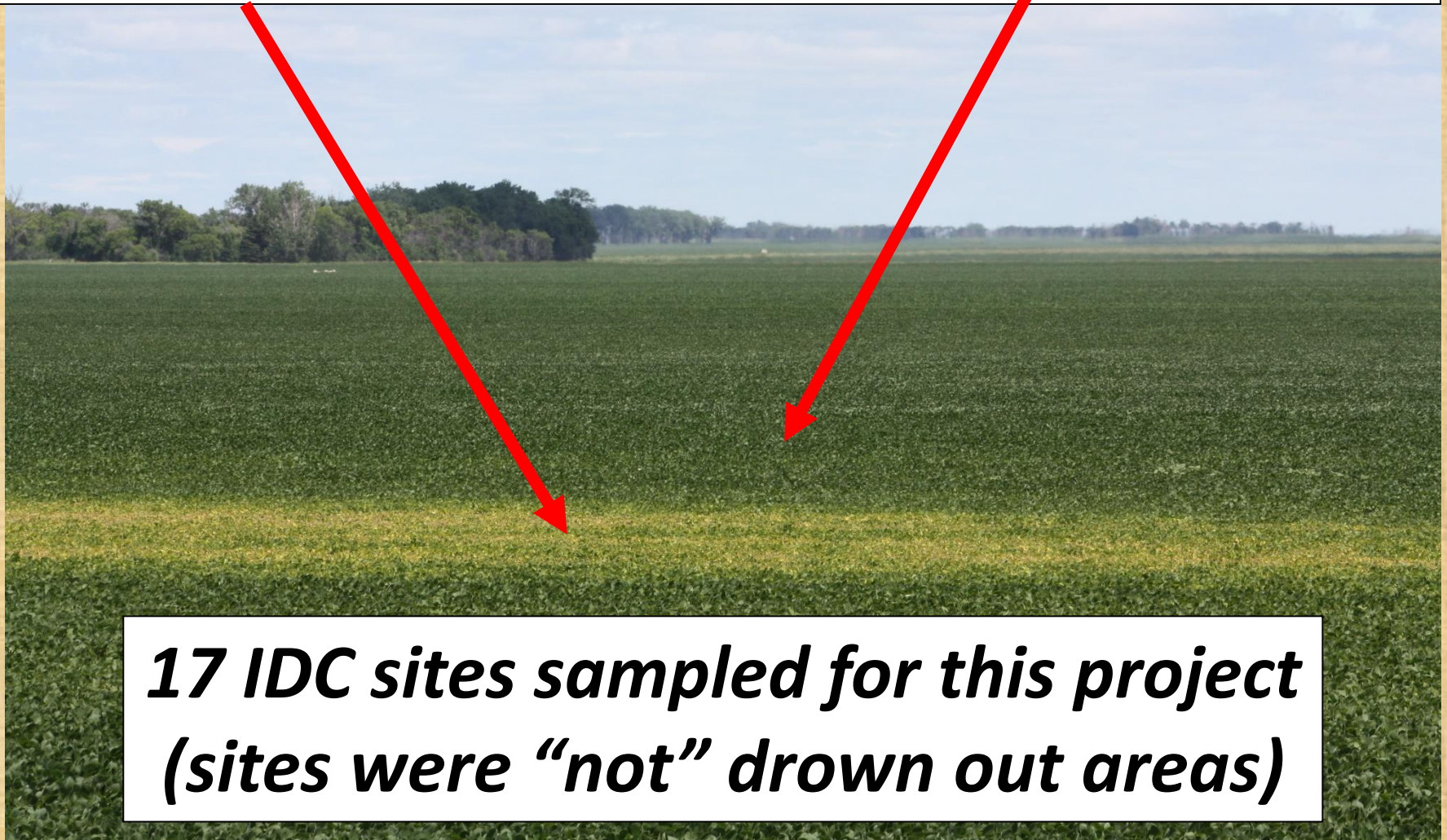
% Soil Samples with Carbonate greater than 5.0%



Fall 2016 samples
(0-6" samples)



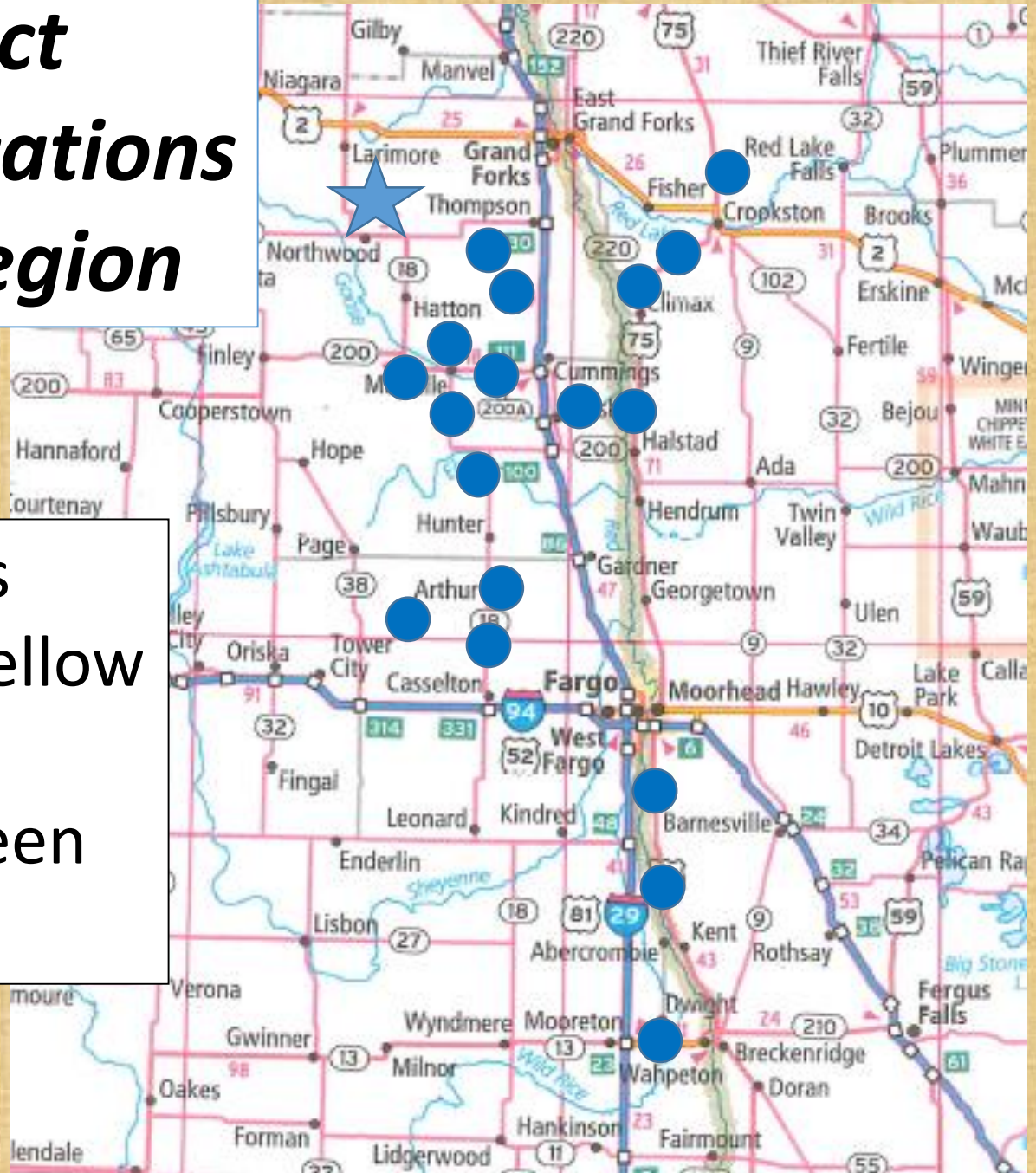
Soil Sampling Method: Sample from IDC area and adjacent Green area



***17 IDC sites sampled for this project
(sites were “not” drown out areas)***

IDC Project Sampling Locations Northern Region

0-6" soil samples
collected from Yellow
soybeans
And adjacent green
soybean area.



Causes for IDC 2016 Northern Region

Location	IDC?	pH	Nitrate (0-6") lb/a	Soluble Salt (e.c.)	Carbonate (CCE%)	Reason for IDC?
Thompson ND	Yellow	8.7	79	.82	6.6	N, Salt, CCE
	Green	8.2	13	.49	4.2	
Mayville ND 1	Yellow	8.3	32	.33	2.4	CCE
	Green	8.0	12	.19	1.2	
Mayville ND 2	Yellow	8.0	21	.45	4.7	CCE
	Green	8.3	13	.43	0.8	
Clifford ND	Yellow	8.5	26	.41	8.4	CCE
	Green	8.0	10	.17	0.7	
Galesburg ND	Yellow	8.3	26	.43	6.8	CCE
		7.8	27	.28	1.1	
Arthur ND	Yellow	8.4	39	.31	1.5	??
		8.4	17	.22	0.8	
Amenia ND	Yellow	8.4	64	.75	2.6	N, salt, CCE
		8.2	34	.29	1.4	

Causes for IDC 2016 Northern Region

Location	IDC?	pH	Nitrate (0-6") lb/a	Soluble Salt (e.c.)	Carbonate (CCE%)	Reason for IDC?
Crookston MN 1	Yellow	8.0	28	.26	1.7	CCE
	Green	8.0	12	.19	0.6	
Crookston MN 2	Yellow	8.2	19	.25	1.6	??
	Green	8.0	11	.11	1.5	
Climax MN	Yellow	8.2	14	.51	7.1	CCE
	Green	8.1	19	.60	3.6	
Wolverton MN	Yellow	8.2	96	4.85	2.6	N, salt, CCE
	Green	8.1	32	0.99	0.8	
Wahpeton ND	Yellow	8.5	15	.99	2.1	Salt, CCE
	Green	8.3	19	.32	1.0	
Reynolds ND	Yellow	8.4	21	.73	12.0	Salt, CCE
	Green	8.0	7	.39	0.8	
Hatton ND	Yellow	8.3	24	.49	3.2	CCE
	Green	7.4	9	.17	0.0	

Causes for IDC - 2016 Northern Region

Location	IDC?	pH	Nitrate (0-6") lb/a	Soluble Salt (e.c.)	Carbonate (CCE%)	Reason for IDC?
Ayr ND	Yellow	8.4	52	.48	2.1	N, salt, CCE
	Green	8.0	10	.20	0.4	
Hillsboro ND 1	Yellow	8.1	22	1.88	3.8	Salt, CCE
	Green	8.0	10	.87	2.0	
Hillsboro ND 2	Yellow	8.4	16	.37	6.6	CCE
	Green	7.4	18	.32	0.0	

Observed reasons for IDC across 17 sites

<u>Factors</u>	<u>Number of sites</u>
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N, Salt, CCE

4

Salt, CCE

3

N, CCE

0

CCE

8

Unknown Reasons

2

Total sites

17

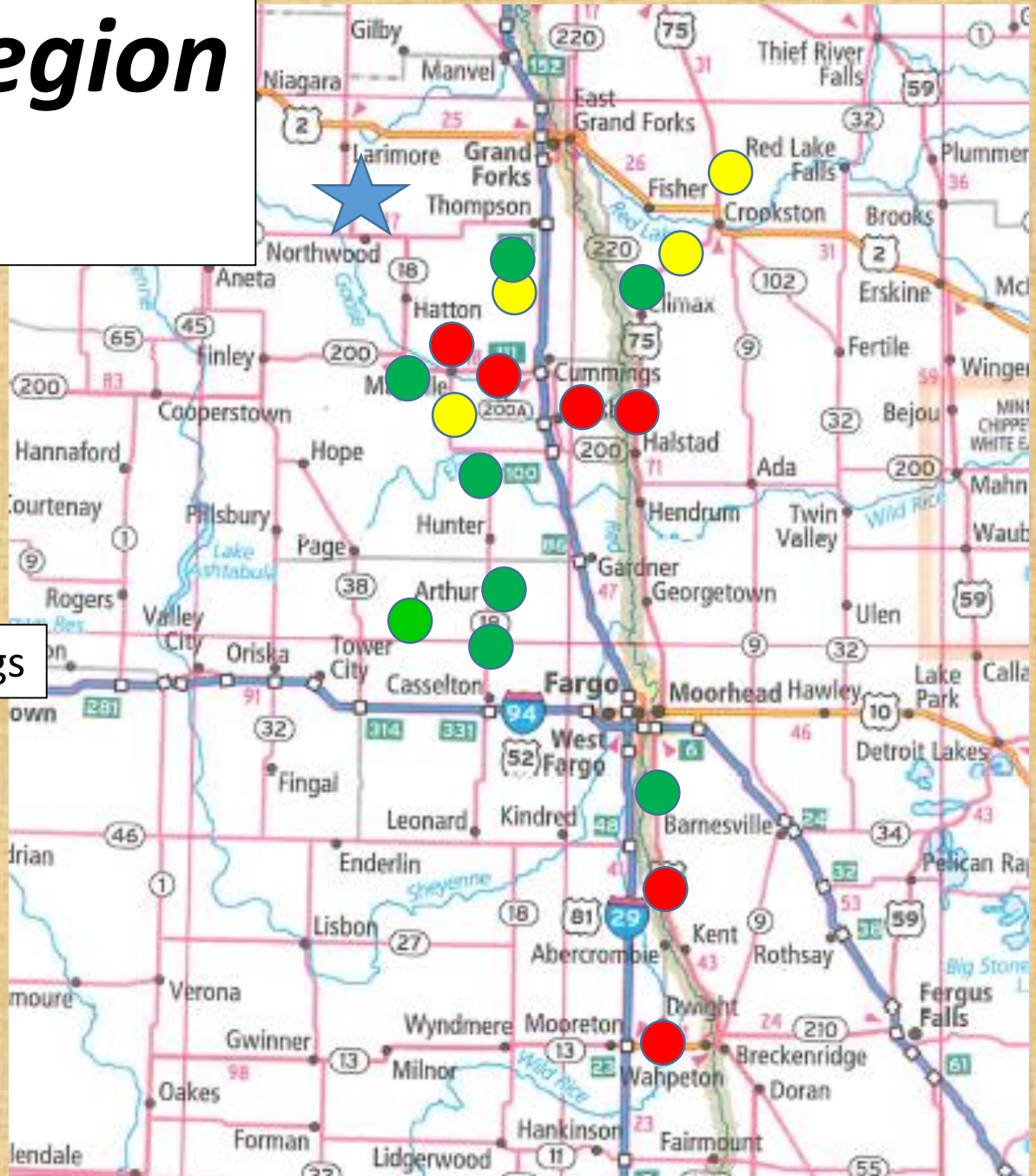
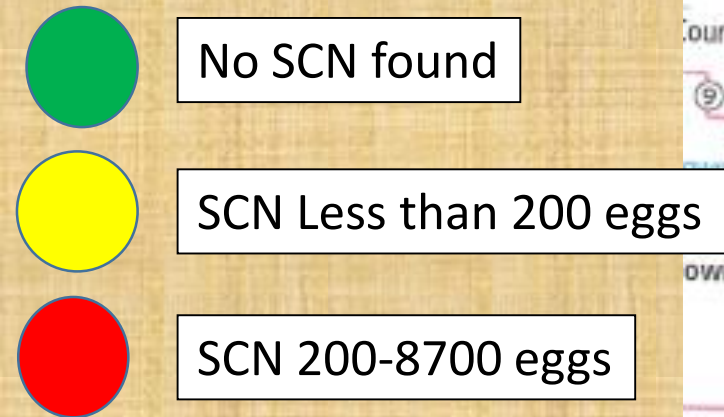
***CCE involved in
15 of 17 sites!!!***

Could SCN make IDC Worse?

- SCN symptoms can be mistaken for IDC, compaction, drought stress etc.



Northern Region SCN Results



IDC Sites Northern Region – SCN level

Location	IDC?	pH	Nitrate (0-6") lb/a	Salt (e.c.)	Carbonate (CCE%)	Reason For IDC?	<i>SCN Eggs/100cc</i>
Thompson	Yellow	8.7	79	.82	6.6	N, Salt, CCE	0
	Green	8.2	13	.49	4.2		0
Mayville 1	Yellow	8.3	32	.33	2.4	CCE	0
	Green	8.0	12	.19	1.2		300
Mayville 2	Yellow	8.0	21	.45	4.7	CCE	0
	Green	8.3	13	.43	0.8		0
Clifford	Yellow	8.5	26	.41	8.4	salt, CCE	100
	Green	8.0	10	.17	0.7		0
Galesburg	Yellow	8.3	26	.43	6.8	CCE	0
		7.8	27	.28	1.1		50
Aurthur	Yellow	8.4	39	.31	1.5	??	0
		8.4	17	.22	0.8		0
Amenia	Yellow	8.4	64	.75	2.6	N, salt, CCE	0
		8.2	34	.29	1.4		0

IDC Sites Northern region – SCN test level

Location	IDC?	pH	Nitrate (0-6") lb/a	Salt (e.c.)	Carbonate (CCE%)	Reason For IDC?	<i>SCN</i> <i>Eggs/100cc</i>
Crookston 1	Yellow	8.0	28	.26	1.7	CCE	100
	Green	8.0	12	.19	0.6		0
Crookston 2	Yellow	8.2	19	.25	1.6	??	200
	Green	8.0	11	.11	1.5		0
Climax	Yellow	8.2	14	.51	7.1	CCE	0
	Green	8.1	19	.60	3.6		0
Wolverton	Yellow	8.2	96	4.85	2.6	N, salt, CCE	350
	Green	8.1	32	0.99	0.8		900
Wahpeton	Yellow	8.5	15	.99	2.1	Salt, CCE	4100
	Green	8.3	19	.32	1.0		4150
Reynolds	Yellow	8.4	21	.73	12.0	Salt, CCE	100
	Green	8.0	7	.39	0.8		200
Hatton	Yellow	8.3	24	.49	3.2	CCE	7300
	Green	7.4	9	.17	0.0		450

IDC Sites Northern Region – SCN level

Location	IDC?	pH	Nitrate (0-6") lb/a	Salt (e.c.)	Carbonate (CCE%)	Reason For IDC?	<i>SCN Eggs/100cc</i>
Ayr	Yellow	8.4	52	.48	2.1	N, salt, CCE	0
	Green	8.0	10	.20	0.4		0
Hillsboro 1	Yellow	8.1	22	1.88	3.8	Salt, CCE	1750
	Green	8.0	10	.87	2.0		2450
Hillsboro 2	Yellow	8.4	16	.37	6.6	CCE	8750
	Green	7.4	18	.32	0.0		0

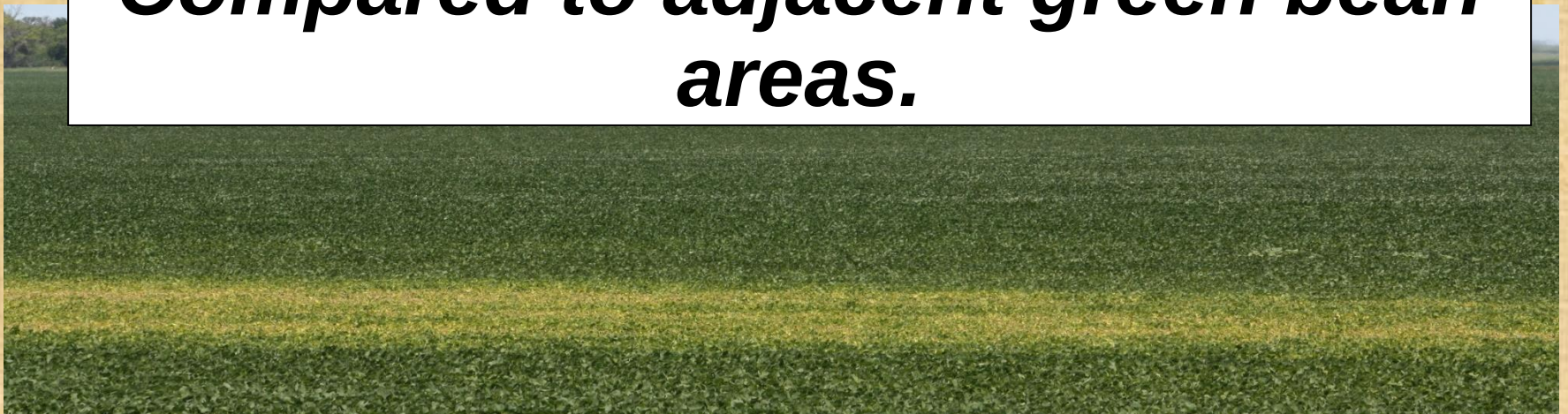
SCN Influence on IDC North Region

Yellow beans (IDC) :SCN higher - 5 sites
Green beans :SCN higher - 6 sites
IDC and green beans
Same SCN levels :SCN same - 4 sites

Summary

Most IDC areas explained by higher levels Carbonates (CCE) in addition to salts or high nitrate (or combinations)

IDC areas do not consistently have higher or lower SCN test levels Compared to adjacent green bean areas.



SCN test - Southern Region Sites

Location	IDC?	pH	Nitrate (0-6") lb/a	Soluble Salt (e.c.)	Carbonate (CCE%)	Reason for IDC?	SCN (eggs/100 cc)
Wilmot, SD	Yellow	8.0	Na	1.82	2.0	salt	0
	Green	7.9	Na	0.78	2.6		0
Wilmot, SD	Yellow	8.2	Na	4.16	9.9	salt, CCE	0
	Green	7.5	Na	1.13	0.4		0
DeGraff 2	Yellow	8.2	38	0.39	8.6	???	250
	Green	8.3	16	0.40	9.7		50
Benson 2	Yellow	7.9	12	0.30	1.7	???	450
	Green	8.0	12	0.36	1.6		1000
Benson 4	Yellow	8.0	84	0.51	5.4	N, CCE	150
	Green	8.2	9	0.16	1.4		0
Benson 5	Yellow	8.2	22	0.32	6.8	???	0
	Green	8.1	23	0.37	9.0		0
Alberta	Yellow	7.9	61	0.59	4.2	N, Salt	850
	Green	8.0	29	0.4	6.7		0

SCN test - Southern Region Sites

Location	IDC?	pH	Nitrate (0-6") lb/a	Soluble Salt (e.c.)	Carbonate (CCE%)	Reason for IDC?	SCN (eggs/100 cc)
Chokio	Yellow	8.0	46	0.66	8.4	salt, CCE	200
	Green	8.0	33	0.43	3.2		200
Graceville	Yellow	8.1	49	0.74	7.4	N, Salt	0
	Green	8.1	16	0.42	7.1		50
Herman	Yellow	8.1	35	0.36	8.2	CCE	0
	Green	8.1	23	0.27	5.7		200
Clarkfield NE	Yellow	7.8	29	1.02	7.2	Salt, CCE	2300
	Green	8.0	30	0.44	2.3		4100
Clarkfield W	Yellow	8.1	66	0.54	6.1	???	5800
	Green	8.0	36	0.54	5.4		3750
Clarkfield S	Yellow	7.9	23	0.44	4.2	CCE	7450
	Green	7.9	13	0.29	0.8		3500
St. Leo 2	Yellow	7.8	24	1.66	9.3	Salt, CCE	0
	Green	7.9	14	0.44	1.8		50

SCN Tests - Southern Region Sites

Location	IDC?	pH	Nitrate (0-6") lb/a	Soluble Salt (e.c.)	Carbonate (CCE%)	Reason for IDC?	SCN (eggs/100 cc)
St. Leo 1	Yellow	8.0	18	0.47	9.9	???	13400
	Green	8.1	12	0.35	10.1		550
Sacred Heart	Yellow	8.2	17	0.33	8.6	CCE	1850
	Green	8.1	11	0.36	5.5		1200
Renville	Yellow	8.2	25	0.49	10.0	???	4150
	Green	8.3	9	0.37	10.5		3100
Clara City	Yellow	8.1	29	0.49	2.8	???	500
	Green	8.1	44	0.56	2.0		900
Raymond	Yellow	7.9	32	1.8	14.2	Salt, CCE	3350
	Green	8.1	8	0.53	8.2		1300
Blomkest	Yellow	8.1	21	0.48	9.7	CCE	11050
	Green	8.1	14	0.35	5.3		6500

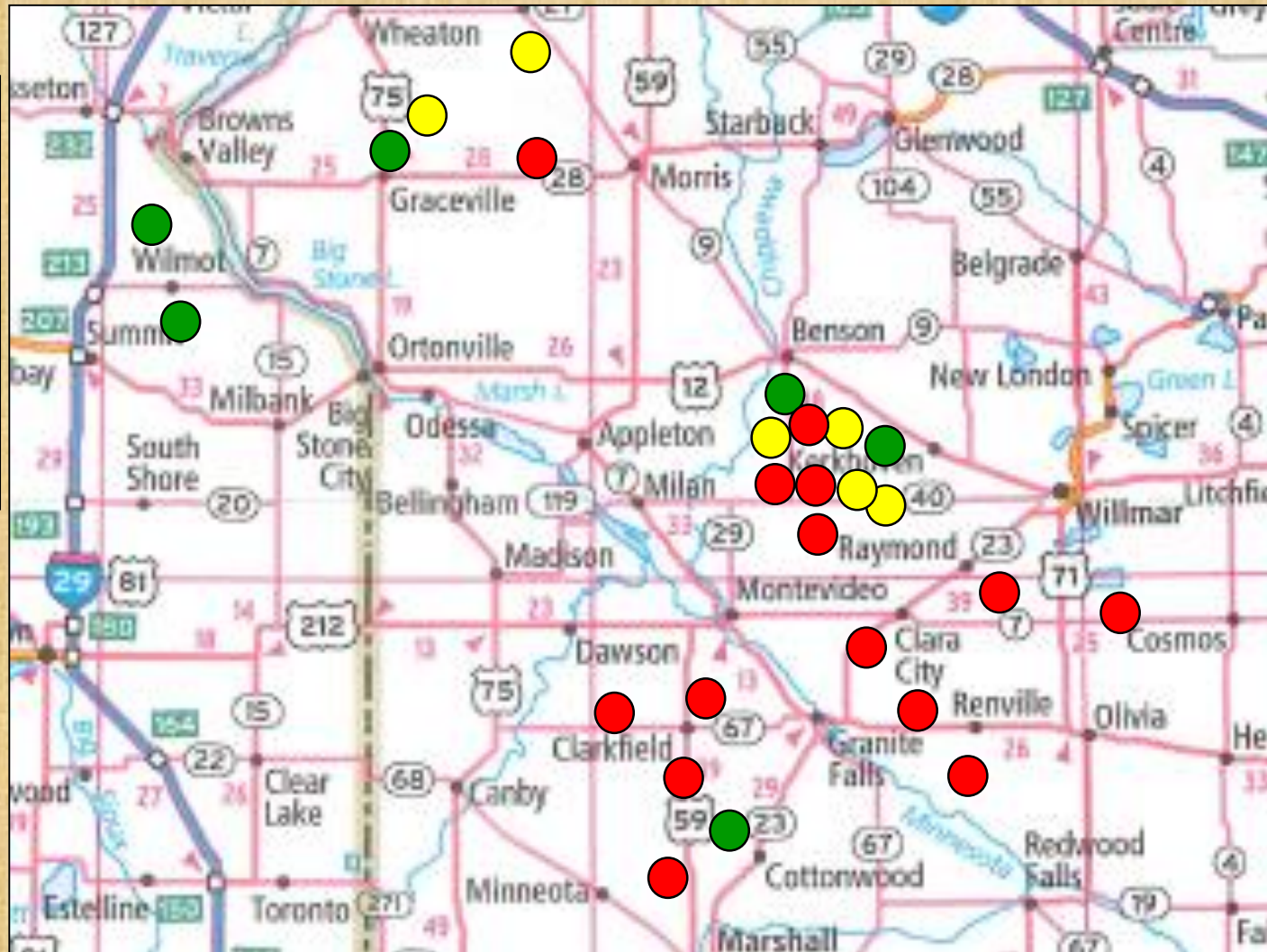
SCN Influence on IDC

Southern Region

Yellow beans (IDC) :SCN higher -10 sites
Green beans :SCN higher - 6 sites
IDC and green beans
Same SCN levels :SCN same - 4 sites

IDC Project Southern Region

0-6" soil samples
collected from
Yellow soybeans
and adjacent
green soybean
area.

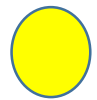


Southern Region SCN Results

Sites positive for SCN



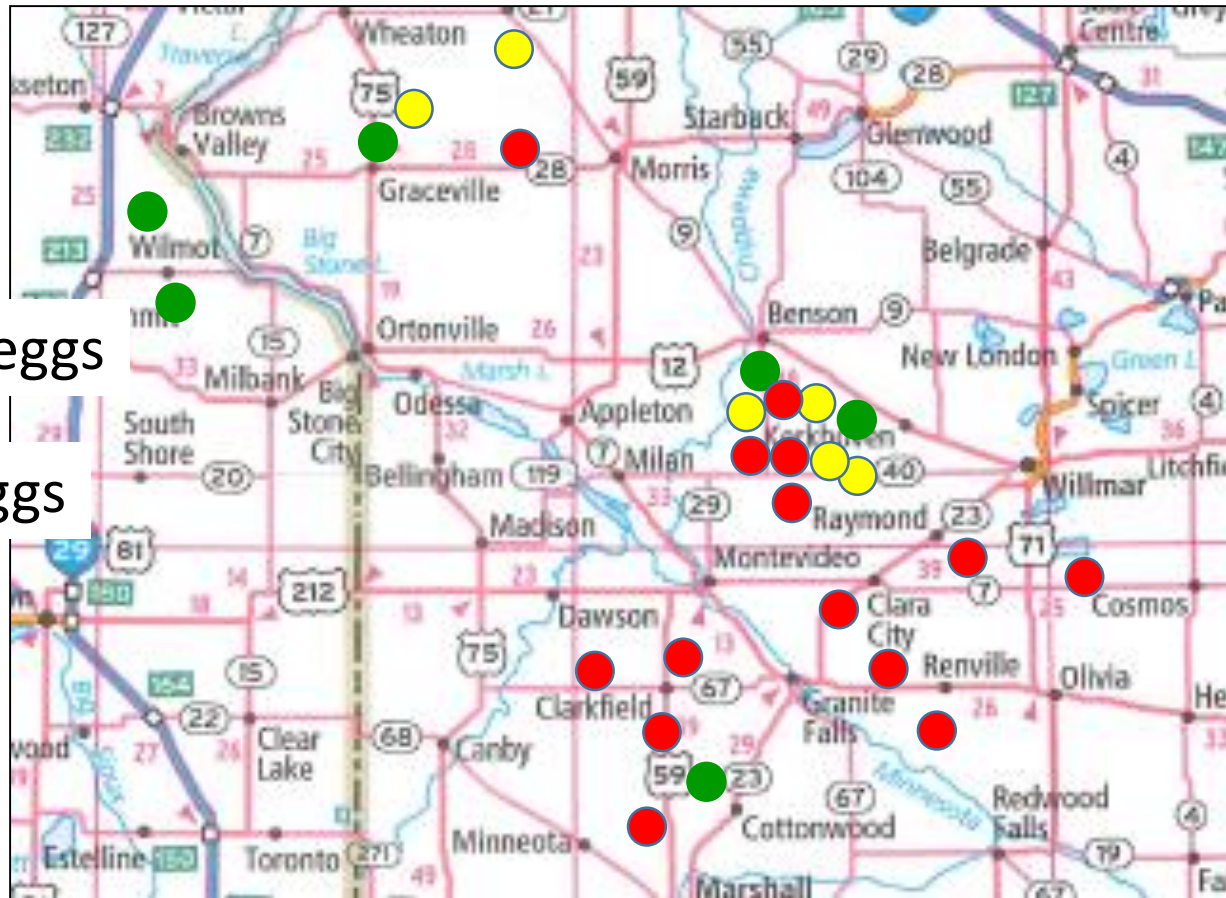
No SCN found



SCN Less than 200 eggs



SCN 200-13,700 eggs



Causes for IDC 2016 Southern Region

Location	IDC?	pH	Nitrate (0-6") lb/a	Soluble Salt (e.c.)	Carbonate (CCE%)	Reason for IDC?
Wilmot, SD	Yellow	8.0	Na	1.82	2.0	salt
	Green	7.9	Na	0.78	2.6	
Wilmot, SD	Yellow	8.2	Na	4.16	9.9	salt, CCE
	Green	7.5	Na	1.13	0.4	
DeGraff 2	Yellow	8.2	38	0.39	8.6	???
	Green	8.3	16	0.40	9.7	
Benson 2	Yellow	7.9	12	0.30	1.7	???
	Green	8.0	12	0.36	1.6	
Benson 4	Yellow	8.0	84	0.51	5.4	N, salt, CCE
	Green	8.2	9	0.16	1.4	
Benson 5	Yellow	8.2	22	0.32	6.8	???
	Green	8.1	23	0.37	9.0	
Alberta	Yellow	7.9	61	0.59	4.2	N, Salt
	Green	8.0	29	0.4	6.7	

Causes for IDC 2016 Southern Region

Location	IDC?	pH	Nitrate (0-6") lb/a	Soluble Salt (e.c.)	Carbonate (CCE%)	Reason for IDC?
Chokio	Yellow	8.0	46	0.66	8.4	salt, CCE
	Green	8.0	33	0.43	3.2	
Graceville	Yellow	8.1	49	0.74	7.4	N, Salt
	Green	8.1	16	0.42	7.1	
Herman	Yellow	8.1	35	0.36	8.2	CCE
	Green	8.1	23	0.27	5.7	
Clarkfield NE	Yellow	7.8	29	1.02	7.2	Salt, CCE
	Green	8.0	30	0.44	2.3	
Clarkfield W	Yellow	8.1	66	0.54	6.1	???
	Green	8.0	36	0.54	5.4	
Clarkfield S	Yellow	7.9	23	0.44	4.2	CCE
	Green	7.9	13	0.29	0.8	
St. Leo 2	Yellow	7.8	24	1.66	9.3	Salt, CCE
	Green	7.9	14	0.44	1.8	

Causes for IDC 2016 Southern Region

Location	IDC?	pH	Nitrate (0-6") lb/a	Soluble Salt (e.c.)	Carbonate (CCE%)	Reason for IDC?
St. Leo 1	Yellow	8.0	18	0.47	9.9	???
	Green	8.1	12	0.35	10.1	
Sacred Heart	Yellow	8.2	17	0.33	8.6	CCE
	Green	8.1	11	0.36	5.5	
Renville	Yellow	8.2	25	0.49	10.0	???
	Green	8.3	9	0.37	10.5	
Clara City	Yellow	8.1	29	0.49	2.8	???
	Green	8.1	44	0.56	2.0	
Raymond	Yellow	7.9	32	1.8	14.2	Salt, CCE
	Green	8.1	8	0.53	8.2	
Blomkest	Yellow	8.1	21	0.48	9.7	CCE
	Green	8.1	14	0.35	5.3	

Causes for IDC - 2016 Southern Region

Observed reasons for IDC across 20 sites

<u>Factors</u>	<u>Number of sites</u>
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N, Salt, CCE	1
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Salt, CCE	5
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N, CCE	0
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CCE	4
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Salt	1
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N, salt	2
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<u>Unknown Reasons</u>	<u>7</u>
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Total sites	20
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***CCE involved in
10 of 20 sites!!!***