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Breaking Through Yield Barriers: Knowing What the Plant Needs and Meeting Those Needs

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College of Agriculture and Life Sciences

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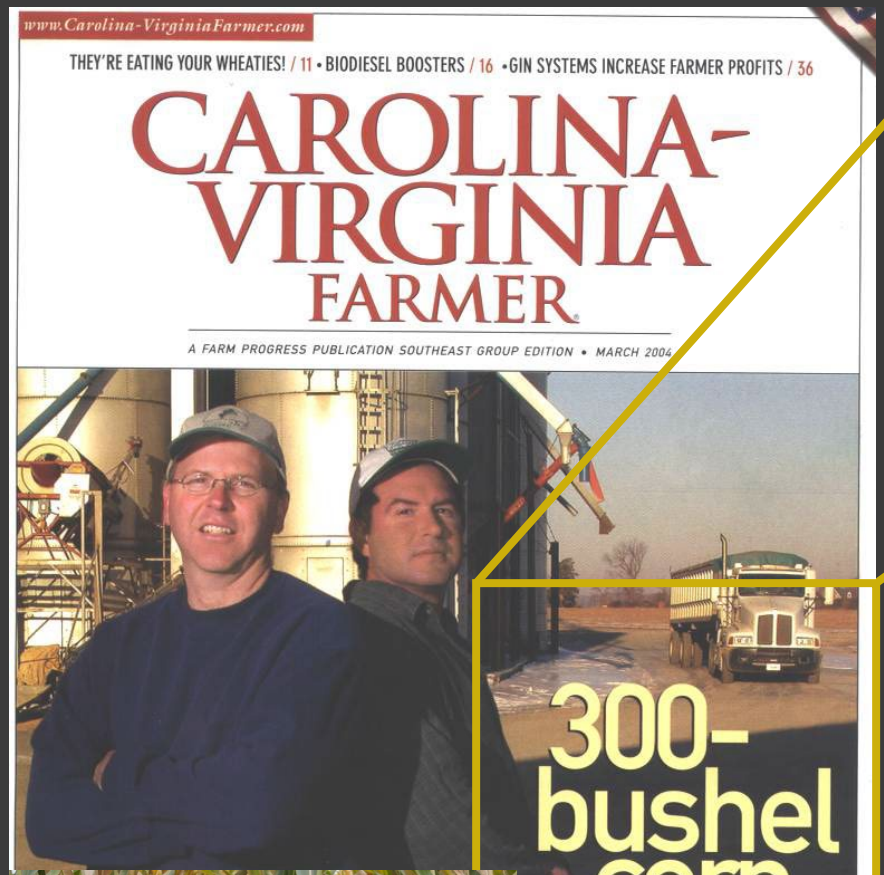

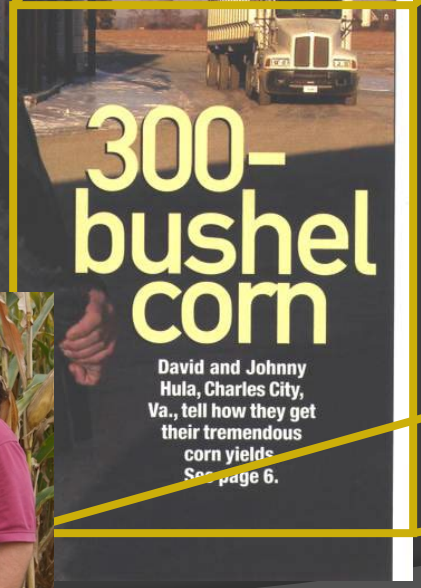

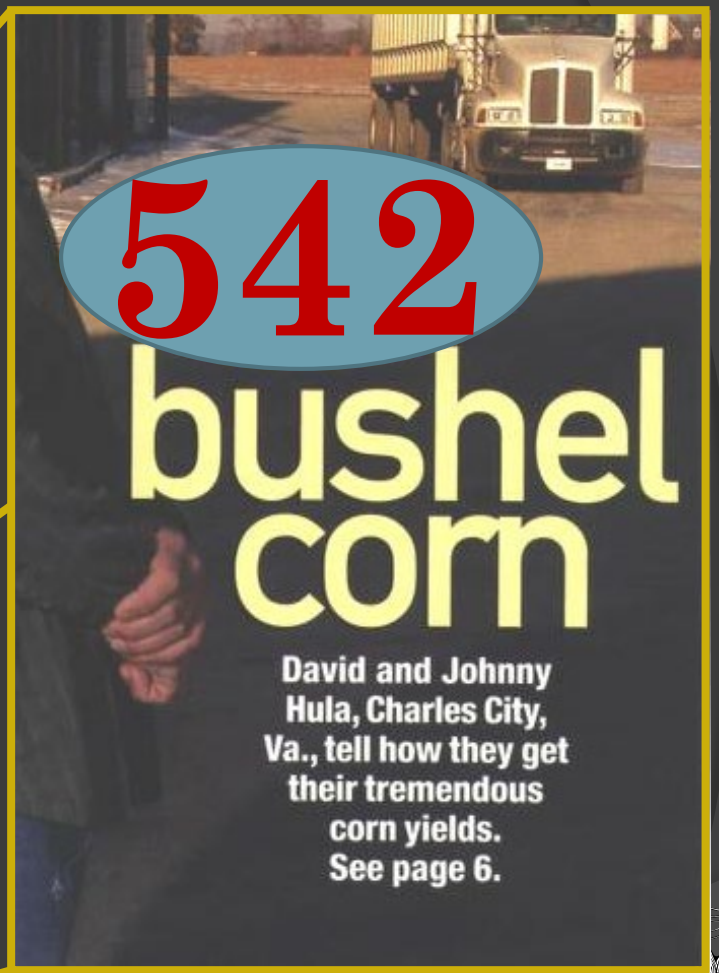

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The Environment of Corn

Rank	Factor	Value	
		bu/acre	%
1	Weather	70+	27
2	Nitrogen	70	26
3	Hybrid	50	19
4	Previous Crop	25	10
5	Plant Population	20	8
6	Tillage	15	6
7	Growth Regulators	10	4
	Total =	260 bu	100%

Fred Below, Seven Wonders of the Corn World
University of Illinois

FIVE ESSENTIALS OF THE CORN ENVIRONMENT

1. Light
2. Water
3. Temperature
4. Nutrients
5. Genetics

Knowing What the Plant Needs

Light

Capture as Much as Possible for as Long as Possible

Maximum Corn Yields are Obtained when:

the corn plant collects the maximum amount of light possible without stress

The Good – The Bad – The Ugly

The Good – Increasing Light Use

- Maximizing the length of Growth without stress
- Higher Plant Populations – Season Long Benefits
- Row Spacing – Early Benefits plus Reduced Stress

The Bad – Crop Stress

- Avoid Heat, Water, and Nutrient Stress at Critical Times

The Ugly – Balancing Light and Stress

Walking the Fine Line – Light vs Stress

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Yield Enhancing Practices – Forsythe Co - 2014

Management Practices	Grain Yield Bu/acre^{-1}	Yield Loss without Practice(s) Bu/acre^{-1}
Low – No Added Management	279.6	- 38.4 *
High – 42,000 seeds/a 100 lb N/a @ plant Seed Trmt Fungicide @ IF and V6	318.0	--------
High with 33,000 seeds/acre	283.2	- 34.8 *
High without N at Plant	299.0	- 19.0 *
High without Seed Trmt	298.5	- 19.5 *
High without Fungicide	293.4	- 24.6

What Makes Growing 300 to 500 Bushel Per Acre Corn So Impossible?

1. Difficulty with Uniform Emergence and Early Growth
   a) The Impact of cold, wet soil on emergence and early growth

2. Limitations on Capturing Light with Higher Plant Population
   a) Water – too little or too much
   b) High Temperatures During Pollination
   c) Nutrients – Right amount, right place, right time, right uptake
   d) Nutrient Interactions

3. The Problems with Lengthening the Grain Fill Period
   a) Heat Hastens Maturity
   b) Premature Senescence
   c) N and K Become Limiting Factors

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Managing The Ugly Through Uniform Emergence

Rapid – Uniform Emergence – Early Growth

Factors Affecting Quick, Uniform Emergence and Early Growth

1. Soil Environment
2. Hybrid
3. Seeding Depth
4. Nutrient Availability
5. Weed Control
6. Pest Control

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1st Emerged
2nd Emerged
3rd Emerged
4th Emerged


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DeKalb DKC 64-35

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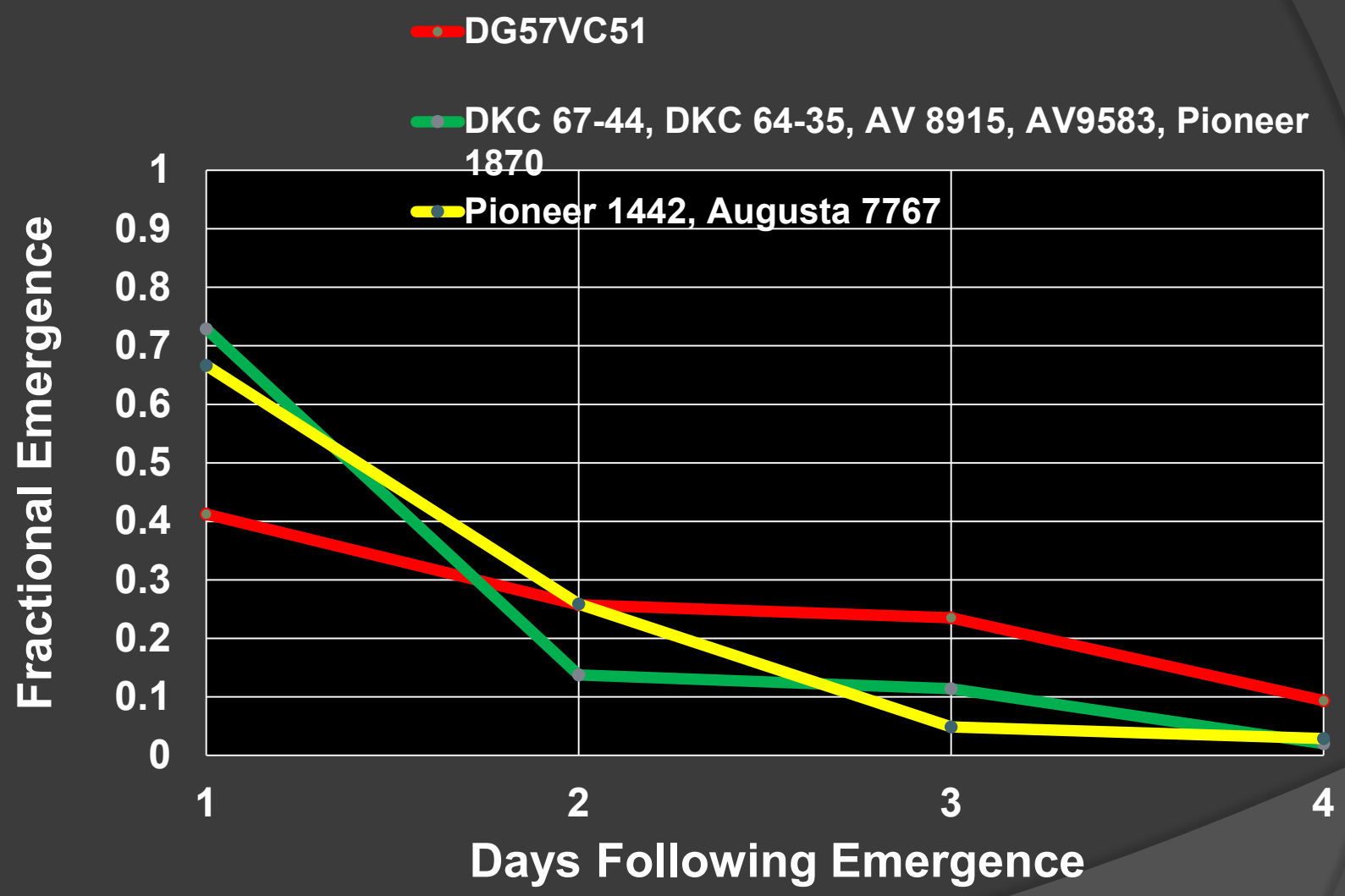
How Important is Emergence?



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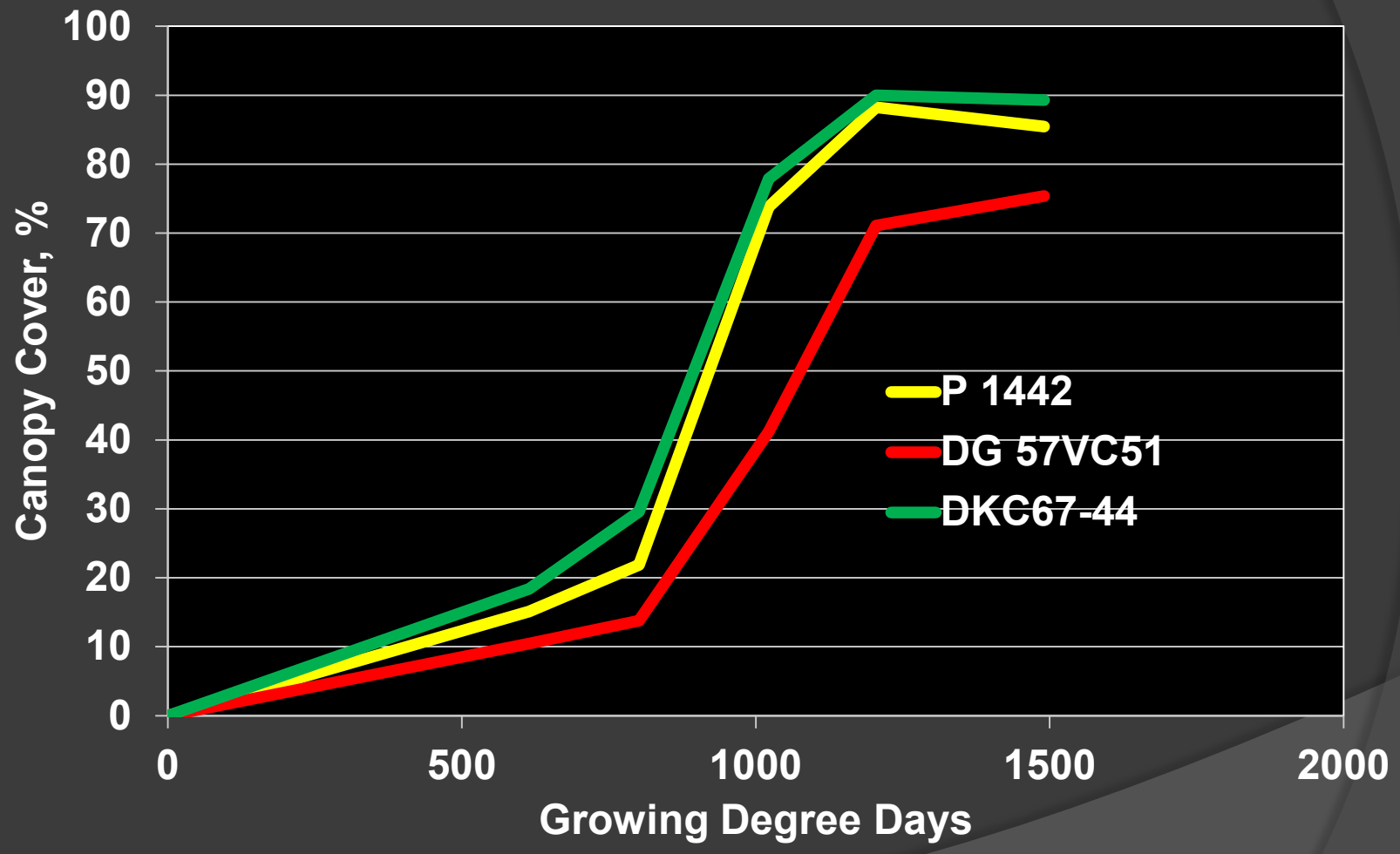
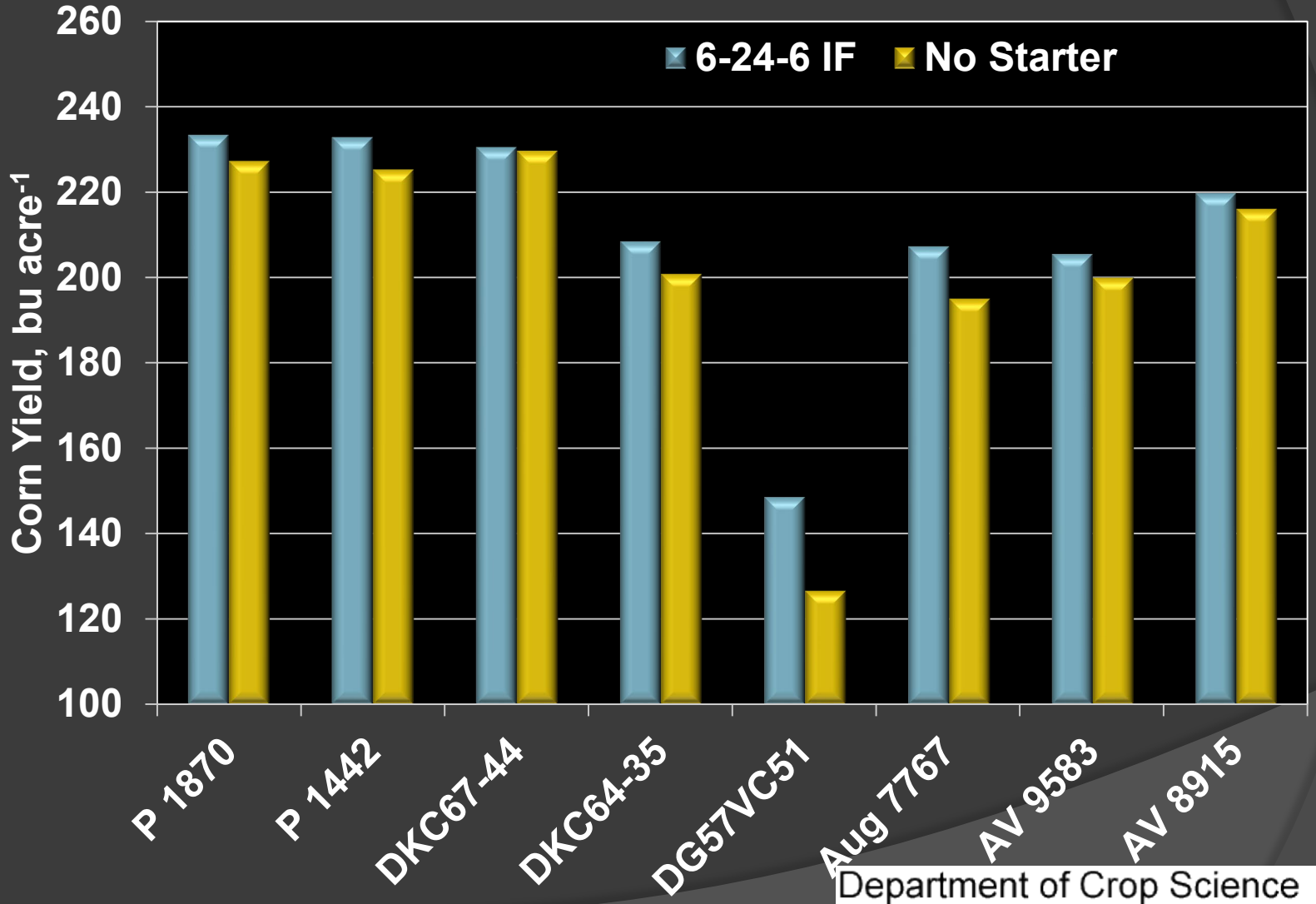
How Important is Uniform Emergence?



How Important is Uniform Emergence?



Managing Nutrients

Nutrient Uptake

BETTER NUTRIENT UTILIZATION

Grower Planted
DKC64-69
19-19-0 @ 20 gpa (2 x 2)

DIFFERENCE WAS

1 lb/a of Zn

DKC64-69
10-27-0 @ 20 gpa (2 x 2)
3-18-18 @ 5 gpa in-furrow

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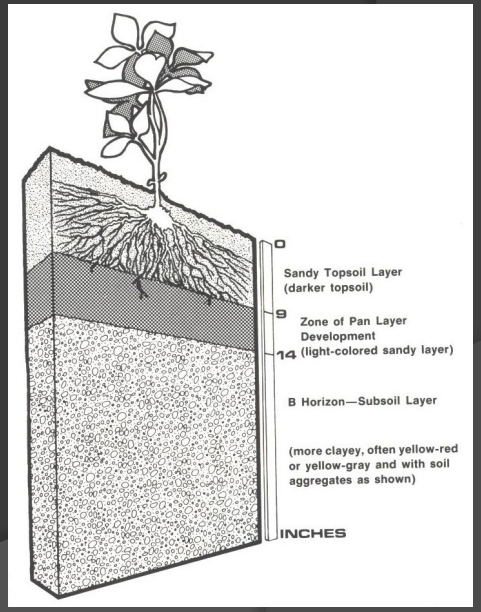
Increasing Nutrient Uptake – Tissue Concentration

Nutrients Need to be Available in the Soil

- Adequate Nutrient Concentration in Root Zone
- Nutrients in the Right Form for Plant Uptake
- Reduce Nutrient Tie-up and Loss

Root Development

- More Roots the More Successful Uptake is



- **Nutrient Interactions**
  - Mg and Ca; N and K; P and Zn S
  - Micronutrients

Managing the Light –Stress Balance With Roots

Growing Better Root Systems

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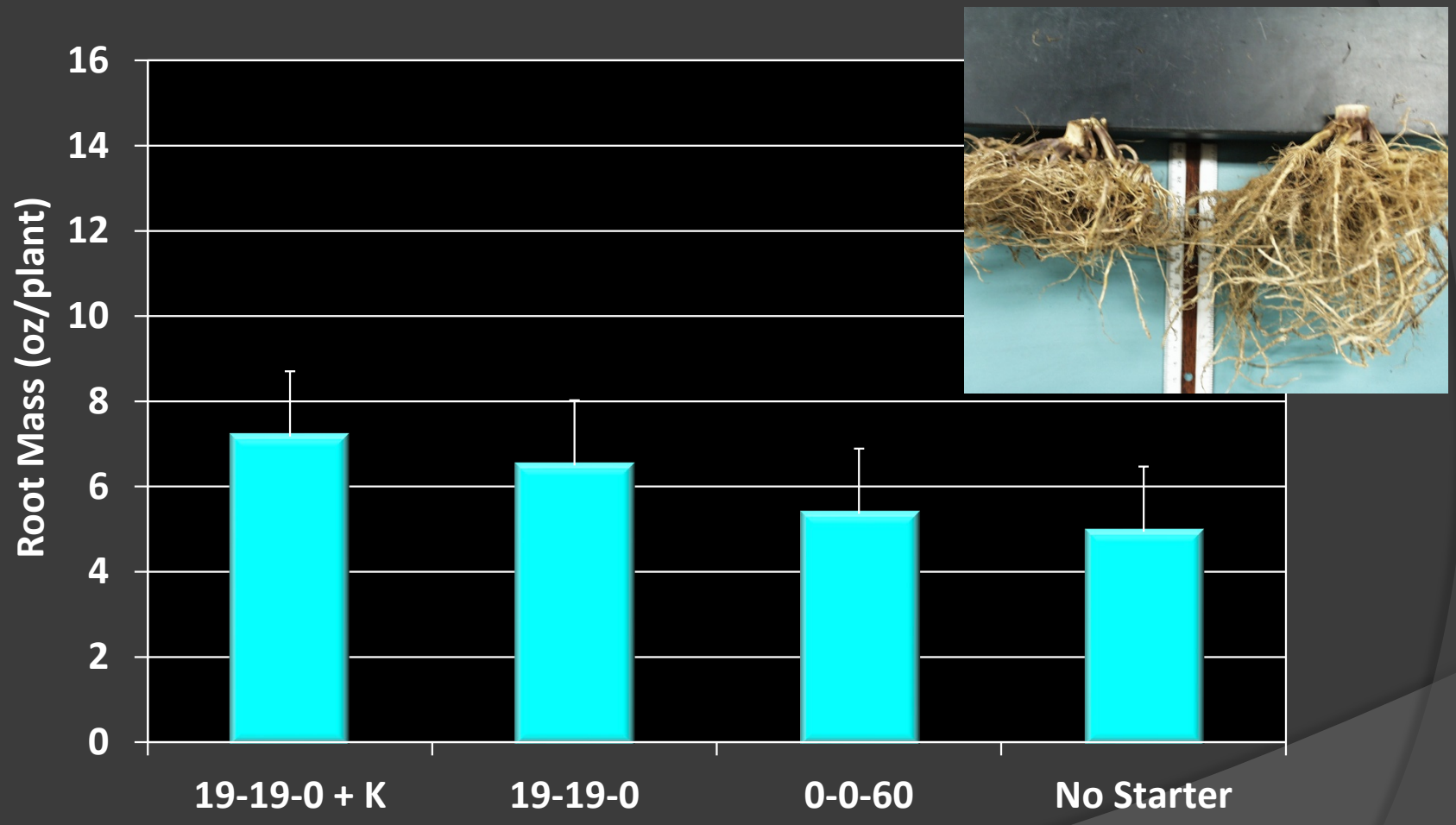
Differences in Root Ball Mass

Fertility Treatments on Root Mass



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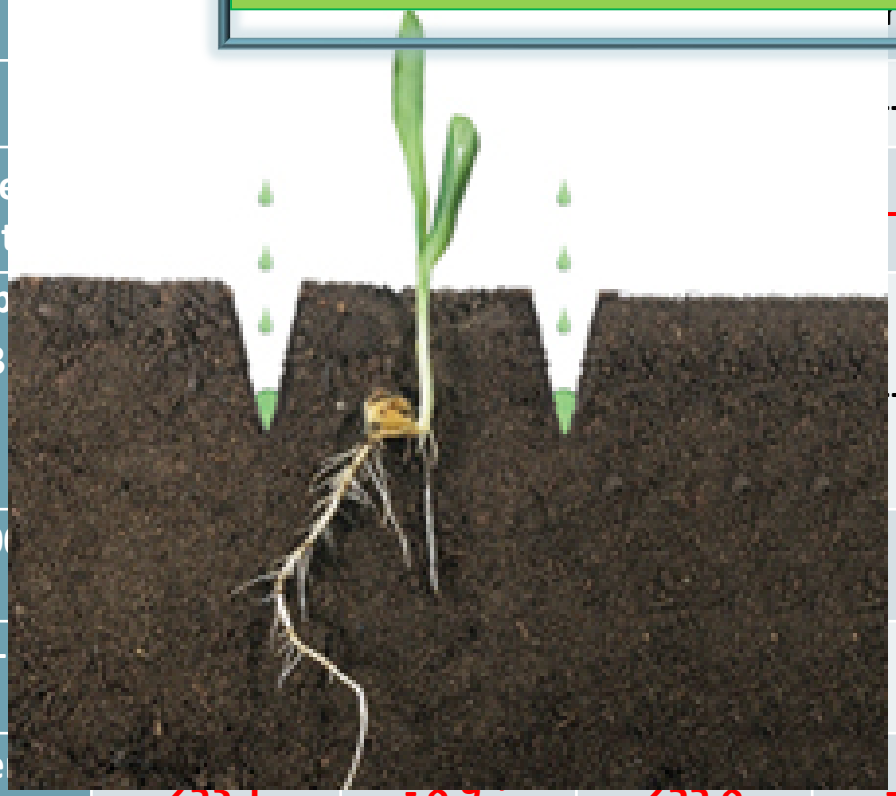
Managing Root Uptake

cing Early Nutrient Concentration n the Seed Zone – 2017

	Pamlico		Surry	
Low – No Adde Management				-18.2
High – 42,000 p 3-18-3 @ V3 2 x 2 x 2 B				
High with 34,0 seeds/acre				1.5
High without 3- 18 @ V3				-8.9
High with Starte One Side of Row	253.1	- 8.9	253.8	-15.1
High without B	262.8	0.7	263.6	-7.4

Placement of Nutrients



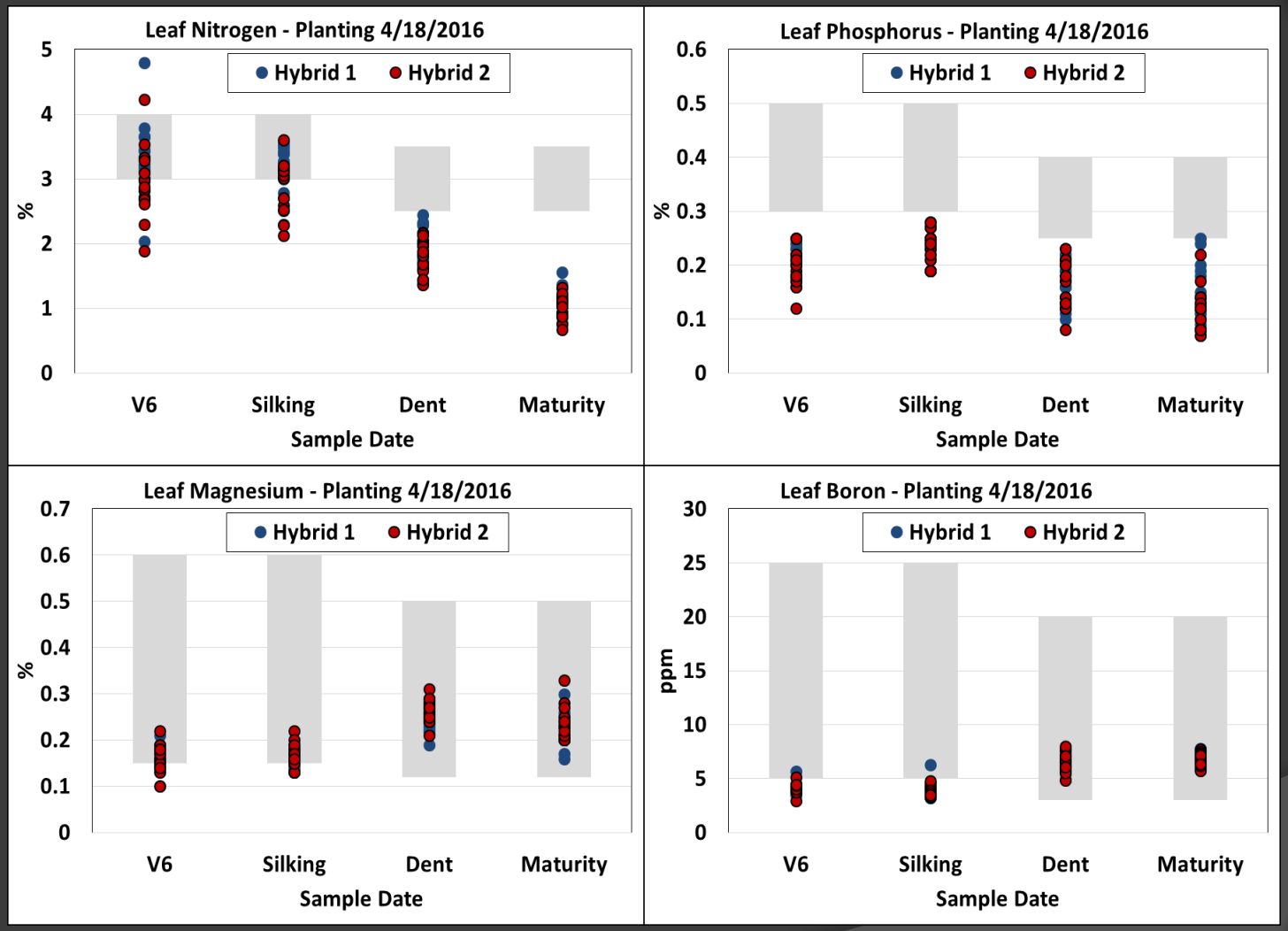
Managing Nutrient Uptake

Nutrient Interactions

Pre-Season Soil Test

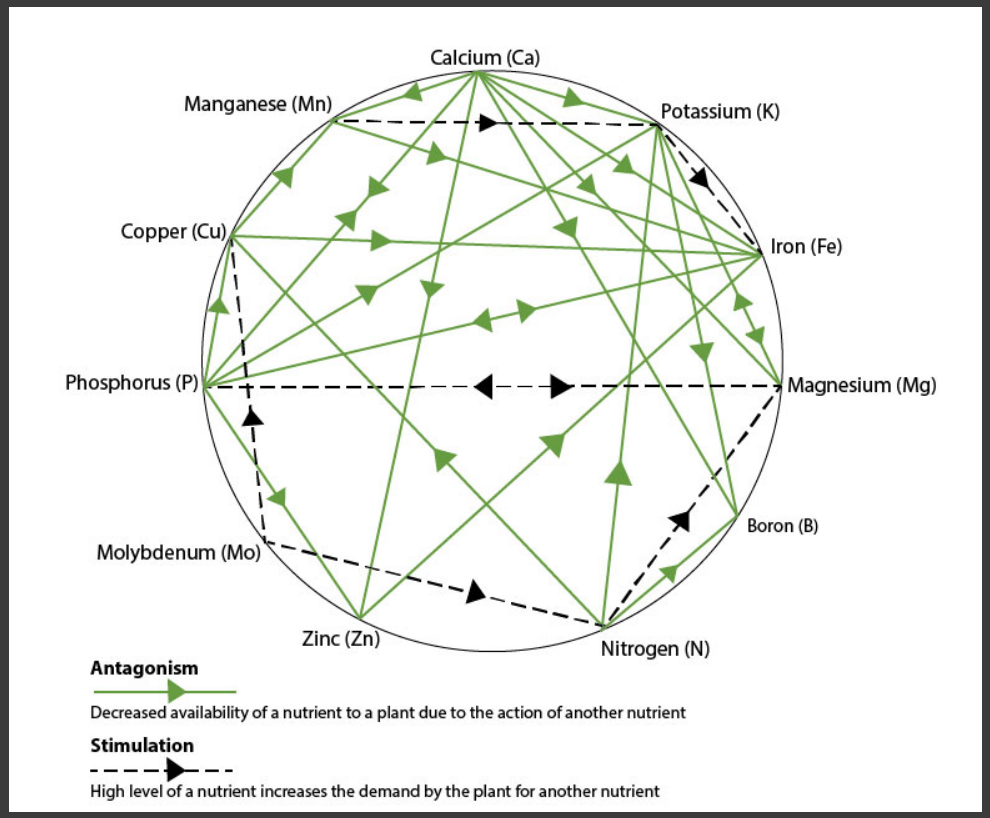
	HM†	W/V	CEC	BS	Ac	pH	P-I	K-I	Ca	Mg	S-I	Mn-I	Zn-I	Cu-I	Na
Field	%	g cc^{-3}	Meq 100 cm^{-1}	%			-- index --		%	%	---------- index ----------				Meq 100 cm^{-1}
H(a)	0.81	1.32	3.8	82	0.7	6.0	257	76	55	17	36	56	53	55	0.1
H(b)	0.56	1.33	2.8	79	0.6	5.9	209	43	54	17	29	55	57	53	0.2
H(c)	0.97	1.30	4.2	77	1.0	5.8	300	88	51	16	39	50	41	56	0.1

2016 Corn Trial: What Nutrients Did We Lack?



How Should Nutrients Be Balanced?

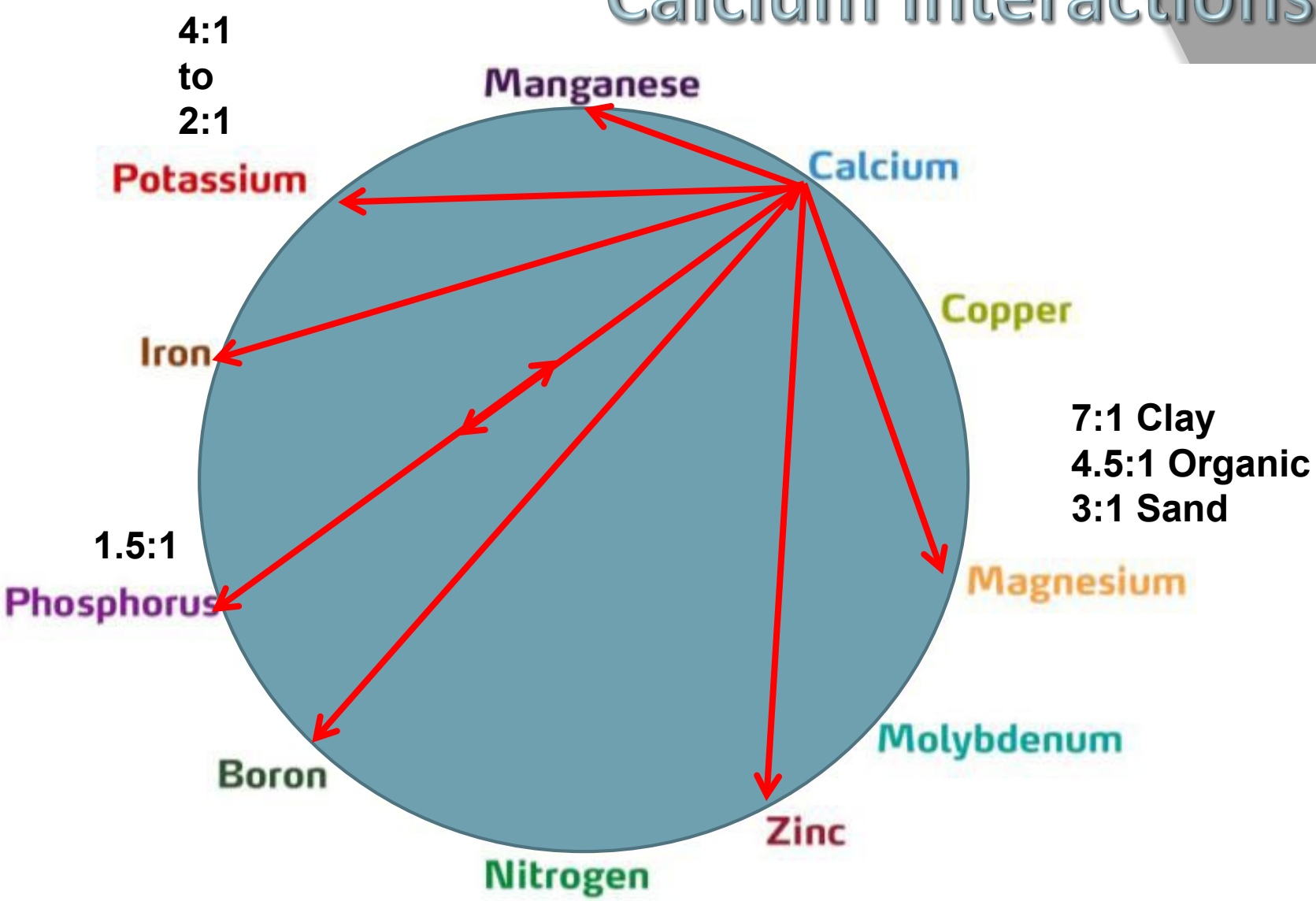
Mulder's Nutrient Chart



High levels of a particular nutrient in the soil can interfere with the availability and uptake by the plant of other nutrients. Those nutrients which interfere with one another are said to be antagonistic.

Stimulation occurs when the high level of a particular nutrient increases the demand by the plant for another nutrient.

Calcium Interactions

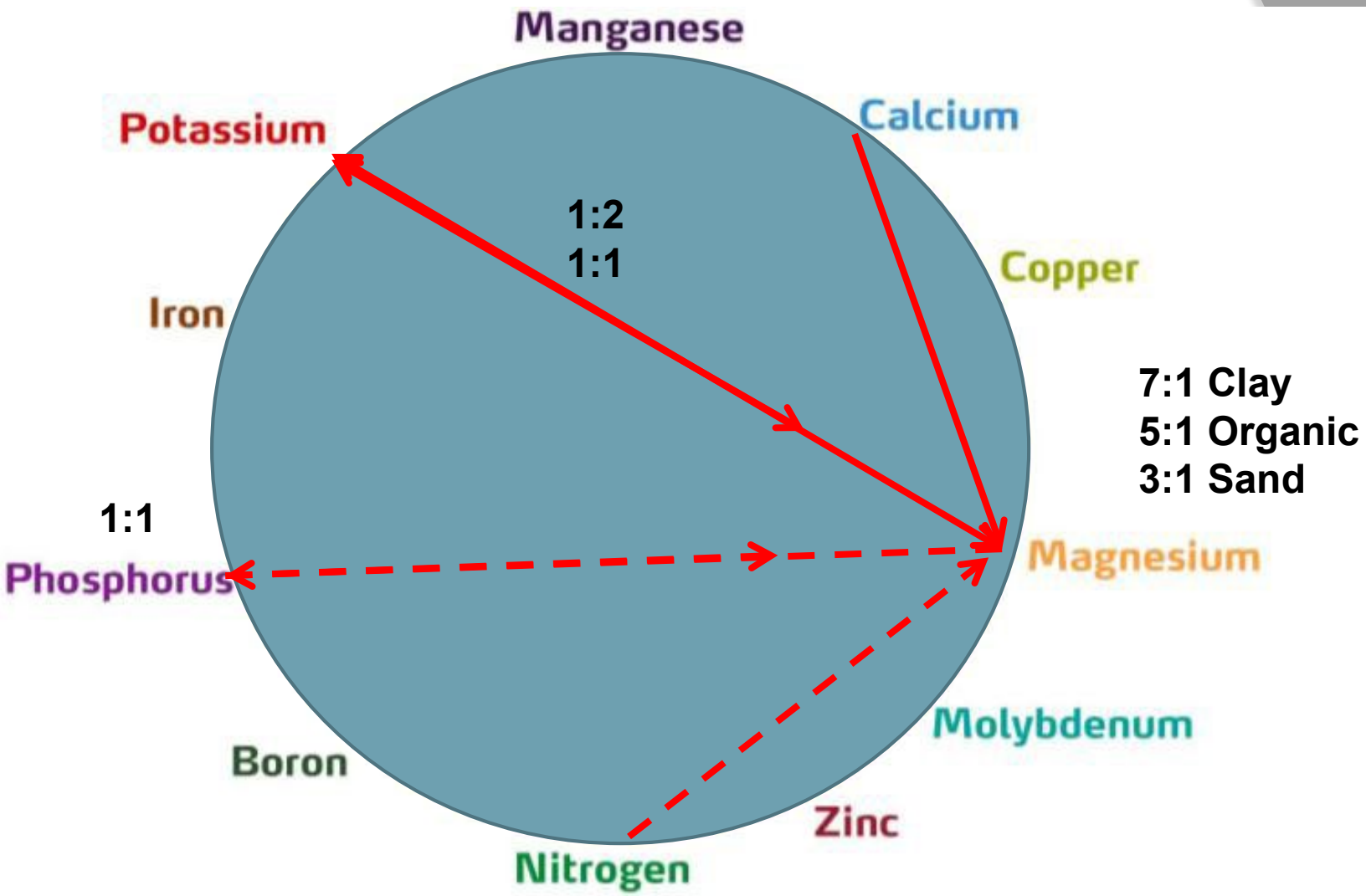


Pre-Season Soil Test – Sandy Soil

	HM†	W/V	CEC	BS	Ac	pH	P-I	K-I	Ca	Mg	S-I	Mn-I	Zn-I	Cu-I	Na
Field	%	g cc^{-3}	Meq 100 cm^{-1}	%			-- index --		%	%	---------- index ----------				Meq 100 cm^{-1}
H(a)	0.81	1.32	3.8	82	0.7	6.0	257	76	55	17	36	56	53	55	0.1
H(b)	0.56	1.33	2.8	79	0.6	5.9	209	43	54	17	29	55	57	53	0.2
H(c)	0.97	1.30	4.2	77	1.0	5.8	300	88	51	16	39	50	41	56	0.1

Ca to Mg Ratio = 3.2:1
Ca to P Ratio = 1.4:1
Ca to K Ratio = 2.8:1

Magnesium Interactions



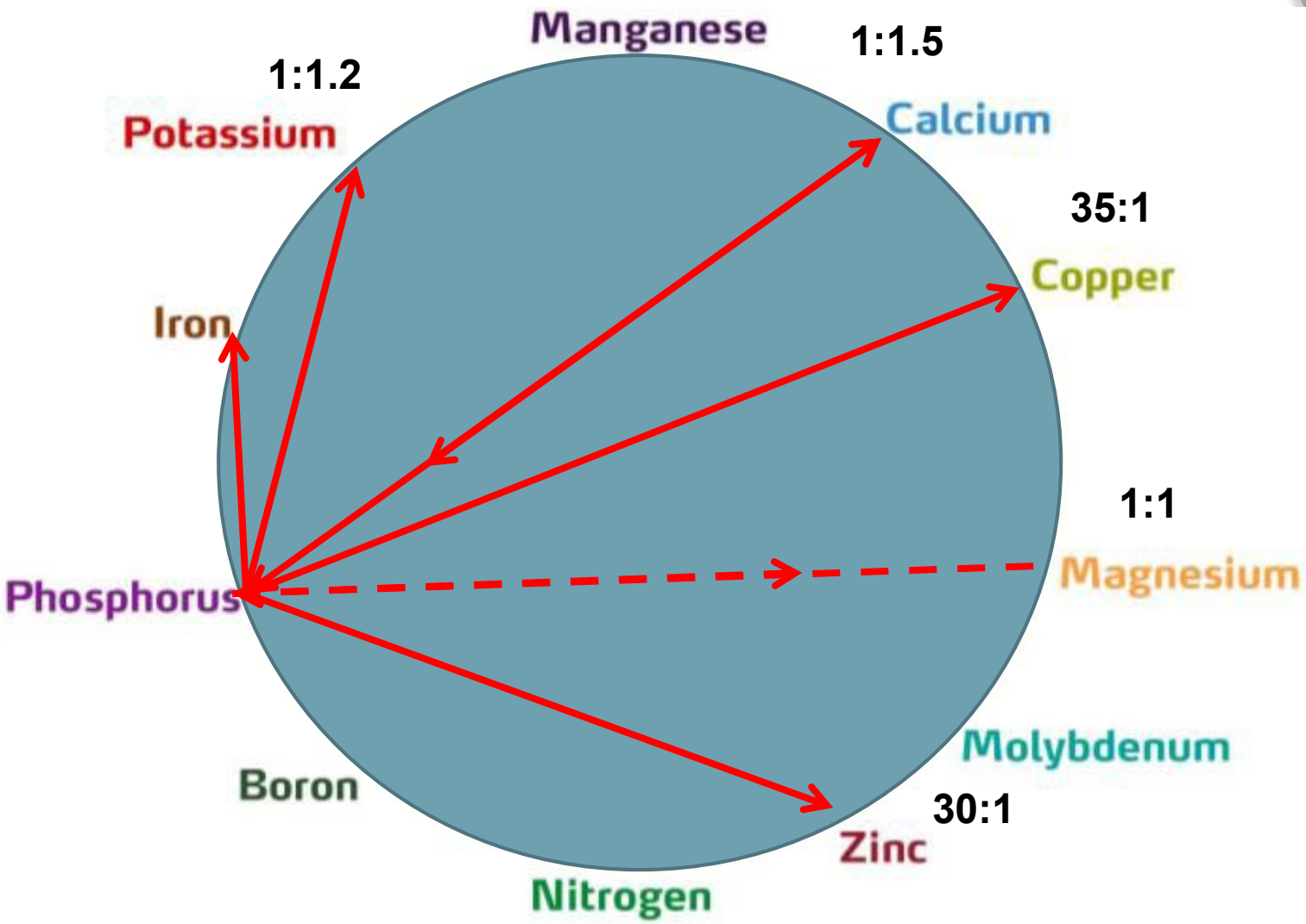
Pre-Season Soil Test – Sandy Soil

	HM†	W/V	CEC	BS	Ac	pH	P-I	K-I	Ca	Mg	S-I	Mn-I	Zn-I	Cu-I	Na
Field	%	g cc^{-3}	Meq 100 cm^{-1}	%			-- index --		%	%	---------- index ----------				Meq 100 cm^{-1}
H(a)	0.81	1.32	3.8	82	0.7	6.0	257	76	55	17	36	56	53	55	0.1
H(b)	0.56	1.33	2.8	79	0.6	5.9	209	43	54	17	29	55	57	53	0.2
H(c)	0.97	1.30	4.2	77	1.0	5.8	300	88	51	16	39	50	41	56	0.1

Mg to P Ratio = 1:3.9

Mg to K Ratio = 1:2

Phosphorus Interactions



Pre-Season Soil Test – Sandy Soil

	HM†	W/V	CEC	BS	Ac	pH	P-I	K-I	Ca	Mg	S-I	Mn-I	Zn-I	Cu-I	Na
Field	%	g cc^{-3}	Meq 100 cm^{-1}	%			-- index --		%	%	---------- index ----------				Meq 100 cm^{-1}
H(a)	0.81	1.32	3.8	82	0.7	6.0	257	76	55	17	36	56	53	55	0.1
H(b)	0.56	1.33	2.8	79	0.6	5.9	209	43	54	17	29	55	57	53	0.2
H(c)	0.97	1.30	4.2	77	1.0	5.8	300	88	51	16	39	50	41	56	0.1

P to Zn Ratio = 135:1

P to K Ratio = 2.1:1

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2018

Pre-Season Soil Test – Peanut Belt Station

	HM†	W/V	CEC	BS	Ac	pH	P-I	K-I	Ca	Mg	S-I	Mn-I	Zn-I	Cu-I	Na
Field	%	g cc^{-3}	Meq 100 cm^{-1}	%			-- index --		%	%	---------- index ----------				Meq 100 cm^{-1}
C2BE	0.66	1.38	4.7	75	1.2	6.0	244	41	60	10	36	73	55	43	0.1

Ca to Mg Ratio = 9.9:1

Ca to P Ratio = 1.9:1

Ca to K Ratio = 7:1

Mg to P Ratio = 1:5

Mg to K Ratio = 1:1.4

P to Zn Ratio = 133:1

P to Cu Ratio = 339:1

P to K Ratio = 3.7:1

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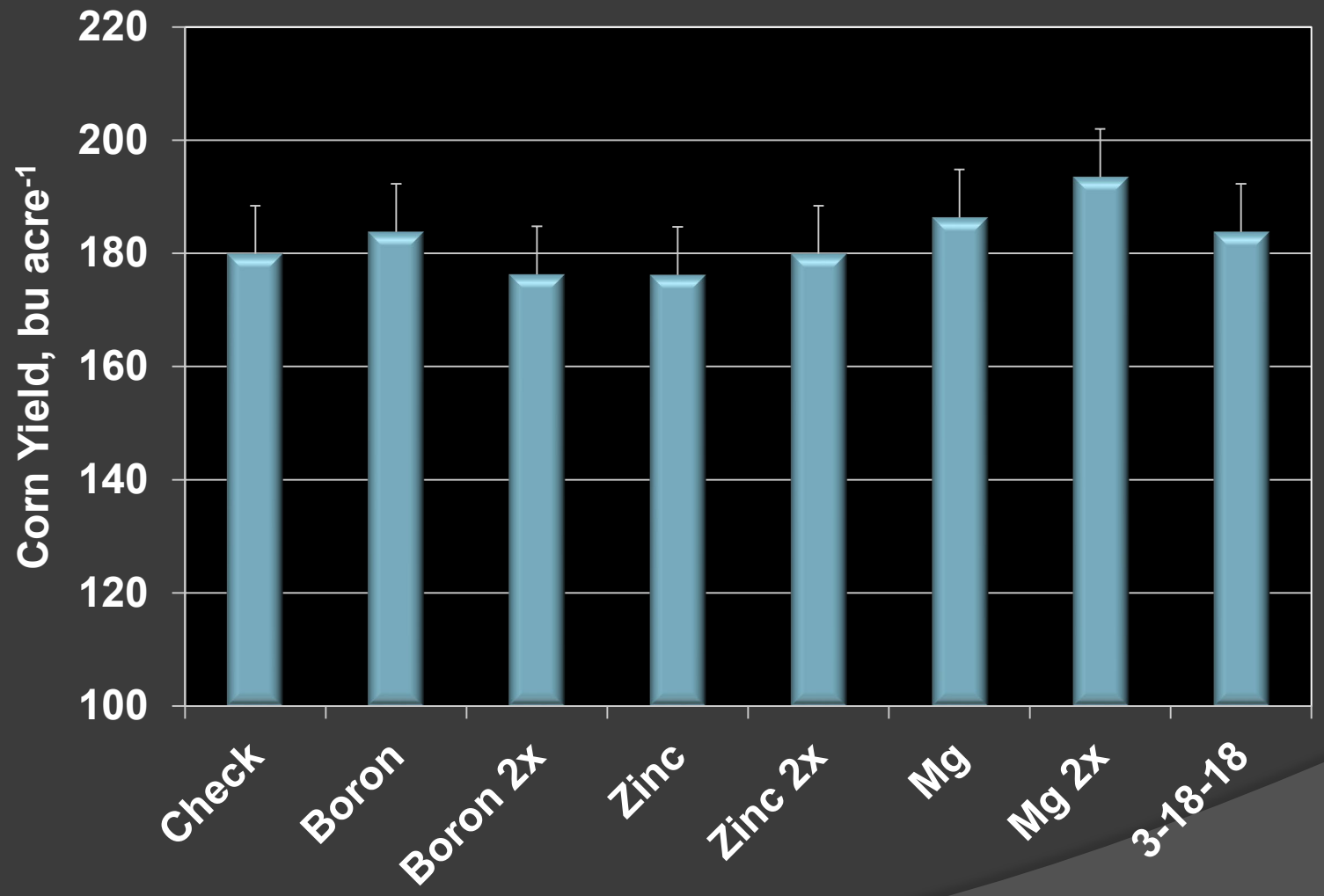
Leaf Tissue Concentrations of Nutrients Following an Application of B, Zn, and Mg - Lewiston Top – V5-V6 Bottom Comparison – V9-V10

	N	P	K	Ca	Mg	S	Fe	Mn	Zn	Cu	B
No B or Zn	3.64	0.36	2.31	0.41	0.17	0.20	167.9	24.2	24.5	20.4	14
B + Zn+Mg	3.75	0.54	2.55	0.38	0.16	0.25	173.1	30.9	40.1	31.5	18.8
No Micro	3.28	0.34	1.68	0.81	0.23	0.21	1151	39.3	20.7	26.3	12.5
B + Zn + Mg	3.36	0.35	1.71	0.75	0.22	0.21	1151	40.6	22.6	22.1	16.4


Magnesium
20 lbs Mg/a


CHECK

Impact of Essential or MicroNutrients on Yield



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Avoiding BAD DAYS

LOOK AHEAD – NOT BEHIND

- Knowing the BIG 5 Things Corn Needs – Ask yourself, "Will Tomorrow Be a GOOD DAY?"
- IF not, know what to do to make it a GOOD day.
- Understanding what the plant needs can help you plan ahead

KNOW YOUR GENETICS

- Does your corn do emergence well?
- Does your corn do early growth?
- Why Are Nutrients Limiting Yield?

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Questions

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