# AGVISE Laboratories

## Established 1976

## John Lee: Soil Scientist

# *Tissue and Soil Testing "Together" Help Make Better Decisions*

# *What is Plant Analysis*

- *"Snap Shot" in the life of a plant*
- *A report on the Nutrient uptake by the Crop to that day*
- *Does not "Look Forward" very far*
- *Tool to use with "Soil Testing"*

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# *Using Plant Analysis as a Tool*

- *Diagnosing visible nutrient symptoms*
  - *Nitrogen vs. sulfur*
- *Evaluating fertilizer placement*
  - *With or without starter*
- *Detecting hidden hunger*
  - *Something just doesn't look right*
- *Monitor spoon feeding nutrients*
  - *Nitrogen (irrigated potatoes)*

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# *Collecting Plant Samples*

- *What part of the plant*
  - *It is critical to collect the right plant part. The interpretation is based on that part.*
- *When*
  - *Various "Stages" for best interpretation*
  - *Within 1 week if comparing "good" and "bad"*
- *Care of the sample*
  - *Brush any dust off the sample*
  - *Iron and manganese contamination from soil*
  - *Ship samples immediately or keep cool*

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# *Specific Plant Part needs to be Collected for "Each Growth Stage"*

- *Early Season*
  - *In most cases the entire above ground plant*
  - *( I.e. wheat at tillering, corn <12")*
- *Mid and Late season*
  - *In most cases the most recently mature leaf (i.e. Leaf opposite corn ear)*
- *Make sure you get enough plant material (95% water)*
- *Plant Sampling Guide & Interpreting a Plant Analysis Report (www.agvise.com)*

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# *Interpreting Plant Nutrient Analysis*

- *Sufficiency Range Research*
  - *University research has determined the sufficient level of each nutrient for many crops. The sufficient range is based on a specific plant part and stage of growth*
- *University Research is from 60's,70's ,80's*
- *"Tissue Sufficiency Range Research" is limited and old for many crops*
- *Crop yields are much higher now!*

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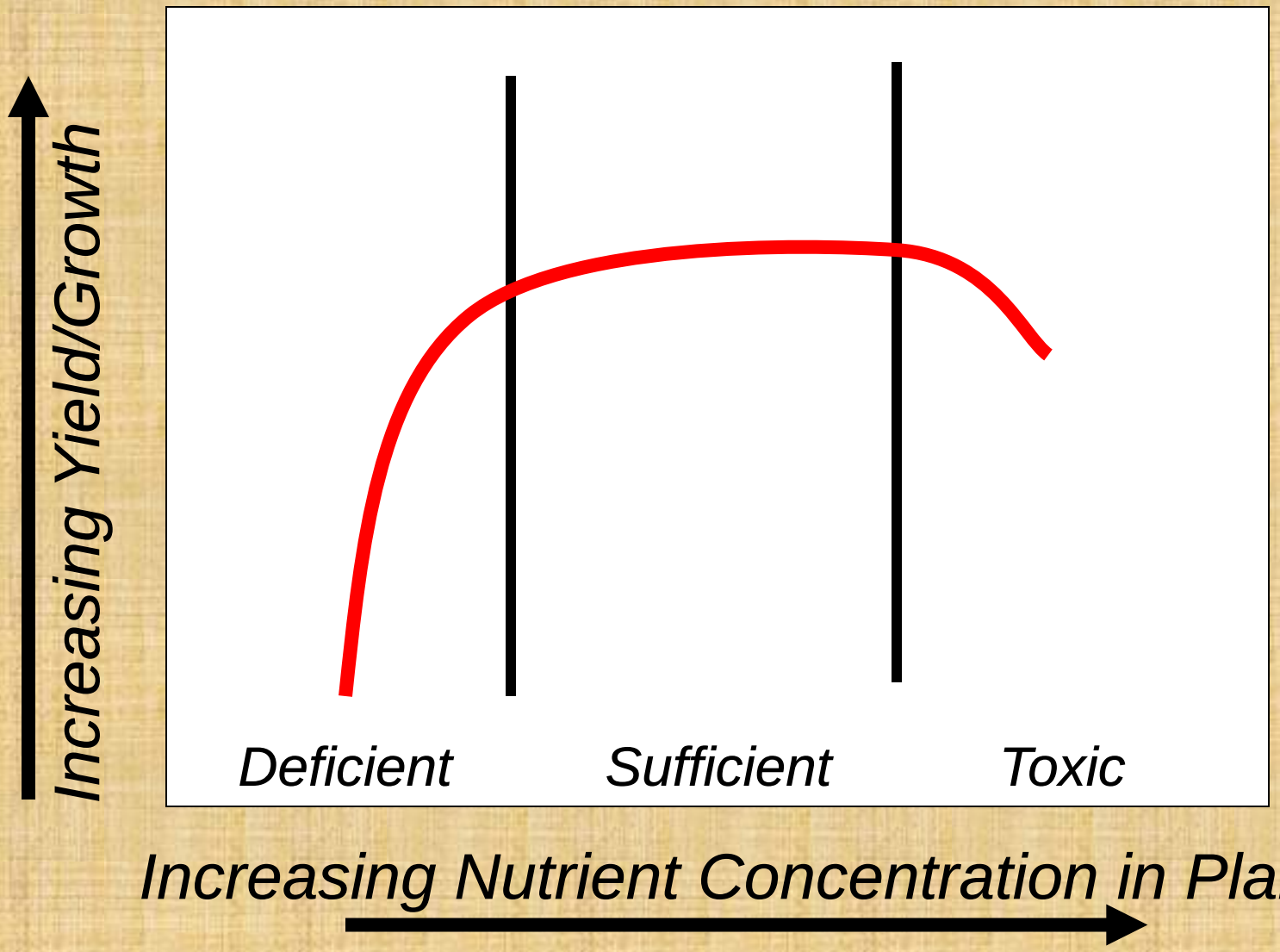
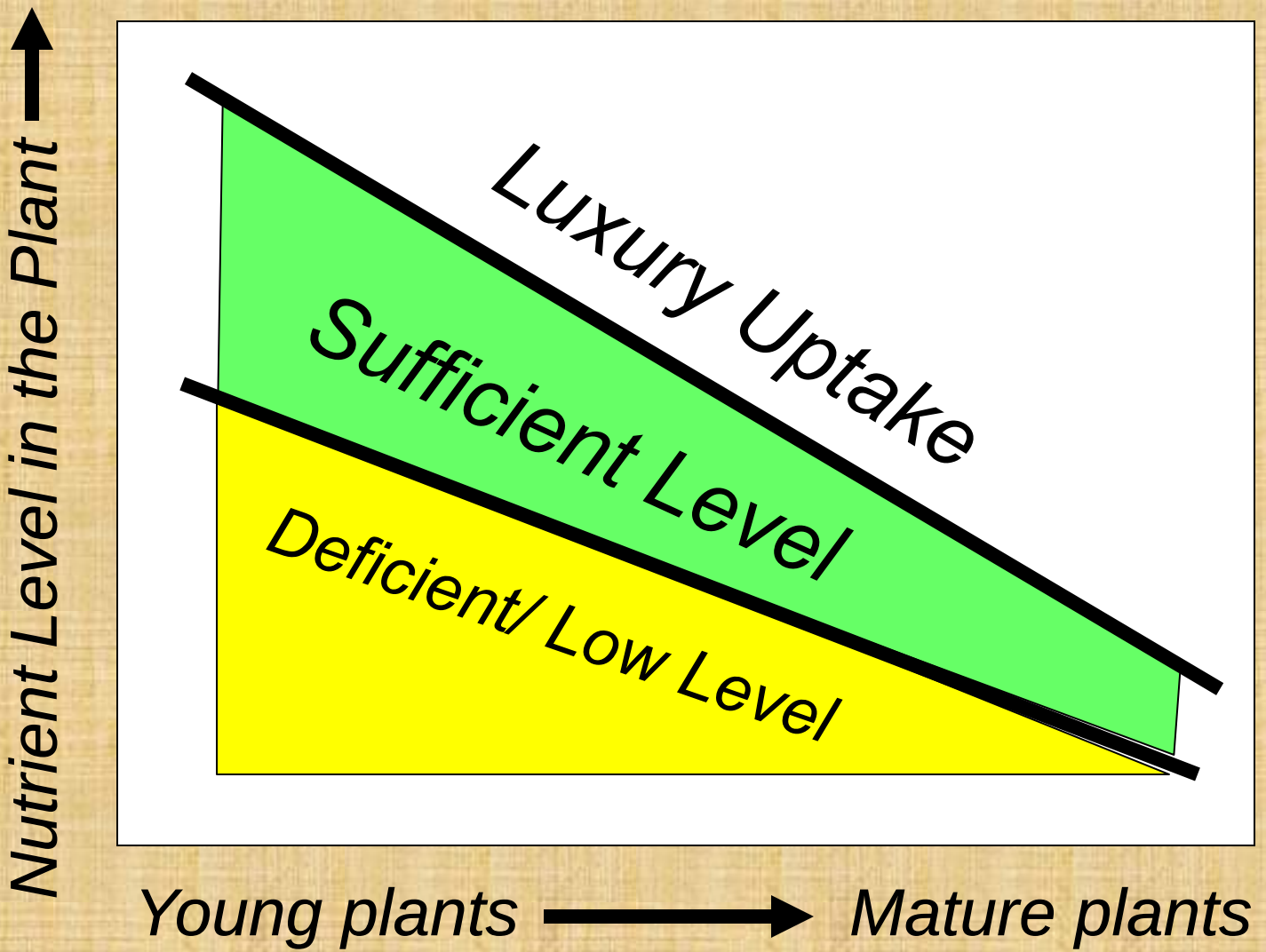
# *Sufficiency Range Interpretation*



# *Sufficiency Range Interpretation*



# *Tissue - Sufficient Nutrient Range vs. Stage of Growth*

| *Crop Stage* | *Phosphorus* | *Potassium* |
|---|---|---|
| *Corn 2-12”* | *.34-.8%* | *2.9-5.0%* |
| *Corn 12-20”* | *.24-.5%* | *2.4-3.5%* |
| *Corn - tasseling* | *.24-.5%* | *1.7-2.8%* |

*Expect nutrient levels in plant tissue to decrease through the season but stay in the “Sufficient Range!*

# *"Plant & Soil Testing"*
# *"Best of Both Worlds"*

- *Good and Bad tissue samples*
- *Good and Bad soil samples*
- *Current growing conditions("Stresses")*
- *Information soil moisture, fertilizer rate, placement and timing, other factors like rotation*

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# *Objectives of 2012 Corn Tissue Sampling Project Demonstration*

- Show tissue nutrient concentrations decline through the season in high yield situation.
- Determine if nutrients applied to L, M, H phosphorus and potassium sites kept tissue nutrient levels in sufficient range through season.
- Get an idea if tissue sufficiency ranges being used are appropriate.

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# *Corn Tissue Sampling Demo 2012*

Cooperator: Chris Goulet, Brent Huebner Morris, MN

1) Two Irrigated Fields
2) Corn-on-corn 5 yrs,
3) 3 Sampling points in each field
4) Grid Soil Samples from 2011
5) Corn Leaf tissue samples collected in 2012 (13 samples)
    a) V5 – V8: June 6, 8, 11, 13, 15, 17, 19, 21
    b) VT : July 9, 11, 13, 15, 17
6) VR P & K Fertilizer applied with strip tillage prior to planting

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# *Grid Soil Test Data (Fall 2011)*
## *One Low, Medium, High (P & K) Grid From Each Field*

| | Field A | | | Field B | | |
|---|---|---|---|---|---|---|
| | Low | Medium | High | Low | Medium | High |
| P ppm | 6 (Olsen) | 10 (Bray1) | 30 (Bray1) | 5 (Olsen) | 10 (Olsen) | 40 (Bray1) |
| K ppm | 103 | 117 | 198 | 114 | 124 | 198 |
| Zn ppm | 1.64 | 1.2 | 3 | 1 | 1.9 | 2 |
| S lb/a | 20 | 22 | 22 | | | |
| B ppm | 0.3 | 0.3 | 0.4 | | | |
| pH | 7.5 | 7.1 | 6.8 | 7.5 | 7.2 | 6.6 |
| OM % | 2.2 | 2.1 | 3.7 | 3.7 | 5.1 | 6.2 |

***Soil Sampled prior to VRT application**
**Field A in Fall 2010**
**Field B in Fall 2011**
**Planted: Spring 2012**

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# Field Images – Morris, MN


Yield 200 – 220 bu/a
Field A


Yield 200 – 220 bu/a
Field B

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# Fertilizer Applied 2012

| | Fertilizer Applied | | | | | |
|---|---|---|---|---|---|---|
| | Field A | | | Field B | | |
| | Low | Med | High | Low | Med | High |
| N (Planting Strip-Till) | 69 | 77 | 69 | 80 | 76 | 65 |
| N (Sidedress UAN early June) | 77 | 76 | 86 | 104 | 109 | 122 |
| N (Pivot UAN end of July) | 35 | 35 | 35 | 35 | 35 | 35 |
| Total N Applied | 181 | 188 | 190 | 219 | 220 | 222 |
| $P_2O_5$ (Planting Strip-Till) | 71 | 76 | 23 | 94 | 68 | 0 |
| $K_2O$ (Planting Strip-Till) | 42 | 40 | 26 | 58 | 56 | 45 |
| Zn (Planting Strip-Till) 9% chelate | 2 pt | 2 pt | 2 pt | 3 pt | 3 pt | 3 pt |
| | | | | | | |

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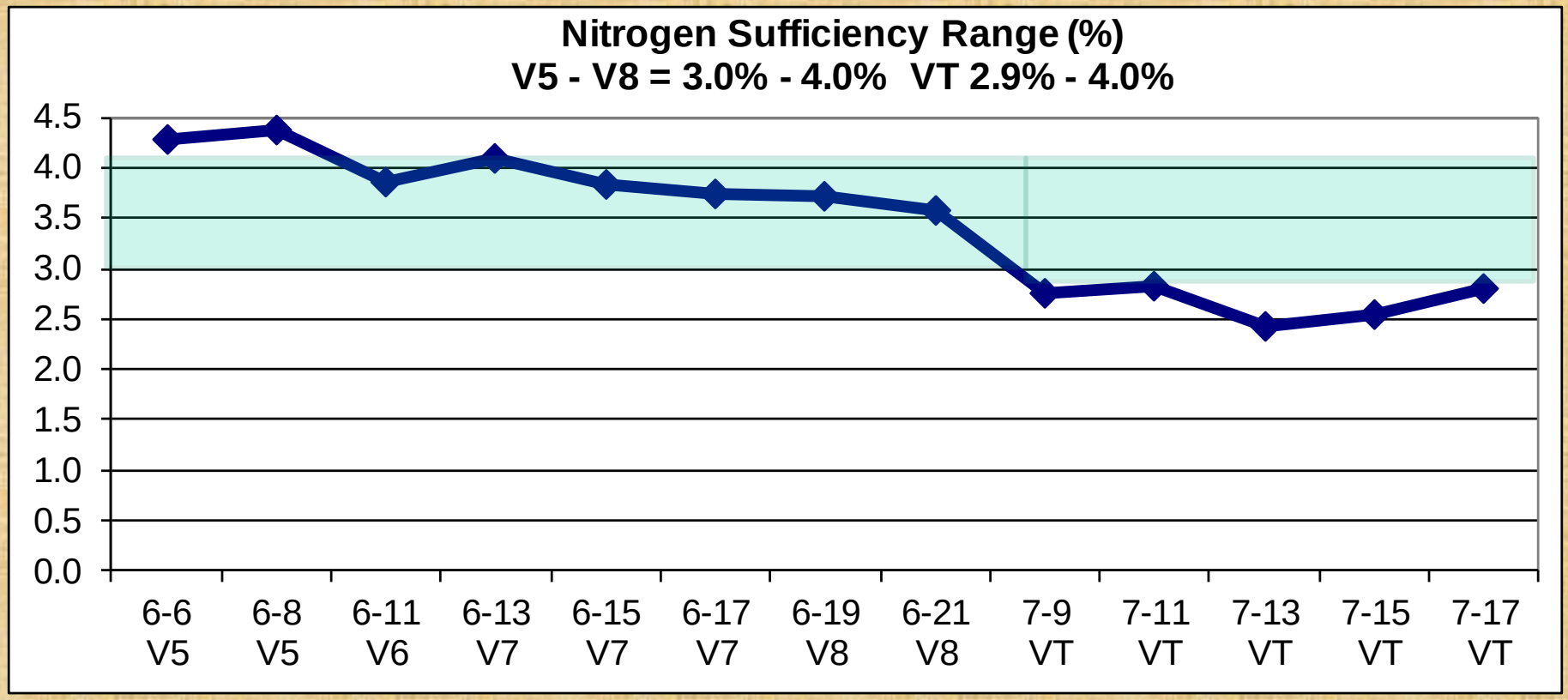
# Nitrogen Tissue Test Results - Stage of Growth




**Average of all 6 tissue samples (3 from each field) on each sample date.**

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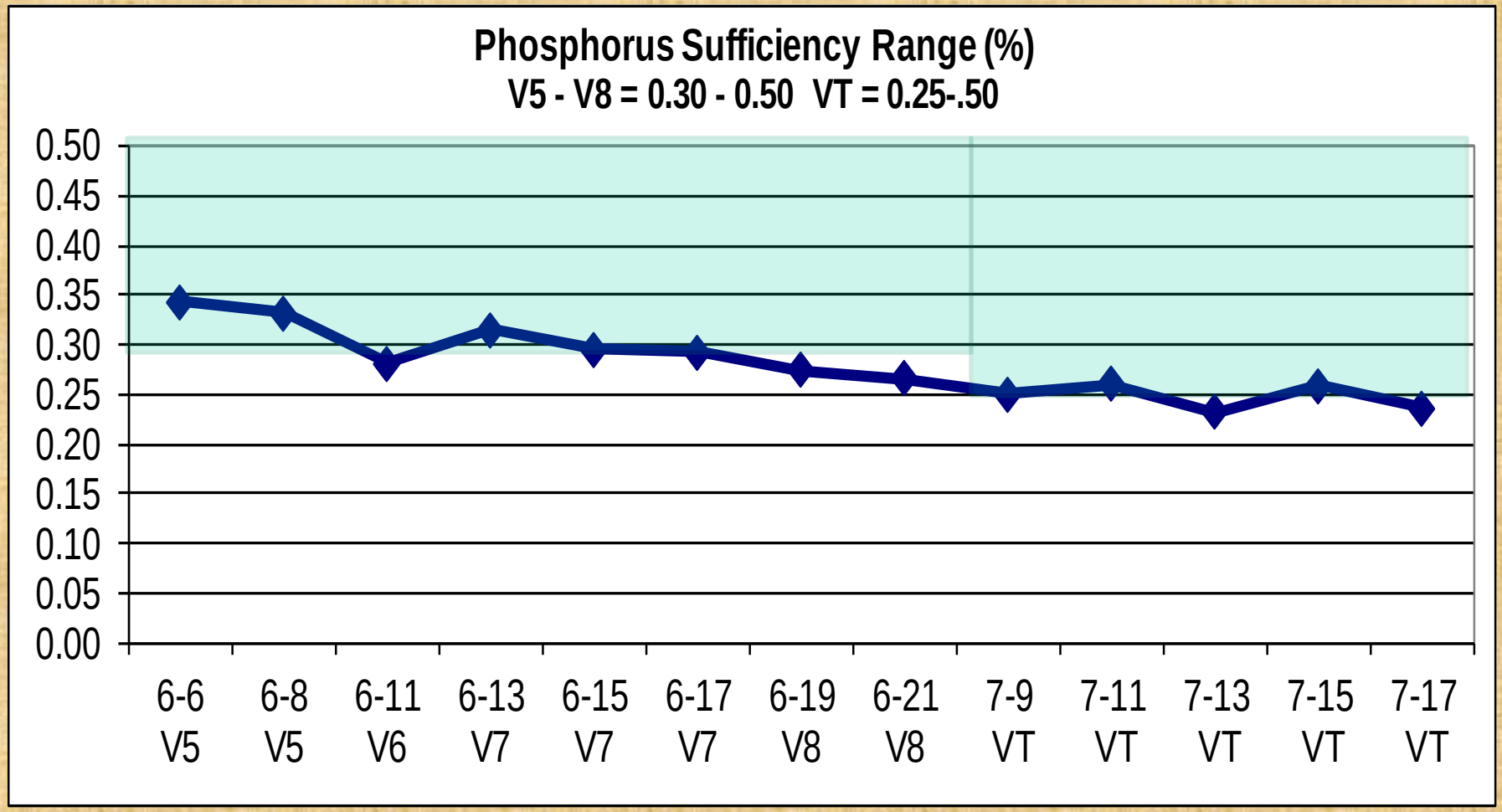
# Phosphorus Tissue Test Results – Sampling Stage of Growth




Average of all 6 tissue samples (3 from each field) on each sample date.

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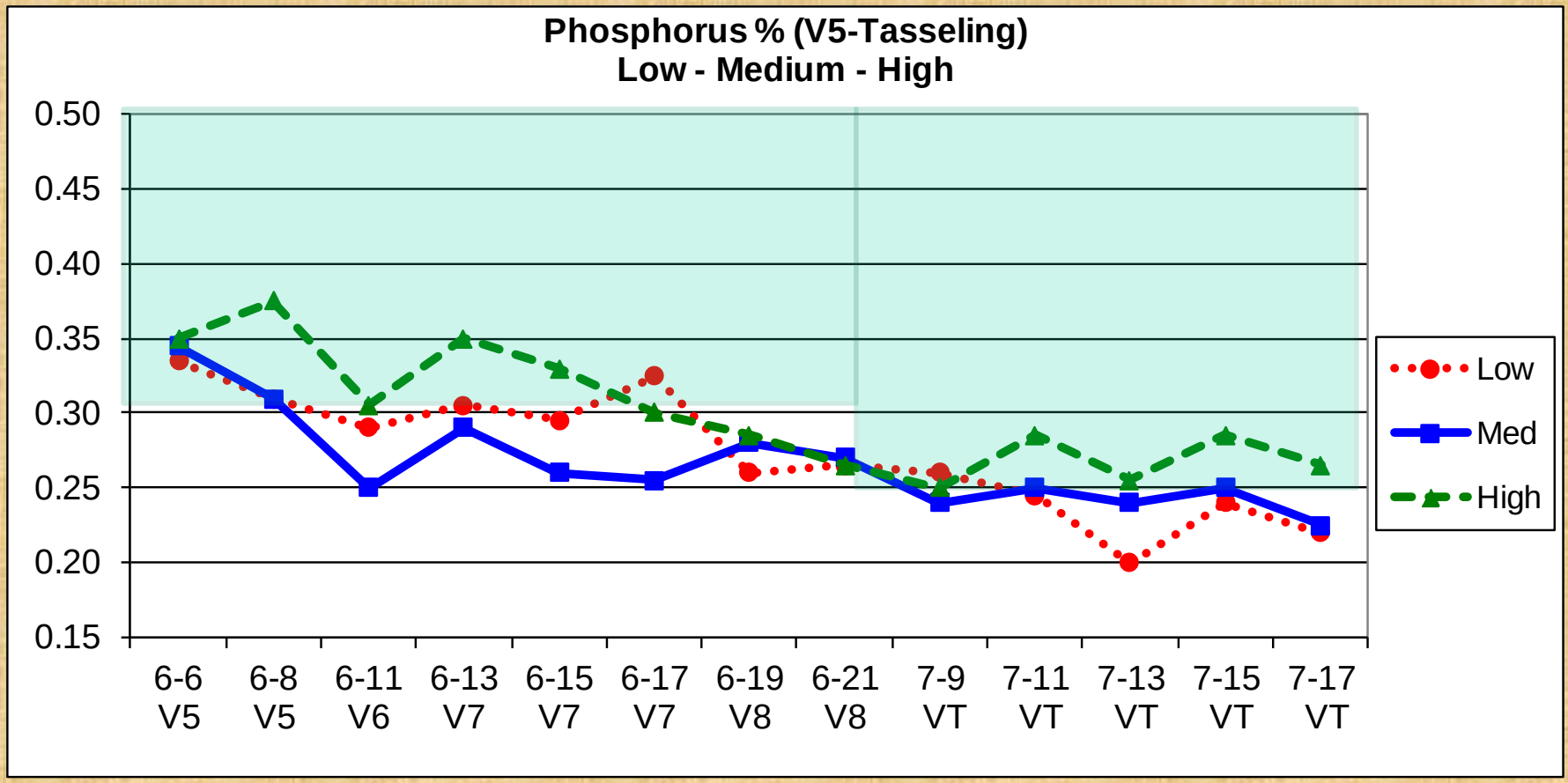
# Phosphorus Tissue Test Results – Growth Stage




**Average P Tissue level of low, medium and high sites from both fields.**

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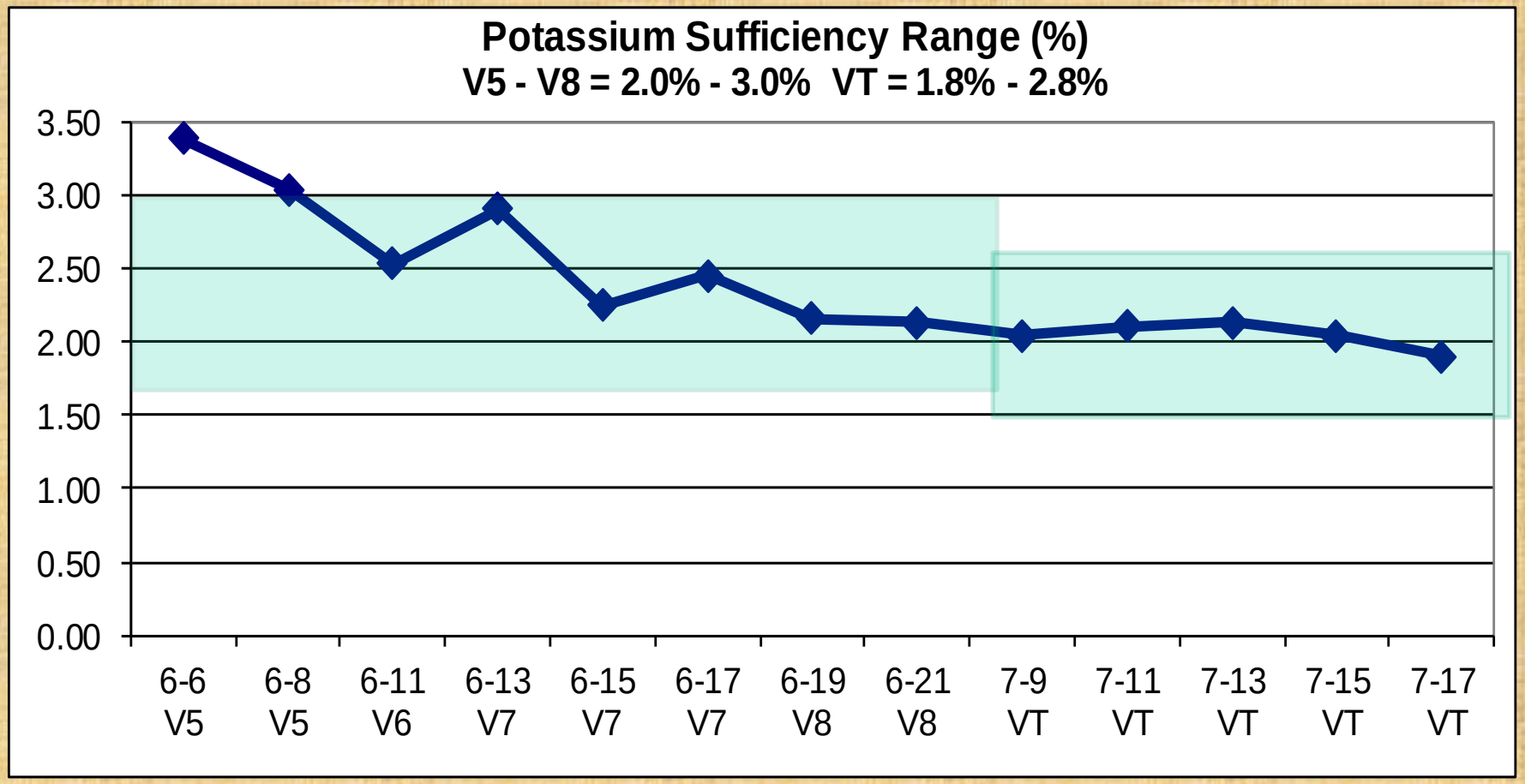
# Potassium Tissue Test Results - Stage of Growth




**Average of all 6 tissue samples (3 from each field) on each sample date.**

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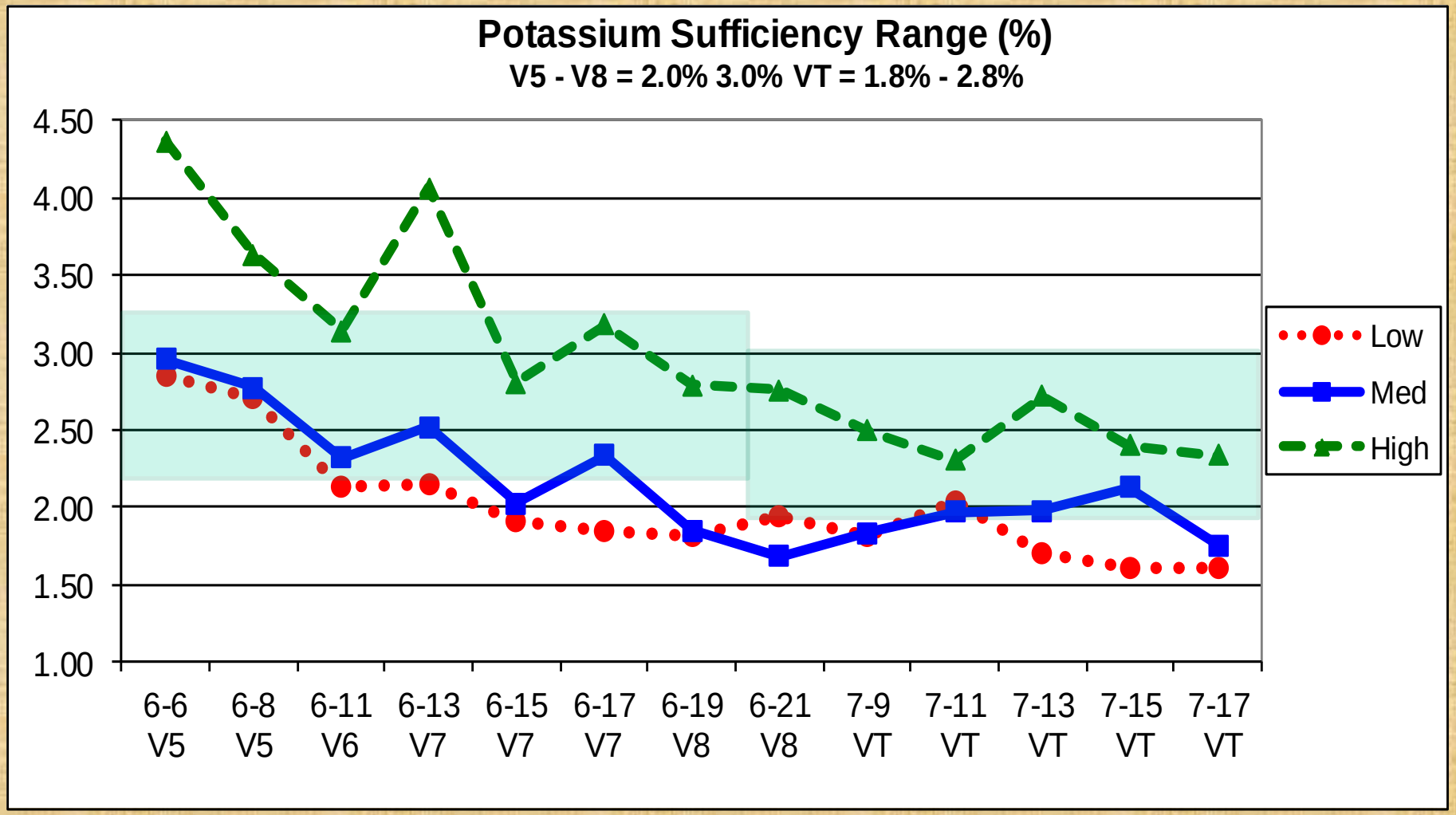
# Potassium Tissue Test Results - Stage of Growth




Average of low, medium and high sites from both fields.

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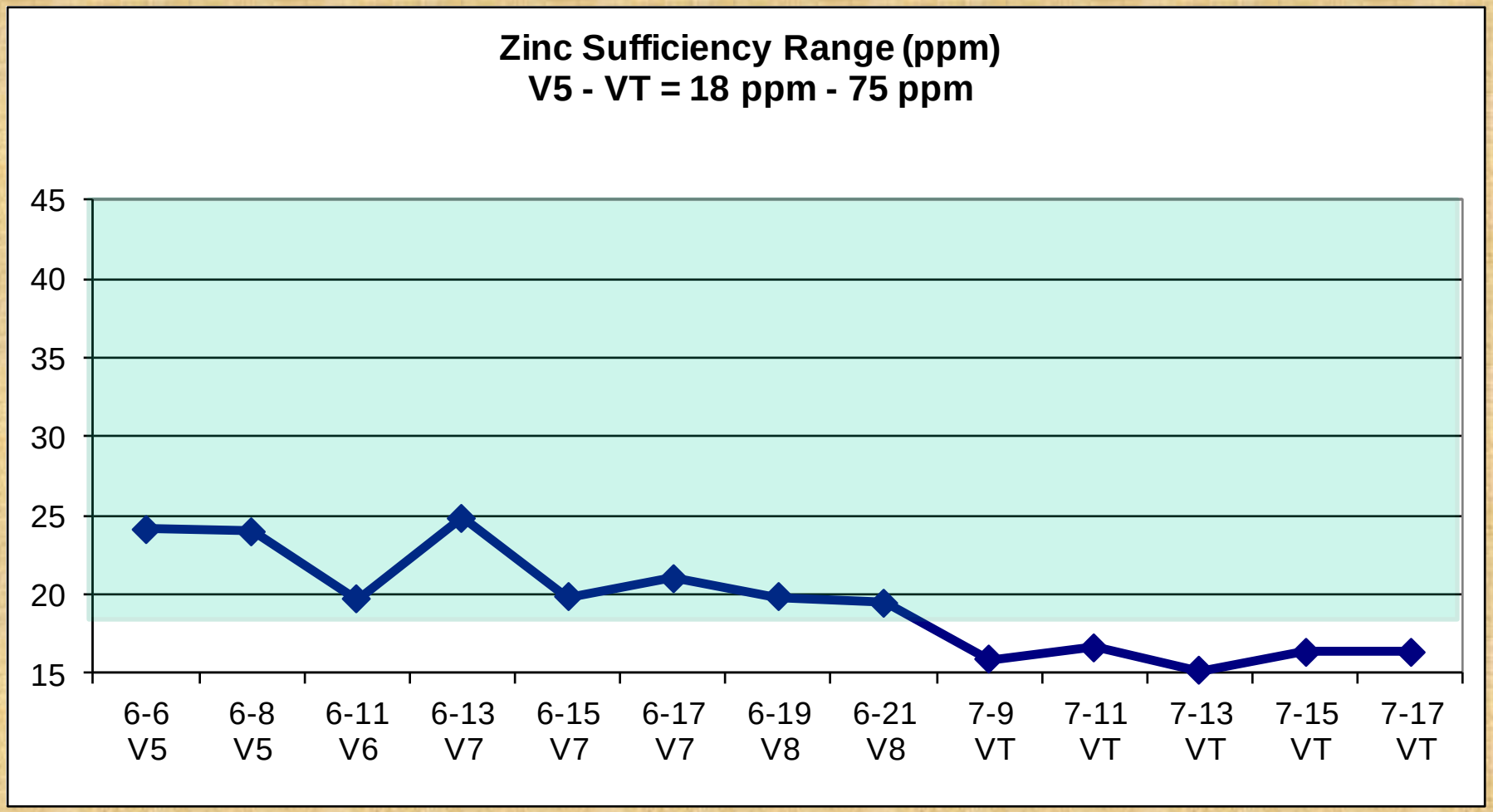
# Zinc Tissue Test Results - Stage of Growth




**Average of all 6 tissue samples (3 from each field) on each sample date.**

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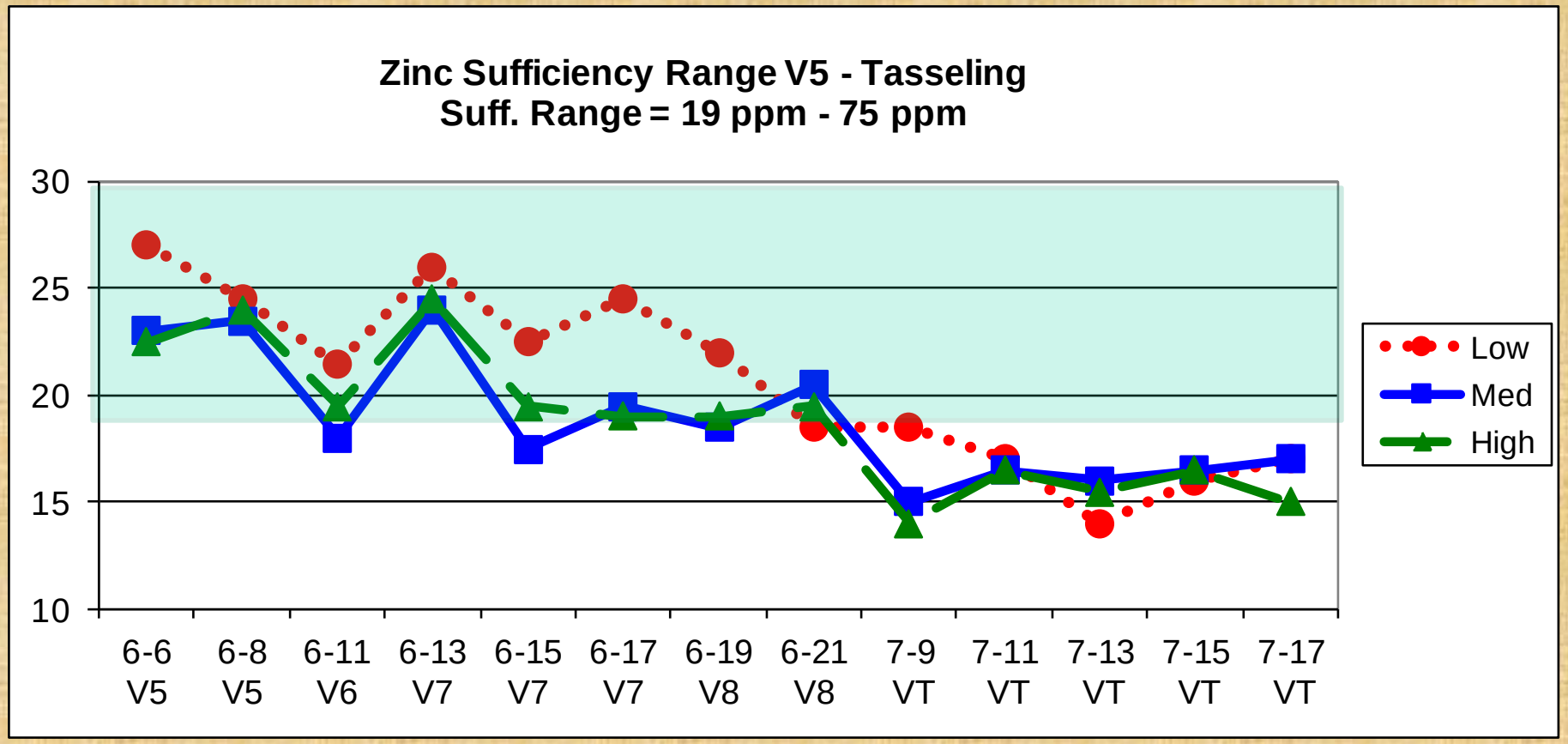
# Zinc Tissue Test Results – Growth Stage




**Average of low, medium and high sites from both fields.**

**All sites soil zinc >1.0 ppm  2-3 pints Zinc Chelate with starter**

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# *Irrigated Corn Tissue and Soil Test Demo*

- Tissue Nutrient levels Declined slowly through the season as expected
- Tissue nutrient levels for P went below the sufficiency range even with recommended fertilizer applications (higher rates Needed?)
- Zinc tissue levels were below sufficiency range, for all sites in July, even with high soil Zn and zinc fertilizer applied?
- Additional university research is needed to reaffirm Zinc tissue nutrient sufficiency range.

# *Winter Wheat – Tissue Demo*

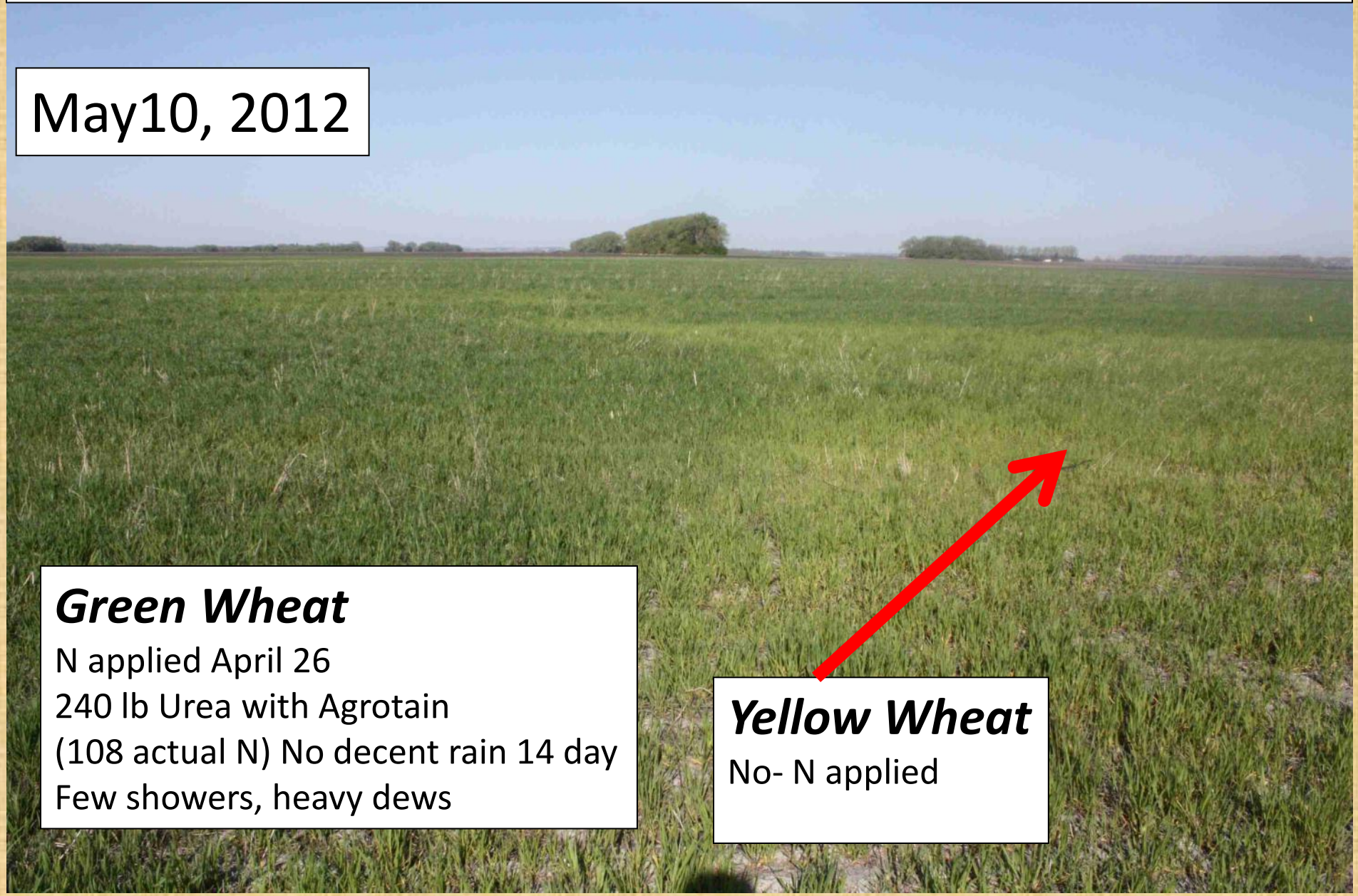
- Prevent Plant field 2011 – Northwood ND
- Winter wheat seeded late
- Start fertilizer only at seeding

# *Objectives of Winter Wheat – Tissue Demo*

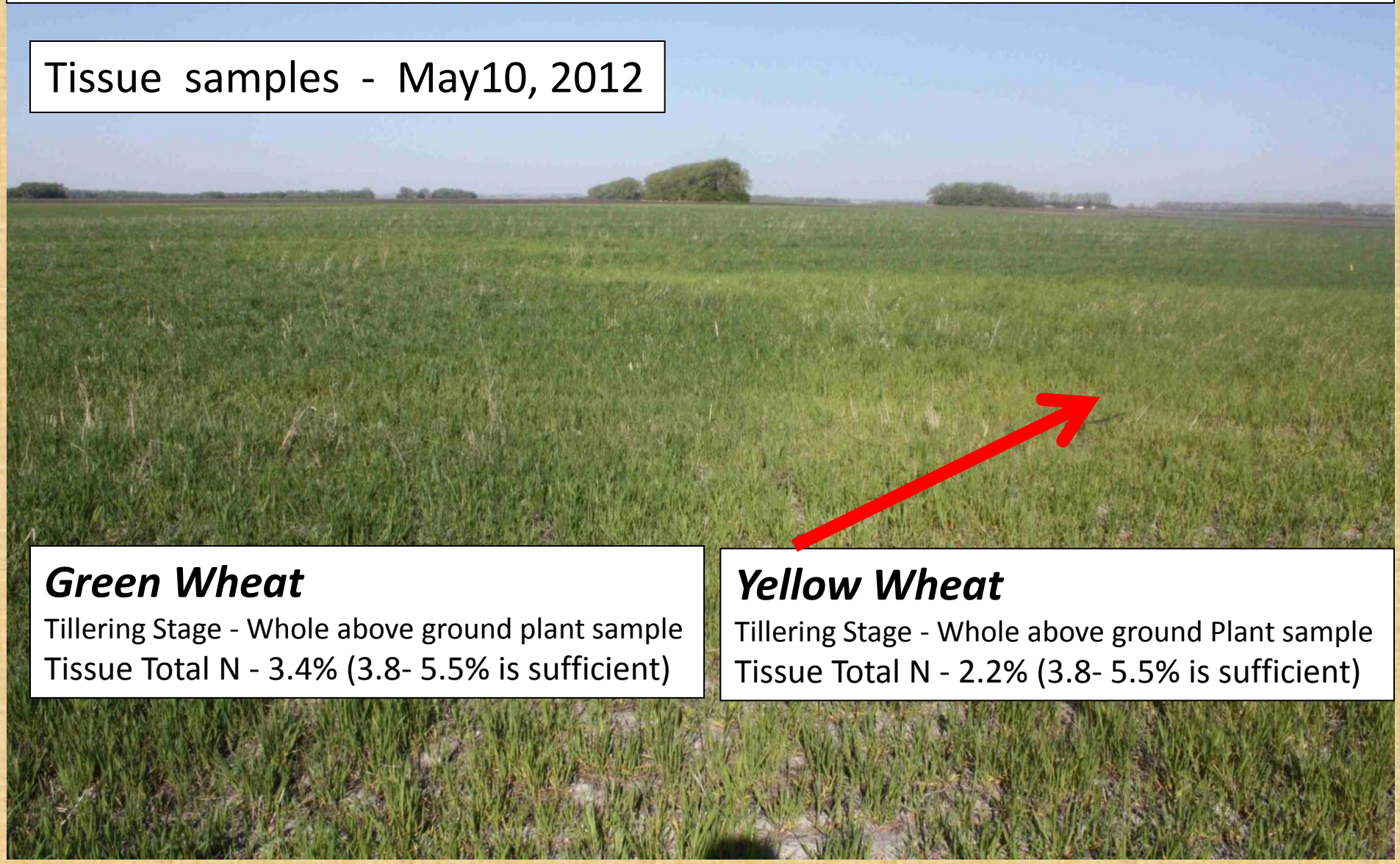
- Determine if tissue and soil testing could distinguished between fertilized and unfertilized treatments
- Determine if N topdressed in April was going to be enough for good yield and protein
- Help grower make decision about additional N application


October 31, 2011
Soil N - 15 lb/a 0-24”

# *Winter Wheat Tissue Example 2012*



# *Winter Wheat - Tissue and Soil Demo 2012*
# *Good and Bad Tissue Samples*



Tissue samples - May10, 2012

***Green Wheat***

Tillering Stage - Whole above ground plant sample

Tissue Total N - 3.4% (3.8- 5.5% is sufficient)

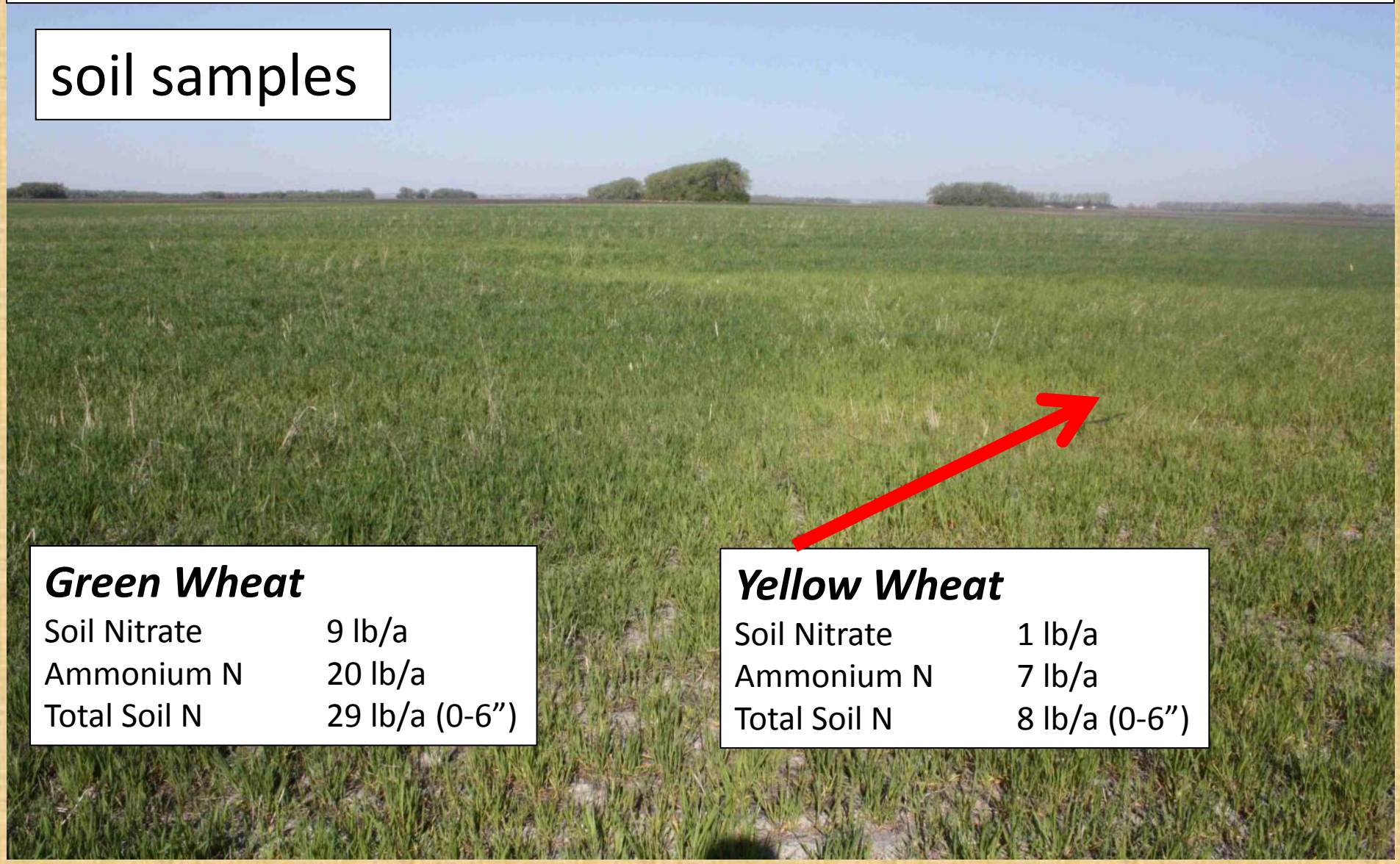
***Yellow Wheat***

Tillering Stage - Whole above ground Plant sample

Tissue Total N - 2.2% (3.8- 5.5% is sufficient)

# *Winter Wheat Tissue and Soil Demo 2012*

## *Good and Bad Soil Samples*



# *Winter Wheat Tissue and Soil Demo 2012*

## *Good and Bad Tissue Samples, Good and Bad Soil Samples*

### *Green Wheat*

Tillering Stage - Whole above ground plant sample

Tissue Total N - 3.4% (3.8- 5.5% is sufficient)

| | |
|---|---|
| Soil Nitrate | 9 lb/a |
| Ammonium N | 20 lb/a |
| Total Soil N | 29 lb/a (0-6”) |

### *Yellow Wheat*

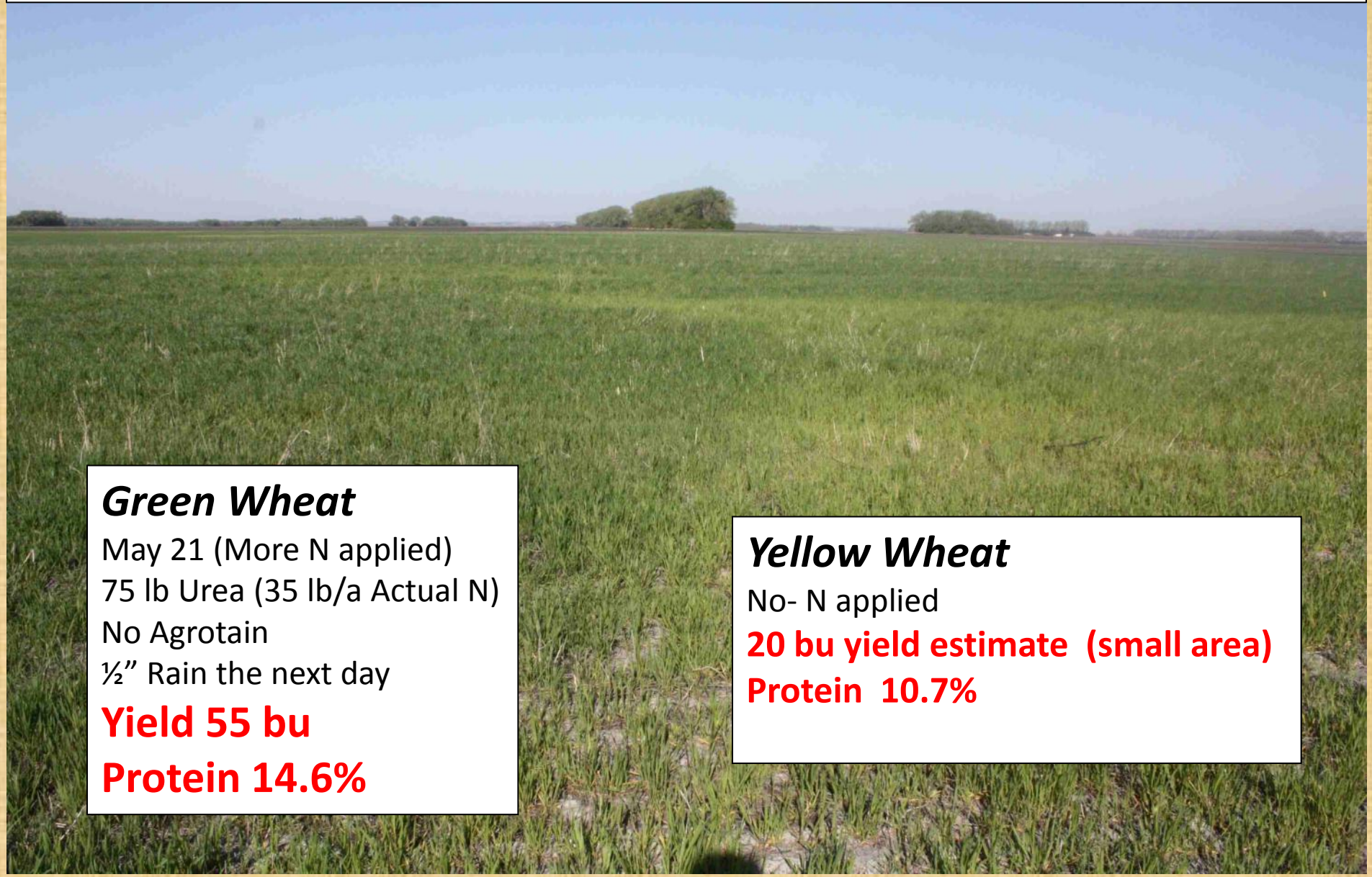
Tillering Stage - Whole above ground Plant sample

Tissue Total N - 2.2% (3.8- 5.5% is sufficient)

| | |
|---|---|
| Soil Nitrate | 1 lb/a |
| Ammonium N | 7 lb/a |
| Total Soil N | 8 lb/a (0-6”) |

# *Winter Wheat Tissue Example 2012*

## *Good and Bad Tissue Samples, Good and Bad Soil Samples*



### *Green Wheat*

May 21 (More N applied)
75 lb Urea (35 lb/a Actual N)
No Agrotain
½" Rain the next day

**Yield 55 bu**

**Protein 14.6%**

### *Yellow Wheat*

No- N applied

**20 bu yield estimate (small area)**

**Protein 10.7%**

# *Winter Wheat*
# *Tissue and Soil Test Demo*

- Tissue and soil tests confirmed N was low in “check” area
- Tissue and soil tests showed fertilized area was marginal in N
- Grower applied additional N timed with forecast rainfall event.
- Two N fertilizer applications made large difference in % protein and yield
- Protecting the Urea with Agrotain was a good decision, but protection only lasts about 10 days.

# *Corn Tissue and Soil Test Demonstration - Starter*

# Corn Tissue and Soil Test Demonstration - Starter

- Objectives
  - Determine if soil and tissue testing could determine if starter fertilizer had been applied
  - Show soil sampling technique that can be used to trouble shoot problems with starter equip

# Plant size without and with starter


Starter – 5 gallons 10-34-0 with 2 pints of zinc chelate

No Starter - 6”

With Starter - 12”

***No Starter***

Tissue Total N – 4.1% (3.5-5.0 is sufficient)
Tissue Total P - .48% (.35-.80 is sufficient)
Tissue Total Zn – 25 ppm (20-75 is sufficient)

***With Starter (5 gallon 10-34-0 - 2pt Zn)***

Tissue Total N – 5.6% (3.5-5.0 is sufficient)
Tissue Total P - .83% (.35-.80 is sufficient)
Tissue Total Zn – 56 ppm (20-75 is sufficient)

# *Tissue Test Results*

Picture 5-23-2012

***No Starter***
Soil nitrate in row – 16 lb/a (0-6” sample)
P Soil test in row – 15 ppm
Zn Soil test in row – 1.6 ppm

***With Starter (5 gallon 10-34-0 - 2pt Zn)***
Soil nitrate in row – 102 lb/a (0-6” sample)
P Soil test in row – 68 ppm
Zn Soil test in row – 5.9 ppm

# *Soil Test – Soil Probes right in row*

Picture 5-23-2012

***No Starter***

**Tissue Total N – 4.1% (3.5-5.0 is sufficient)**

Soil nitrate in row – 16 lb/a (0-6” sample)

**Tissue Total P - .48% (.35-.80 is sufficient)**

P Soil test in row – 15 ppm

**Tissue Total Zn – 25 ppm (20-75 is sufficient)**

Zn Soil test in row – 1.6 ppm

***With Starter (5 gallon 10-34-0 - 2pt Zn)***

**Tissue Total N – 5.6% (3.5-5.0 is sufficient)**

Soil nitrate in row – 102 lb/a (0-6” sample)

**Tissue Total P - .83% (.35-.80 is sufficient)**

P Soil test in row – 68 ppm

**Tissue Total Zn – 56 ppm (20-75 is sufficient)**

Zn Soil test in row – 5.9 ppm

Picture 5-23-2012

# *Tissue Plus Soil Test Helps Make better Decisions*

- Tissue and soil tests showed difference between “short” and “tall” corn
- Tissue levels were in sufficiency range for short and tall plants
- Soil test confirmed lack of starter was the difference
- Starter stimulated early growth and may lead to yield advantage in shorter season (up north)

# *Corn – Tissue and Soil Test Nitrogen Demonstration*

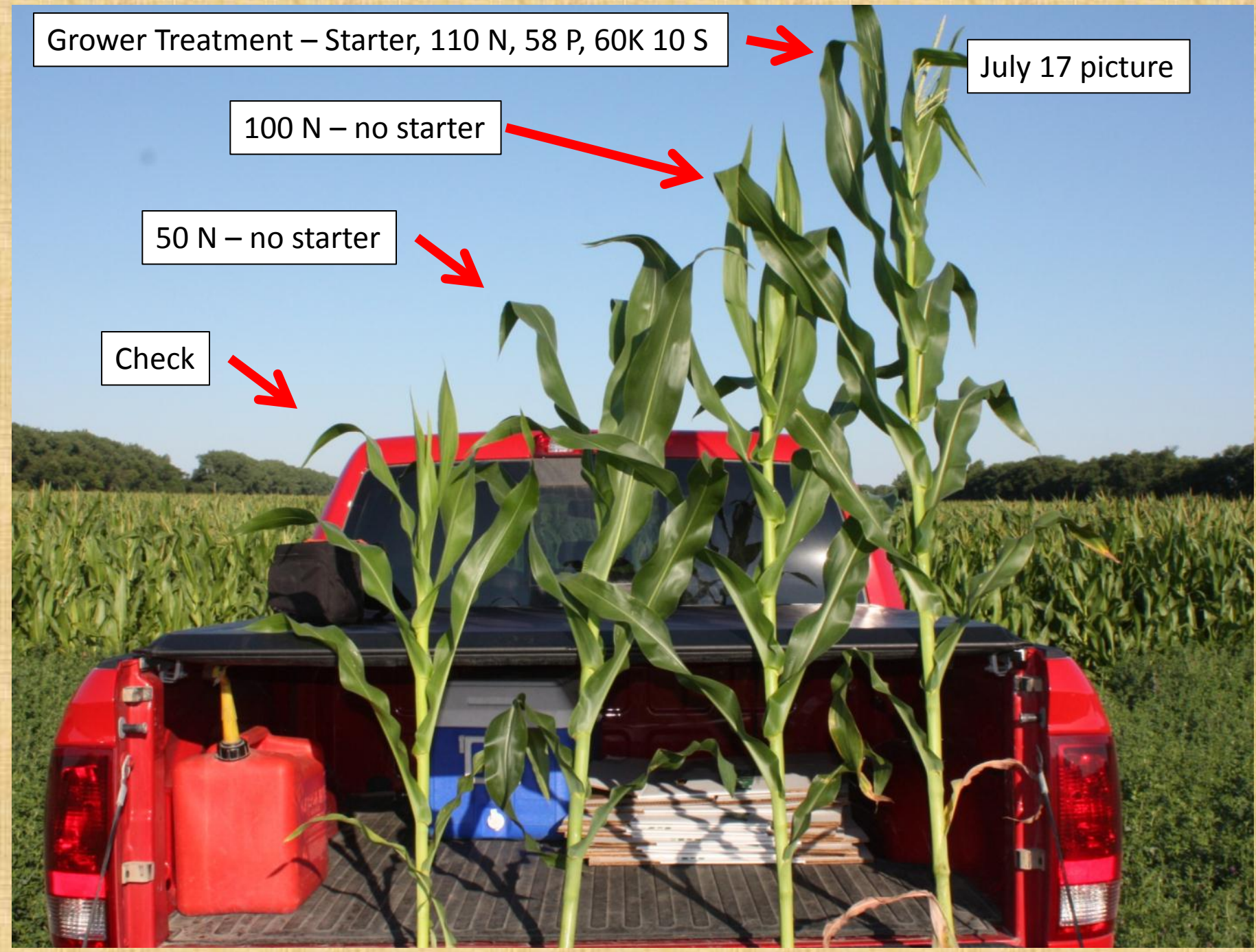
- Determine if tissue and soil tests during the season could distinguish N treatments during the season
- Determine if tissue and soil tests at the end of the season could distinguish the N treatments
- Help grower decide if his N rates are sufficient.

# *Corn – Tissue and Soil Test Nitrogen Demonstration*

- Soil Test Levels
- Previous crop – soybeans
- N - 25 lb/a
- P - 12 ppm (Olsen P)
- K – 100 ppm
- S – 30 lb/a
- Zn - .9 ppm
- OM 1.5%
- pH 6.2

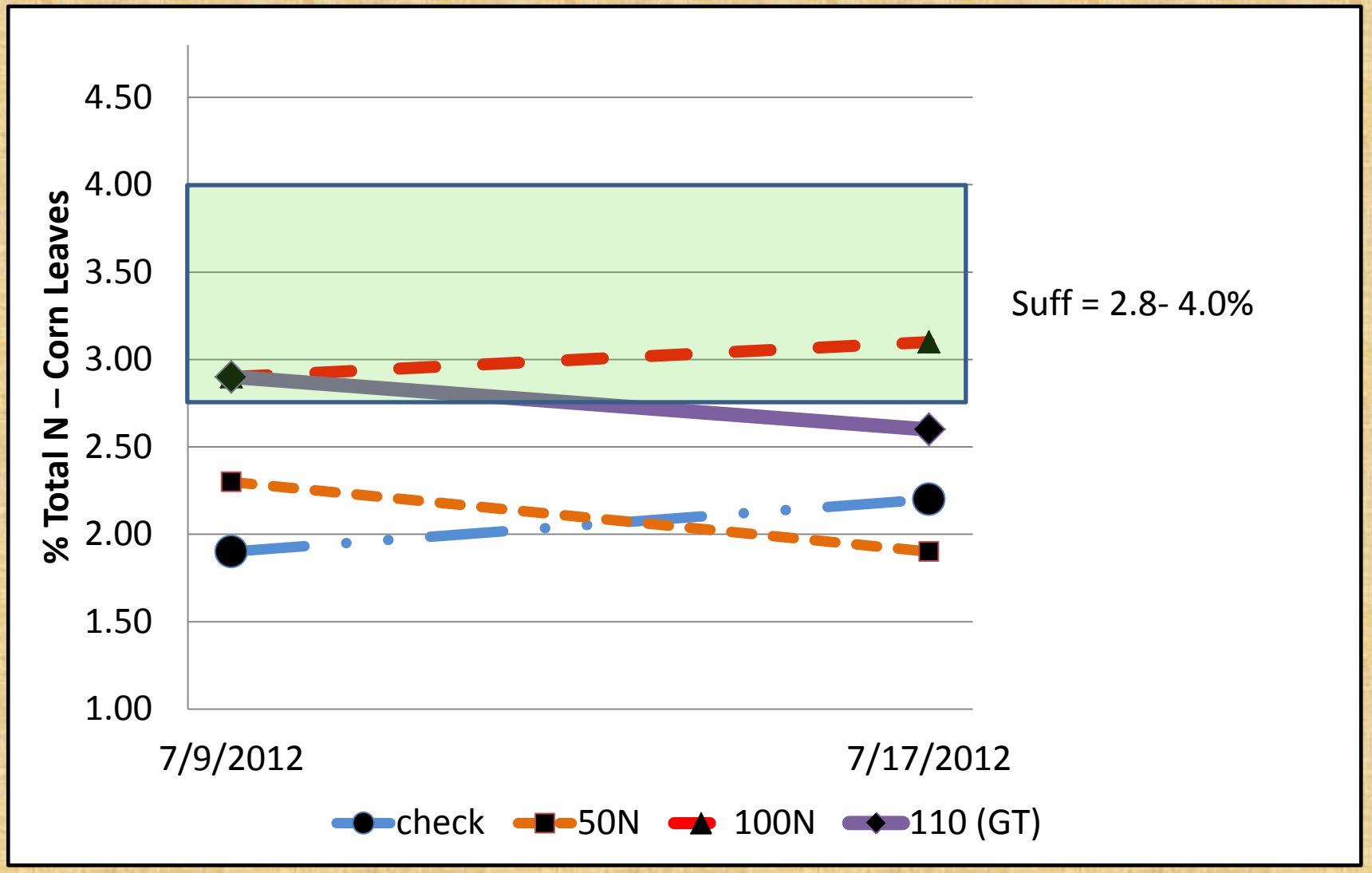
# Corn – Nitrogen Demo

- Check area (no starter - no broadcast N,P,K,)
- N Top-dressed at 6” corn (AMS) 1” rain that evening
  - 50 and 100 lb/a actual N (about May 25)
- Grower Treatment (5 gallon 10-34-0 starter plus Zn)
  - 110 N
  - 59 $P_2O_5$
  - 60 $K_20$
  - 10 S
  - .5 Zn


Grower Treatment – Starter, 110 N, 58 P, 60K 10 S
July 17 picture
100 N – no starter
50 N – no starter
Check

# Corn N – Tissue Tests

## Check, 50, 100, 110 (Grower Rate)




N Deficiency showing on lower leaves, even on high N treatment
07/17/2012 06:52

# *Corn Stalk Nitrate and Soil N Test at the end of the season (September 26)*

| Treatment | Corn Stalk Nitrate ppm | Fall Soil Nitrate 0-24" lb/a |
|---|---|---|
| Check | 35 ppm | 5 lb/a |
| 50 lb/a N topdressed | 185 ppm | 8 lb/a |
| 100 lb/a N topdressed | 162 ppm | 8 lb/a |
| Grower trt – 110 lb/a N pre-plant incorporated | 188 ppm | 24 lb/a |

***Corn Stalk Nitrate Interpretation***

Low: (Less than 250 ppm) Likely that N deficiency limited yield

Marginal: (250-700) Possible that N deficiency limited yield

Optimal: (700-2000) Yield was not limited by N

Excessive: (>2000 ppm) Nitrogen supply was excessive

# *Corn – Tissue and Soil Test N Demonstration*

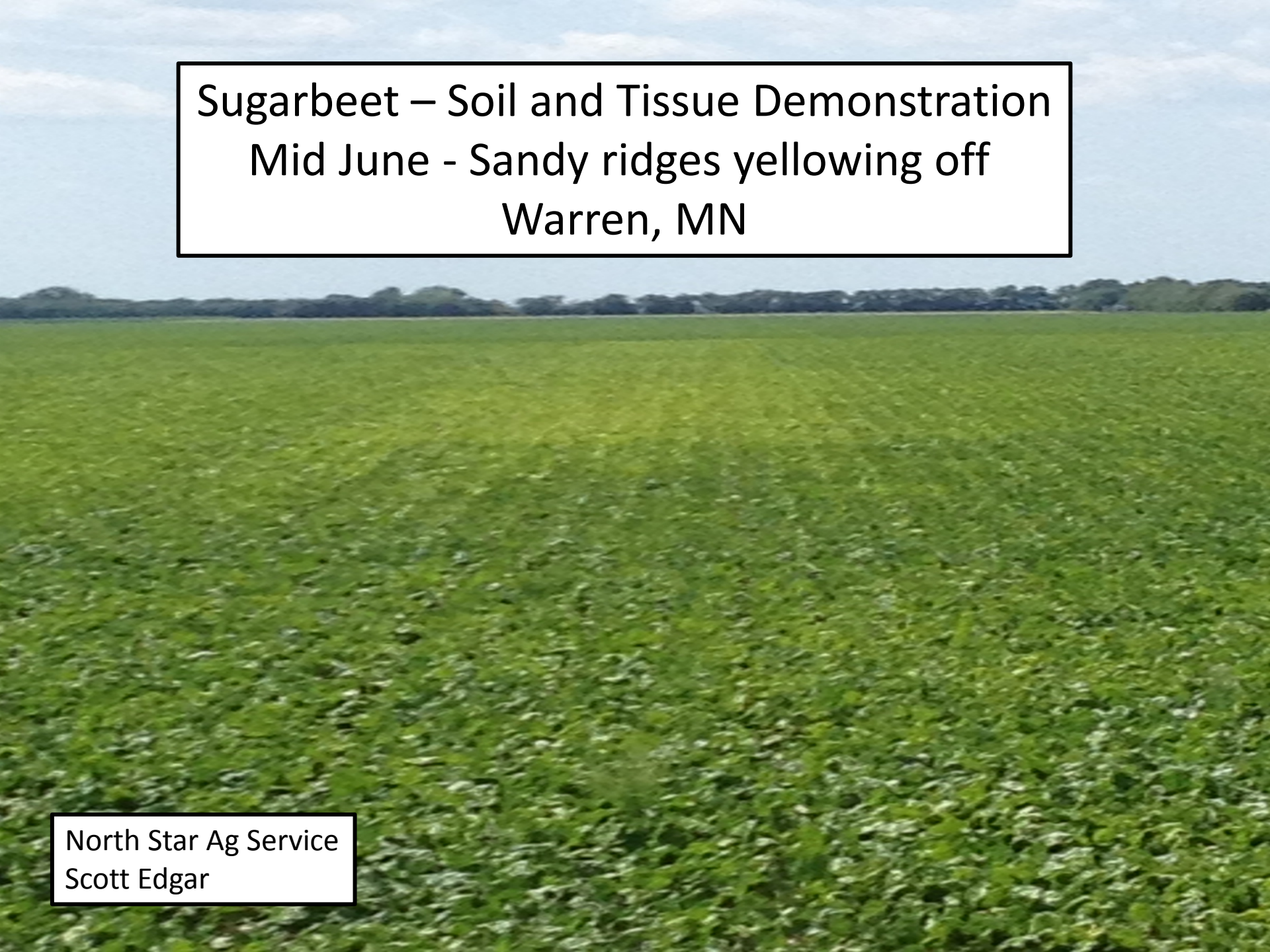
- Tissue test in season identified N treatment differences.
- End of season corn stalk nitrate test and 24” soil test confirmed N was limiting (even with grower rate!).
- Grower may need to increase N rate for corn (140 bu/a corn could have been higher?)

# Sugarbeet – Soil and Tissue Demo

- Determine if tissue and soil tests could determine if nutrients were causing yellow beets on sandy ridges
- Follow with tissue and soil tests after in-season fertilizer application to confirm nutrient uptake by crop

North Star Ag Service
Scott Edgar

# Sugarbeet – Soil and Tissue Demonstration
## Mid June - Sandy ridges yellowing off
## Warren, MN



North Star Ag Service
Scott Edgar

# *Sugarbeet Soil Analysis June 20, 2012*

| Site Appearance | Sulfur 0-6” | Sulfur 6-24” | Chloride 0-6” | Chloride 6-24” |
|---|---|---|---|---|
| | lb/a | lb/a | lb/a | lb/a |
| Yellow | 8 | 24 | 4 | 8 |
| Green | 108 | 240+ | 22 | 104 |

Sulfur Sufficiency Range: 15 lb/a topsoil?

Chloride Sufficiency Range: 40 lb for wheat?

Soil nitrate for good and bad >80 lb/a 0-24”

# ***Tissue Analysis - June 27***

| Site | Sulfur | Chloride |
|---|---|---|
| Yellow | .14% | .22% |
| Green | .23% | .87% |

Sulfur Sufficiency Range: .25% to .50%

Chloride Sufficiency Range: Sugarbeets?

All other nutrients in sufficiency range

# ***Sugarbeet Tissue Analysis After Fertilizer Trial Strips (July 11)***

| Treatment | Sulfur | Chloride |
|---|---|---|
| Yellow (check) | .13% | .13% |
| Green (adjacent good) | .28% | .41% |
| Potassium Chloride – 50 lb/a | .17% | **.42%** |
| AMS - 50 lb/a<br>Potassium Chloride – 50 lb | **.50%** | **.47%** |

# Sugarbeet – Soil and Tissue Demo

- Tissue and soil tests showed differences between yellow and green beets
- Tissue tests 10 days after fertilizer application (1” rain) showed nutrient uptake
- Additional research planned for sulfur and chloride on sugarbeets?

# *Corn – Soil and Tissue Demonstration Purple and Stunted plants*

- Use tissue and soil tests to determine reason for purple corn.
- Determine if tissue test after fertilizer application would show plant nutrient uptake.

Greg Reidman
Riverbend Agronomy

# *Corn – Soil and Tissue Demonstration*
# *Purple and Stunted plants*

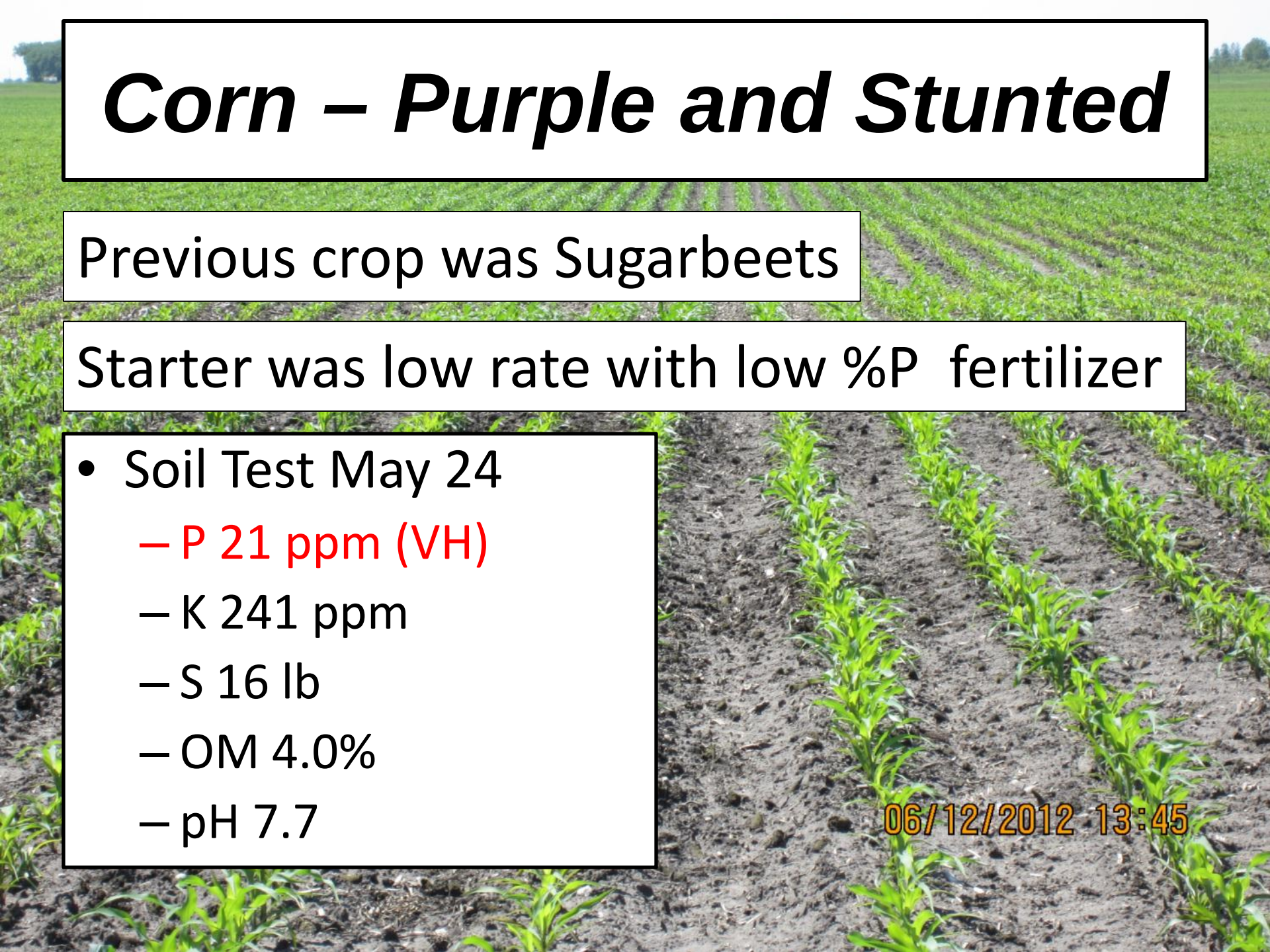
Greg Reidman
Riverbend Agronomy

# *Corn – Purple and Stunted*

Previous crop was Sugarbeets

Starter was low rate with low %P fertilizer

- Soil Test May 24
  - P 21 ppm (VH)
  - K 241 ppm
  - S 16 lb
  - OM 4.0%
  - pH 7.7

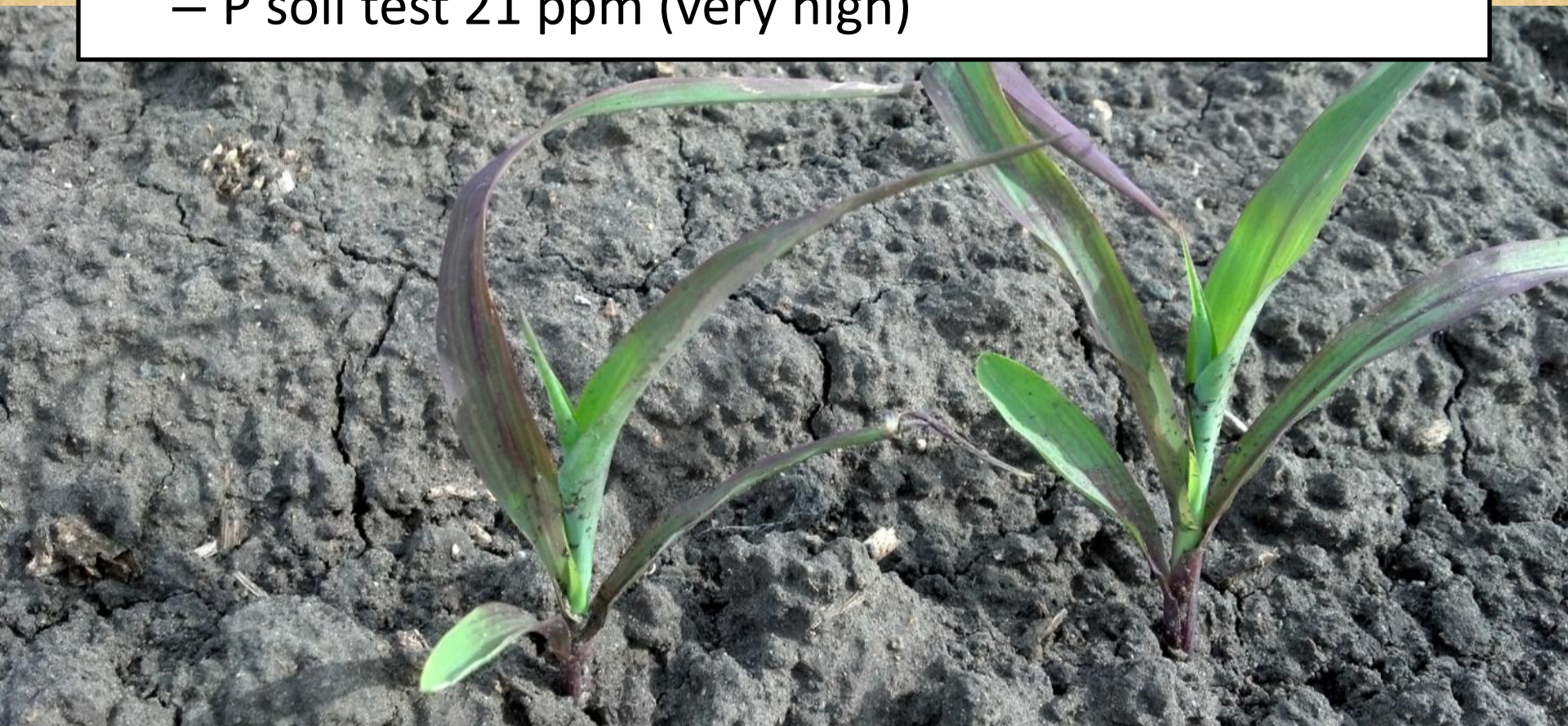


# ***Sugarbeets don't support Mycorrhizae (Fallow syndrome)***

- Fungus helps plant take up nutrients like P & Zn
- Previous crop of sugarbeets, canola, fallow don't support mycorrhizae and fungus population decreases

# *Tissue Analysis - May 24*

- Phosphorus very low in tissue
  - .17%  Sufficiency range is .35% to .8%
  - P soil test 21 ppm (very high)



# *Rescue in season?*

- 6 gallon 9-24-3 applied
  - placed near row with single disc
- 4 gallon 10-34-0 + Zn
  - Foliar application

# *P Def. - Rescue in season?*

***Tissue Test 2 weeks trt***

Check - .24% P

Treated - .22% P

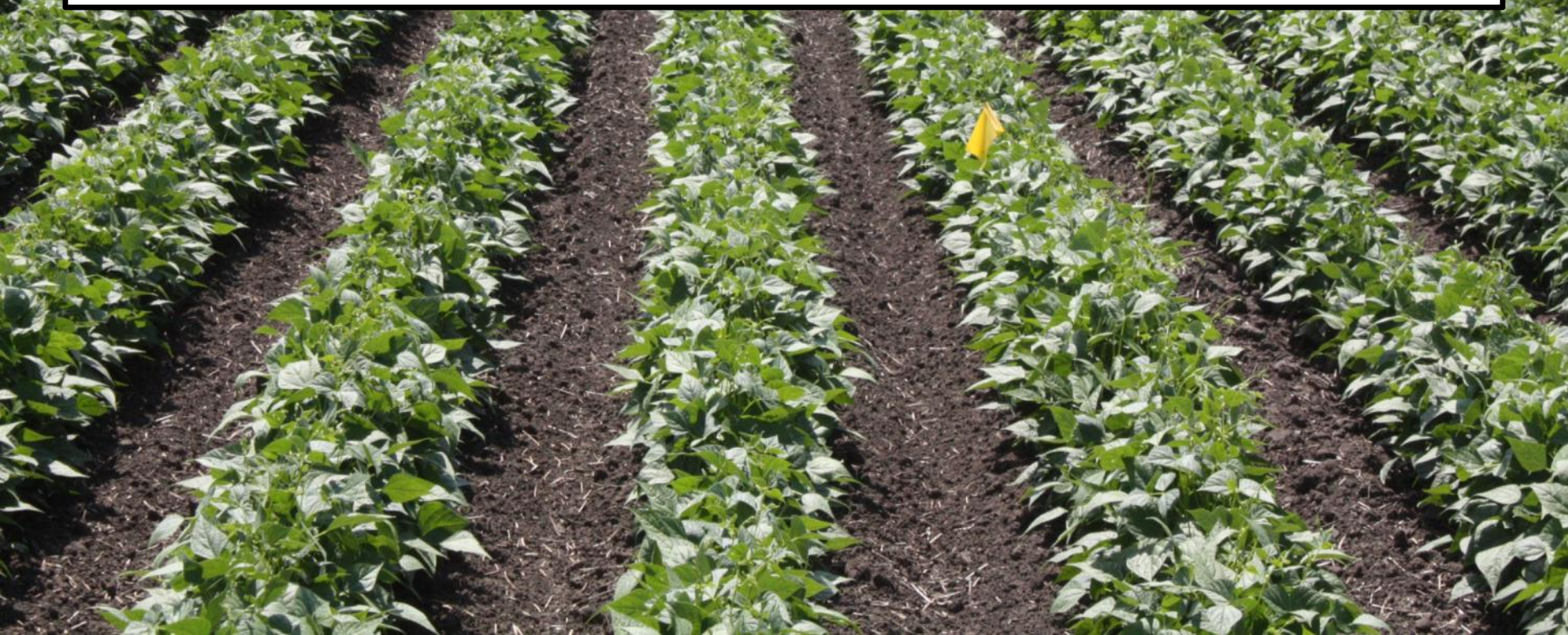
(Sufficiency Range is .35% - .80%)

- No difference in growth
- No difference in tissue P
- Yield loss estimated at 40 bu/a

# *Corn – Tissue and Soil Test Demo – Purple Corn*

- Tissue Test indicated low P was issue
- Soil Test was high in P
- Previous Crop of Sugarbeets pointed towards “Fallow Syndrome”
- Low rate of low %P starter (too little)
- Rescue Treatment did not show up in tissue analysis or in observed growth
- Grower needs “Strong Starter P” program for corn following sugarbeets or do not plant corn after beets

# *Navy Bean Tissue and Soil Test Demonstration*



# *Navy Bean – Tissue and Soil Test Demonstration*

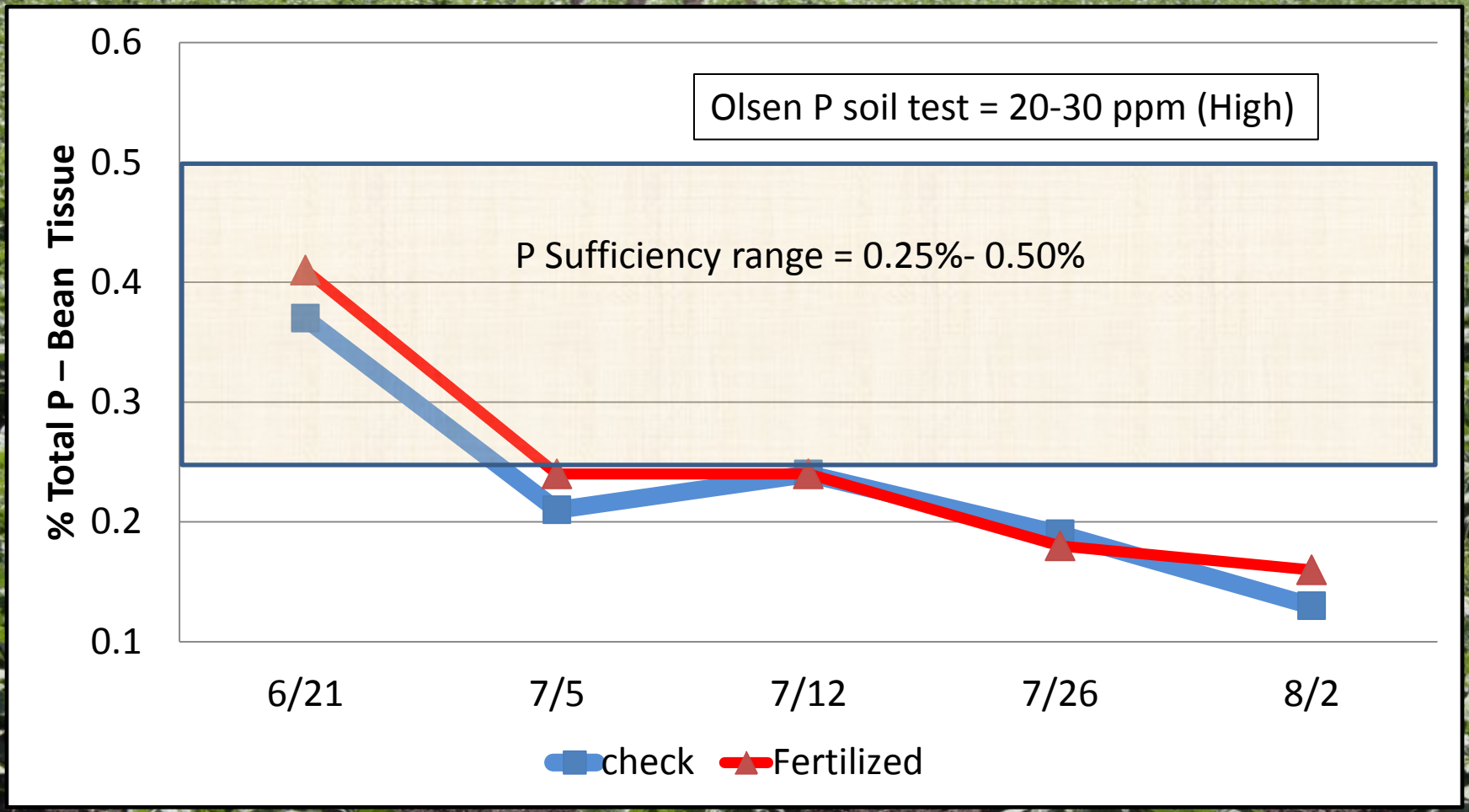
- Use tissue and soil testing to distinguish fertilizer and unfertilized treatments
- Determine if tissue nutrient levels stayed in the sufficient range through the season.
- Do some scouting for Bow Season!

# *Navy Bean – Soil Test – July 17 Demonstration - Hatton ND*

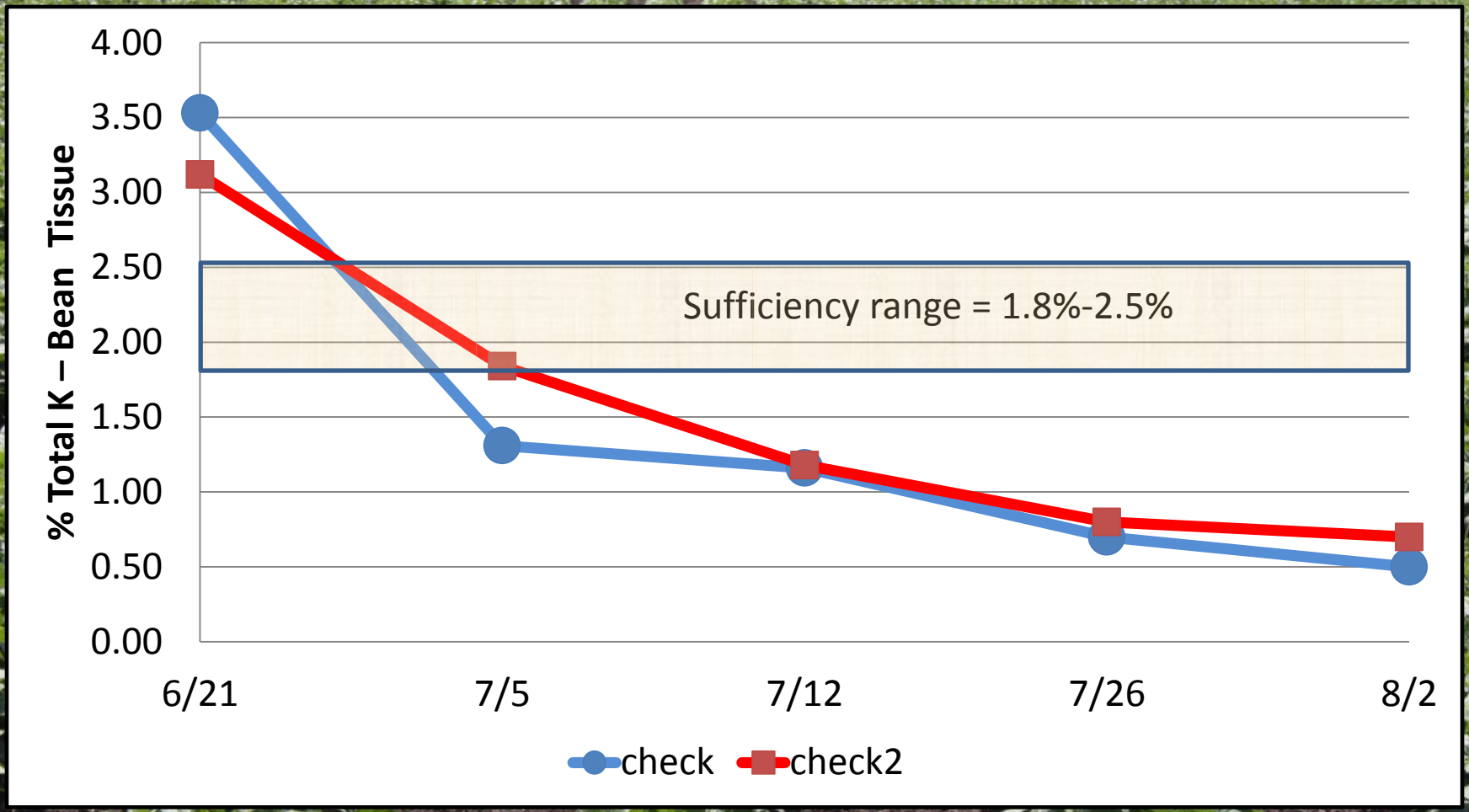
| Treatment | N 0-6” | P (Olsen) | K | S 0-6” | Zn | OM |
|---|---|---|---|---|---|---|
| | Lb/a | ppm | ppm | lb/a | ppm | % |
| check | 10 | 30 | 235 | 6 | 2.6 | 2.6 |
| Fertilized | 24 | 24 | 227 | 14 | 2.4 | 2.8 |

20-31-0-15 preplant broadcast and tilled

# P – Tissue levels –Navy Beans



# K – Tissue levels – Navy Beans




K soil test = 235 ppm ( No K fertilizer applied)

# Navy Bean Tissue and Soil Test Demonstration

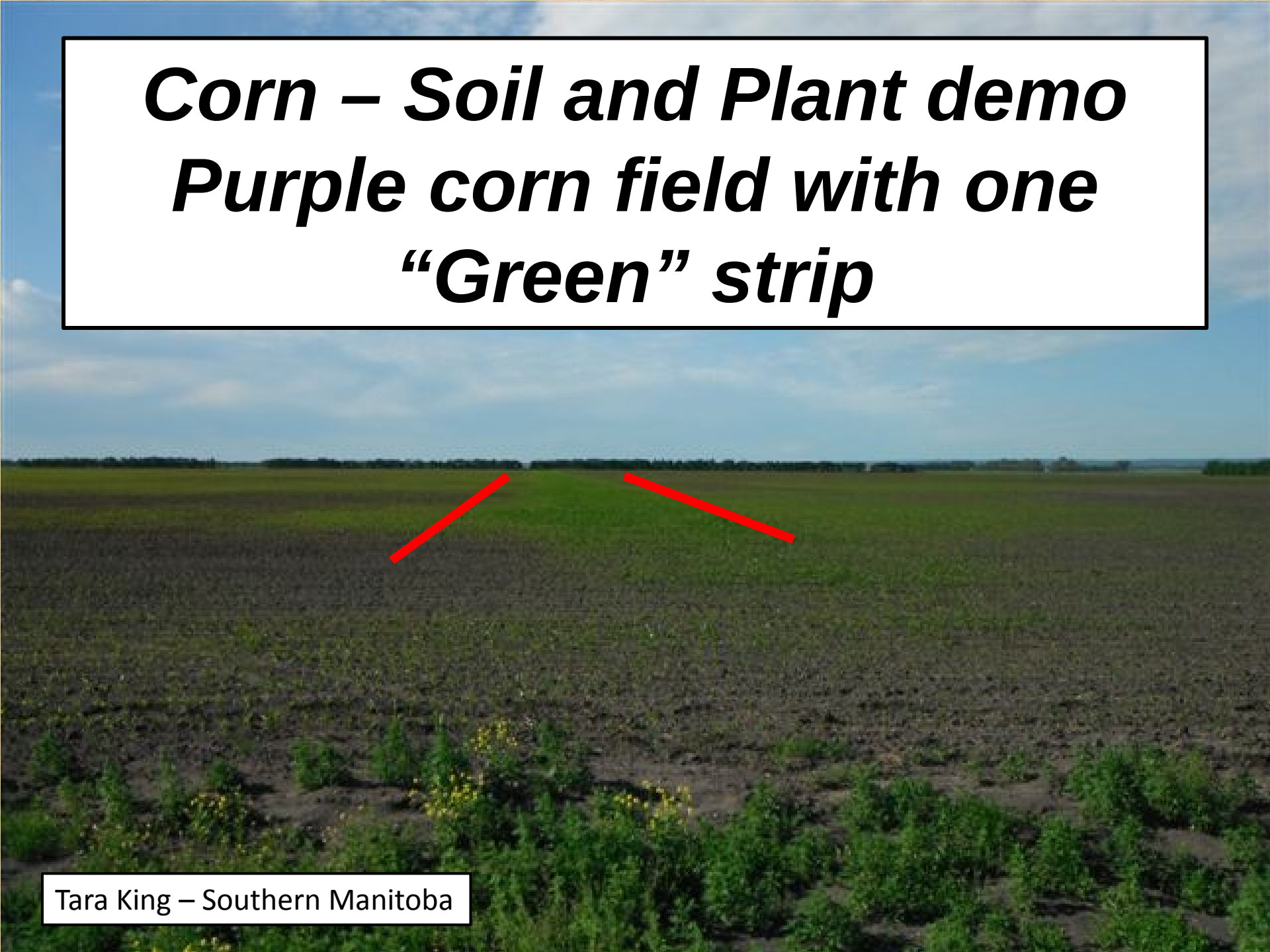
- Tissue levels for P & K dropped off once topsoil got dry
- Soil test showed both P and K levels were high
- Tissue tests from fertilized and unfertilized area showed uptake issues once topsoil got dry (no difference in P treated or untreated)
- As crop approached maturity we expect most nutrient levels to decline, but not this early!

# *Tissue & Soil Testing Together Provide Better Information*

- Tissue testing alone may indicate nutrients are low, while a soil test shows the nutrient level to be high. You need info on rotation, soil conditions, fertilizer, placement, timing and other stresses!
- Having both tissue and soil tests (Good" & "Bad") is critical when trouble shooting problem areas!
- Tissue and soil samples together provide best information for making decisions

# Questions

# *Corn – Soil and Plant demo Purple corn field with one "Green" strip*



Tara King – Southern Manitoba

# *Corn – Soil and Tissue Demonstration Purple and Stunted plants*

- Previous Crop  - canola
- No starter fertilizer with seed
- Fallow syndrome suspected

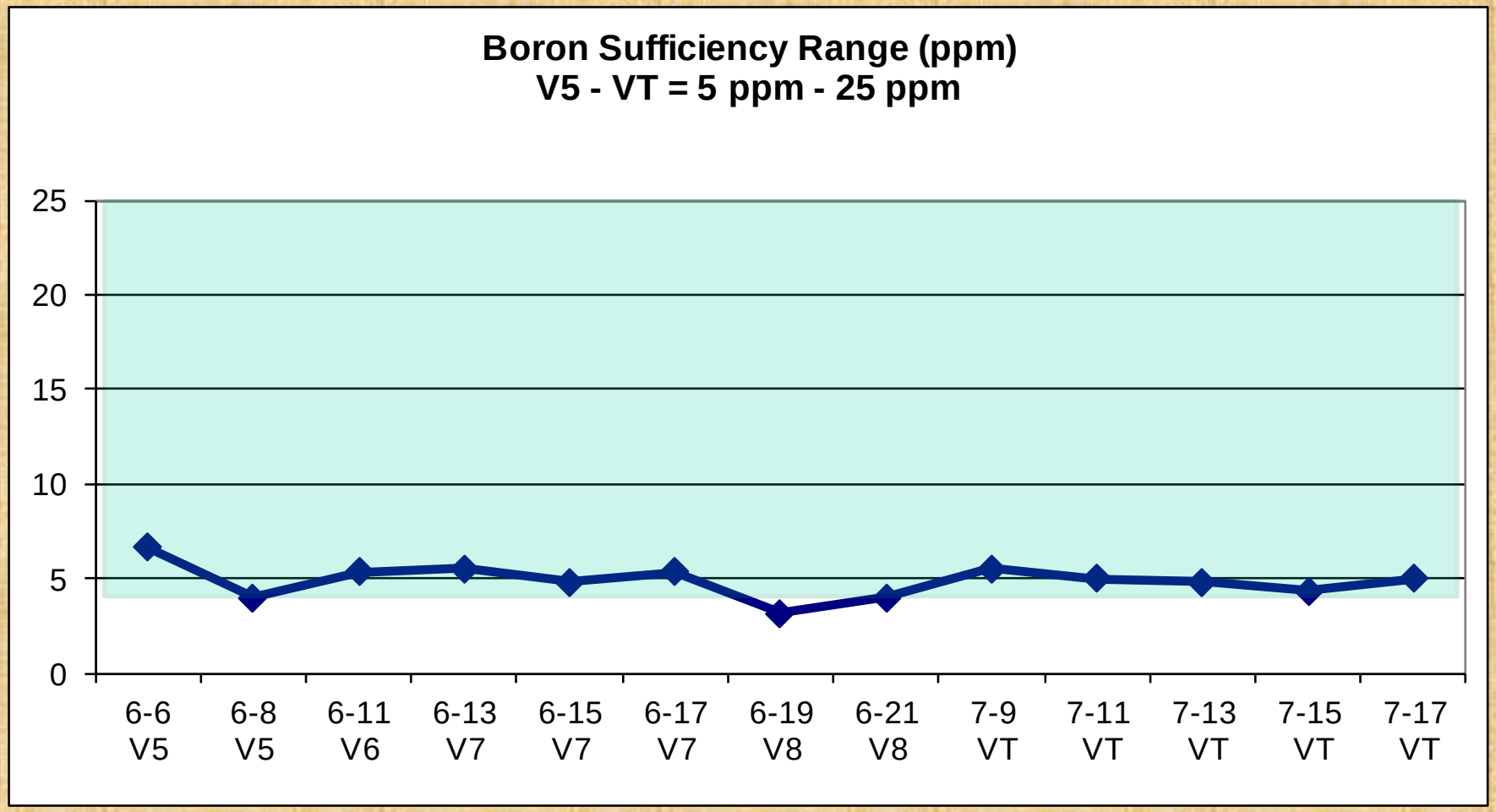
***Fallow syndrome*** is a situation where a beneficial fungus called Mycorrhizia die because there are no host plant roots to grow on. Mycorrhizia is a beneficial fungus which helps plants take up phosphorus, zinc etc. Crops following fallow need extra P fertilizer.

***Canola and sugarbeets*** do not support Mycorrhizia fungus so they die off. The following crop then needs extra P fertilizer to ensure adequate P uptake.

Purple stunted corn
Previous crop: canola
Tissue P = .14% (suff .35 - .80)
P soil test 8 ppm (Olsen)

Green normal height corn
Previous crop: ***Old tree row***
Removed previous year
Tissue P = .28% (suff .35 - .80)
P soil test 8 ppm (Olsen)

# Boron Tissue Test Results  Stage of Growth




**Average of all 6 tissue samples (3 from each field) on each sample date.**

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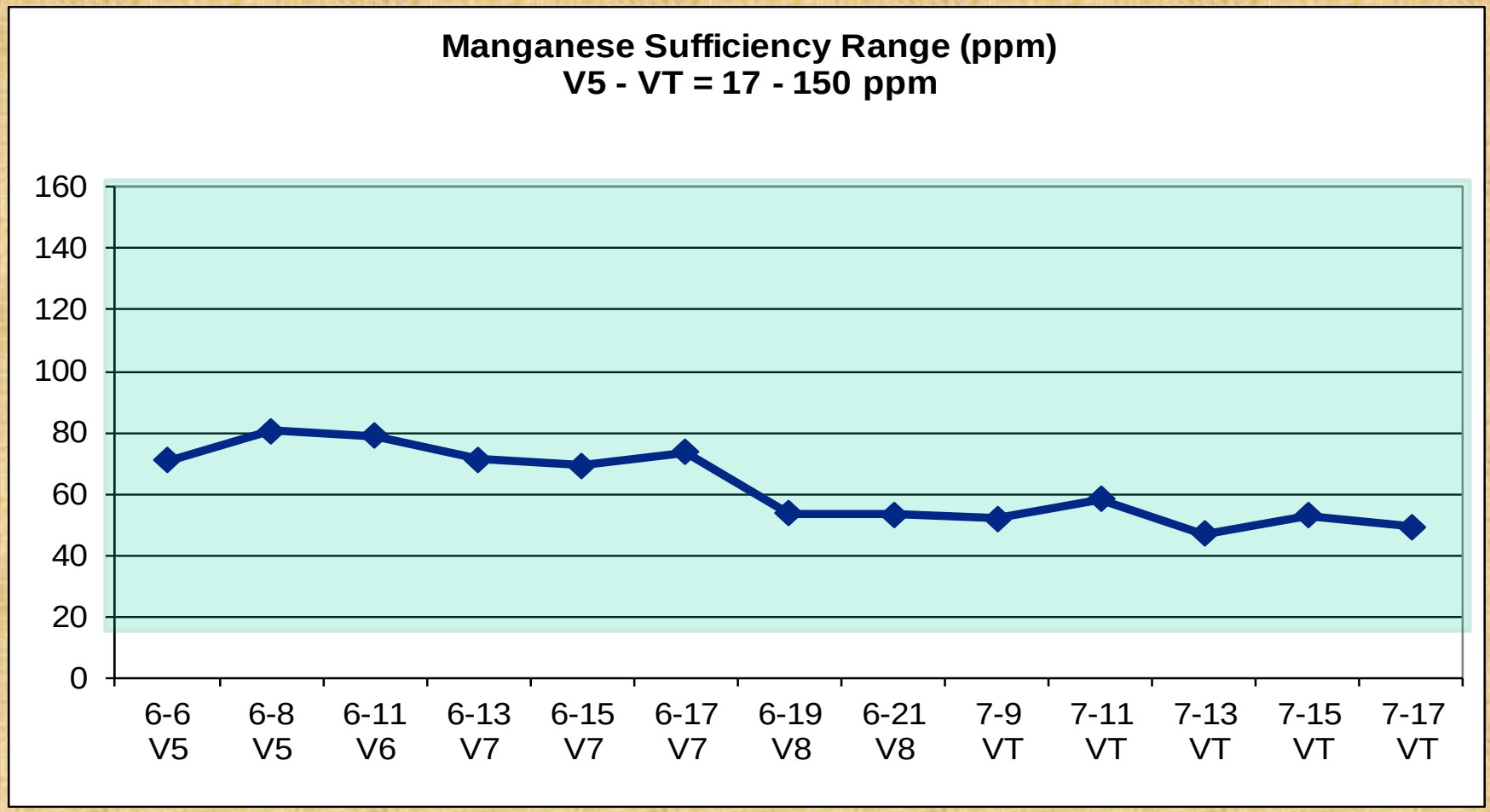
# Manganese Tissue Test Results - Stage of Growth




**Average of all 6 tissue samples (3 from each field) on each sample date.**

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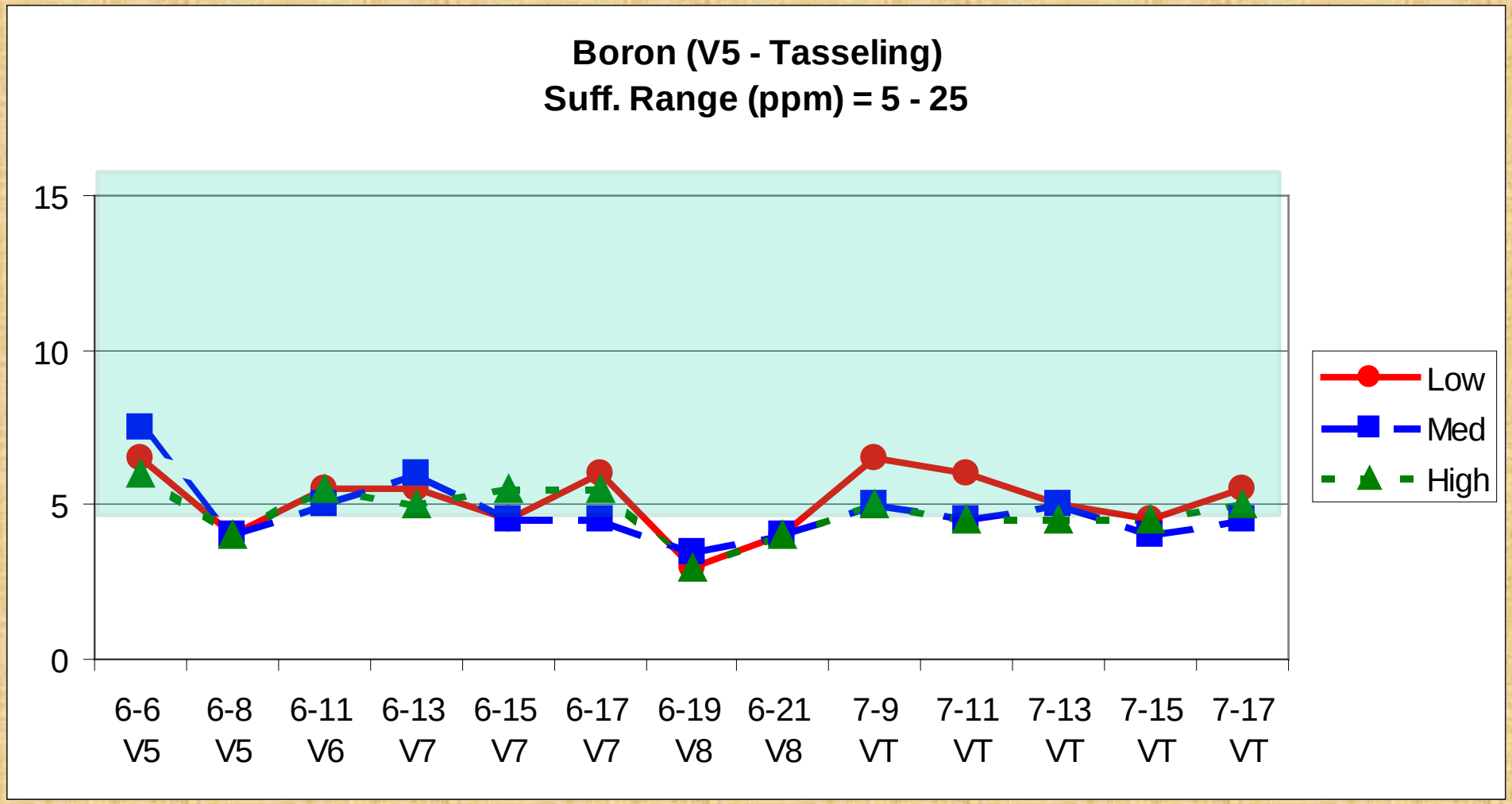
# Boron Tissue Test Results – Stage of Growth




**Average of low, medium and high sites from both fields.**

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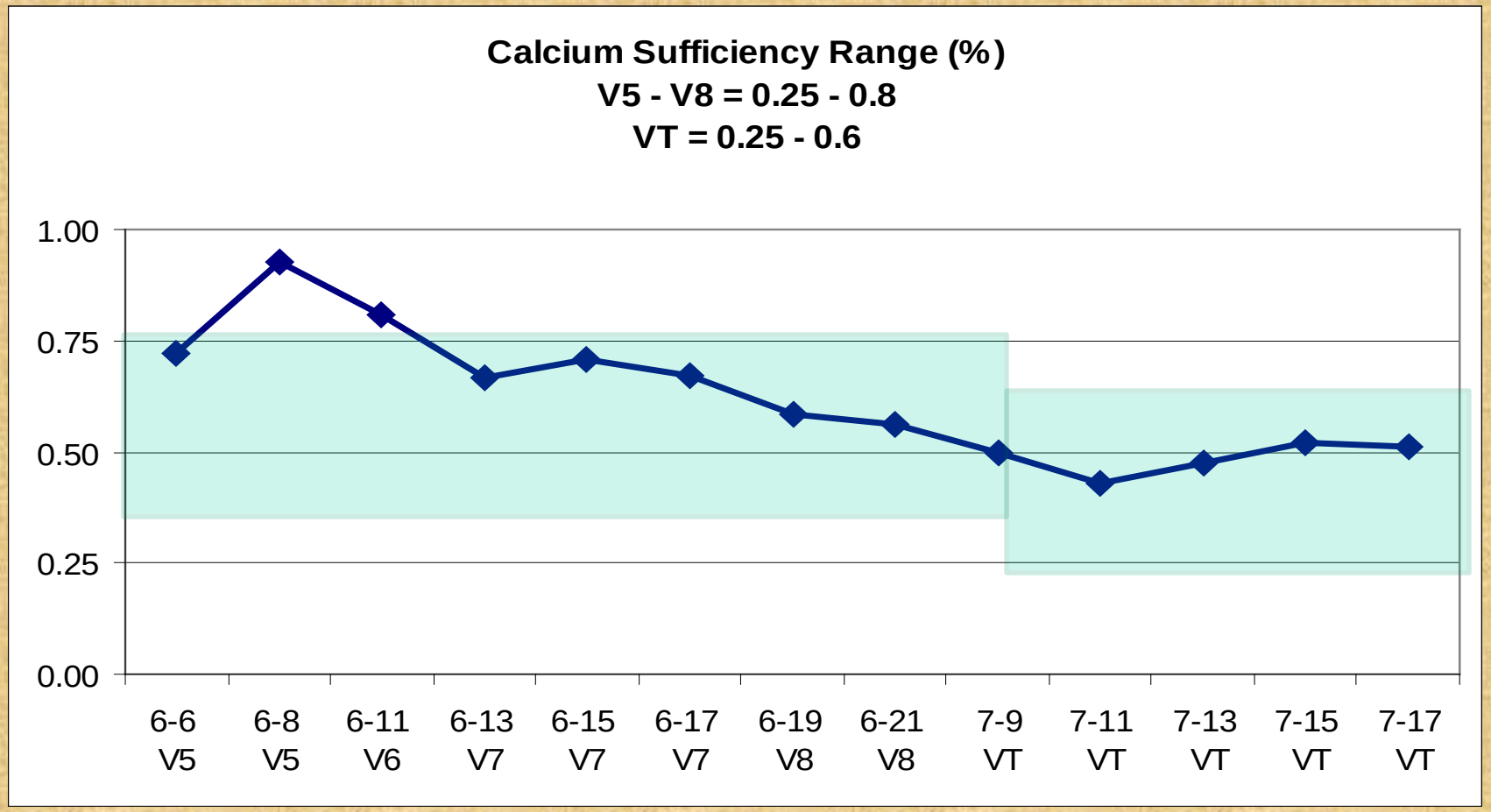
# Calcium Tissue Test Results - Growth Stage




Average of all 6 tissue samples (3 from each field) on each sample date.

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# ***Fertilizer recommendation cannot be based on a plant nutrient analysis alone***

- *Field/Soil Information Needed*
  - *Is the nutrient level in the soil low?*
  - *What rate and placement of fertilizer?*
  - *Has fertilizer been applied recently?*
  - *Is Crop Stressed? - soil compaction, drought, flooding, root disease, pesticide carryover*

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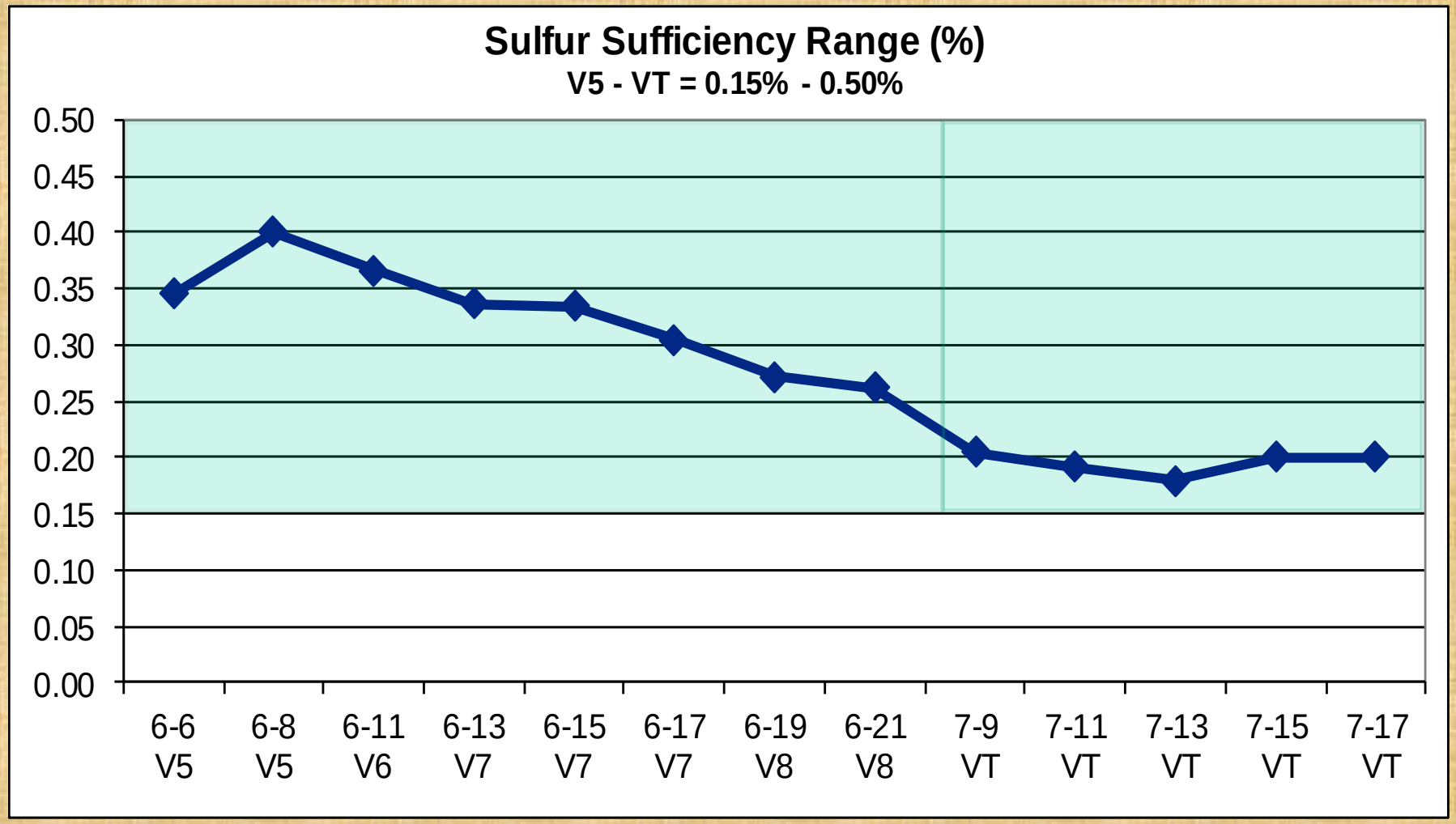
# Sulfur Tissue Test Results - Growth Stage




**Average of all 6 tissue samples (3 from each field) on each sample date.**

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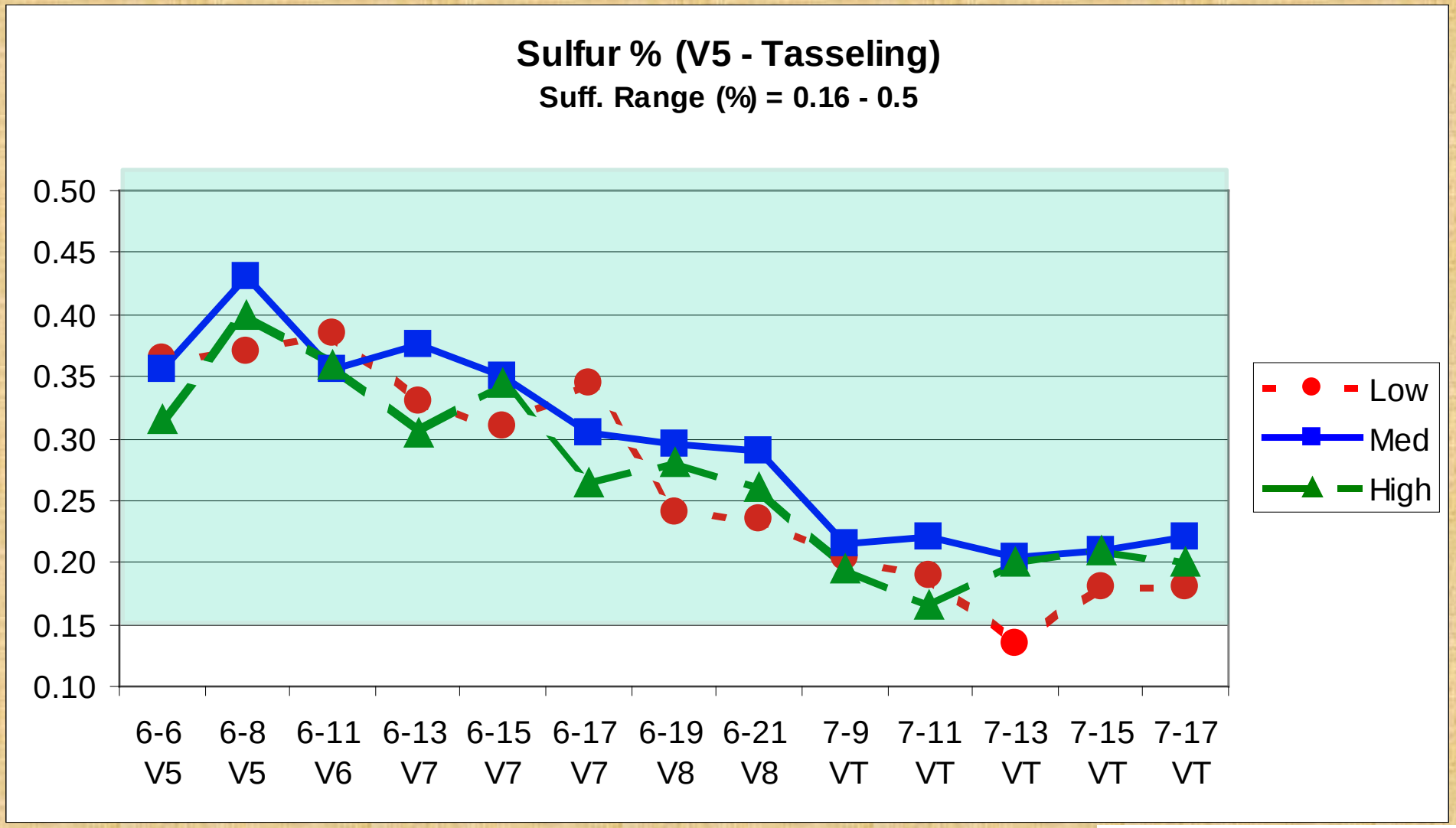
# Sulfur Tissue Test Results - Stage of Growth




**Average of low, medium and high sites from both fields.**

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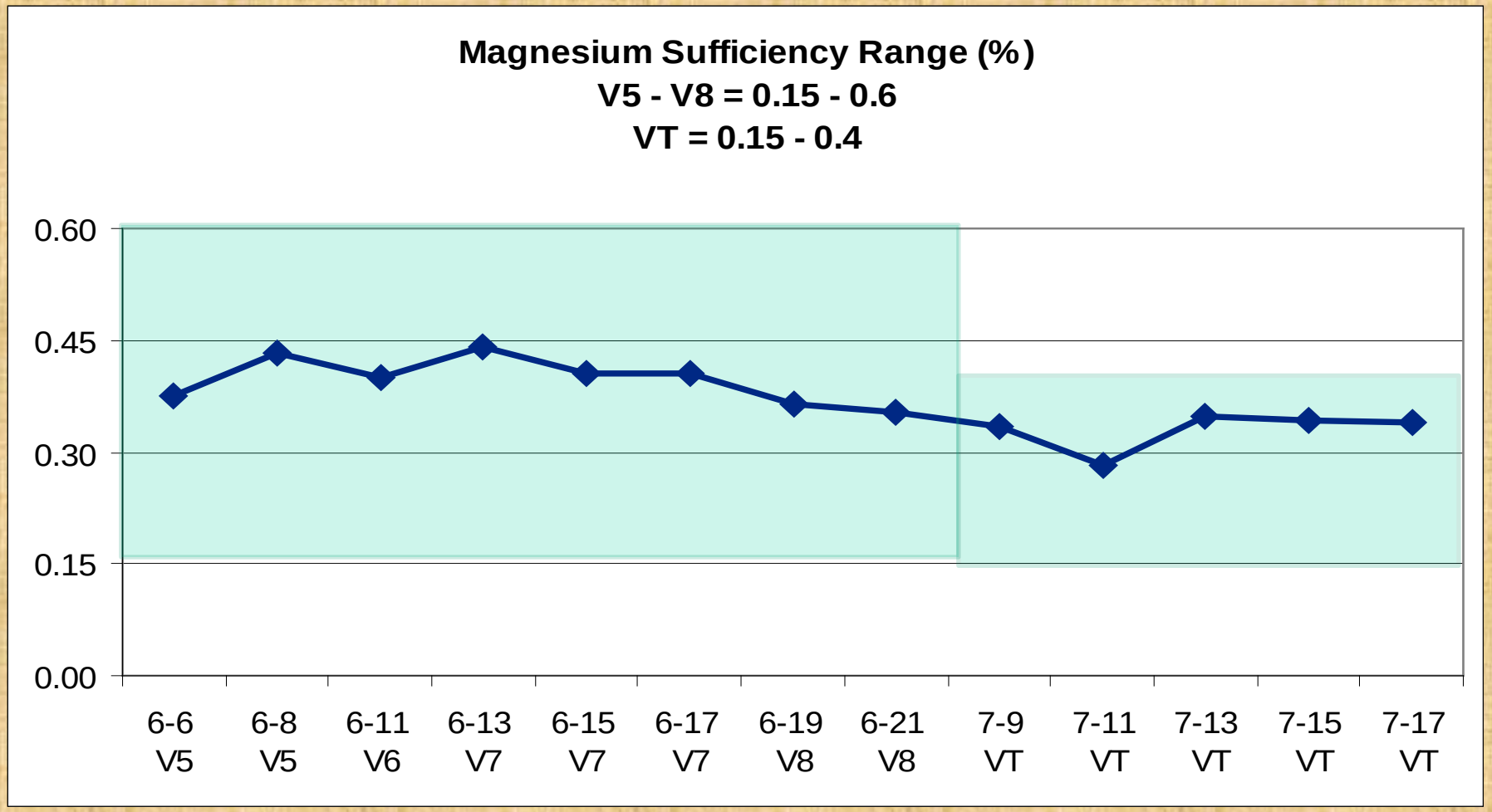
# Magnesium Tissue Test Results - Stage of Growth




**Average of all 6 tissue samples (3 from each field) on each sample date.**

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