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# **Institute of Ag Professionals**

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# ***Phosphorus And Potassium Recommendations: How Do We Adapt To The Constant Changes In Agriculture?***



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# Changes

- Farms have become larger
- Yields have increased
- Fertilizer is no longer a “cheap” input
- More acres are rented
- Greater ability to fine tune recommendations within fields

# Four Key Questions

- Can/should you build and maintain?
- What is a good target to build to?
- What is the probability that I will achieve a positive yield response in a given soil test class?
- What is the average yield increase for the class I am building to?

# **P and K**

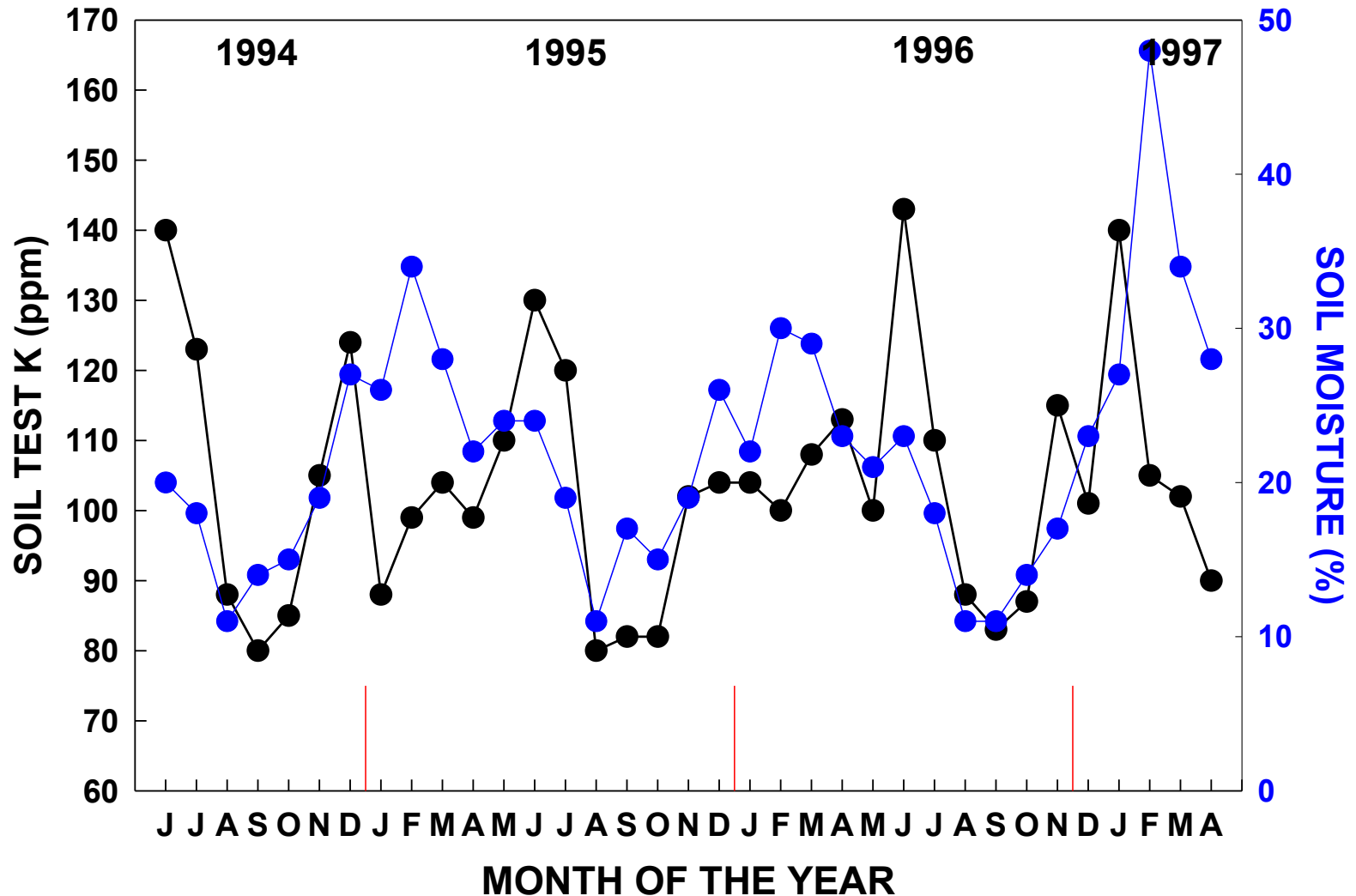
## **Similar but Chemically Different**

- Both exist in conceptual pools
  - Available
  - Moderately Available
  - Very slowly available
- K is held on exchange sites, P is not
- P forms complexes K does not
- Both have limited mobility in the soil

- P can be banked in the soil to some degree
- Retention, Release, and Fixation is a complex process
  - Acid soils – retention more likely
  - Basic soils – higher potential for fixation
- Soil tests measure an index of the available P pool – not the total
- At best the efficiency of P is about 30% in a single year
  - Some fertilizer supplies the plant and other goes to replenish soil supply

- K can be banked in the soil to some degree
- K can be fixed within clay layers
- Soil moisture is an important determining factor in what the soil test will be
- Leaching from residue can affect the soil test values
- The K soil test suffers from significant seasonal variability, more so than P

# Seasonal STK Variation



Ebelhar, Varsa, and Peck. IL



# P and K Management

- Can be challenging
- Soil testing is a key tool
  - Plant tissue testing can be used but it is not calibrated test
- Soil tests are indexes
  - Associated to probability of response
  - Correlated to crop response
  - Further calibrated to be able to tell you how much fertilizer to apply

# Risk

- Soil sampling associated risk
- How certain are you that the soil sample is representative of your area

180 X 180

|    |   |   |   |   |   |
|----|---|---|---|---|---|
| VH | H | M | H | H | L |
| H  | L | L | H | M | M |

300 X 300

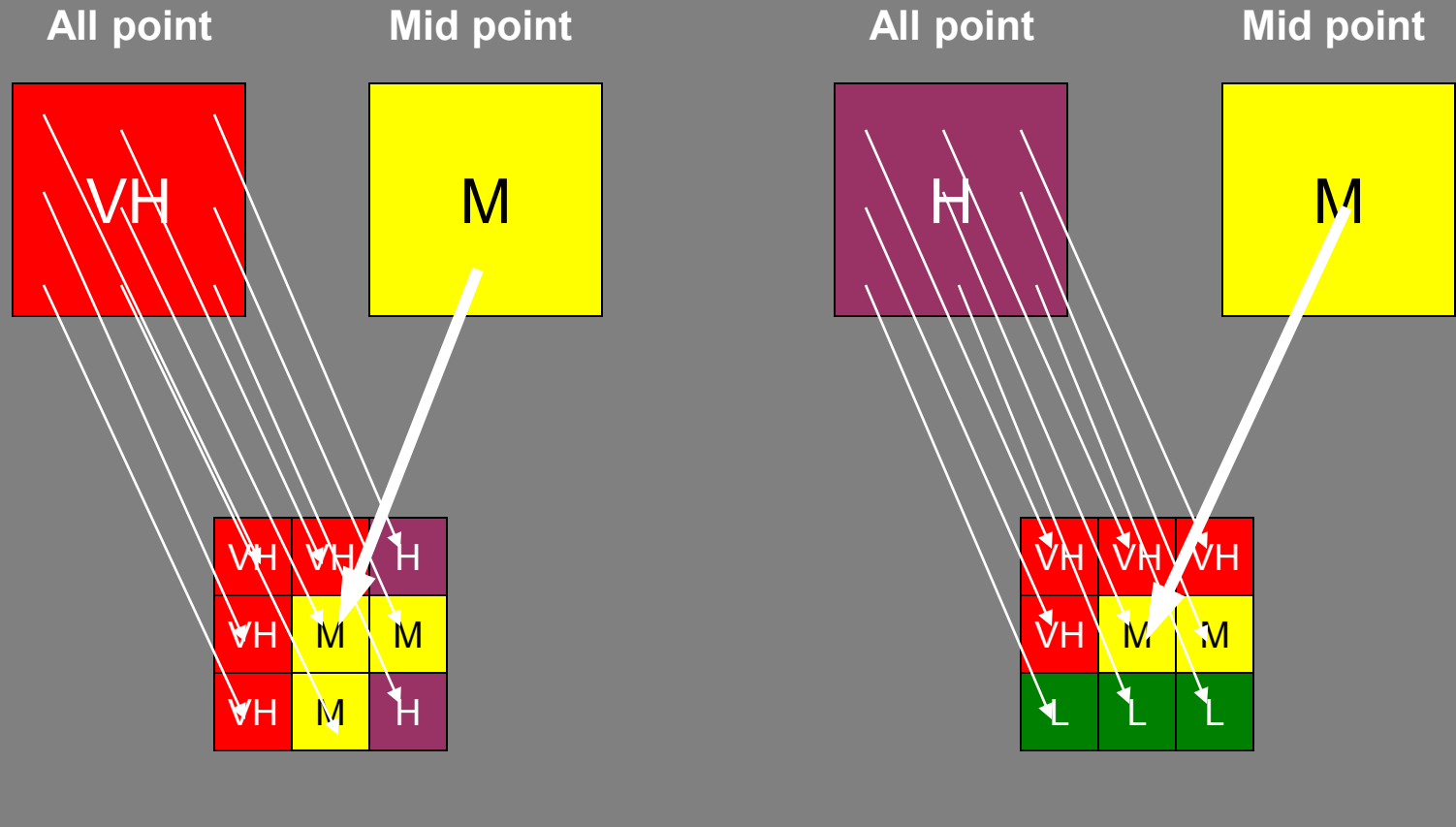
|   |   |   |
|---|---|---|
| H | M | M |
|---|---|---|

60 X 60



|    |    |    |    |    |    |    |    |   |    |    |    |   |   |    |   |    |   |   |
|----|----|----|----|----|----|----|----|---|----|----|----|---|---|----|---|----|---|---|
| VH | VH | H  | H  | VH | VH | M  | M  | L | L  | M  | VH | M | H | L  | L | L  | L | M |
| VH | M  | M  | VL | H  | M  | VL | L  | L | M  | VH | L  | M | H | L  | M | L  | L | M |
| VH | M  | H  | VH | VH | H  | H  | L  | M | H  | VH | L  | L | M | M  | L | L  | M | M |
| VH | VH | VH | M  | M  | L  | L  | L  | L | M  | M  | L  | M | L | L  | M | M  | L | L |
| VH | M  | M  | M  | M  | VL | M  | VL | L | H  | VH | H  | L | M | VH | M | VH | M | L |
| L  | L  | L  | M  | L  | L  | L  | L  | H | VH | VH | VH | M | M | M  | L | M  | L | L |

**Renville A location    soil P test**

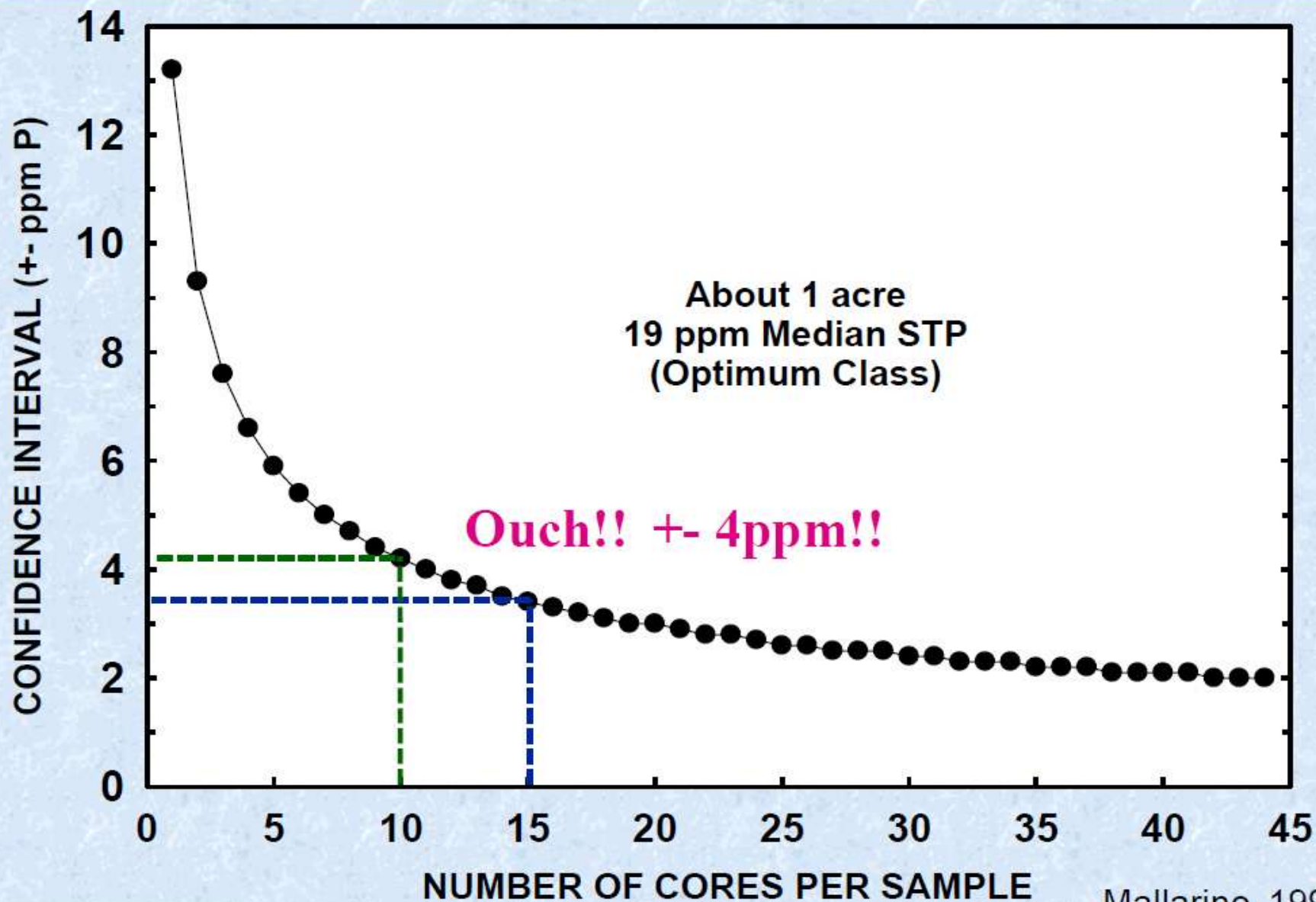


**Renville A location All point vs Mid point**  
**9 - 60 X 60 ft. cells = 1 - 180 X 180 ft. cell**

# Chance of equaling average soil test with the mid pt. or one random sample

|    | 55 X 55 m     |        | 75 X 75 m |        |
|----|---------------|--------|-----------|--------|
|    | Mid pt.       | Random | Mid pt.   | Random |
|    | ----- % ----- |        |           |        |
| RA | 33            | 38     | 33        | 24     |
| RM | 29            | 40     | 50        | 33     |
| S  | 79            | 80     | 25        | 68     |

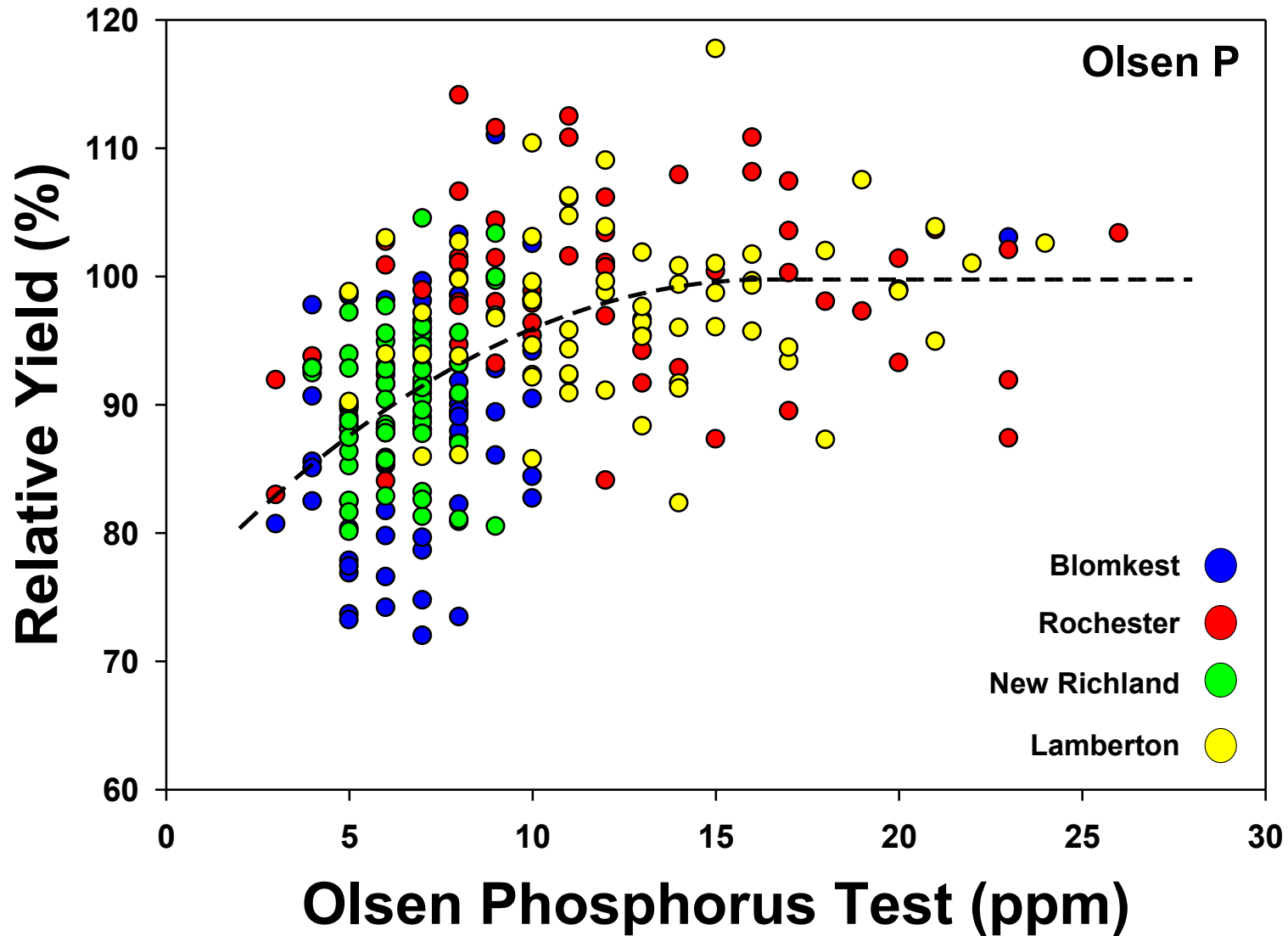
# How Accurate is Your Soil Sample



# Soil Sampling Effects on Soil Test P

- Size of grid
  - The smaller the grid the better evaluation.
  - Size of grid or sampling area is limited by economics.
- Location of sample within the grid.
  - A random sampling point in an area will be a better indicator of the average value for the area compared to using the mid pt.

# Corn Relative Yield Data





# Critical STP Levels - Corn

|           |  | Relative Yield |     |      |
|-----------|--|----------------|-----|------|
|           |  | 95%            | 98% | 100% |
|           |  | -----ppm-----  |     |      |
| Bray-P1   |  | 10             | 15  | 18   |
| Olsen-P   |  | 9              | 12  | 16   |
| Mehlich-3 |  | 15             | 24  | 29   |

**Olsen P**

**Olsen Phosphorus Test (ppm)**

**Legend:**

- Foxhome (Red)
- Blomkest (Blue)
- Grand Meadow (Green)
- Lamberton (Yellow)
- Stewart (Cyan)

# Critical STP Levels - Soybeans

|           |  | Relative Yield |         |         |
|-----------|--|----------------|---------|---------|
|           |  | 95%            | 98%     | 100%    |
|           |  | -----ppm-----  |         |         |
| Bray-P1   |  | 13             | 20      | 21      |
| Olsen-P   |  | 10             | 13      | 16      |
| Mehlich-3 |  | Non est        | Non est | Non est |

# Critical Soil Test Levels

- Targeting the right spot can be key for management
- Remember the uncertainty about soil testing
  - Fewer samples or cores = more uncertainty
- Critical soil test only gives you 1/3 of the picture
  - What about the probability of response

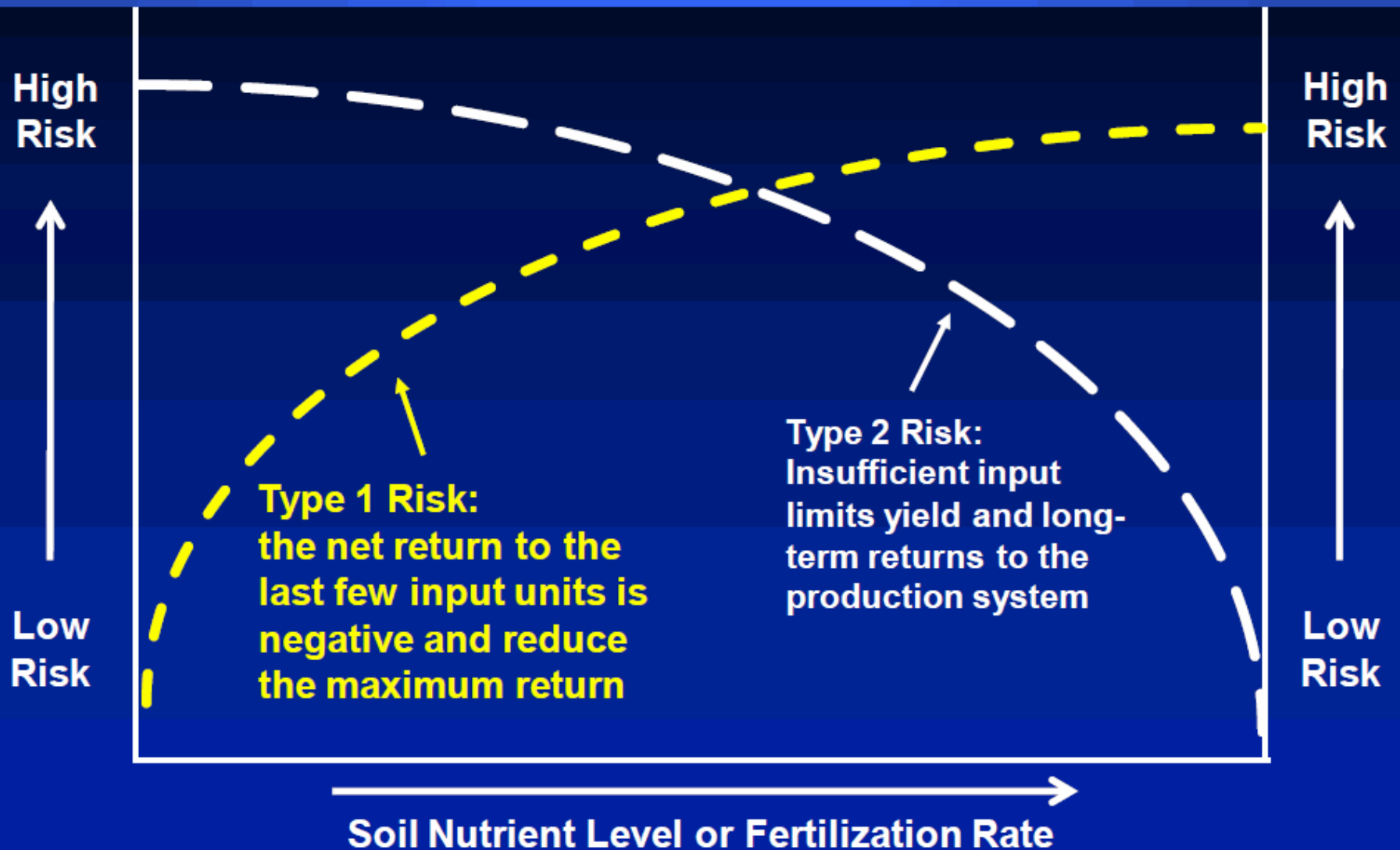
# Corn Yield Response Data

|           | Probability of Response | Level of Response (Yield Increase) |
|-----------|-------------------------|------------------------------------|
|           | %                       | %                                  |
| Very Low  | --                      | 14.8                               |
| Low       | 80                      | 10.8                               |
| Medium    | 60                      | 4.2                                |
| High      | 25                      | 2.5                                |
| Very High | 7                       | 0.6                                |

# Risk!!!

- Are there inherent differences in achievable yields between the soil P classes
- What can you afford to do?
  - High cash rents
  - High fertilizer costs
  - Opportunity costs associated with other inputs

# Proposed Kansas Model



# Land Tenure

- Owned land
  - Secure land tenure
  - Any banked P and K can be used for future crops
  - Long term investment
- Rented land
  - Less secure tenure
  - Any banked P and K may be available for other producers to use
  - Short term investment



# Maintaining a Medium

- Higher chance of a return for your investment
  - Higher return per lb P applied
  - Lower fertilizer cost
  - Frequent soil testing is a must!
- 
- Current U of M recs if followed diligently should maintain a medium

# Maintaining a High

- Low probability that yield will be limited by the nutrient
- Higher investment in fertilizer
- Lower return per lb P
- Maximize total production
- Soil testing can be less frequent

# Optimum Classes

- Is there one optimum class for all growers?
- Grower defined optimums
  - Attitude towards risk
  - How were soils sampled
  - Land tenure
- Let University data help make the decisions

# Return to P – All Years

Corn years 1 and 3, SB year 2

|      |        | Year 1 | Year 2 | Year 3 | Total |
|------|--------|--------|--------|--------|-------|
| Low  | U of M | \$125  | \$162  | \$204  | \$491 |
|      | BPM    | \$105  | \$152  | \$185  | \$443 |
| Med  | U of M | \$63   | -\$23  | \$142  | \$181 |
|      | BPM    | \$38   | -\$28  | \$132  | \$143 |
| High | U of M | -\$3   | -\$31  | \$79   | \$45  |
|      | BPM    | -\$40  | -\$20  | \$99   | \$39  |

**\*\*Assuming no yield increase from U of M recs for Year 1 and Year 2**

# Future P Suggestions

- There is flexibility
- Economics are not always straight forward
- Many interactions to deal with
- Many philosophies that do not always agree
- Where is the Universities Role
  - We do not regulate
  - We are here to provide the needed information for producers to make their own decision

# Future P Suggestions

- Rented Ground
- Set your “optimum” level to maximize return
  - Maintaining in the medium class
  - 10-15 ppm Bray
  - Higher probability that you will get a modest return on investment
- Focus on opportunity costs
  - What will give the best return
- Realize that more vigilance is needed

# Future P Suggestions

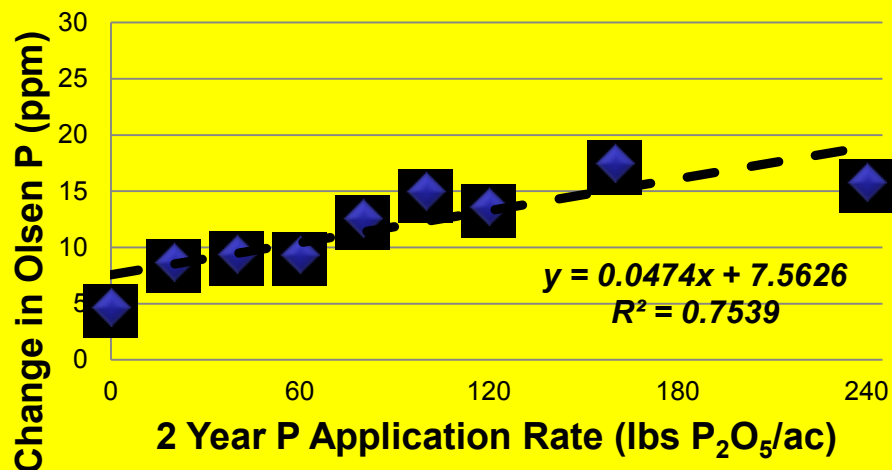
- Owned Ground
- Focus on long term productivity
- Set “optimum” level to where risk is minimized
  - Low chance of a yield loss
  - Any P over applied can be utilized by further crops
  - 15-25 ppm Bray-P1
  - Maintain around the critical level
  - Realize that the maintenance range will have be adjusted based on sampling procedures

# Rates

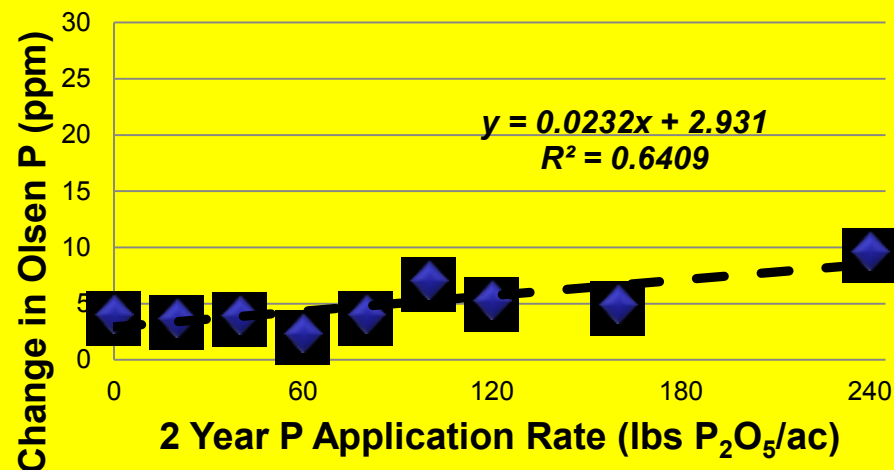
- Build rates around current suggestions
  - U of M recs for Low and Very Low soil tests will build
- Rapid building can be expensive
  - Not all soils will build the same
  - Not all soils will build
- Focus on long term yield averages instead of trying to fertilize for last year's yield
- Recognize that suggestions are suggestions



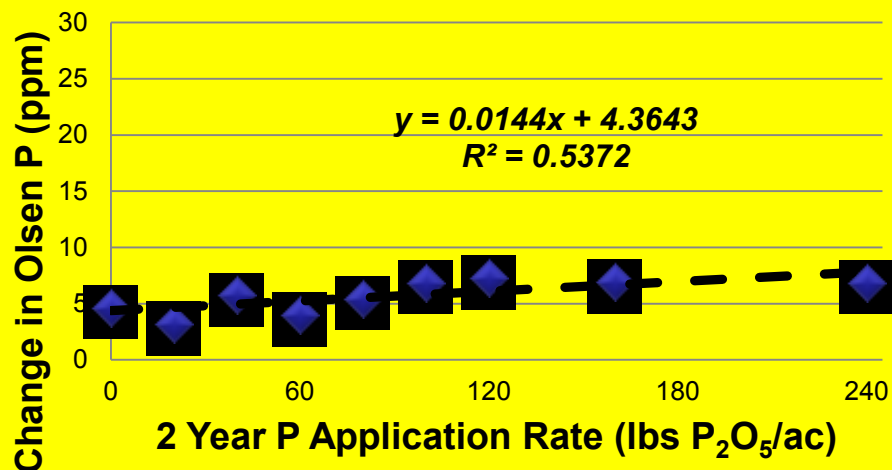
## Lamberton - Fall 2010



## Morris - Spring 2011



## Saint Charles - Fall 2010

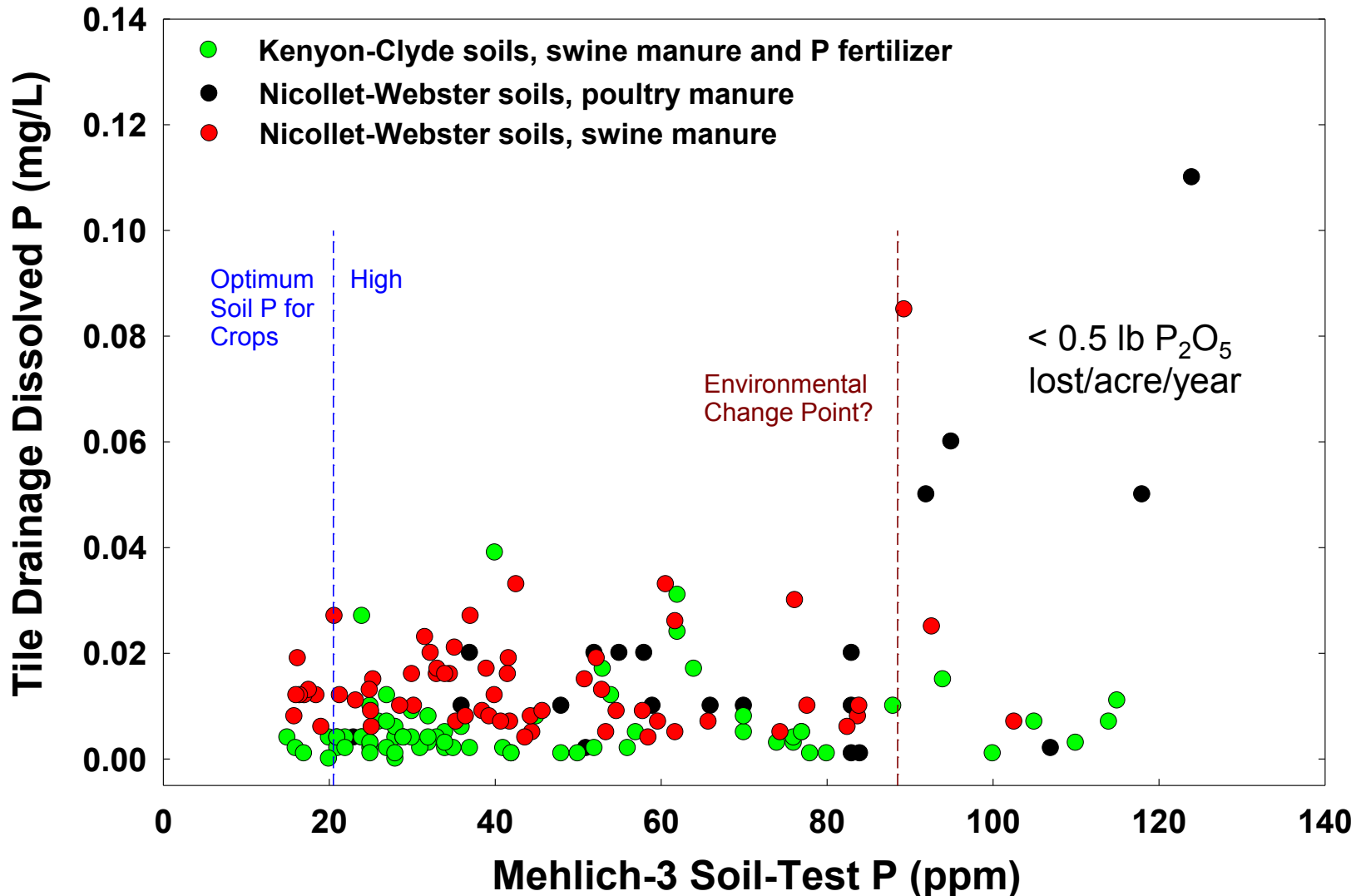


|          | Lamberton                                       | Morris | Saint Charles |
|----------|-------------------------------------------------|--------|---------------|
|          | -----lb P <sub>2</sub> O <sub>5</sub> /ppm----- |        |               |
| Bray P-1 | 13                                              | 20     | 41            |
| Olsen P  | 21                                              | 43     | 69            |

# Target Your Inputs

- Know when enough is enough
  - P and K can leach if soils test reach certain levels
  - Generally not an issue with most agronomic ranges
- If manure is available faster building may be possible
  - Manure is a resource but also a waste product

# Manure P, Soil P, and Tile Drainage P



# Thank You Questions?



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***<http://www.extension.umn.edu/nutrient-management/index.html>***



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