Nutrient Control BMPs:

Soil Testing
Plant Tissue Analysis
Fertilizer Application
Spill Prevention

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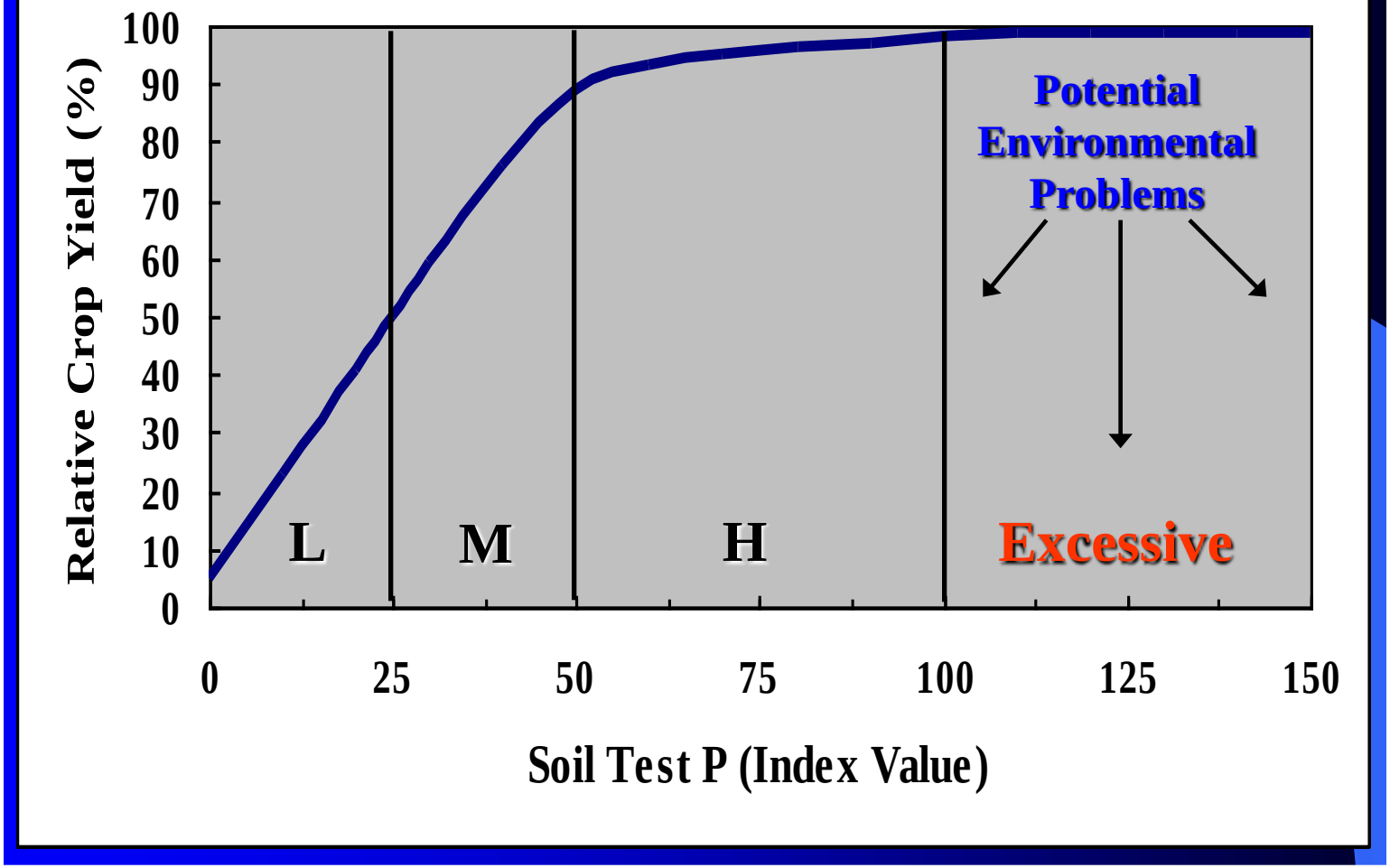
Soil Testing

Importance

- Part of the "Nutrient Control Practices" listed under approved BMPs for water quality improvement in the EAA.
- Soil testing is an essential tool to formulate a sound amendment and nutrient management program.
- With increased emphasis on environmental quality and rising cost of fertilizer materials, soil testing has become an important tool to identify areas where inadequate or excess fertilization has occurred.

Relationship Between Soil Test P, Crop Yield, and Potential for Environmental Problems due to Excessive Soil P



Soil Testing: 3-Step Process

- 1. Soil Sampling:

  a) Collection of Soil Samples

  b) Handling and Submitting

- 2. Laboratory Extraction and Analysis:

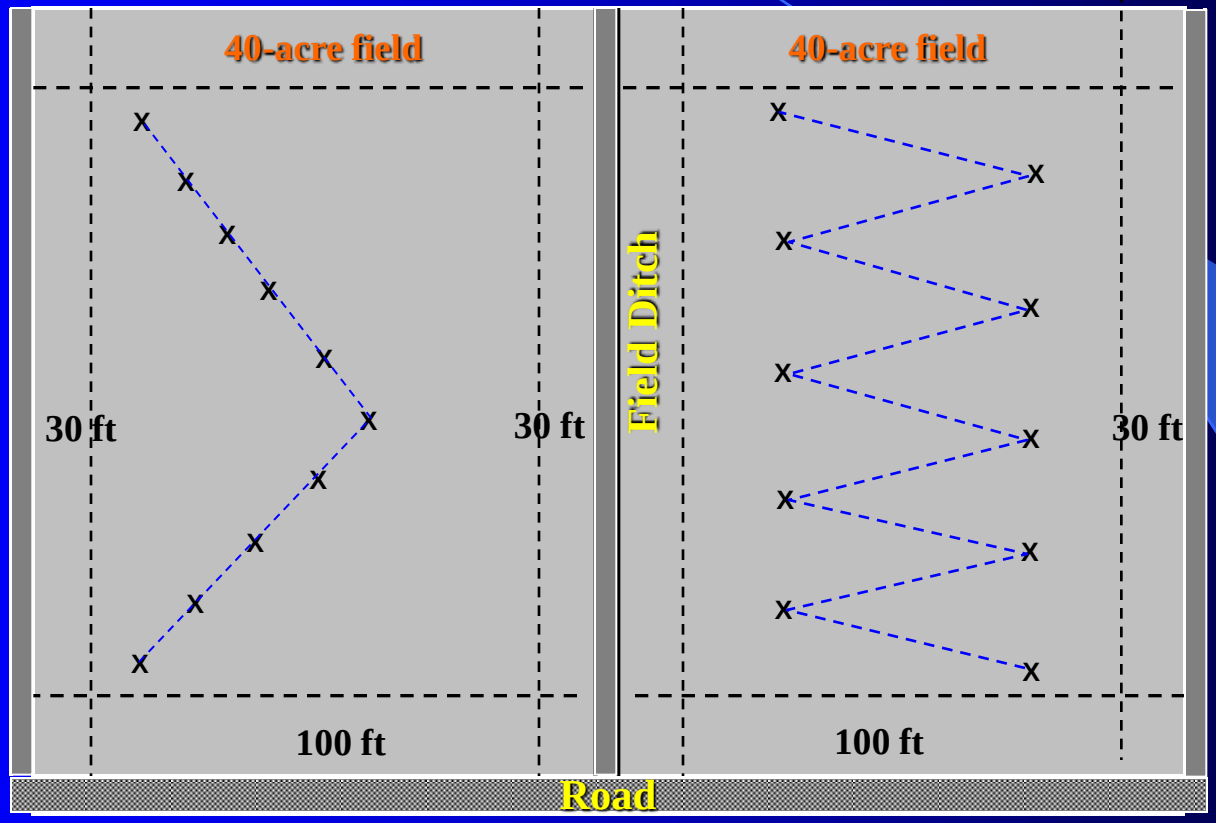
  a) Sample Preparation

  b) Extraction and Measurement of Nutrients.

- 3. Interpretation and Fertilizer Recommendation:

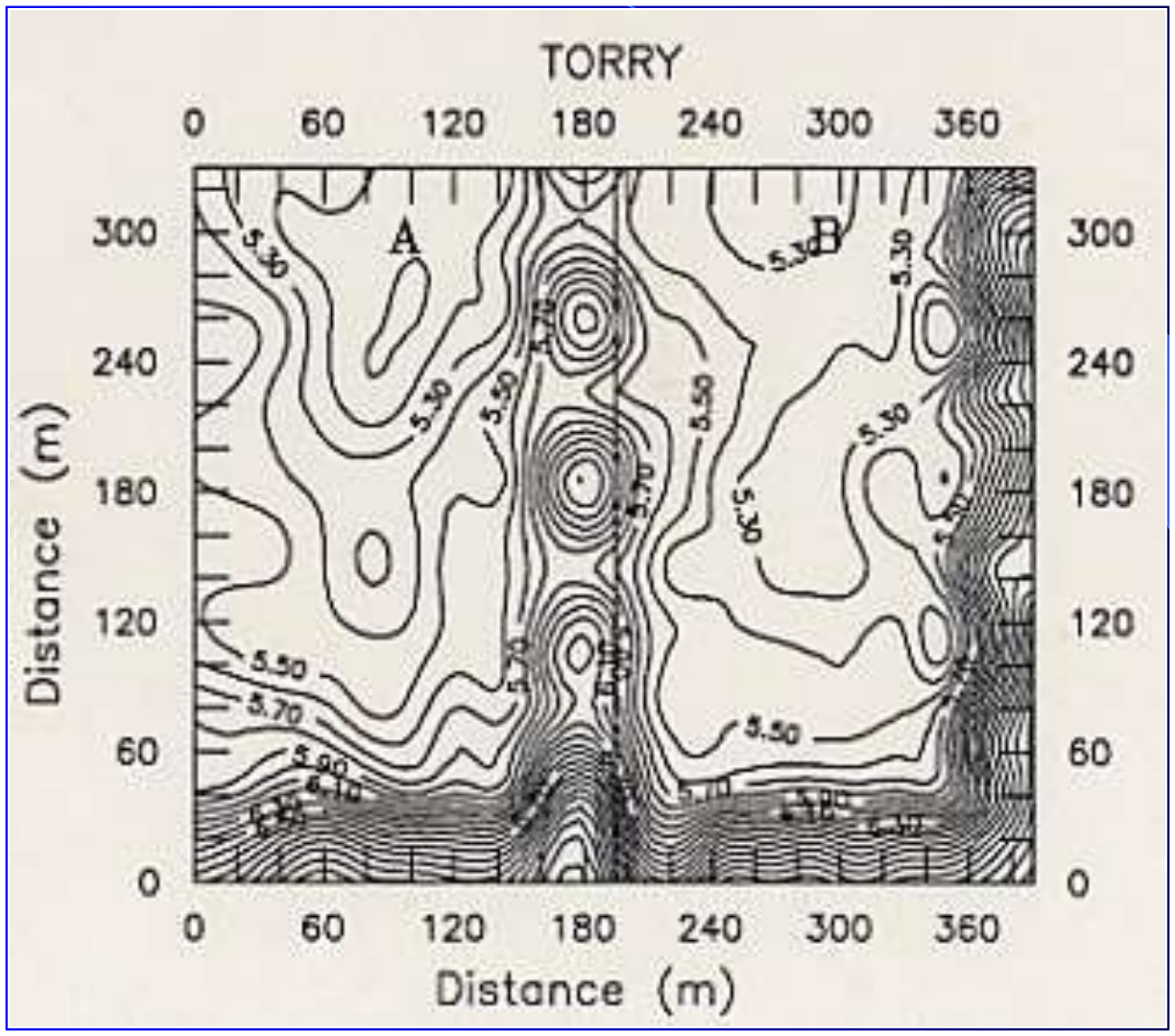
  Making sense of the results to make reasonable nutrient (fertilizer) application recommendations for a specific crop.

1. Soil Sampling: Collection

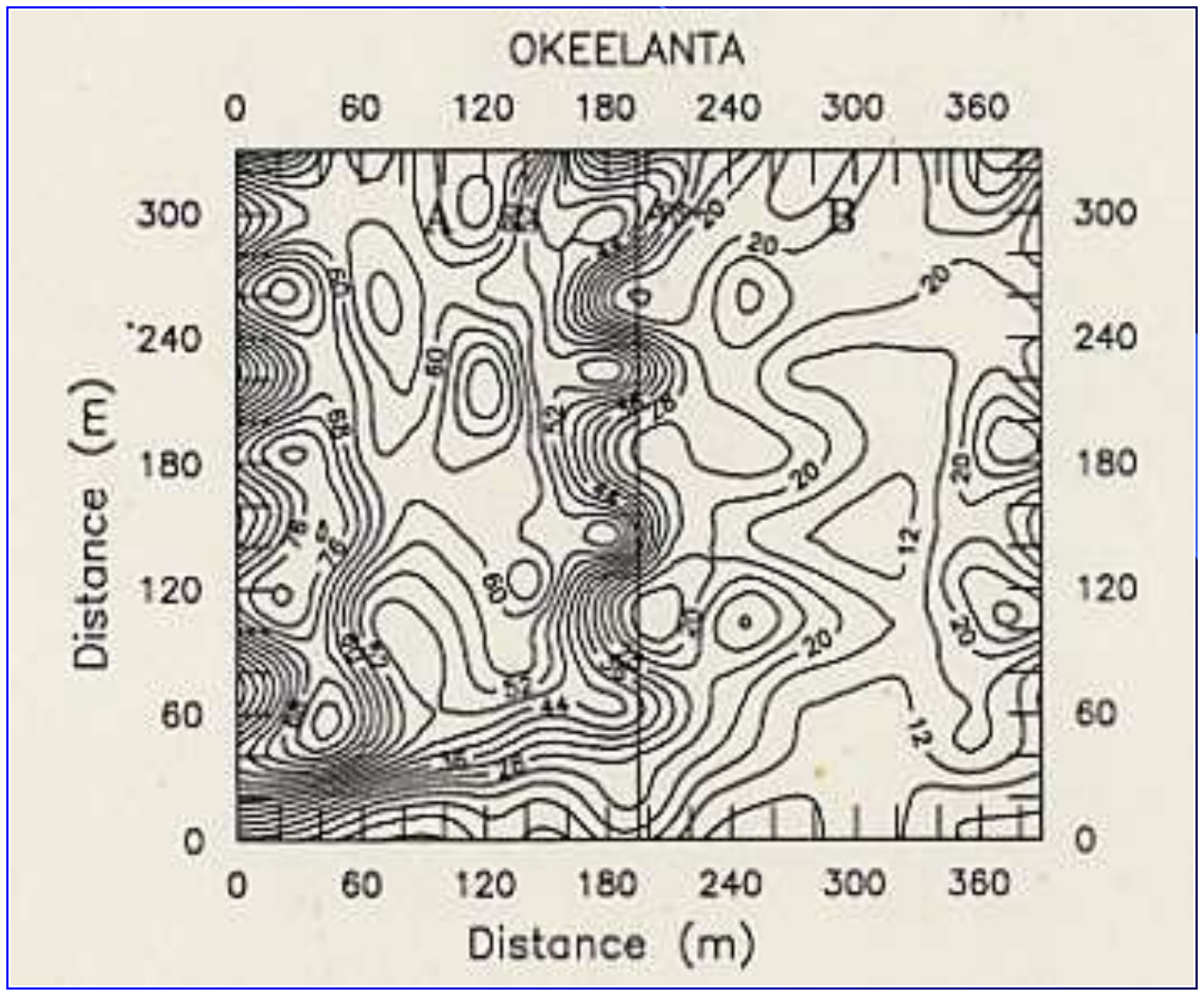


- Critical to the soil testing process
- High field variability
- Remember that a very small area is sampled
- 20-25 cores samples collected per 40-acre field

Soil pH contour map
Torry muck (EAA)



Soil-test Pw contour map
Okeelanta muck (EAA)



1. Soil Sampling: Handling and Submitting

Proper handling is also important:

- Thoroughly mix the composite; break up cores.
- Soil samples should be delivered as soon as possible after collection.
- Clearly label and identify sample.
- Include contact information.

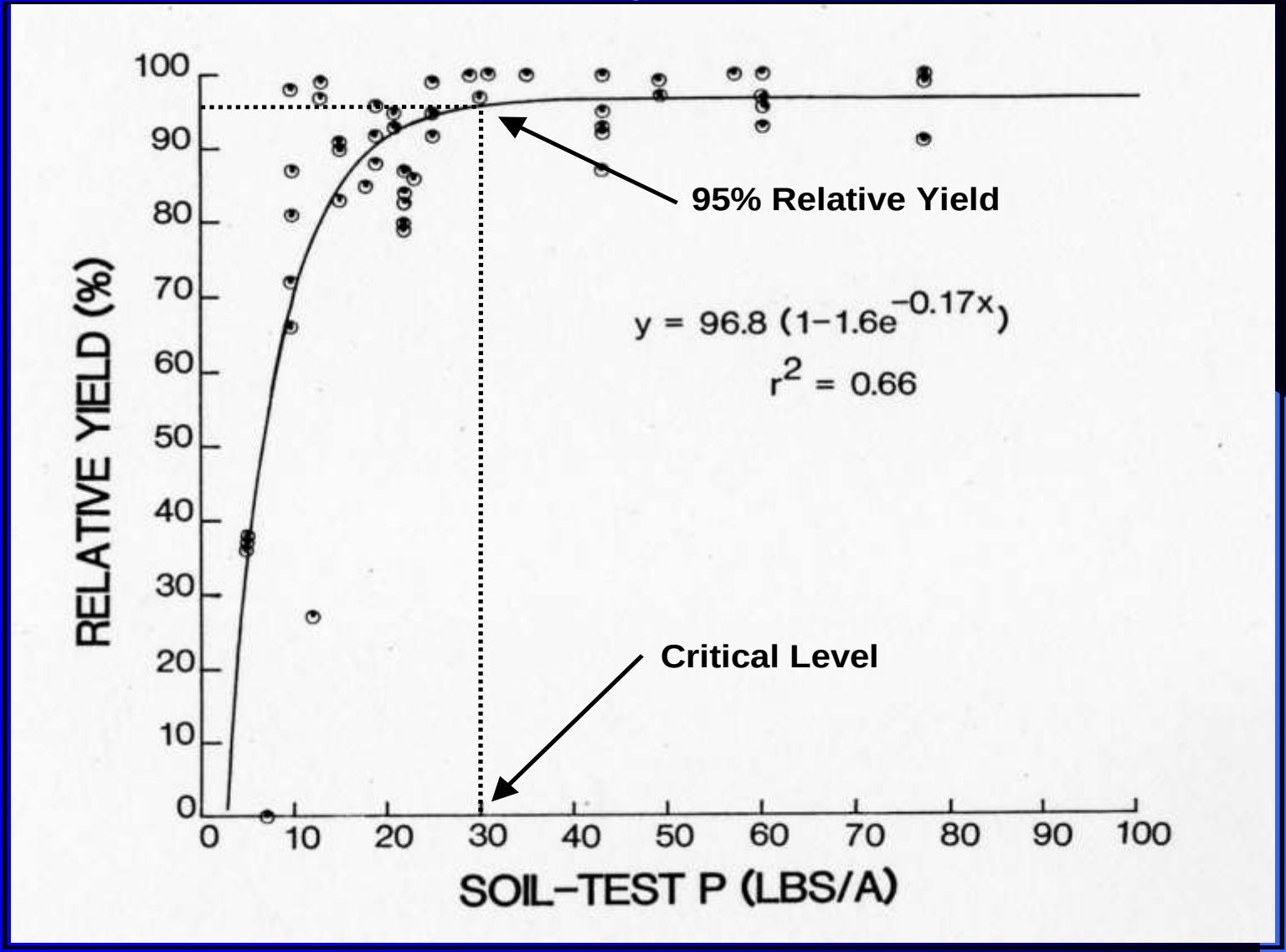
2. Laboratory Analysis: Sample Preparation

2. Laboratory Analysis: Sample Preparation

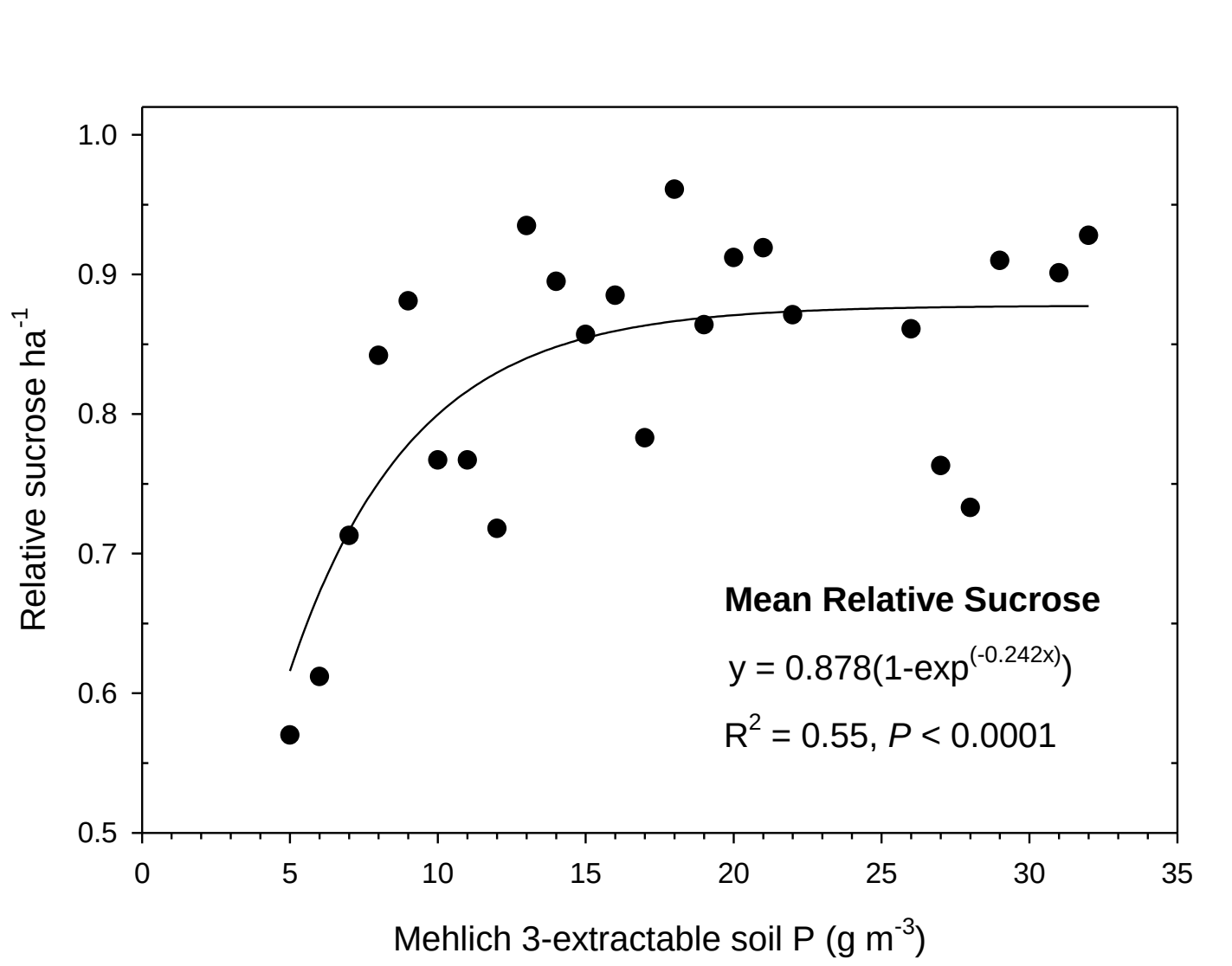
2. Laboratory Analysis: Measurement

3. Interpretation and Recommendation

Response of Crisphead Lettuce to Soil-Test P Levels



Proposed Revision of Sugarcane P Calibration



Revised Sugarcane P Calibration

Mehlich 3 Soil P g P/m^3	Phosphorus Fertilizer Rate lb P_2O_5/acre			
	Plant Cane	Ratoon 1	Ratoon 2	Ratoon 3+
$\leq$ 8	75	75	60	50
9-15	60	60	50	50
16-20	50	50	40	40
21-25	40	40	40	40
26-30	0	30	30	40
31-35	0	0	20	30
36-40	0	0	0	20
> 40	0	0	0	0

Fertilizer Application

3 Goals of Fertilizer Application BMPs

- Fertilize to cover all crop needs
- Reduce over- or misapplication
- Eliminate spills, cleanup spills

Rationale

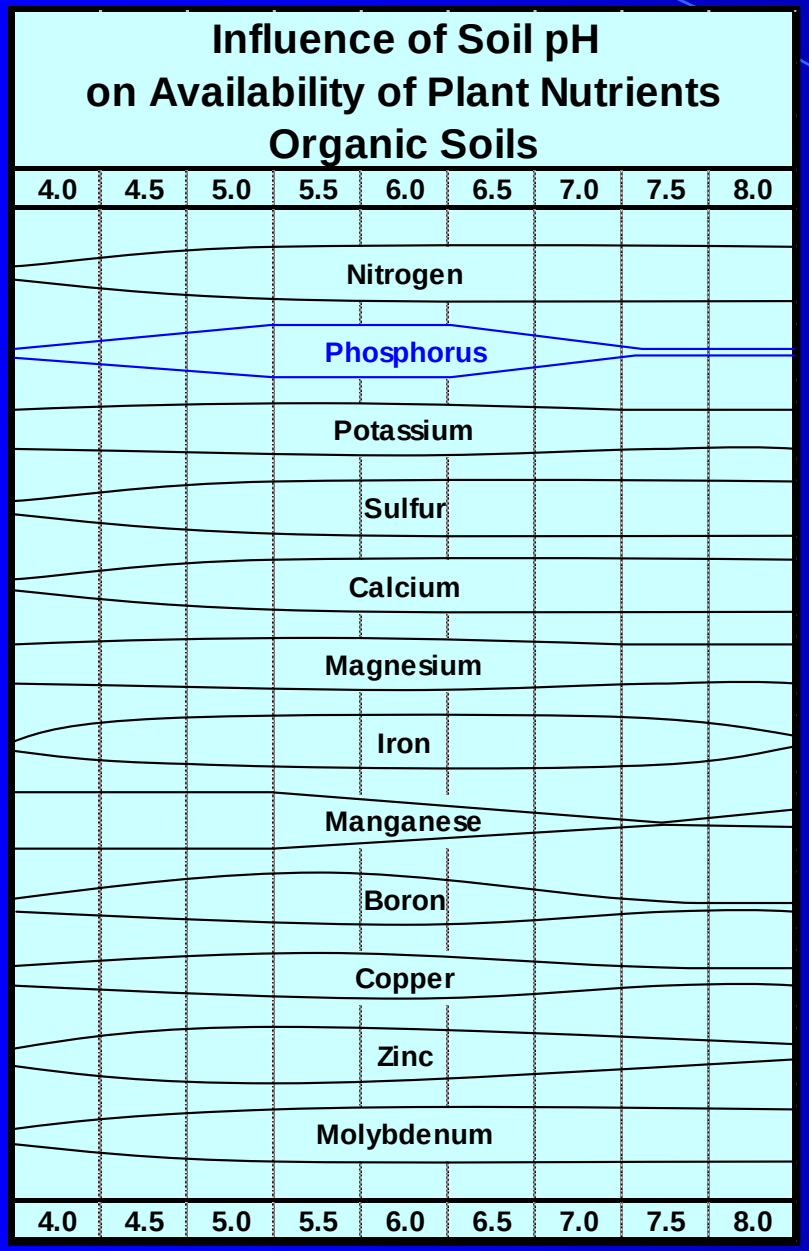
Apply minimum amount of P fertilizer that is needed to produce optimum yields

- Increase fertilizer use efficiency
- Timing of fertilizer application/split applications
- Placement of fertilizer close to root zone
- Fertilizer sources: soluble/slow release fertilizers

Banding of P Fertilizers

- Places fertilizer close to the root zone; more efficient uptake by plant.
- Reduces the soil-fertilizer surface contact area, resulting in less P fixation.
- Reduces likelihood of overlapping application to same rows.
- The most important advantage of banding is the significant reduction of the overall amount of P applied especially to vegetables.

Banding of P Fertilizers



Banding increases P availability to plants by:

a. providing concentration of P in narrow band in root zone (most important in short-lived shallow rooted crops)

b. decreasing pH in that narrow application zone, which temporarily allows > P availability by slowing P fixation

Fertilizer Misapplication Prevention

Misapplication of fertilizer P:

- Application of P fertilizer to soils with high P fertility levels.
- Application of P fertilizer to soils at higher than the recommended rates.
- Application of P fertilizer to non-target areas due to mechanical failures or lack of proper training.

Misapplication of P Fertilizer

Problems caused by increased P concentrations:

- Algal blooms
- Excessive aquatic weed growth
- Low dissolved oxygen levels
- Increased TP and TDP in drainage water
- Increased P loads off the farm
- Decreased drainage capacity of canals

Fertilizer Misapplication Prevention: Tune/Calibrate Equipment

- Before planting season starts
- Monitor actual application rates vs. calculated amounts

Fertilizer Misapplication Prevention:
Reduce Turning Speed

Never broadcast fertilizer near canals. Use AIRMAX pneumatic controlled-edge applicator for those areas.

Fertilizer Misapplication Prevention:
Proper Training

Recommendations to Reduce Fertilizer Spills

- Park fertilizer hoppers/trailers and field application rigs far away from ditch/canal banks.
- Park fertilizer hoppers/trailers on level ground (avoid slopes leading to open water).
- Limit the number of loading sites … easier to "police".
- Properly train all personnel involved in handling fertilizer material.
- Policy: Park fertilizer hopper/trailers ONLY at sugarcane loading ramp sites.

Loading Site on Level Ground

Inspection of Fertilizer Loading Site

Recommendations to Reduce the Impact of Fertilizer Spills

- Contain spills on tarps placed under/between trailer and application rigs.
- Have buckets/shovels available for immediate clean-up.
- Sweep "mini-spills" off trailer/hopper onto tarp and apply soil/dirt/fertilizer clean-up mix in target field.
- Policy: All personnel involved in handling and spreading fertilizer should have a copy of the Standard Operating Procedures (SOP) on handling fertilizer spills.

Plant Tissue Analysis

Sugarcane Leaf Nutrient Optimum Ranges

Nutrient	Optimum Range	Est. 5-10% Loss	Est. 25% Loss
	----------%----------		
N	2.0-2.6	1.8	1.6
P	0.22-0.30	0.19	0.17
K	1.0-1.6	0.9	0.8
Ca	0.22-0.45	0.20	0.18
Mg	0.15-0.32	0.13	0.11
Si	≥0.60	0.50	0.20
	----------mg/kg----------		
Fe	55-105	50	40
Mn	20-100	16	12
Zn	17-32	15	13
Cu	4-8	3	2

Additional Leaf Analysis Information

McCray, J. M., and R. Mylavarapu. 2010. **Sugarcane nutrient management using leaf analysis.** http://edis.ifas.ufl.edu/AG435

McCray, J.M., V.I. Ezenwa, R.W. Rice, and T.A. Lang. 2010. **Sugarcane plant nutrient diagnosis.** http://edis.ifas.ufl.edu/SC075

Ezenwa V.I., J.M. McCray, P.R. Newman, and R.W. Rice. 2008. **Sugarcane leaf tissue sample preparation for diagnostic analysis.** http://edis.ifas.ufl.edu/SC076

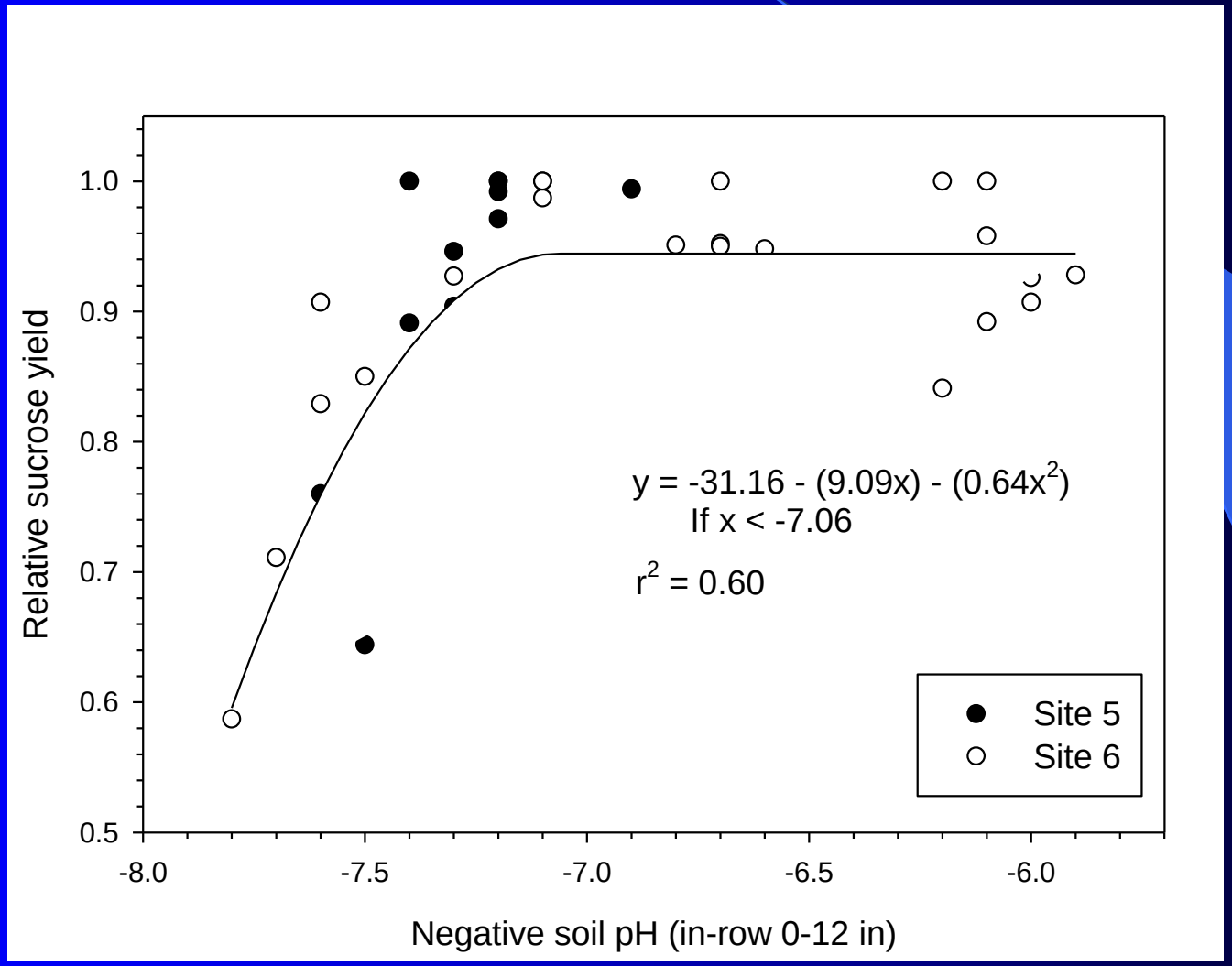
Excel Spreadsheet to calculate DRIS indices for Sugarcane
http://erec.ifas.ufl.edu/DRIS/DRISCalculator.zip

Proposed Elemental Sulfur Recommendations for Sugarcane on Organic Soil

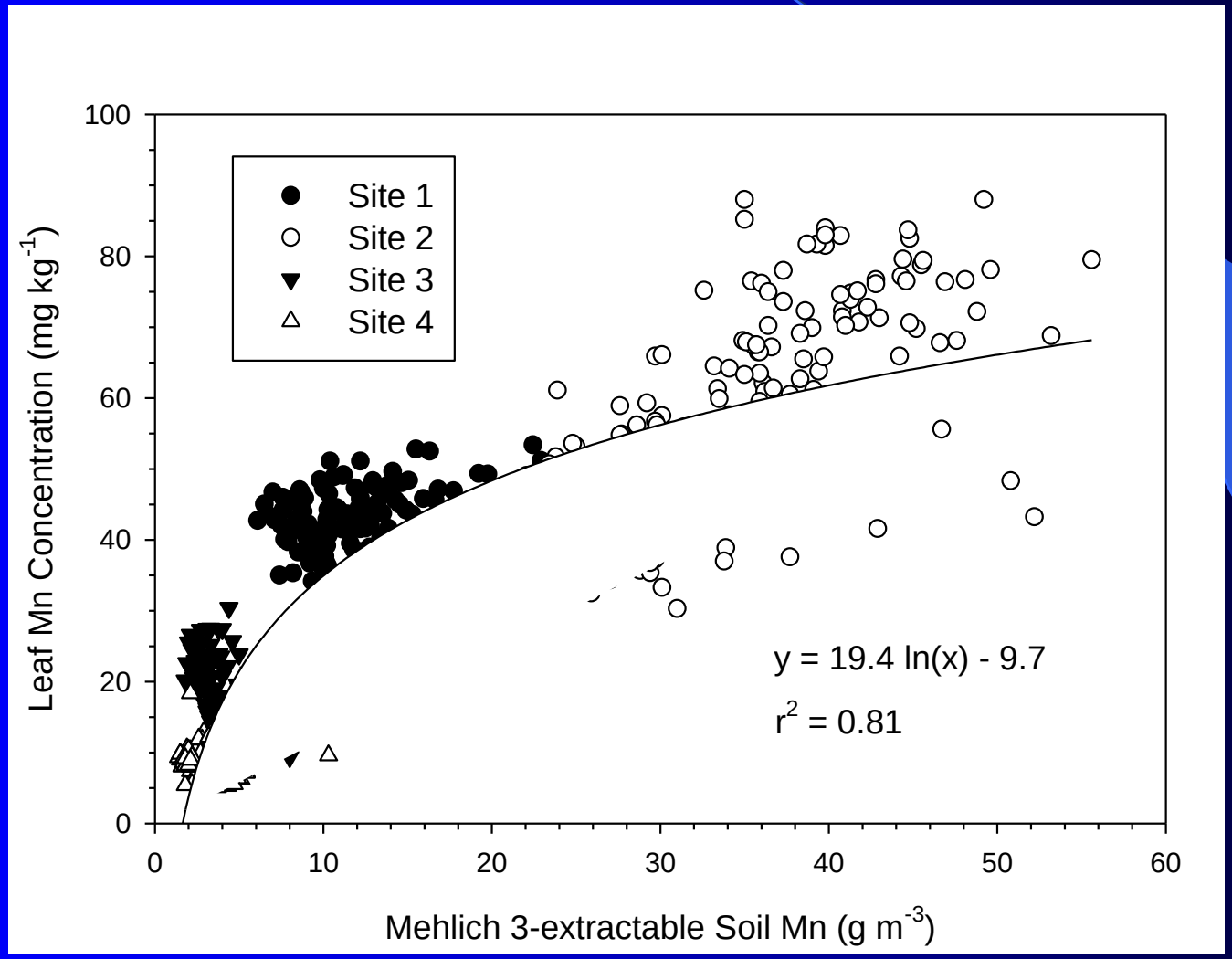
Purpose of Elemental Sulfur

- In high pH soils, micronutrients are less available to the crop
- Elemental sulfur reduces pH as certain soil bacteria oxidize the sulfur to sulfate
- By banding the sulfur under the row, it can have the maximum benefit, and limit the volume of soil you are treating
- As soils get shallower with subsidence there are more situations with high pH and potential micronutrient deficiencies

Sugarcane Yield and Soil pH



Leaf and Soil Manganese

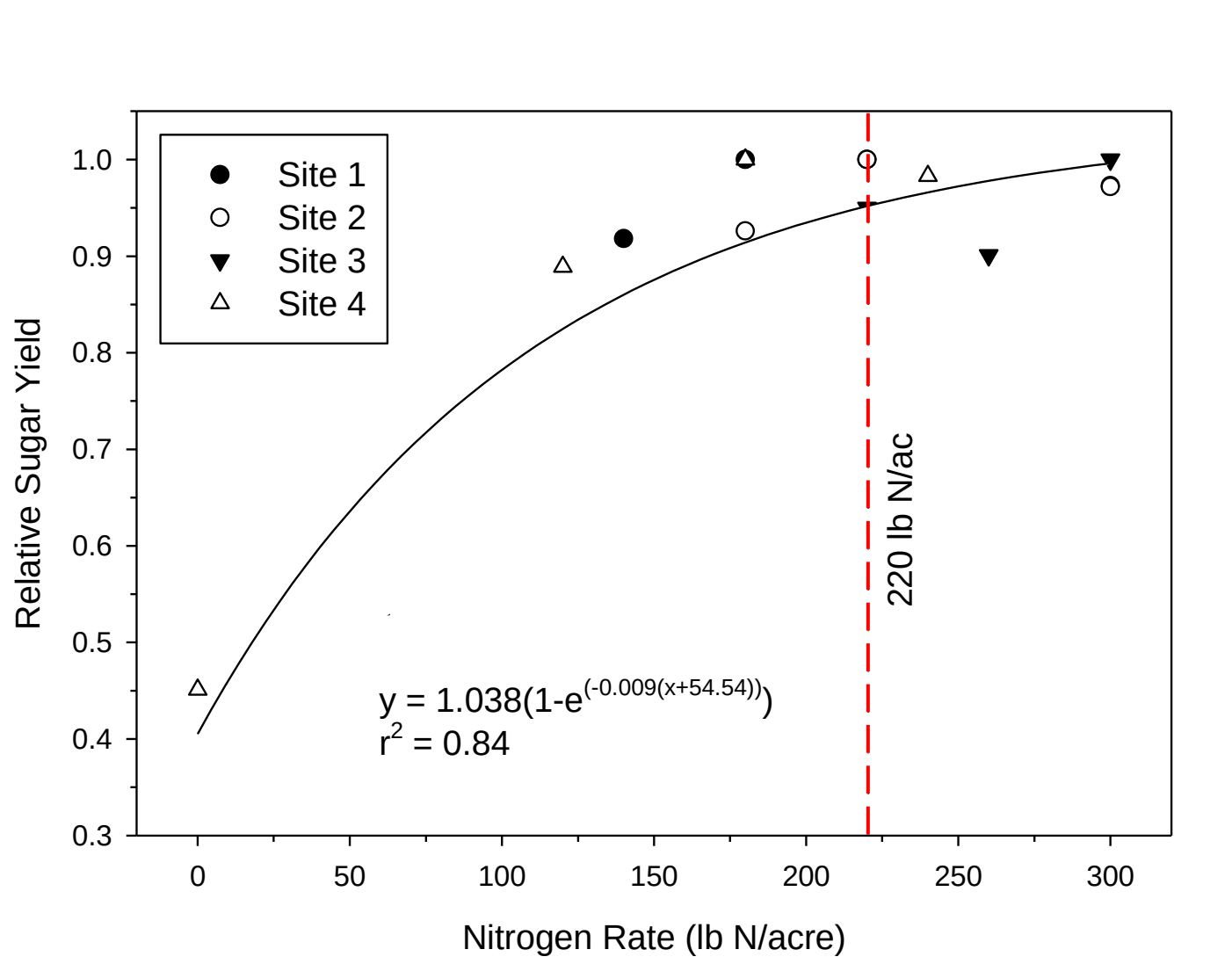


Preliminary Proposed Sulfur Recommendations for Sugarcane on Organic Soils

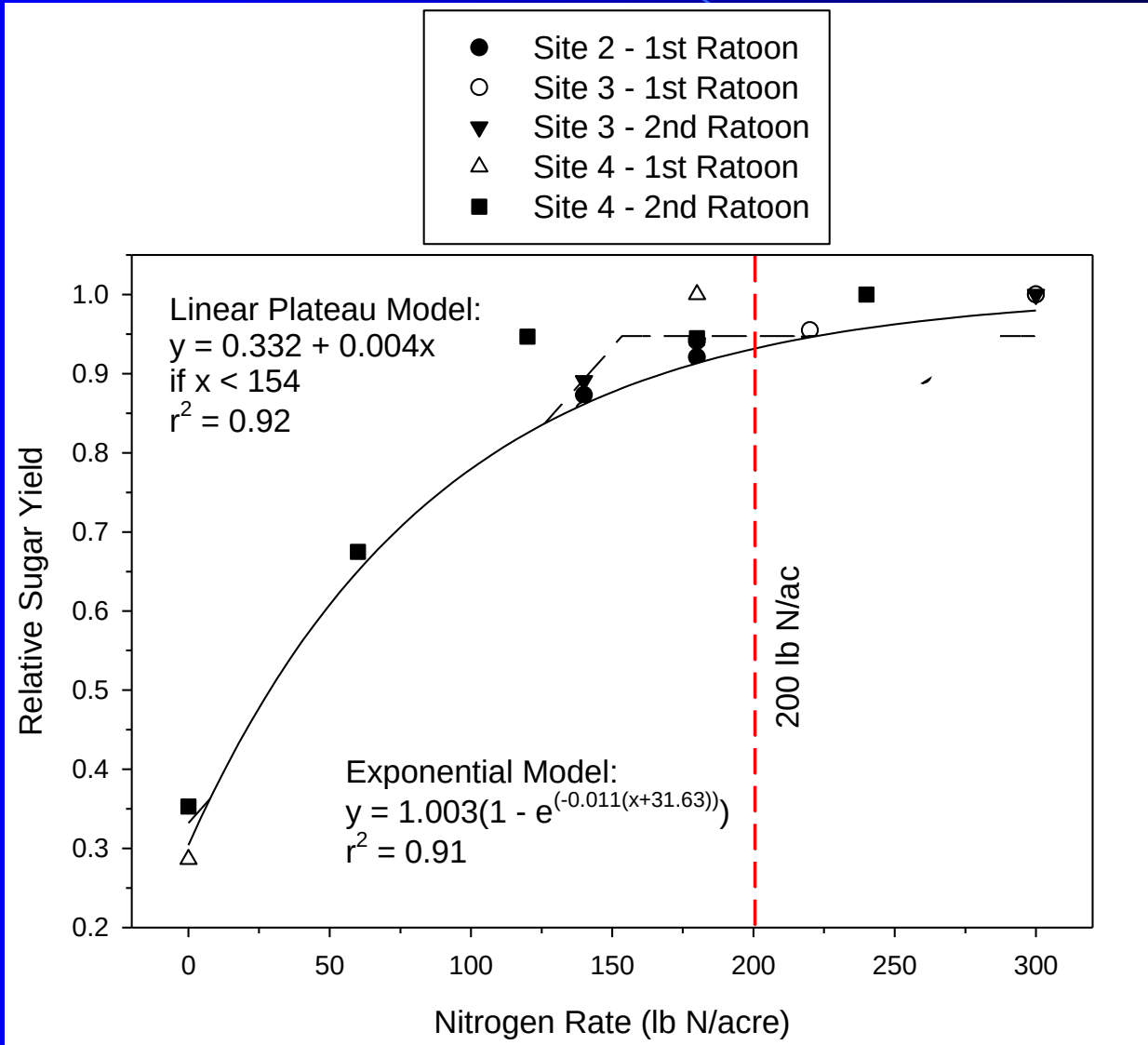
Soil pH	**Elemental S (lb/ac preplant in furrow)**
≥7.5	250 – 500
7.2-7.4	100 – 250
6.6-7.1	100 (STM5) if Mehlich 3 extractable Mn < 5.0 This could be combined with another source of Mn
Elemental S application would likely work well as a variable rate application because of the variable nature of pH as soils become shallower.	

Proposed Nitrogen Fertilizer Recommendations for Sandland Sugarcane

Plant Cane Yield Response to Nitrogen



Stubble Cane Yield Response to Nitrogen



Proposed Nitrogen Recommendations

- Plant Cane: 220 lb N/acre in 5 split applications
- Stubble cane: 200 lb N/acre in 4 split applications
- Recommendations may also include an exception for excessive rainfall: Additional 30 lb N/ac if $\geq$ 4 inches rainfall in 2 days and within 20 days after a previous application

Take Home Summary

- Nutrient BMPs very successful <u>and</u> economical
- Requires proper annual training of personnel
- Research on fertilizer use efficiency invaluable:
  - Fertilizer sources – slow release, micros, etc.
  - Soil fertility – pH effects, cycling, soil extractants, etc.
  - Crop nutrition – leaf analysis, supplementals, etc.