1-1-2010

# 2010 Cranberry Management Update: Nutrient Management BMPs

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# Nutrient Management

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# SARE Project surveys at Cranberry Update Meetings

- Project (LNE 05-217) funded by Northeast Region Sustainable Agriculture Research and Education Program

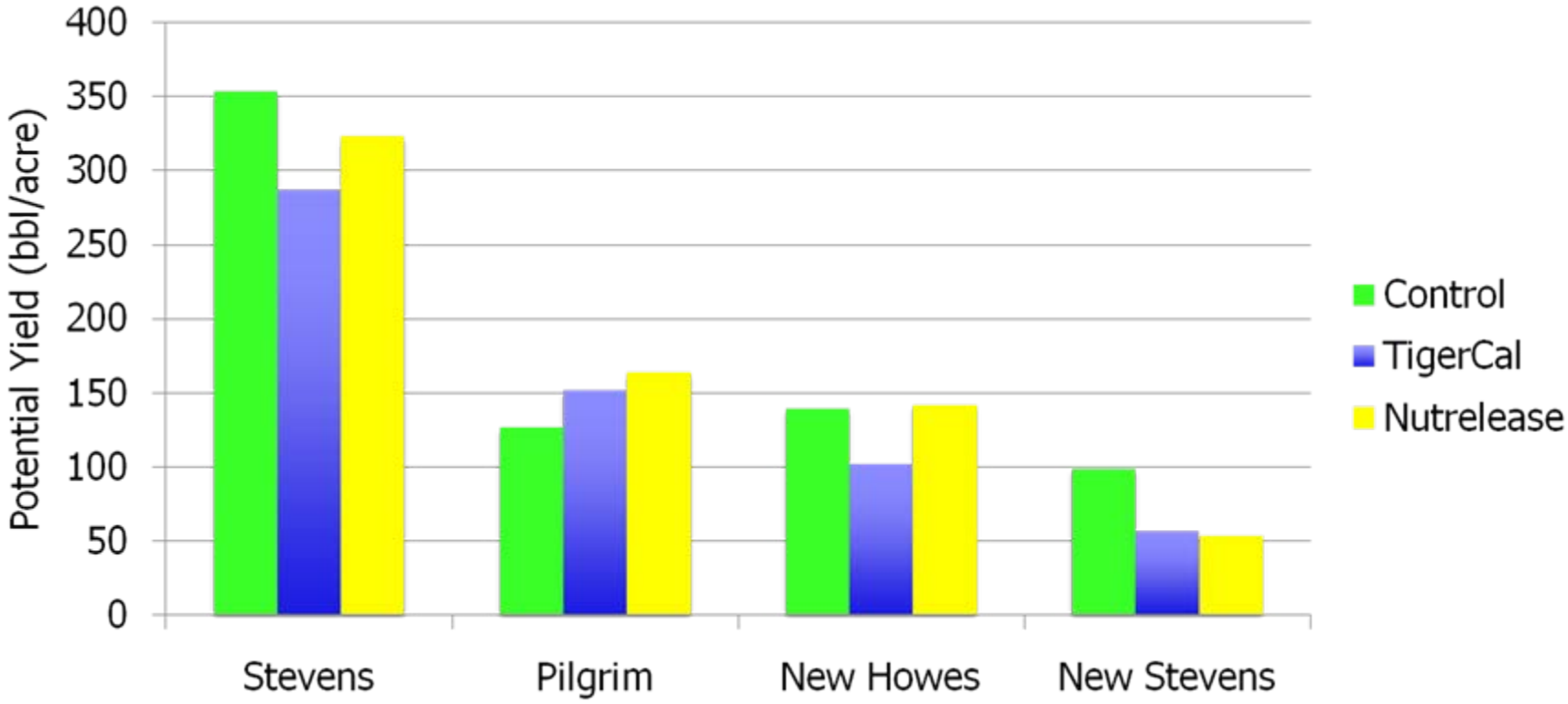
| Irrigation/Frost/drainage | January-08 | January-09 |
|---|---|---|
| | Percent | |
| Irrigation automation | 8 | 9 |
| On-off cycling during frost protection | 10 | 16 |
| Drainage | | |
| Installed submerged drainage last 2 years | | 39 |
| 60% into existing bogs | | |
| Did other drainage improvements | | 51 |
| Most cleaned or deepened ditches | | |
| Would install drainage tiles in a renovated bog | | 65 |
| Note: depth/spacing very variable, most used shallow depth / wide spacing | | |

| **Nutrient management** | **January-08** | **January-09** |
|---|---|---|
| | **Percent** | |
| N-P ratios (by grower reporting) | | |
| All applications 1N to more than 1 P (eg. 12-24-12, 5-15-30) | 36 | 15 |
| All applications 1N to no more than 1 P (eg. 15-15-15, 18-8-18) | 34 | 61 |
| Plan to reduce P use | 36 | |
| Reduced P use | | 51 |

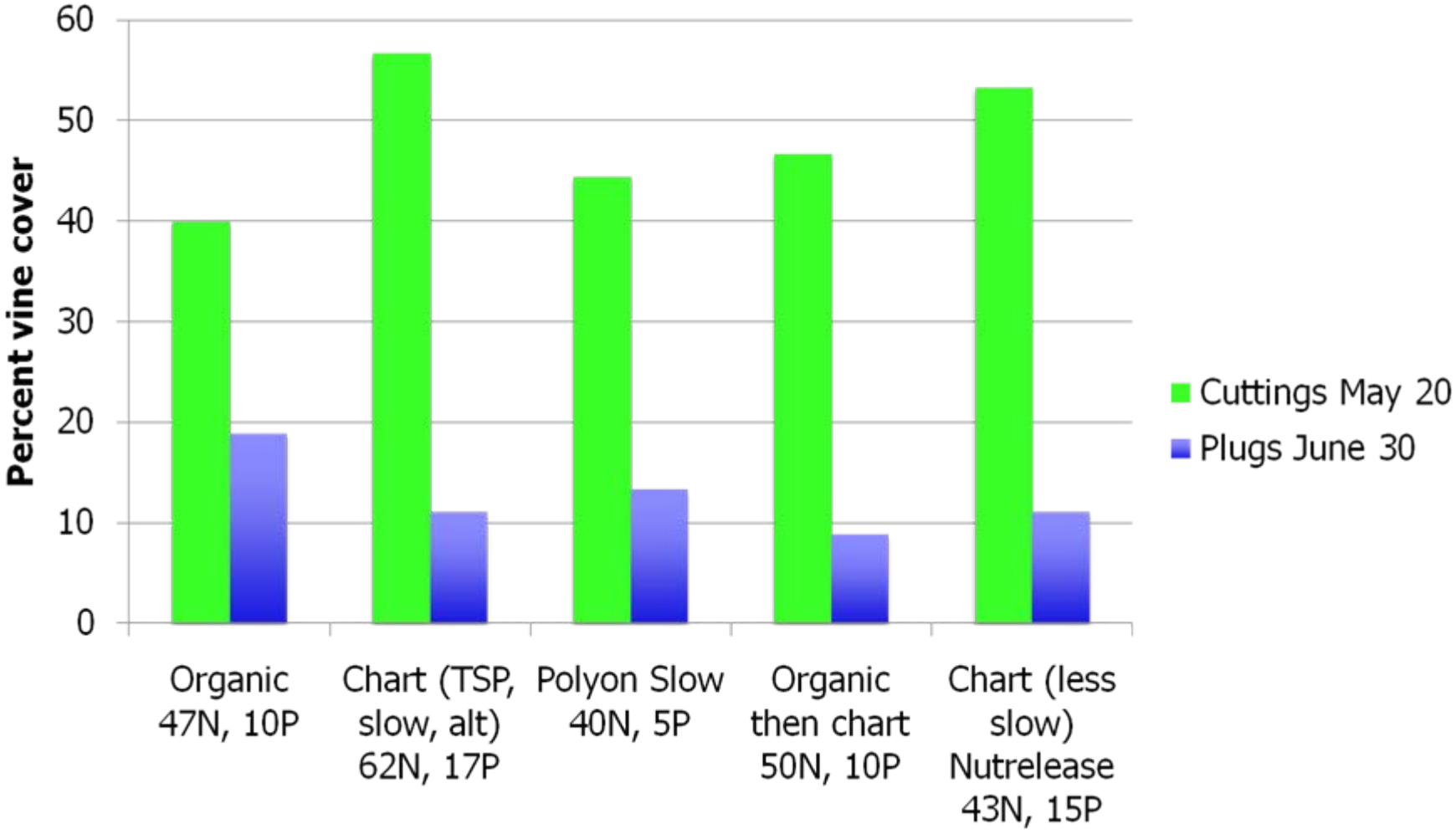
**Final meeting survey (n=102)**

| | % respondents |
|---|---|
| Would prune in lieu of sanding | 31 |
| Schedule irrigation using sensors or floats | 21 |
| Cycle irrigation during frost protection | 16 |
| Improved/installed drainage in the last 3 years | 39 |
| Purposely reduced P use in the past 3 years | 51 |
| | |
| Implemented 2 of 5 stated practices | 33 |
| Implemented 3 of 5 | 14 |
| Implemented 4 of 5 | 6 |
| Implemented all 5 | 2 |

# Highlights of field research – Supplements



# Highlights of field research – New Plantings



# Nutrient Management BMPs

- Original Guide produced in 1996
- Some practices revised and some added in 2000
- Much research since
- Revision began in 2009

# BMP Guide

- Entire Guide to be revised in 2010
- Looking for grower input
- Final product will be posted online
- Will include hot links  (Chart Book sections, references)

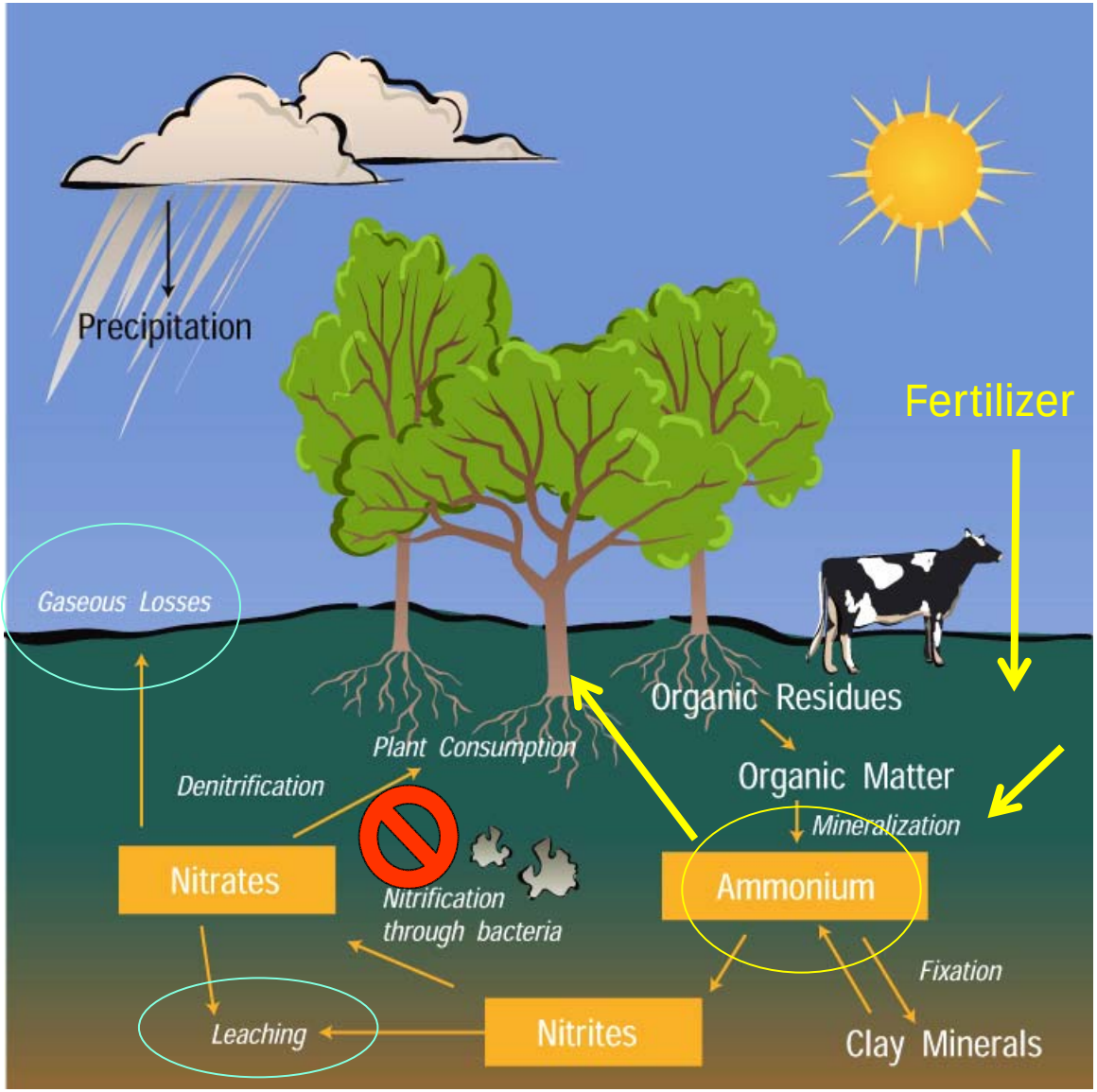
# Nutrient BMP - General

- Soil temperature important to nutrient uptake
  - Wait for 55F

- Drainage!!
  - Nutrient uptake requires water and oxygen
  - Too wet – no oxygen
  - Too dry – elements won't dissolve and move to roots

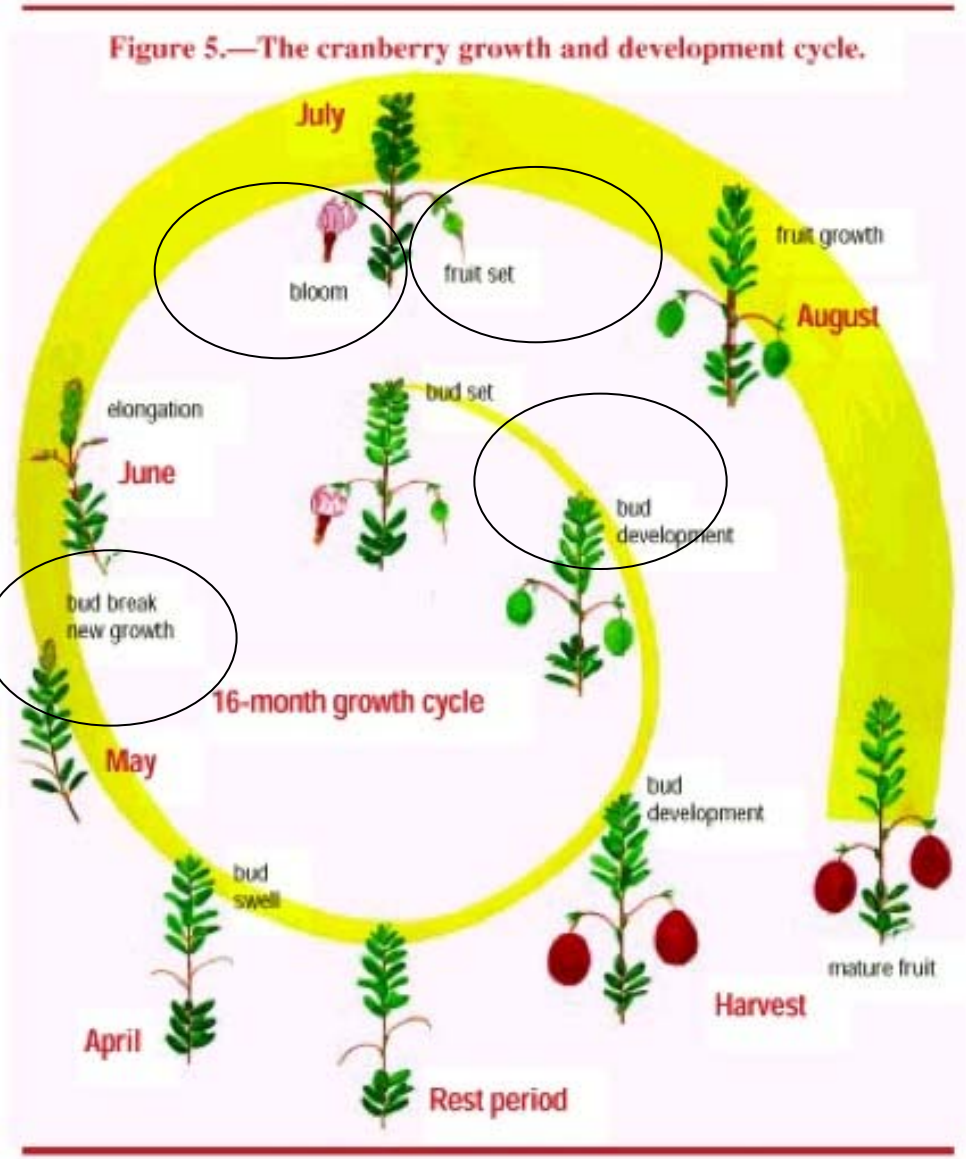
# Nitrogen – Nitrogen Cycle

- Ammonium
- Soil T
- Low pH
- Removal in crop (~23 lb in 150 bbl)



# Nitrogen – Plant Cycle

- Add N when the plant needs it
- Soil T – best to add when between 55F and 70F
- Rate based on cultivar, growth stage, appearance, tissue test



# BMP Phosphorus

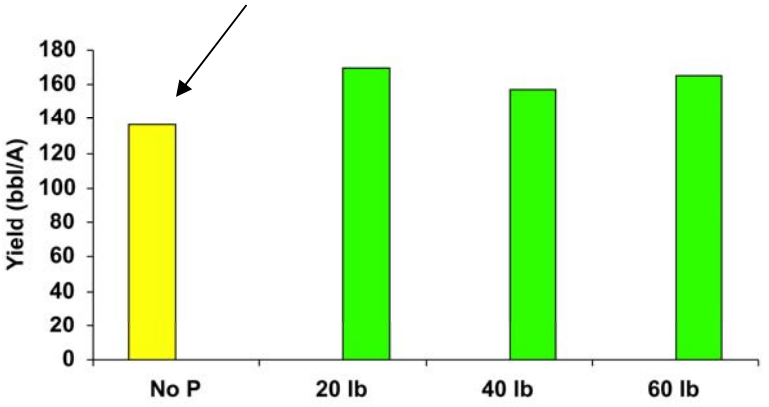
- Unless you can document a serious deficiency, there is no need to exceed 20 lb/a P.
- Test tissue periodically – 0.1-0.2% is the standard range. See timing recommendations in chart book and handout.
- Do not apply P to saturated soil

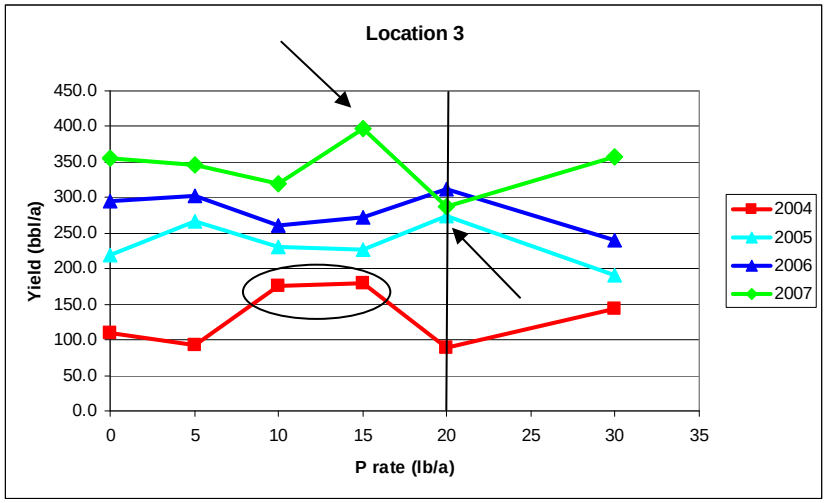
# BMP Phosphorus

- The best fertilizer choices have 1N:1P or more than 1N:1P
- Examples 1:1 15-15-15; 13-13-13
  - If you use less than 45 lb/acre N, P will be less than 20 lb/acre
- Example more than 1:1 18-8-18
  - With this, 45 lb/acre N gives ~8.5 lb/acre P

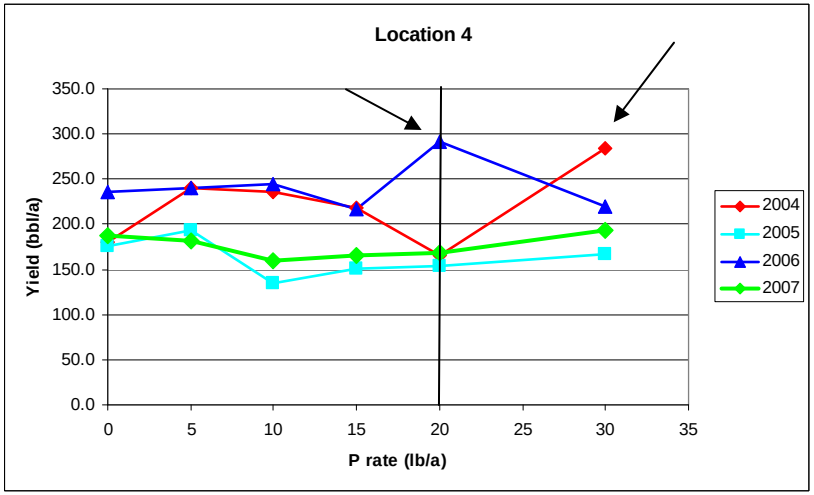
# Why P reduction?

- Pollution concerns for fresh water
- Clean Water Act mandated TMDL process



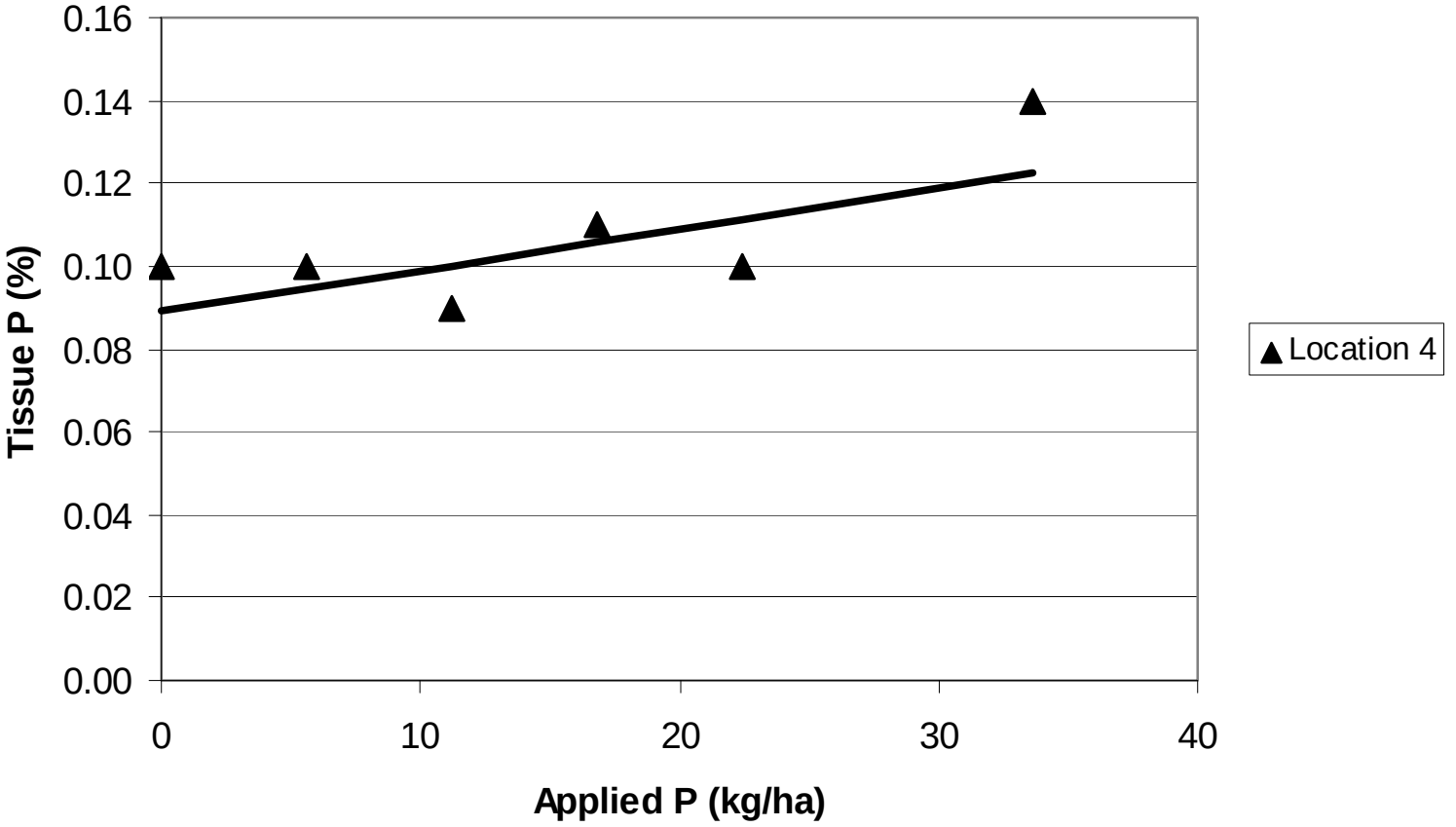

Tissue P in normal range




Tissue P below normal range

# Tissue P

## (2006 regression data)




# Summary – recent field plots

- Trends indicate that some P may be better than no P, although not much of a rate response
- At one location P in the tissue was below the standard range and there was a response to >20 lb P/acre
- Further justification for a target P rate of no more than 20 lb P/acre and some justification for lower rate consideration

# Fertilizer and yield – whole bog comparison

(P in lb·a$^{-1}$; Yield in bbl·a$^{-1}$)

| | Site 1 | | Site 2 | |
|---|---|---|---|---|
| **Year** | **P rate** | **Yield** | **P rate** | **Yield** |
| 2002 | 17.8 | 117 | 24.9 | 117 |
| 2003 | 14.4 | 119 | 22.3 | 119 |
| 2004 | 5.6 | 172 | 17.3 | 196 |
| 2005 | 16.5 | 190 | 24.0 | 121 |
| 2006 | 6.4 | 163 | 5.7 | 244 |
| 2007 | 10.4 | 156 | 11.4 | 136 |
| 2008 | 5.9 | 221 | 7.6 | 272 |
| pre-reduction | 17.8 | 117 | 22.1 | 138 |
| post-reduction | 9.9 | 170 | 8.2 | 217 |

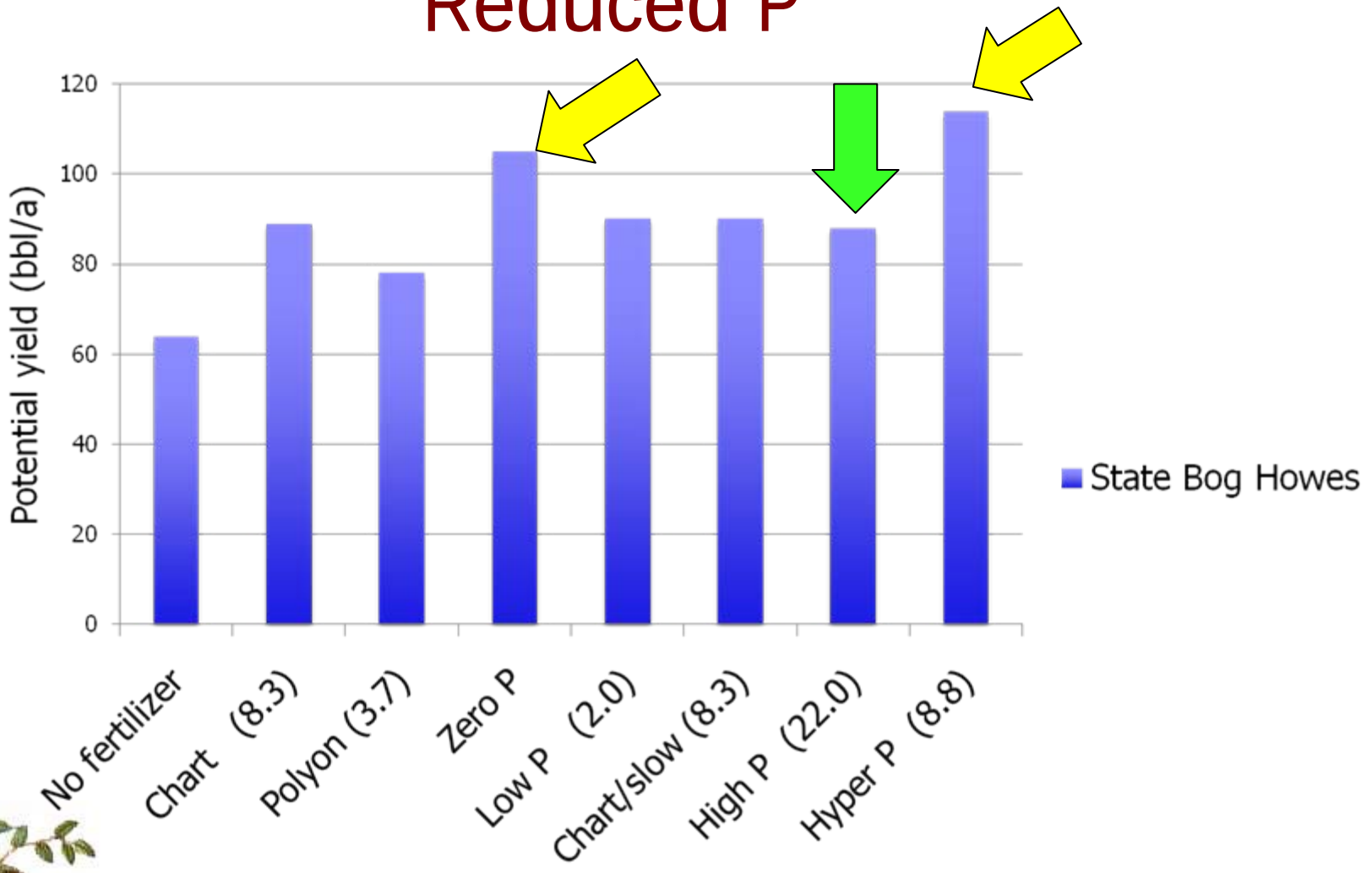
# Fertilizer and yield – whole bog comparison

(P in lb·a$^{-1}$; Yield in bbl·a$^{-1}$)

| | Site 3 | | Site 4 | |
|---|---|---|---|---|
| **Year** | **P rate** | **Yield** | **P rate** | **Yield** |
| 2002 | 28.8 | 221 | 35.5 | [65]* |
| 2003 | 19.8 | 136 | 32.4 | 150 |
| 2004 | 21.2 | 218 | 28.0 | 277 |
| 2005 | 26.1 | 134 | 24.8 | 159 |
| 2006 | 7.1 | 256 | 12.9 | 286 |
| 2007 | 14.7 | 197 | 16.7 | 252 |
| 2008 | 19.2 | 220 | 9.1 | 359 |
| pre-reduction | 28.8 | 221 | 30.2 | 195 |
| post-reduction | 18.0 | 194 | 12.9 | 299 |

*Insect infestation at this site in 2002

# Highlights of field research – Reduced P




All except 'No fertilizer' received 25 #N

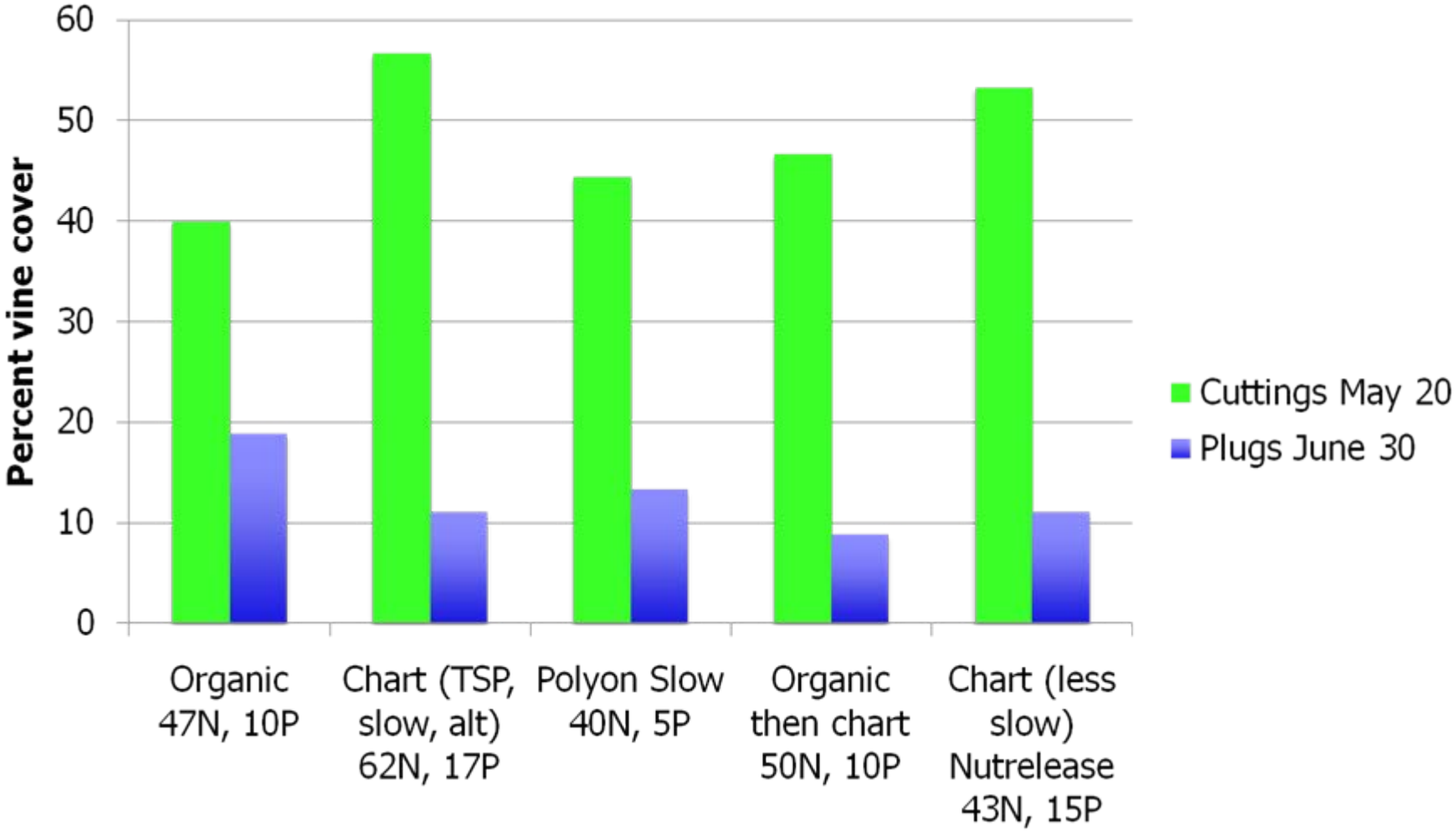
# Highlights of field research – Reduced P


All except 'No fertilizer' received 25 #N

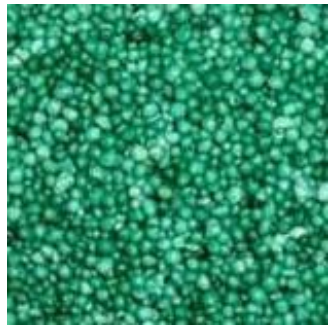
# New Plantings

- Roots take up nutrients
  - Plugs can be fertilized right away but...
    - May look dormant in first 2-3 weeks
  - Cuttings, all slow after a week or wait ~3 weeks
- Use slow release N
- Limit use of complete N-P-K
- Do not use high P materials
  - Use 1N to 1P or less than 1P
  - Limit to 30 lb P/acre in year 1

# Highlights of field research – New Plantings



# Reactive Layer/Polymer

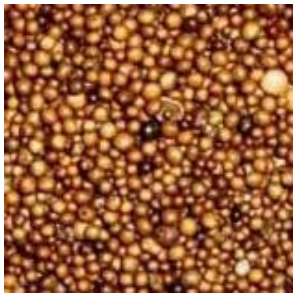


- Controlled and Slow
- Release : Osmotic Diffusion
- Factors Effecting Release:

Coating

Temp

# Resin Coated



- Osmocote
- Release : Fissure Movement / Diffusion
- Factors Effecting Release:

Coating

Water

Temp

# Sulfur-Coated Urea

- Controlled release, faster than others
- Release : Catastrophic Eruption, Microbial , $H_2O$ penetration
- Factors Effecting Release:


Microbial

pH


Water


Temp

# Natural Organics

- Release：Microbial; SLOW
- Factors Effecting Release:

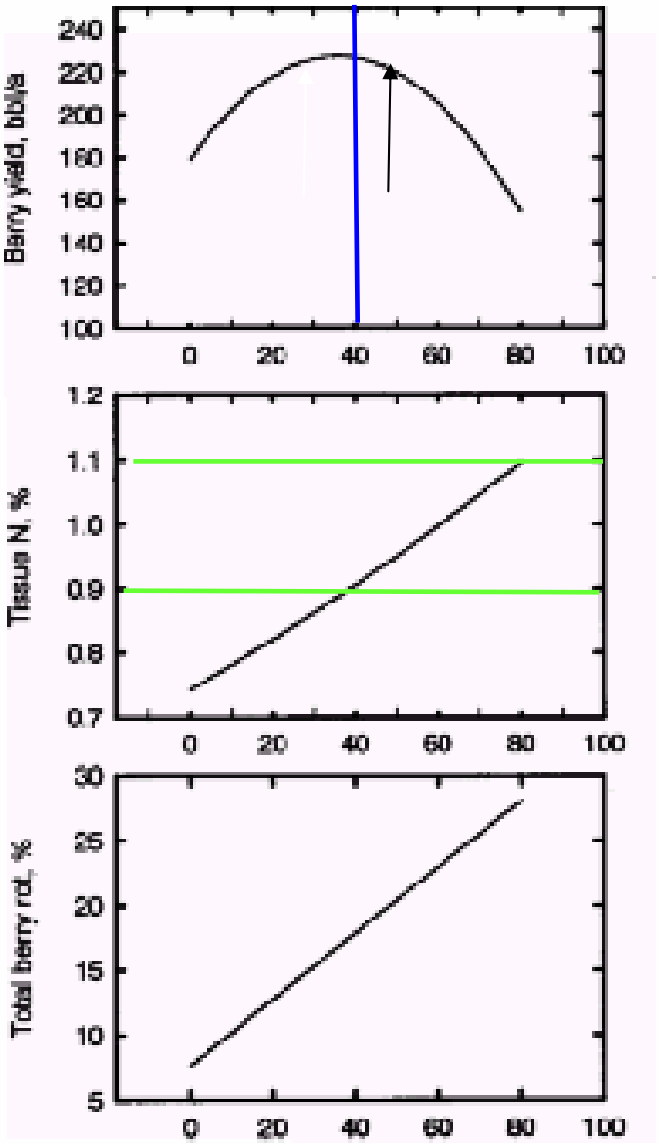


Microbial pH Water Temp

# Water quality (N)

- If some is good – more is NOT better
  - Disease
  - Overgrowth
  - Poor production
  - AND increased risk to coastal waters
- The Physiology of Cranberry Yield

## Figure 11.—Yield, tissue N, and rot of cranberries with various N fertilizer rates.*




*Massachusetts-grown 'Stevens'

# Keep fertilizer out of water

- Don’t apply to ditches
- Drop ditch levels
- Divert water pathways or impound
- Avoid applications before heavy rain or irrigation

# CES/SMAST Field Study
# Cranberry Bog Nitrogen Loss

| Bog ID --> | EH | PV | BEN | WS | M-K | ASH |
|---|---|---|---|---|---|---|
| **Nitrogen Inflow to Bog** | | | | | | |
| Irrigation | 0.4 | 1.5 | 0.6 | 0.2 | 1.7 | 2.4 |
| Groundwater | 0.0 | 0.0 | 1.0 | 0.3 | 0.0 | 0.0 |
| Frost Protection | 0.8 | 1.8 | 1.4 | 0.5 | 1.6 | 2.0 |
| Pest Management | 0.0 | 0.2 | 0.1 | 0.1 | 0.1 | 0.1 |
| Harvest | 1.3 | 3.4 | 4.5 | 1.2 | 4.2 | 2.9 |
| Winter Protection | 3.0 | 3.7 | 5.2 | 1.4 | 4.8 | 4.0 |
| Total IN | 5.5 | 10.5 | 12.8 | 3.6 | 12.4 | 11.3 |
| **Nitrogen Outflow from Bog** | | | | | | |
| Drainage/Infiltration | 5.7 | 6.7 | 10.5 | 4.6 | 7.7 | 7.2 |
| Harvest | 2.1 | 5.3 | 9.4 | 4.3 | 4.5 | 2.8 |
| Winter | 4.0 | 4.6 | 6.4 | 1.7 | 4.0 | 5.2 |
| Total OUT | 11.9 | 16.5 | 26.3 | 10.5 | 16.2 | 15.2 |
| **Net Nitrogen Loss (lb/a/yr)=** | **6.4** | **6.0** | **13.5** | **7.0** | **3.7** | **3.8** |

| Nitrogen Output to Downgradient Systems (lb N/acre/yr) | |
|---|---|
| Pine-Oak Forest | 0.4 |
| Cranberry Bog Nitrogen Output | 6.4 |
| Residential (density 1 per 2.5 acres) | 5.7 |
| Direct Precipitation on Bay | 9.8 |

(Flow Through Bog = 8.6)

# How can we reduce N output?

- Practice BMPs regarding rate, timing, split applications
- Look at it more as a water problem
  - Amount of flow
  - Direction of flow
  - Pathway of flow

# Amount of flow

- Follow recommendations on flooding, drainage, and irrigation
- Research on looking at how to limit groundwater upwelling
  - Compare 2 upwelling sites (10 lb/a/yr) vs.
  - 4 not upwelling sites (5 lb/a/yr)

# Direction of flow

- Diversion
  - Tail water recovery
- Can also relate to attenuation

- Research on how to limit flow-through situations – by-pass canals?
  - Compare flow-through (8.6 lb/a/yr)
  - To all other types (6.4 lb/a/yr)

# Pathway of flow

- Attenuation function of ponds, steams, and wetlands
- Vegetative channels or retention ponds between the bog and the final discharge point – research planned on how to best accomplish this

# Attenuation

- Mill Brook watershed (Howes and Millham, 1991)
  - TDN leaving the bog was 0.99 ppm
  - Downstream the load had decreased to 0.71 ppm

# April 2007 report to DEP
## (Woods Hole Group and Teal Partners)

# Literature review - attenuation

- Denitrification in wetlands is the most effective at attenuating N
  - $NO_3$ to $N_2$
- Denitrificaiton in ponds and streams next best
- Uptake by vegetation less effective

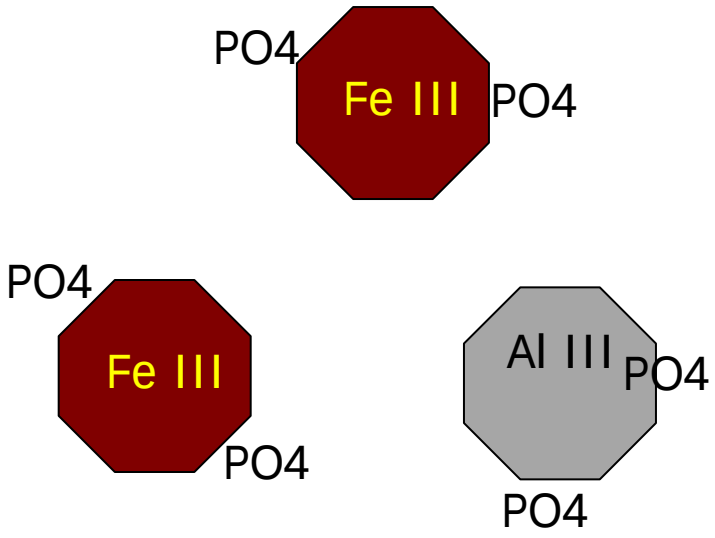
# Models and Lit. review
# MEP conservative estimates

- Ponds – 50% attenuation
  - 2 studies: 39-95% and 84-96%
- Streams – 30% attenuation
  - 30-40% observed in riverine systems
- Salt marshes – 40% attenuation
  - Range of 40-50% in previous Howes work

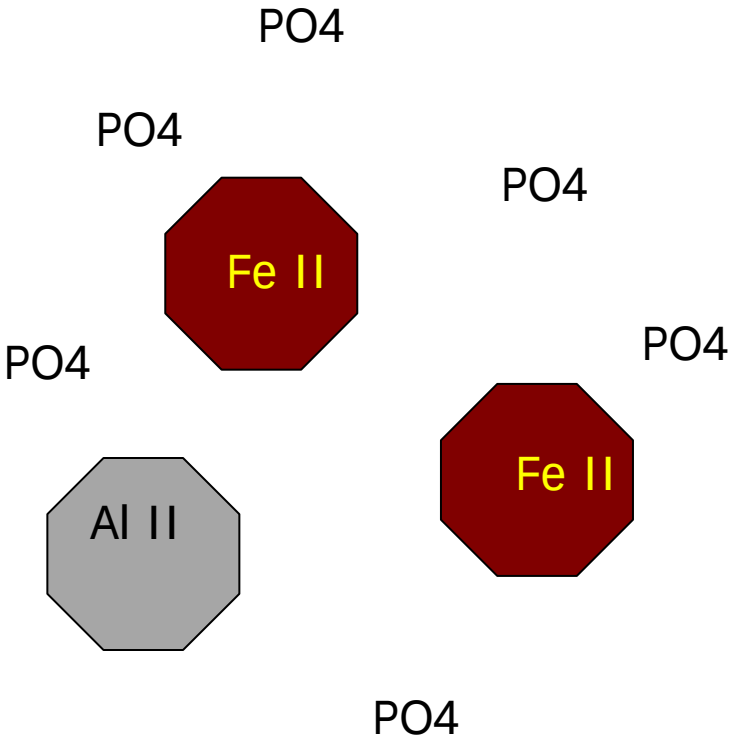
# Water Quality P

- More is not better
  - We saw this in the field experiments earlier
- Again think of it as a water problem
  - Also think about oxygen

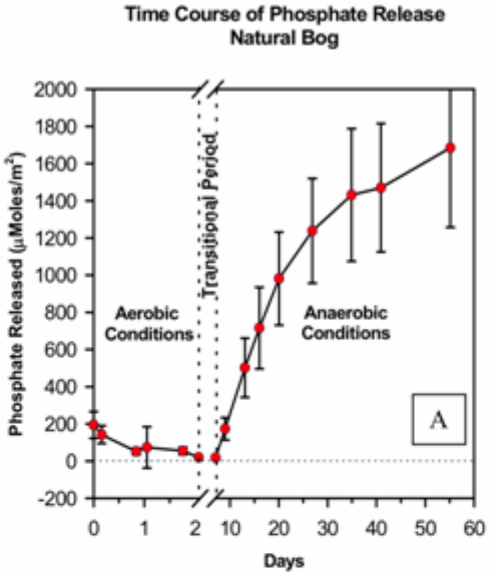
## Oxygen present




## Oxygen depleted

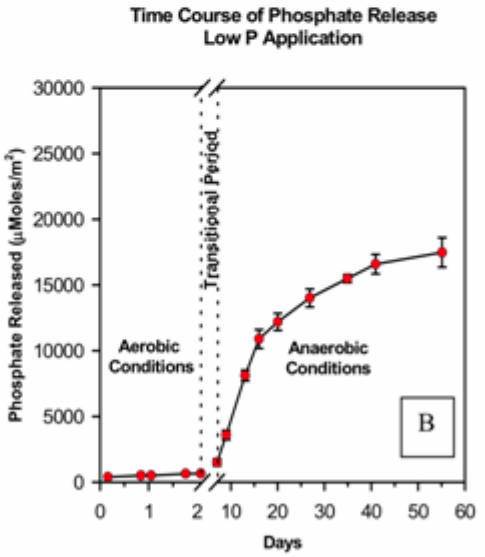


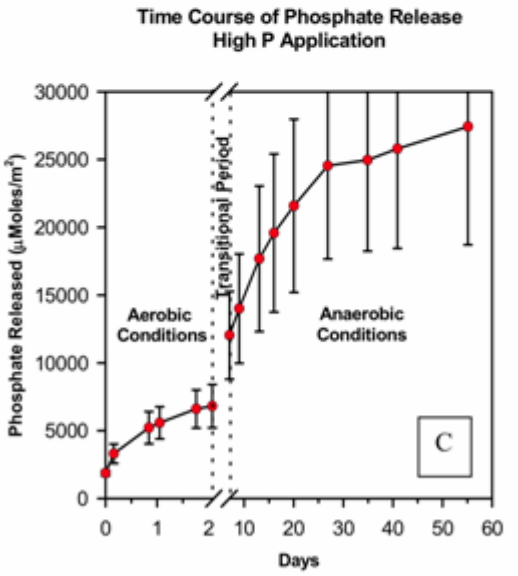

**Figure**




Natural Bog

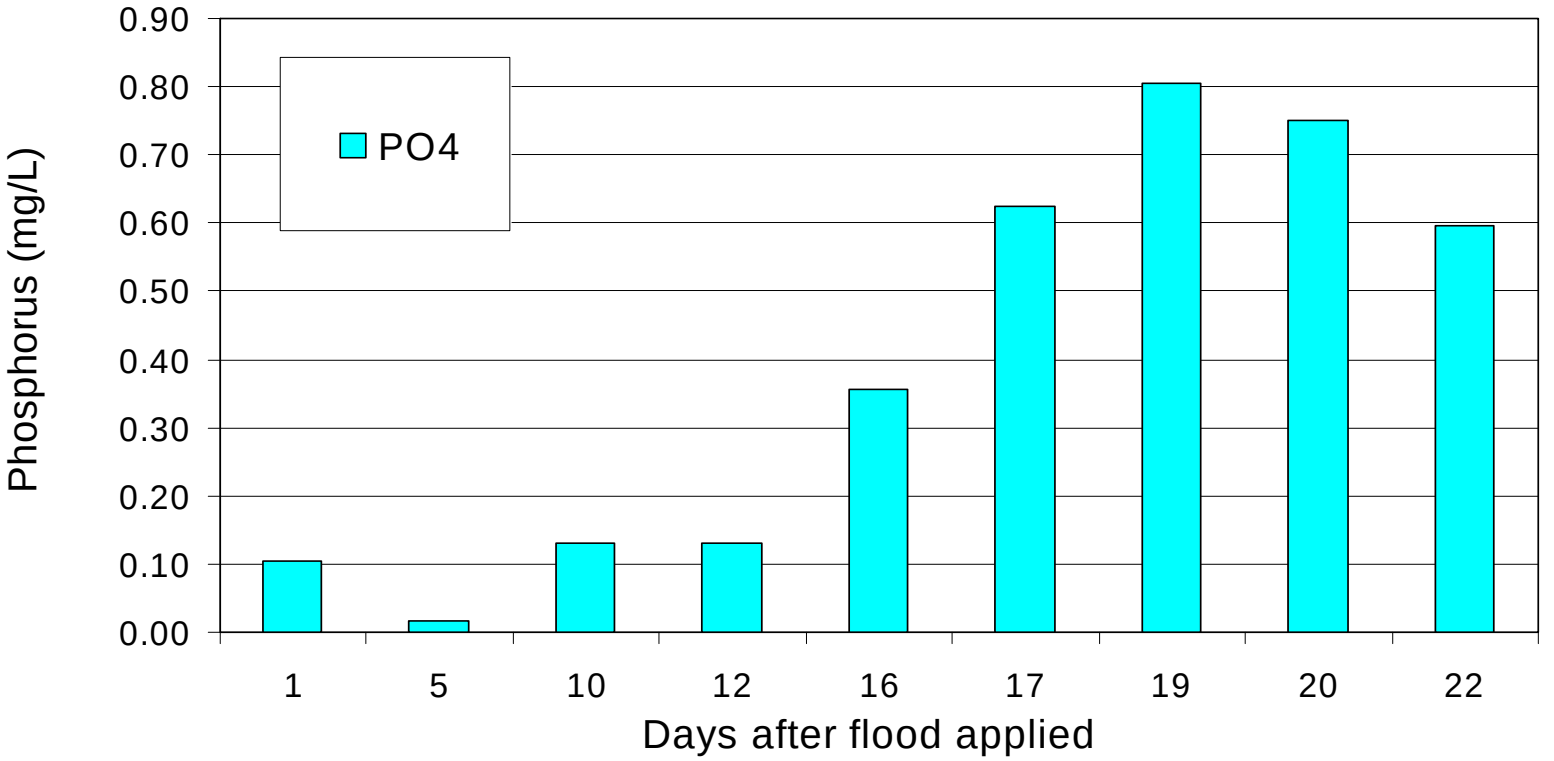
10-18 lb P/a




>20 lb P/a

Fig. 1. Time course of phosphate release from flooded soils excised from natural cranberry bogs (unmanaged, A) and commercial cranberry bogs in MA receiving either 12-20 kg•ha$^{-1}$ (B) or greater than 22 kg•ha$^{-1}$ (C) applied P fertilizer per season. Note that the Y-axis on A is ~$10^{-1}$ those of B and C. Bars represent S.E., n= 6 (A) or 12 (B and C).




- Laboratory results were similar to those in water collected from a harvest flood

# BMP recommendations

- Apply 20 lb P/a OR LESS
  - Based on the laboratory study, highest risk for P mobilization - bogs receiving >20 lb P
- Allow particles to settle prior to discharge of harvest flood but do not hold the flood for more than ~10 days

# Fall fertilizer is not recommended

- Most danger of water quality issues due to saturation
- If indicated by tissue test or vine appearance, use low or no P formulations and limit N to 5 lb/acre.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Questions?