



# What's in your bag?

Calculating N-P-K  
Nutrient Management BMPs

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# Topics to be covered

- Choosing N rates
- Comparing available fertilizers
- How to calculate application rate
  - Nitrogen
  - Phosphorus
  - Potassium
- Calculations for supplements and liquids
- Phosphorus reduction
  - Monitoring tissue levels
- Water quality
  - Data from P reduction
  - Flood handling BMP

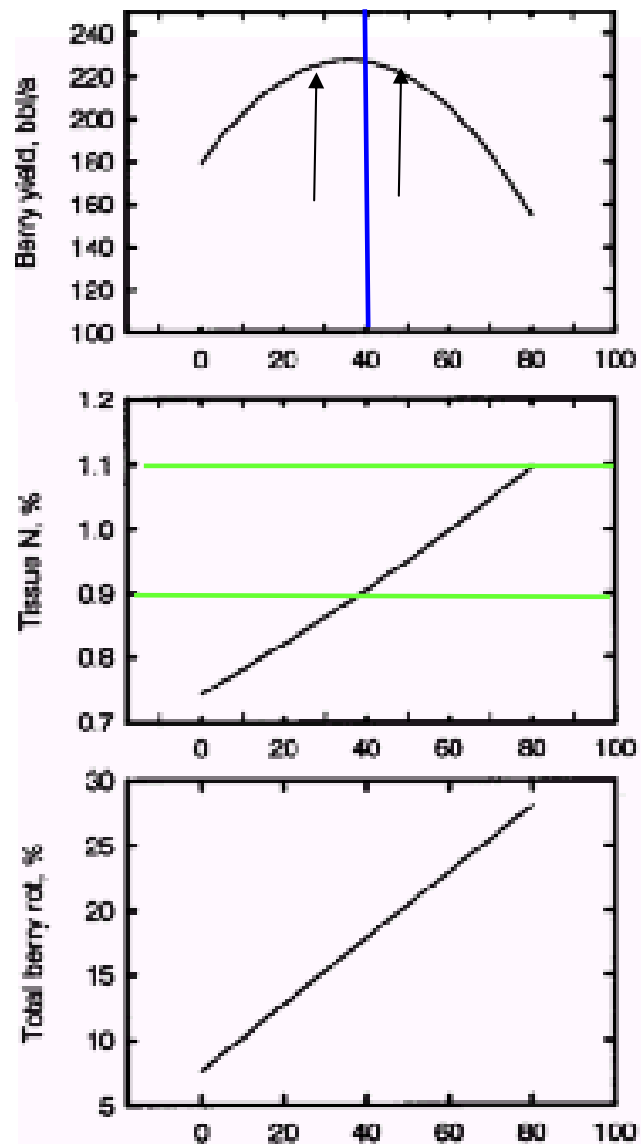


# Nitrogen and Cranberries

- Nitrogen is arguably the most important fertilizer element applied to cranberries.
- Most growers base their fertilizer program on the amount of N they think the bog needs
- There is a body of research on N needs and rates



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



\*Massachusetts-grown 'Stevens' N rate, lb/a



# Optimal N rate (lbs/a)

|                                    |       |
|------------------------------------|-------|
| ● Davenport - all                  | 20    |
| ● Davenport - S in WI              | 40    |
| ● Hart et al. - Cr in OR           | 40    |
| ● Hart et al. - S in OR            | 60    |
| ● DeMoranville - EB in MA          | 30    |
| ● Davenport/DeMoranville - S in MA | 20-60 |



# Nitrogen fertilizer sources

| Fertilizer         | %N    |  | Fertilizer       | %N     |
|--------------------|-------|--|------------------|--------|
| Ammonium sulfate   | 21    |  | Ammonium nitrate | 34     |
| Urea               | 45-46 |  | UAN              | 32     |
| MAP                | 11    |  |                  |        |
| DAP                | 18    |  | Blends           | varied |
| Amm.PolyP (liquid) | 10    |  |                  |        |
|                    |       |  |                  |        |



# Common choices

- NPK ammoniated
- NPK blends
- NPK slow release
  - IBDU
  - MU
  - Osmocote
- Ammonium sulfate
- Urea
- All of these are granular
- Some liquids
  - fish



# How to calculate nitrogen

- First number on the bag is the percent N in the fertilizer
  - eg. 12-24-12 is 12% N
- To calculate pounds of N in a certain amount of fertilizer
  - Pounds of fertilizer x first number as a decimal
  - eg. 200 lbs 12-24-12 has 24 lbs N
$$200 \times (12 \times 0.01) = 24$$



# How to calculate N

● To calculate how much fertilizer to use to get a set number of pounds of N

■ Pounds of N / first number as a decimal

■ eg. 40 lbs of N needed using 12-24-12

$$40 / (12 \times 0.01) = 333$$



# Calculating amounts to apply starting from scratch

- Decide on N rate (season)
- Decide on split
- Decide on product
- Calculate amount of product to apply for each timing



# Calculating amounts to apply starting from scratch – example

30 lb N/acre                      20% in May; 80% bloom

12-24-12 for both applications

N = 12%, as a decimal = 0.12 (multiply first number by 0.01)

May: 20% of 30 lb =  $[20 \times 0.01] \times 30 = 6$  lbs N

lbs 12-24-12:  $6 / 0.12 = 50$  lbs fertilizer/acre

Bloom: 80% of 30 lb =  $[80 \times 0.01] \times 30 = 24$  lbs N

lbs 12-24-12:  $24 / 0.12 = 200$  lbs fertilizer/acre

Total fertilizer = 250 lbs

# Calculating amounts to apply changing from known practice

- What is your current material and fertilizer rate?
- How much N did that contain?
- Decide on new product
- Calculate amount of that product to apply based on previous N rate and split rate



# Calculating amounts to apply changing from known practice example

Currently using 300 lb/acre 12-24-12

Fertilizer contains 12% N

300 lbs contains 36 lbs N  $[300 \times (12 \times 0.01)]$

New choice is 18-8-18 – still want 36 lbs N

Use 200 lbs  $[36 / (18 \times 0.01)]$



# That's the N – how about P?

- Generally added with N in an N-P-K formulation
- Can be applied independently as super-P or triple super-P (new plantings)
- Those forms can be blended into N-P-K also



# Other P fertilizers used in custom blending

- MAP (11-49-0)
  - Monoammonium phosphate
  - Forms an acidic zone around the particles in the soil
- DAP (18-47-0)
  - Diammonium phosphate
  - Used in lowbush blueberry production
  - Provides more N
- Ammonium polyphosphate (10-34-0)
  - Liquid used to make ammoniated materials



# Phosphorus fertilizer sources

| Fertilizer        | %N | %P <sub>2</sub> O <sub>5</sub> | lb P actual in 100 lb |
|-------------------|----|--------------------------------|-----------------------|
| Super P           | 0  | 21                             | 9.2                   |
| Triple Super P    | 0  | 45                             | 19.8                  |
| MAP               | 11 | 49                             | 21.6                  |
| DAP               | 18 | 47                             | 20.7                  |
| Amm.POLY (liquid) | 10 | 34                             | 15                    |
| Rock P            | 0  | 34                             | 15                    |

# Calculating phosphorus

- The second number on the bag is not actual P!!



What's on the bag!



# Calculations

- Example #1 – 45 lb N

I used 375 lb/acre 12-24-12 – how much P?

$$375 \times 0.24 \times 0.44 = 39.6 \text{ lb/acre}$$

0.24 is the second bag number converted to a decimal  
[ $24 \times 0.01 = 0.24$ ]

0.44 converts  $P_2O_5$  to actual P



# Calculations

- Example #2 – 45 lb N

I used 250 lb/acre 18-8-18 – how much P?

$$250 \times 0.08 \times 0.44 = 8.8 \text{ lb/acre}$$

0.08 is the second bag number converted to a decimal

$$[8 \times 0.01 = 0.08]$$

0.44 converts  $P_2O_5$  to actual P



# Calculations

- Example #3 – 45 lb N

I used 300 lb/acre 15-15-15 – how much P?

$$300 \times 0.15 \times 0.44 = 19.8 \text{ lb/acre}$$

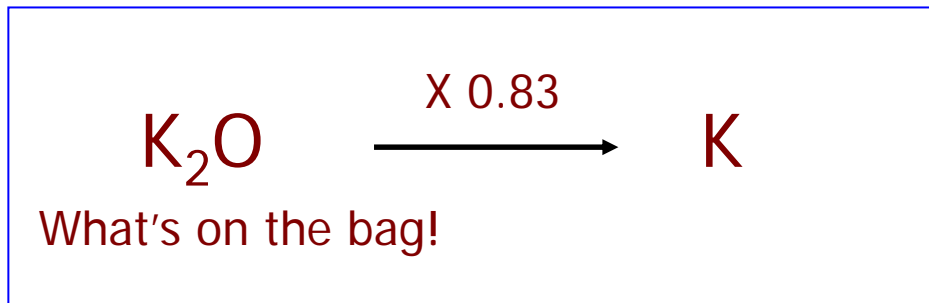
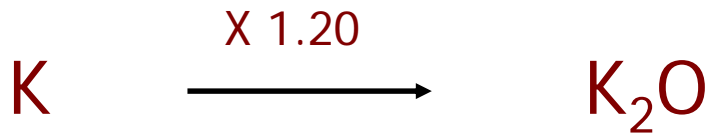
0.15 is the second bag number converted to a decimal  
[15 x 0.01 = 0.15]

0.44 converts  $P_2O_5$  to actual P



# Calculating potassium

- The third number on the bag is not actual K!!



# Calculations

- Example – 45 lb N

I used 375 lb/acre 12-24-12 – how much K?

$$375 \times 0.12 \times 0.83 = 37.4 \text{ lb/acre}$$

0.12 is the third bag number converted to a decimal  
[12 x 0.01 = 0.12]

0.83 converts  $K_2O$  to actual K



# Calculating seasonal budgets

- For each application – run the N, P, and K calculations
- Add all applications for the season
- Include fall applications in the following season
  - eg. 2007 season includes fall 2006 and all pre-harvest 2007 applications
  - If using fish as fall fertilizer pre-harvest – count that in the next year



# Liquids and supplements

- Anything that comes as granular or powder (even if you dissolve it and chemigate) – use the calculations as we just went over
- Liquids require a conversion from volume to weight to calculate pound of N, P, and K



# Example Fish 2-4-2

- Determine the weight of a gallon of the product in pounds or use the weight of a gallon of water as an estimate (8.34 lb/gal)
- Pounds N, P, K per gallon applied =
  - $8.34 \times 0.02 = 0.17$  lb N per gal
  - $8.34 \times 0.04 \times 0.44 = 0.15$  lb P per gal
  - $8.34 \times 0.02 \times 0.83 = 0.14$  lb K per gal
- Multiply these figures by the number of gallons applied to get total pounds of N, P, and K



Calculation examples are in the  
2008 Chart Book – coming soon

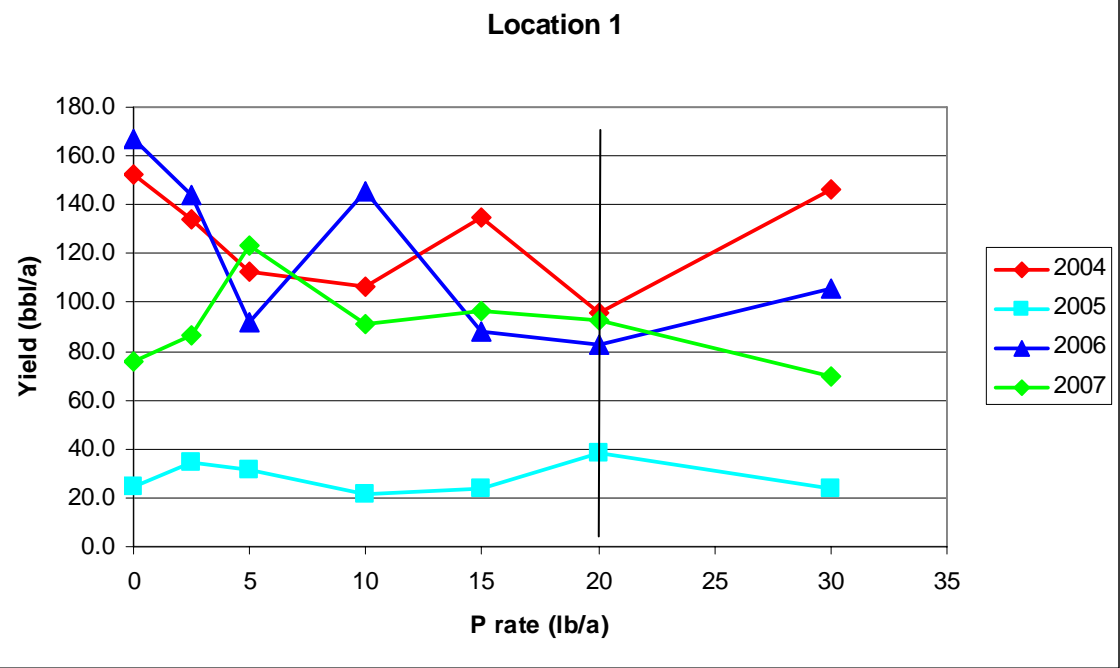


# Phosphorus reduction and monitoring

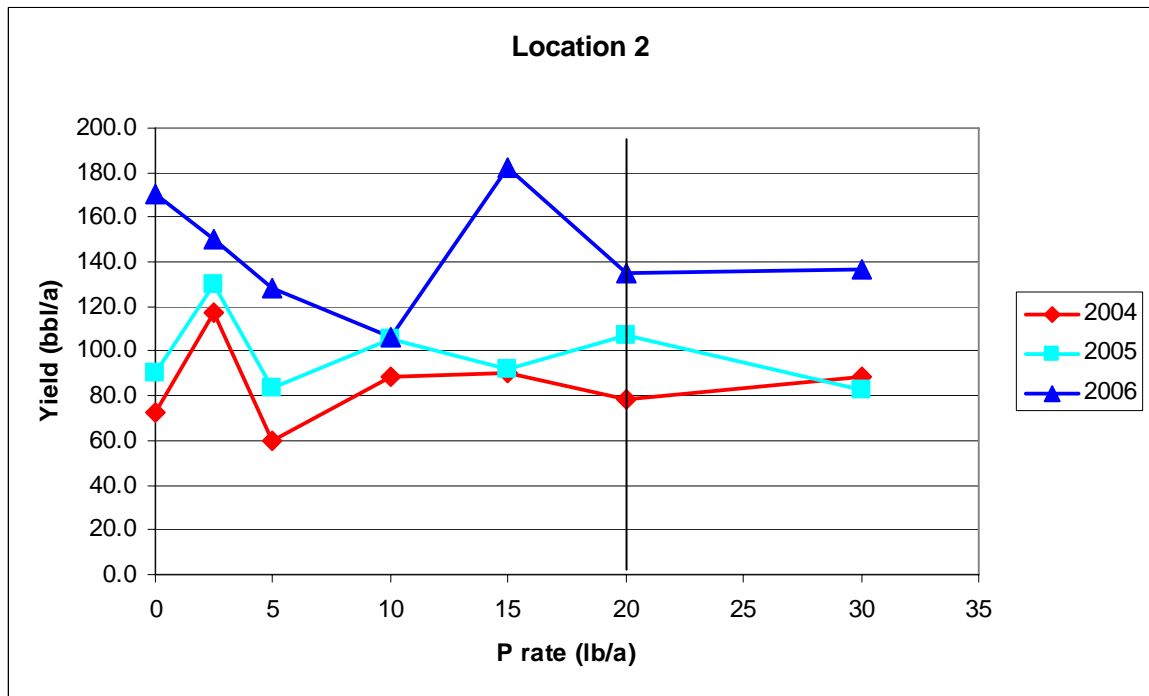
- Plot and whole farm research shows P reduction is viable
- But for how long and how do we monitor?
- Yield records and tissue sampling
  - Tissue to 'catch' a problem before yield declines
  - Also yield can be up or down due to other factors



Massachusetts plot research  
2004-2007

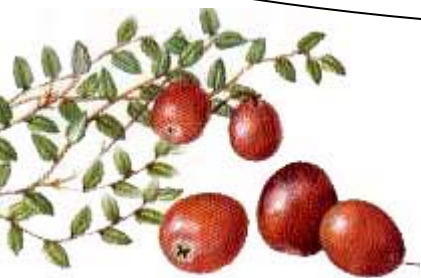


Loc. 1 had tissue P below std. range



# Yield comparisons – field scale

| <u>Year</u>    | <u>EH</u>     |              | <u>PV</u>     |              |
|----------------|---------------|--------------|---------------|--------------|
|                | <u>P rate</u> | <u>Yield</u> | <u>P rate</u> | <u>Yield</u> |
| 2002           | 17.8          | 117          | 24.8          | 117          |
| 2003           | 14.3          | 119          | 22.3          | 119          |
| 2004           | 5.6           | 172          | 17.3          | 195          |
| 2005           | 16.5          | 190          | 24.0          | 121          |
| 2006           | 6.4           | 162          | 5.7           | 244          |
| pre-reduction  | 17.8          | 117          | 22.1          | 138          |
| post-reduction | 10.7          | 161          | 5.7           | 244          |



# Tissue standard is 0.1-0.2% P

<0.1% --- increase P rate and retest next year

0.1 – 0.11% -- stay the course but retest next year

0.12 – 0.15% -- test again in 2-3 years

0.16% or greater – test again in 3-4 years



# Why P reduction?



## Cranberry Bog Total Phosphorus

| CES/SMAST<br>Field Expt. | TP<br>Fertilization<br>(lb/a/yr) | TP<br>“Storage”<br>(lb/a/yr) | TP “Export”<br>(lb/a/yr) |
|--------------------------|----------------------------------|------------------------------|--------------------------|
| Bog ID                   | Mean 2003-04                     |                              |                          |
| EH                       | 10.0                             | -5.5                         | 1.4                      |
| PV                       | 19.8                             | -14.9                        | 2.7                      |
| BEN                      | 16.8                             | -13.6                        | 1.2                      |
| WS                       | 17.5                             | -12.6                        | 3.2                      |
| M-K                      | 20.4                             | -19.1                        | -0.5**                   |
| ASH                      | 30.2                             | -29.3                        | -0.2**                   |
| <b>Mean</b>              | <b>19.1</b>                      | <b>-14.1</b>                 | <b>1.28</b>              |

A Flow-through Bog was found to have a higher annual TP loss of 8.8 lb/a/yr (Howes & Teal 1995)

- Environmental benefit to P reduction
- P concentration in outlet water decreased with fertilizer reduction and was lower on mineral sites

**mean ppm TP in flood discharges**

| <u>Bog</u> | <u>2002</u> | <u>2003</u> | <u>2004</u> | <u>2005</u> |
|------------|-------------|-------------|-------------|-------------|
| EH         | 0.377       | 0.424       | 0.237       | 0.097       |
| PV         | 0.384       | 0.439       | 0.528       | 0.408       |
| M-K        | 0.100       | 0.170       | 0.118       |             |
| ASH        | 0.109       | 0.127       | 0.147       |             |

↑  
reduction

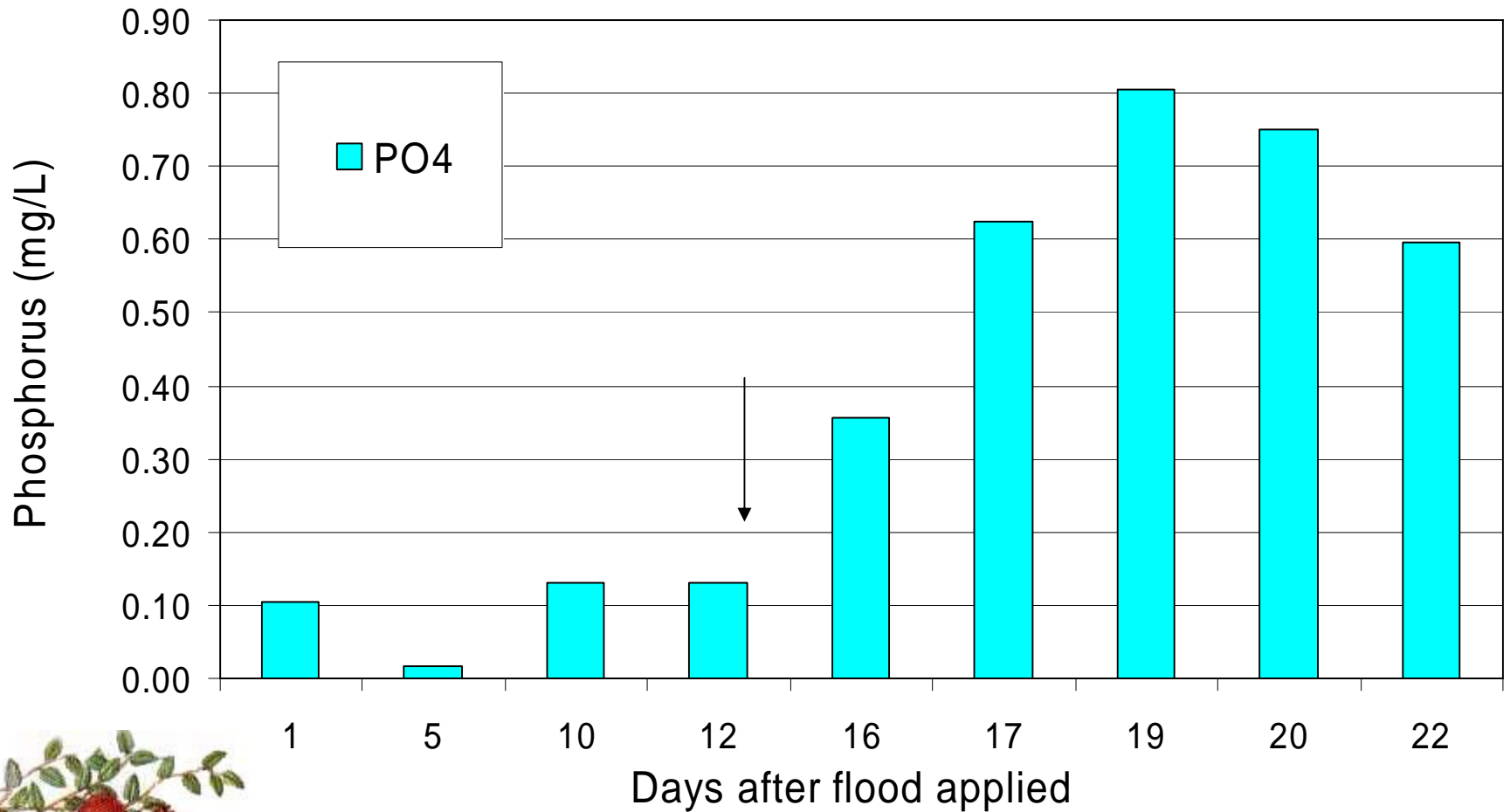


# BMPs for P reduction

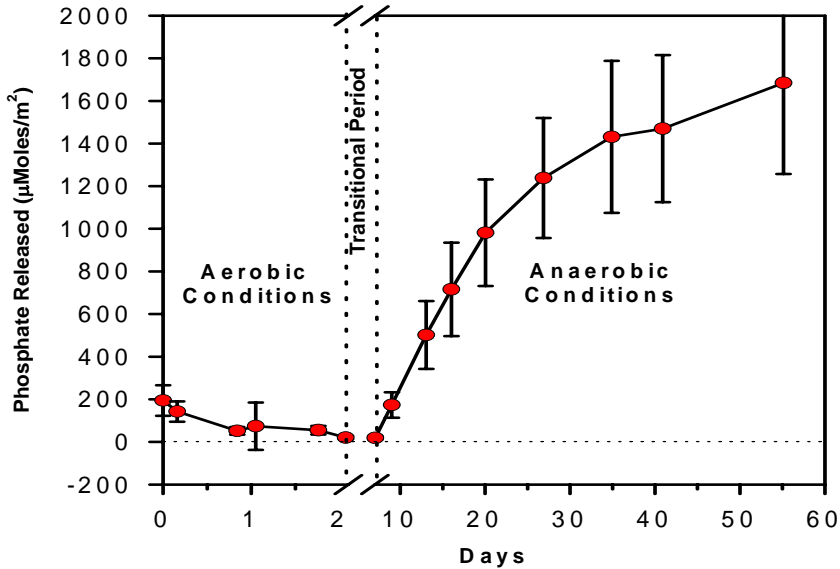
- Use no more than 20 lb/acre
- At sensitive sites, reduce below 20 lb/acre
- If possible avoid discharge of water after fertilizer applications – impound or tailwater
- Flood management is critical
  - Harvest -- hold 2-4 days then discharge a moderate pace to finish by no later than day 10
  - Winter -- Release from beneath ice ASAP



# Most Phosphorus Loss occurs during flooding/draining as inorganic P released from the soil



Time Course of Phosphate Release  
Natural Bog

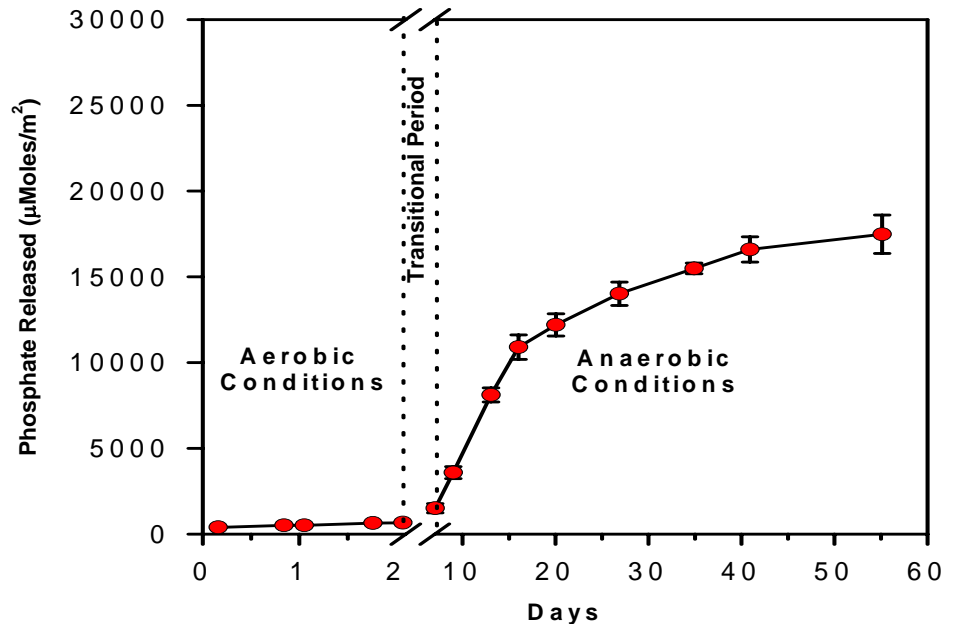


**P Release increased with amount of P Fertilization**

**Total P Release primarily when soil became anoxic  
(rapid rise after day 10)**

**10 fold difference in release**

Time Course of Phosphate Release  
Low P Application



# Questions?



**BEST MANAGEMENT PRACTICES**  
Phosphorus Management in Cranberry Systems

Phosphorus levels in the soil increase during the summer growing season. Since soils have definitely reached this point by the time recommended for tissue sampling (August 15-20), it is a good idea to take your soil and plant samples before the phosphorus peaks.

**BEST MANAGEMENT PRACTICES**  
Nitrogen Management in Cranberry Systems

**Recommended Practices**

- Soil testing:** Periodically test soil for organic matter content and soil pH. Soil should be tested for organic matter content as this material releases nitrogen for use by the cranberry plants. Test soil for organic matter every 3-5 years, always testing the year after tilling. Sandy bogs have less potential for natural N release. As organic matter in the soil increases, less fertilizer N should be used. Soil pH should be tested at least once every three years (more often if you are attempting to modify pH). As soil pH rises, biological fixation of atmospheric nitrogen is less desirable nitrogen sources. This phenomenon is more pronounced in bogs with high organic matter content. Soil pH in cranberry bogs with soil organic matter content of 0-5% should be between pH 4.0 and 5.0, while soils with organic matter content greater than 5% should have a pH of 4.5 or less.
- Soil temperature:** Plan nitrogen fertilizer applications based on soil type and temperature. On sandy soils, nitrogen fertilizer may be applied throughout the season. Otherwise, applications should be based on soil temperatures. For typical cranberry bogs, applications of N should not be necessary early in the spring. From flood removal until soil temperatures reach 50°F, adequate N should be available through biological processes. Nitrogen is slowly released from the soil early in the spring when the cranberry plants are dormant.

The single most important nutrient element in cranberry production is nitrogen. Nitrogen is required by cranberry plants for the production of organic matter (leaves and stems, roots, and fruit leop). Cranberry plants get nitrogen from the soil, from water (very little), or from added fertilizers. Approximately 95% of the nitrogen in a given soil that becomes plant available in a single growing season comes from the decomposition of soil organic matter. Cranberry plants grow in acidic organic soils, washed by surface application of sand or mixed soils. Average organic matter in the surface horizon of Massachusetts cranberry soils is 0% sand, silt and clay make up less than 2% of the soil. Nitrogen release from the soil organic matter depends on temperature and soil moisture status. The release process slows as temperatures drop and bacterial activity in the soil. When the soil is waterlogged, the bacteria cannot get enough air to function well. As with many biological reactions, nitrification is also temperature dependent, tending to increase as the soil temperature rises. A natural bacterial reaction, nitrification, where ammonium is further metabolized by nitrate, may also occur. This second reaction is unfavorable for cranberry production. Each season, nitrogen is removed during harvest and depending removal of fallen leaves from the bog floor). When the bog is harvested, more than 20 lbs N/A is removed in an average (150 MBE) crop. The amount of nitrogen removed increases with increasing crop load and is reduced when crops are small. To compensate for this loss and to supplement natural N release from the soil, cranberry growers add fertilizer to their bogs. Unlike most horticultural crops, cranberry growers do not use synthetic nitrogen. Although cranberries preferentially use soil-borne nitrogen, they have very low activity of the enzyme (nitrate reductase) that converts nitrate into metabolically usable ammonium inside the plant. Thus, it is unlikely that much of the nitrate taken up by cranberries is actually used in the plant. For this reason, fertilizers in which all of the nitrogen comes from ammonium (including urea) are recommended for cranberry production. This also serves to minimize the potential for loss of nitrate to the surrounding environment. The required amount of added nitrogen fertilizer varies by season, cultivar, and general state (depth, color) of the cranberry plants.

University of Massachusetts Cranberry Experiment Station

