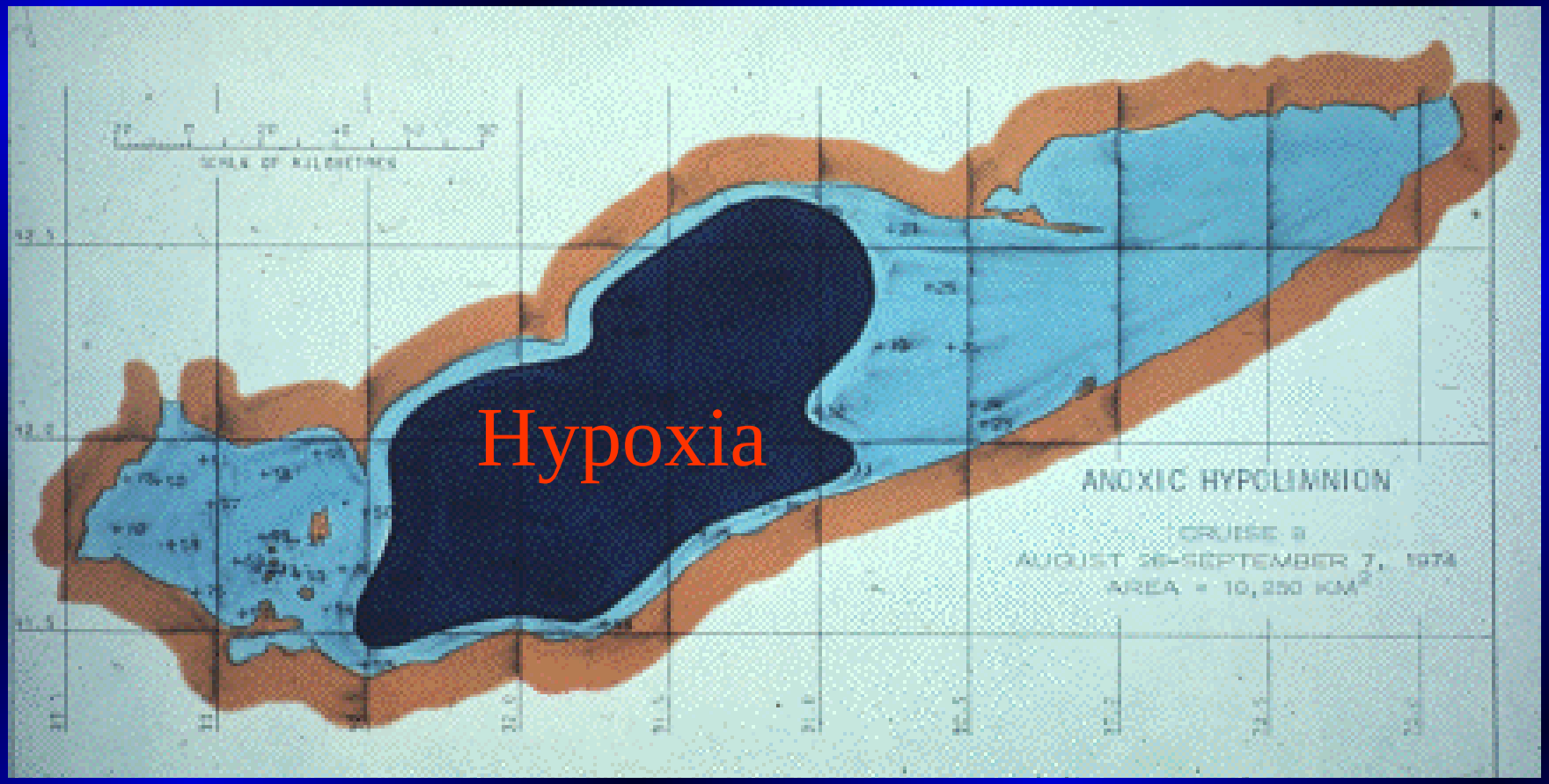
What we know about

Phosphorus Loading to Lake Erie

(and what we need to understand better)

R. Peter Richards
National Center for Water Quality Research
Heidelberg University
Tiffin, Ohio

Perrysburg, Ohio Crop Nutrient Retailers' Meeting February 29, 2012


Hypoxia
ANOXIC HYPOLIMNION
CRUISE 8
AUGUST 26-SEPTEMBER 7, 1974
AREA = 10,250 KM²

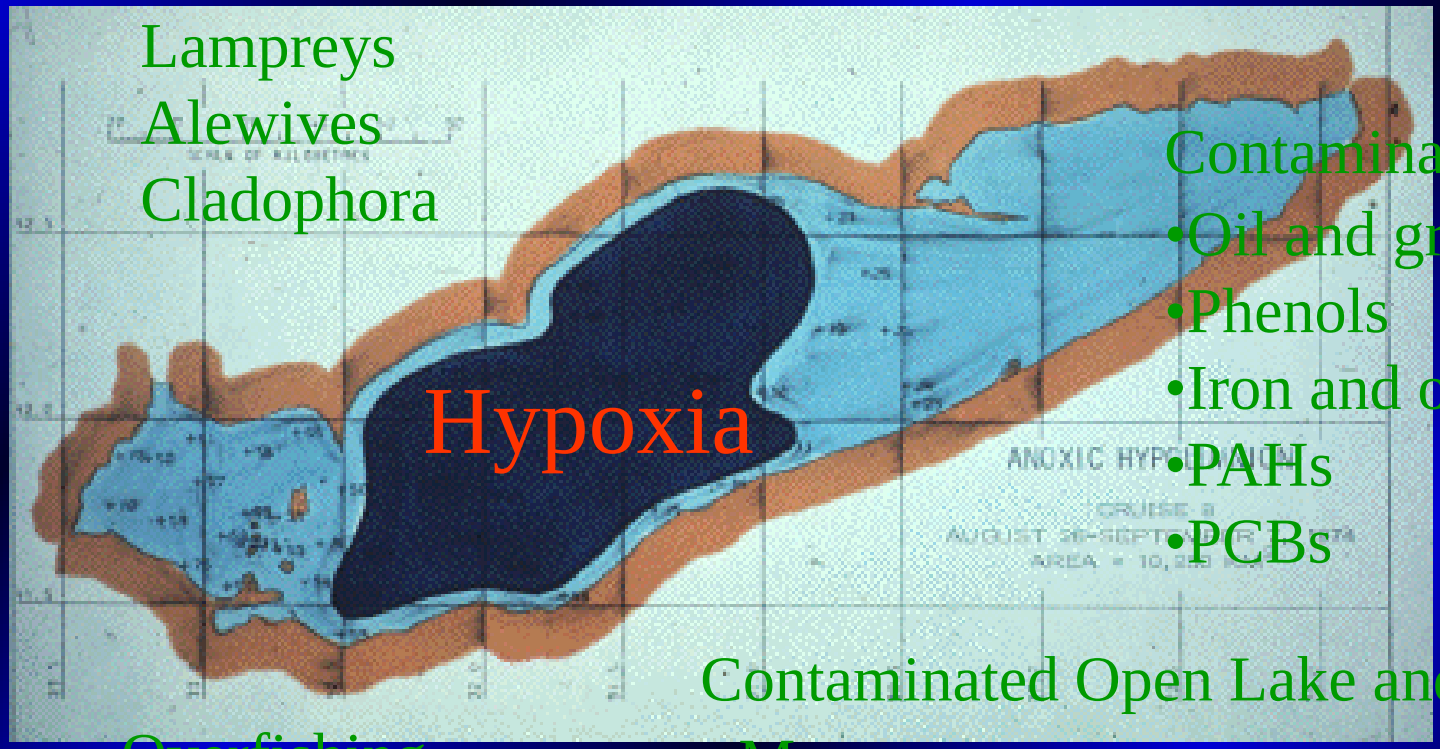
Some things we know

- Excessive algae and hypoxia reflect excess nutrients
- They can be reduced by controlling phosphorus (P)
- At present, most of the P entering the Western Basin comes from the landscape - non-point source origin
- Much of the P entering the Central Basin comes from the Western Basin

June 22, 1969

Lake Erie is Dead!

What was wrong with Lake Erie?



Lampreys
Alewives
Cladophora

Contaminated Harbors
- Oil and grease
- Phenols
- Iron and other metals
- PAHs
- PCBs

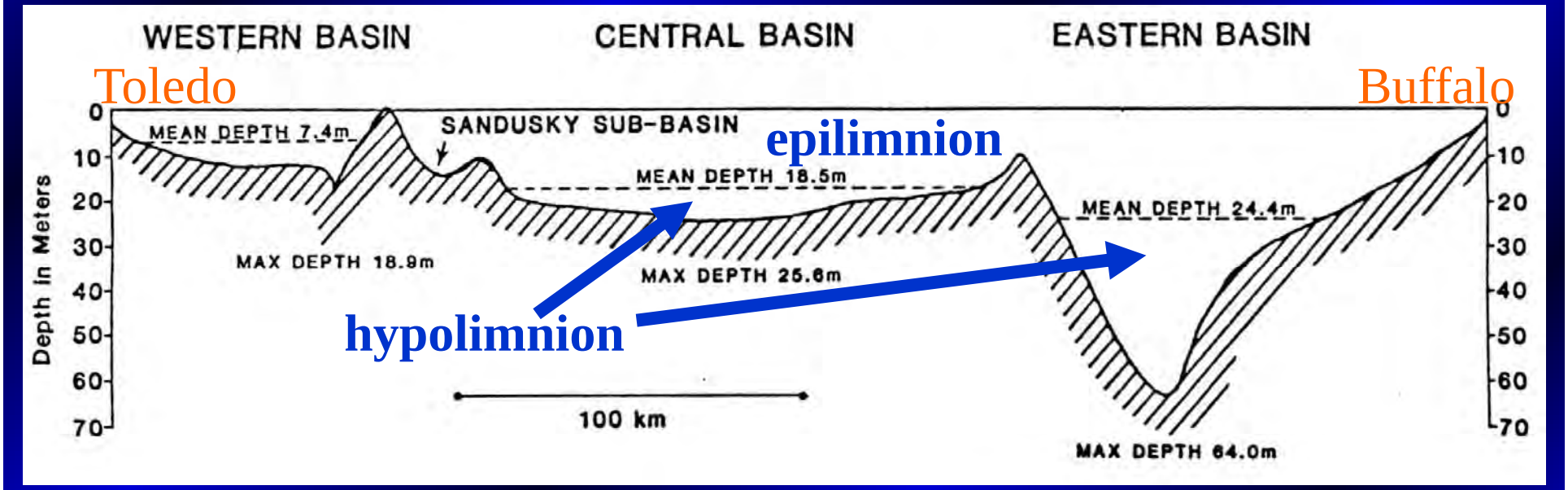
Contaminated Open Lake and Fish
- Mercury
- PCBs
- DDT, DDE

Overfishing
- Blue Pike
- Walleye

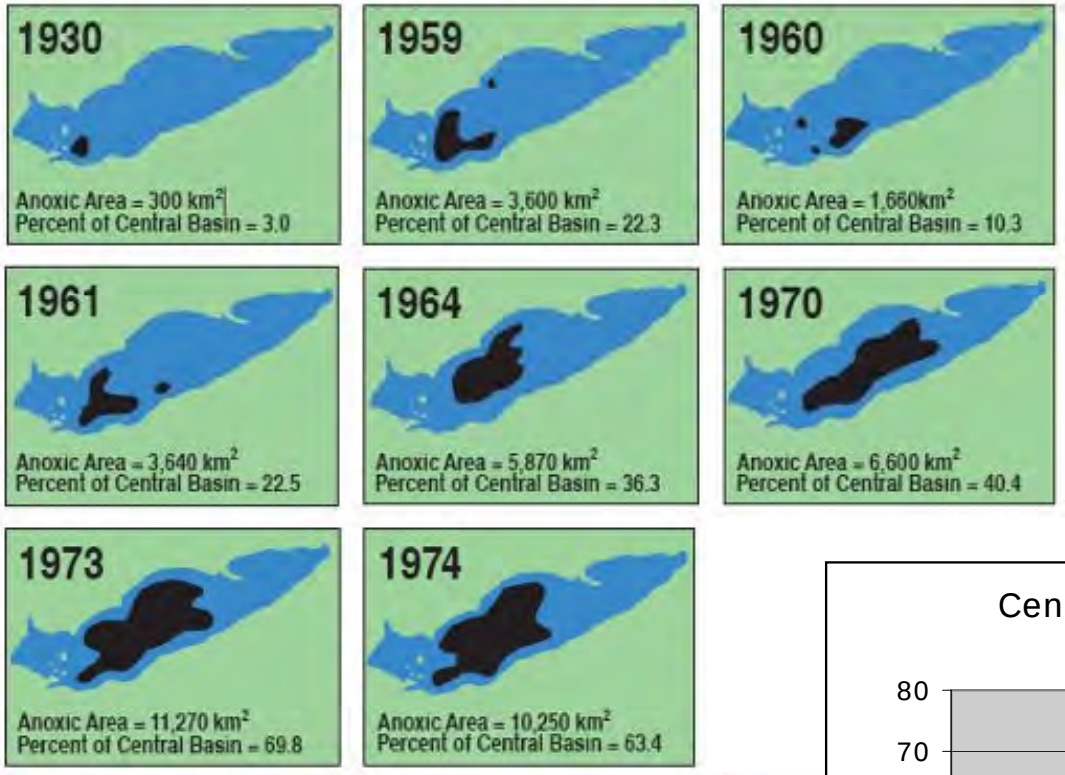
No more mayflies...

Causes of anoxia

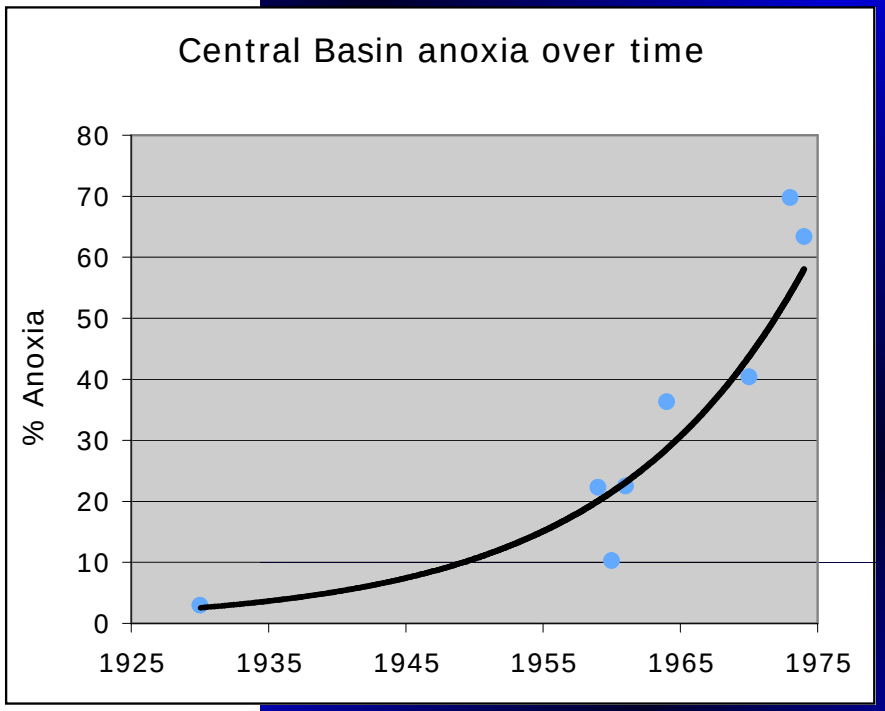
- A Central Basin problem
- Excess nutrient loading
- Thin hypolimnion



Distribution of Anoxia in Lake Erie (1930-1982)



Anoxia increasing rapidly!

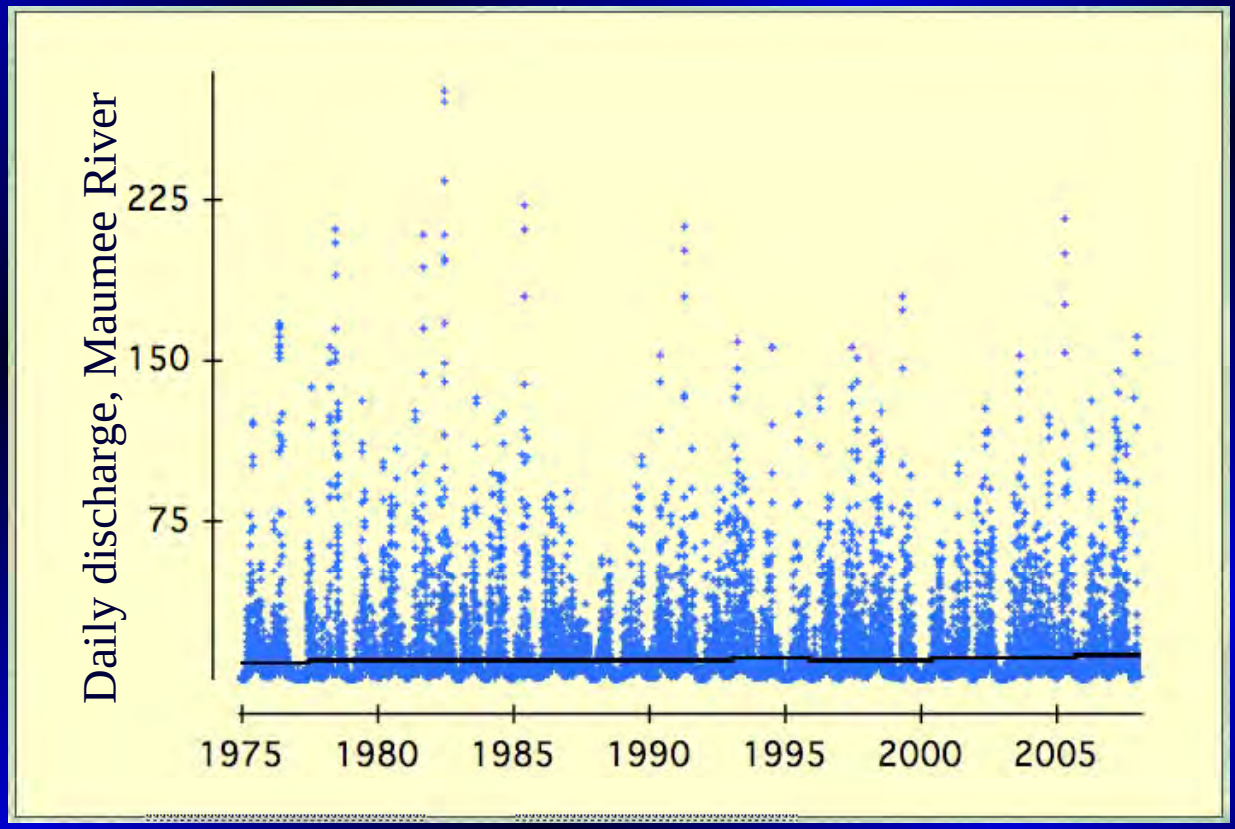


Modified from EPA-GLNPO

Remediation

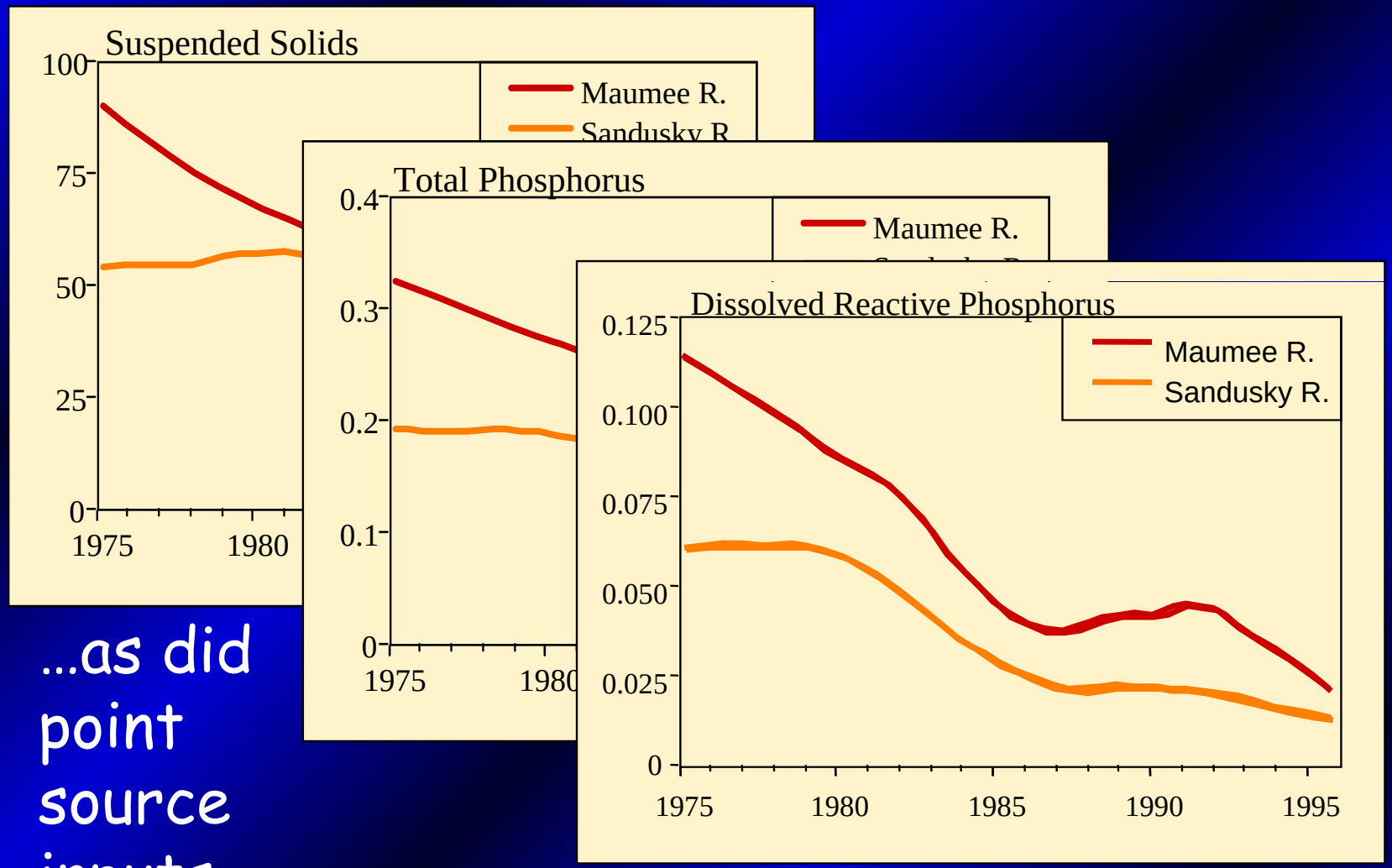
- Make phosphorus the limiting nutrient
- Reduce phosphorus inputs
  - Detergent phosphorus ban
  - Sewage Treatment Plant upgrades
  - Nonpoint source management
    - Fertilizer and manure management
    - Erosion prevention
      - Conservation tillage
      - Buffer strips

Looking for Signs of Success

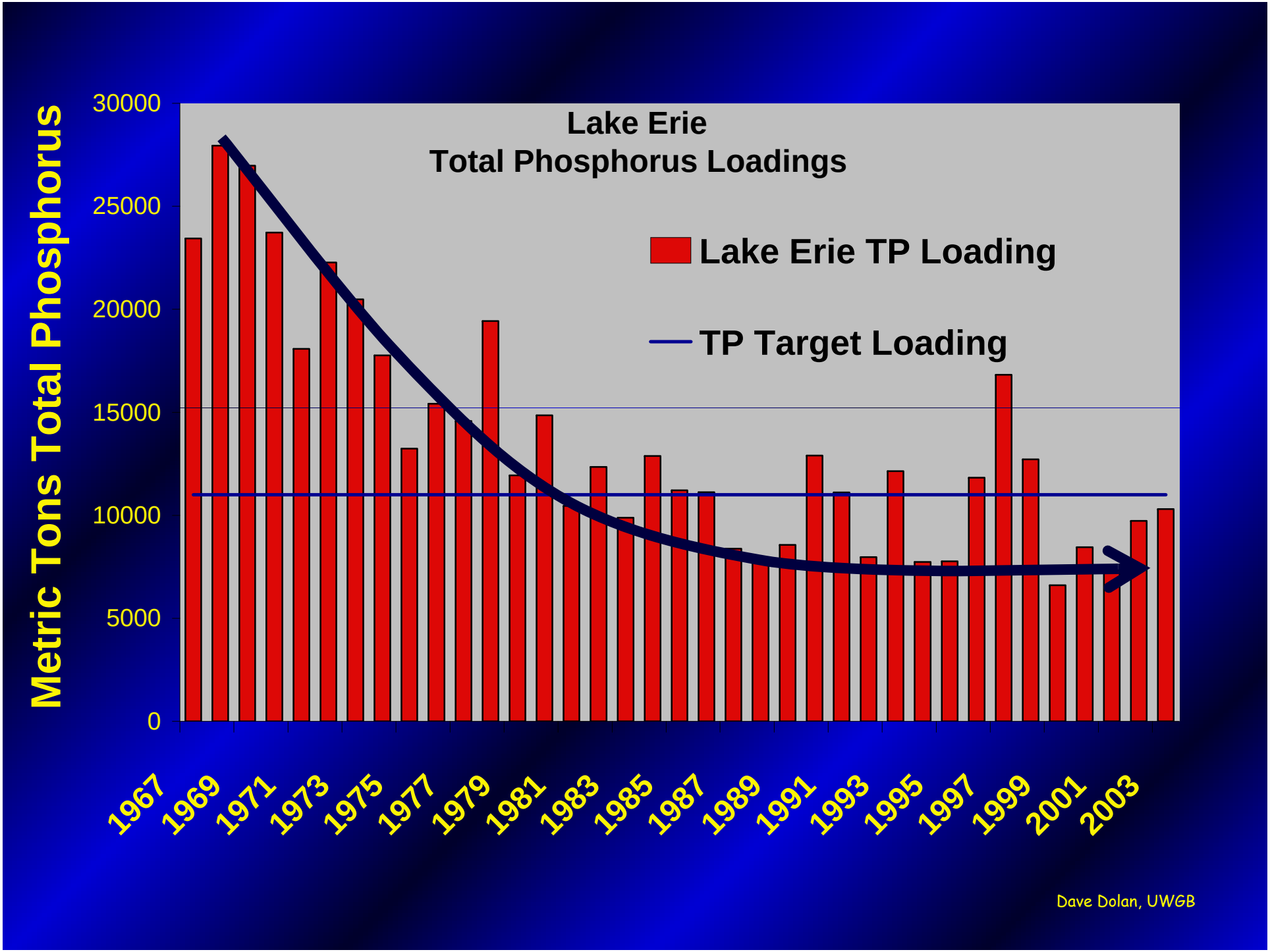


Compared to short-term fluctuations, trends are quite subtle things!

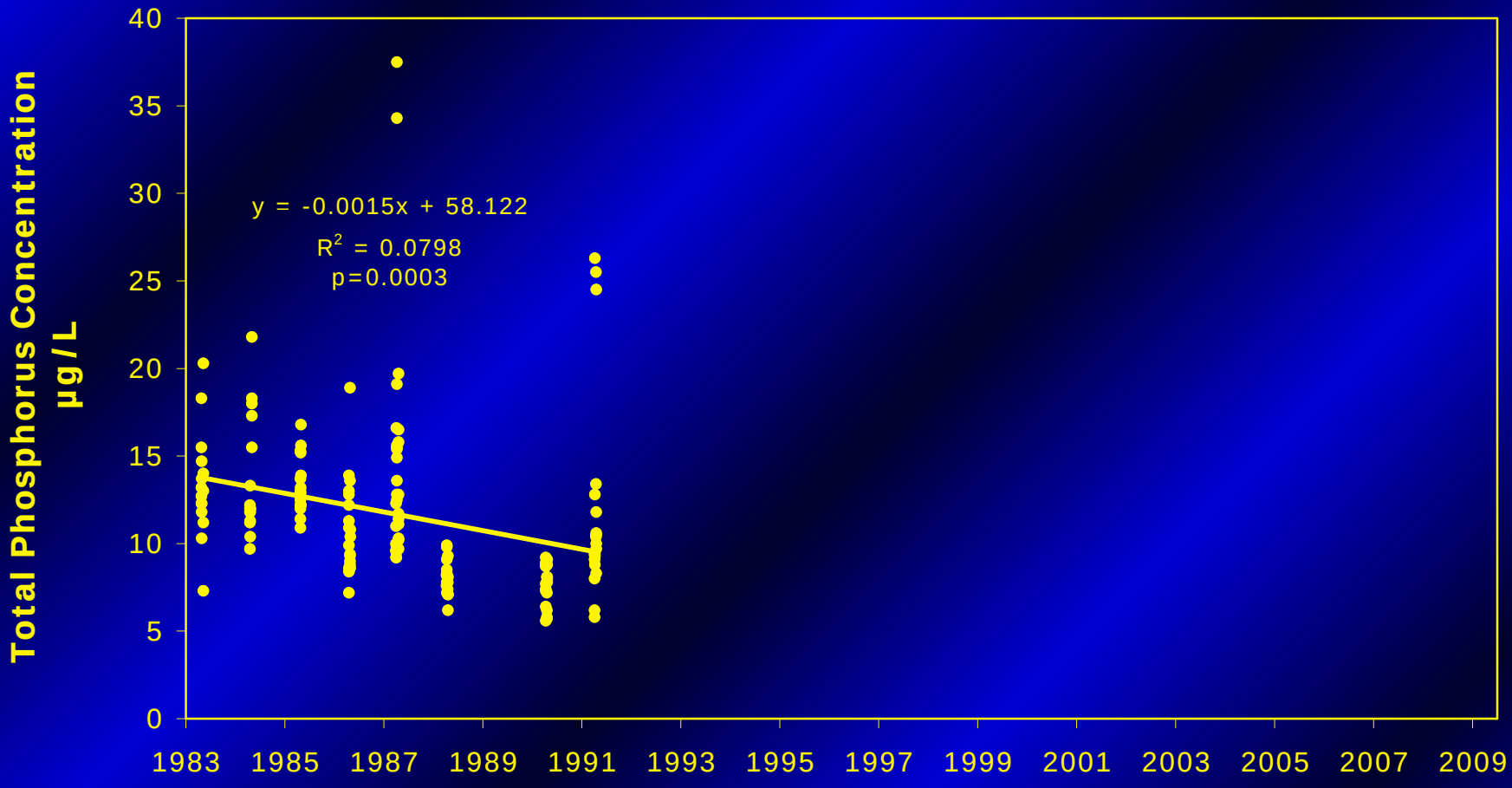
Tributaries improved…



…as did point source inputs.


Lake Erie
Total Phosphorus Loadings
Metric Tons Total Phosphorus
Lake Erie TP Loading
TP Target Loading
30000
25000
20000
15000
10000
5000
0
1967
1969
1971
1973
1975
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
Dave Dolan, UWGB

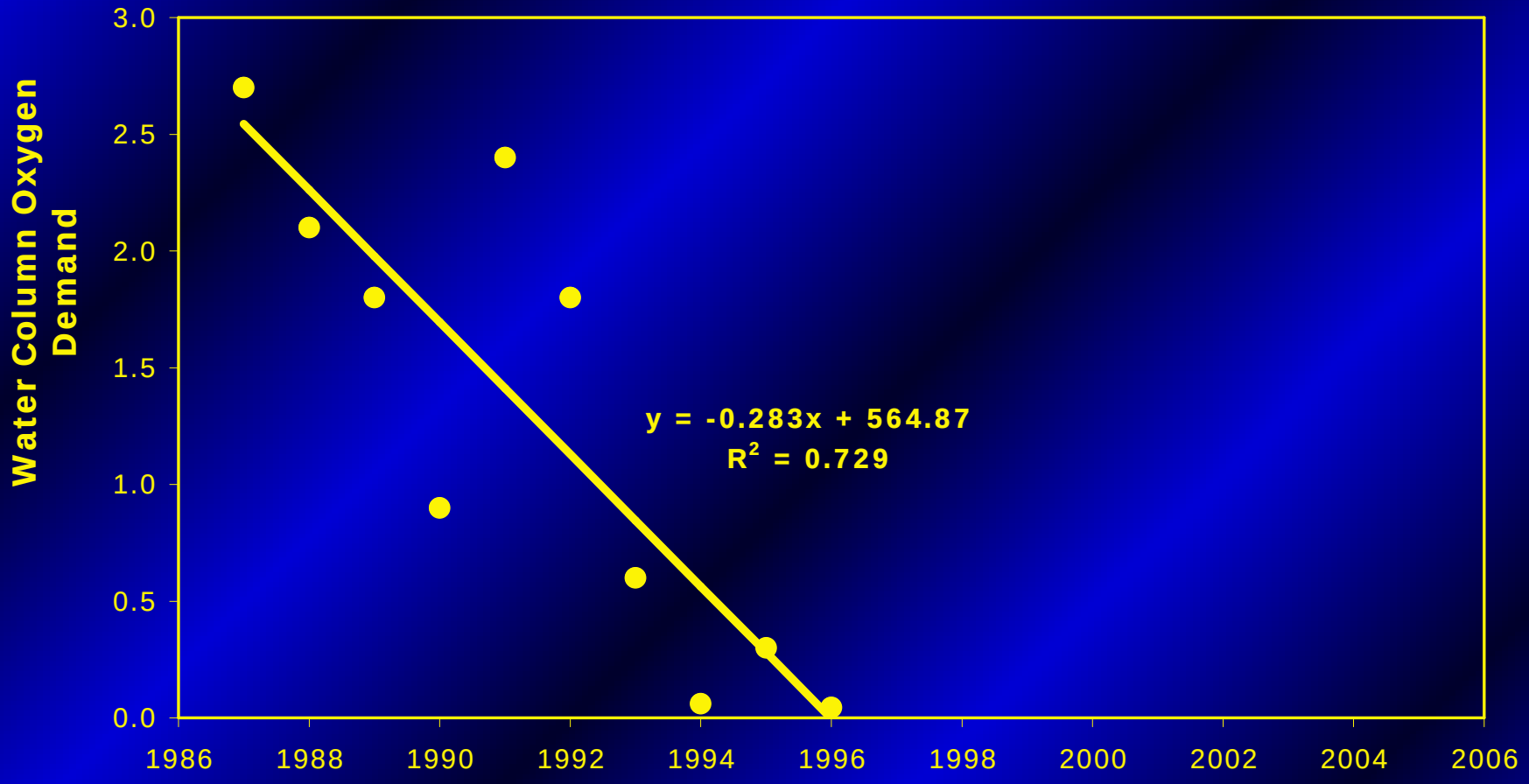
Central Basin Spring TP



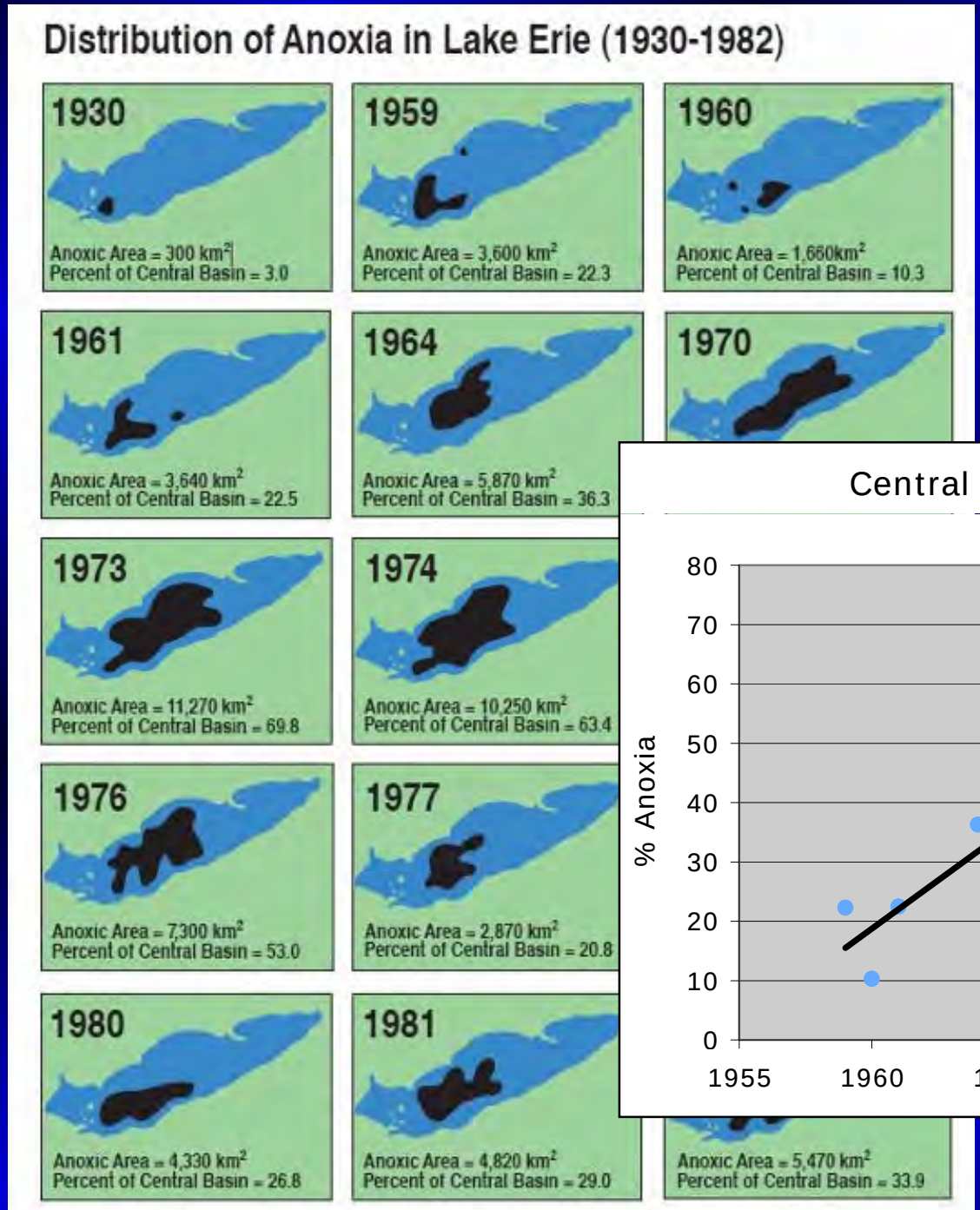
Data from EPA-GLNPO

Central Basin Oxygen Depletion Rate

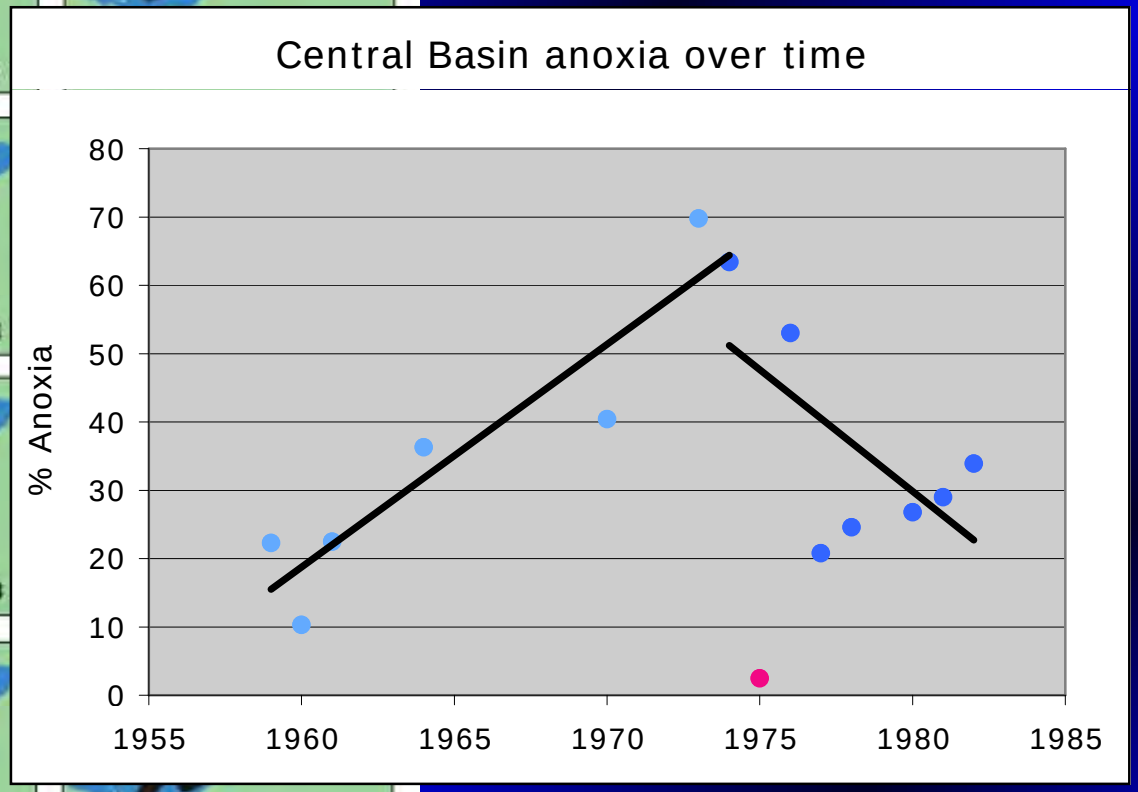
Using tentative alternate method, Rucinski et al. (in prep)



Dan Rucinski, LimnoTech



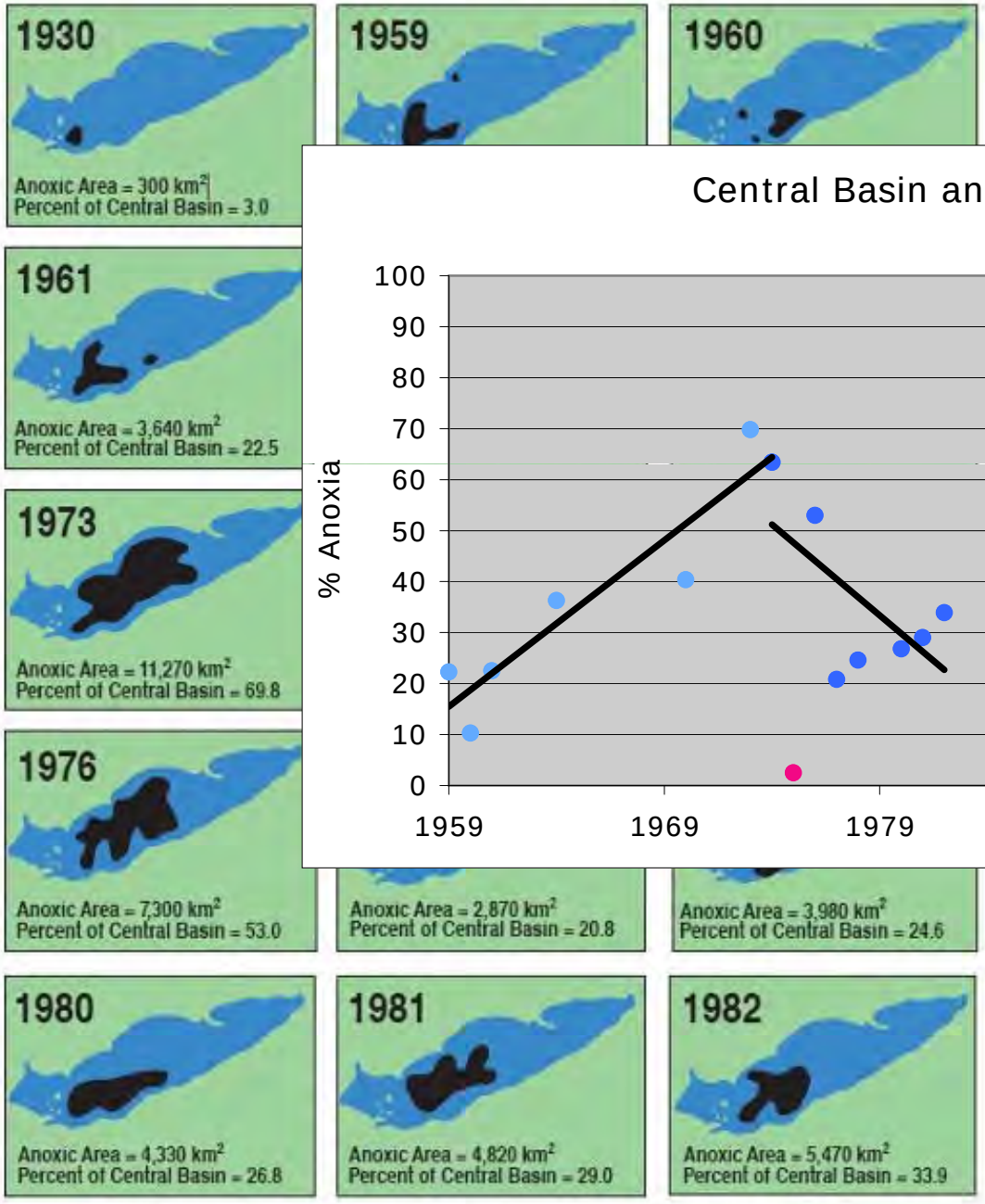
Anoxia decreasing again…



EPA-GLNPO

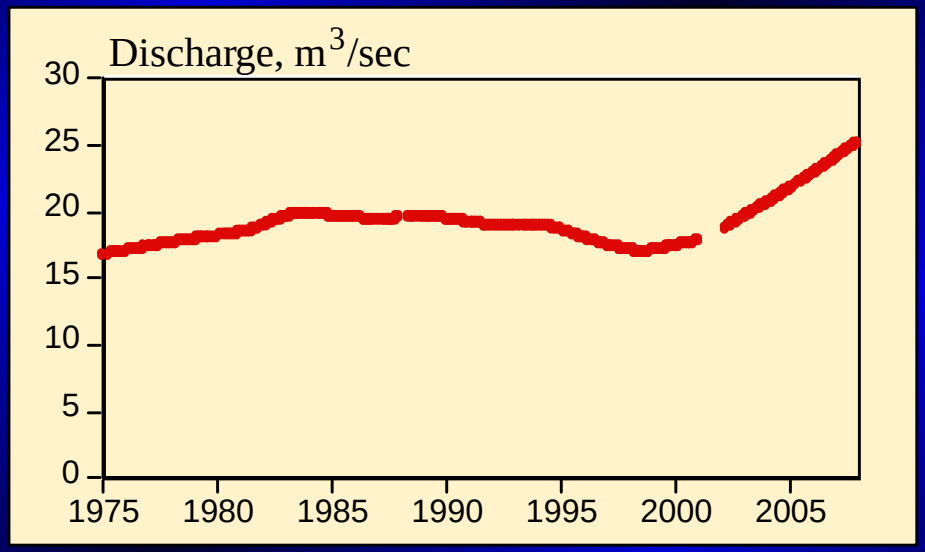

And then it happened…
The return of
THE DEAD ZONE

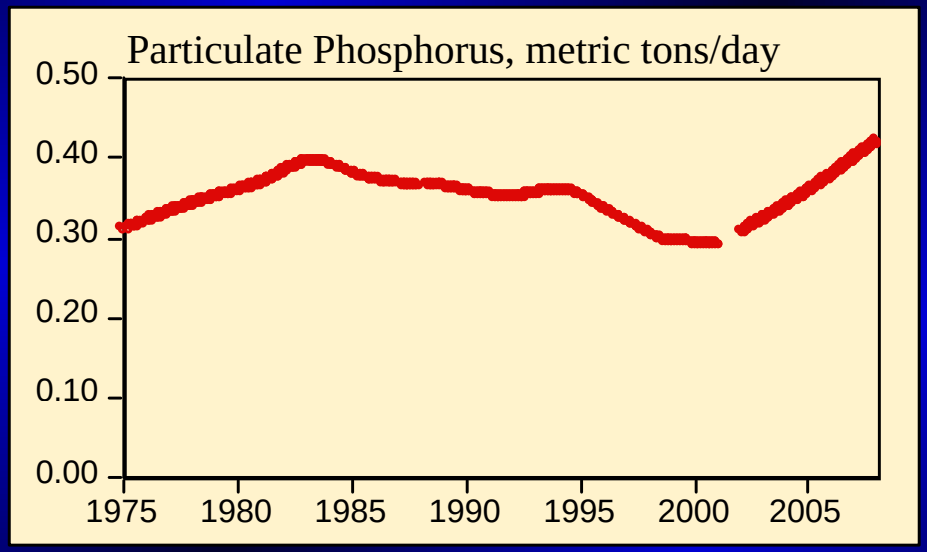
Distribution of Anoxia in Lake Erie (1930-1982)

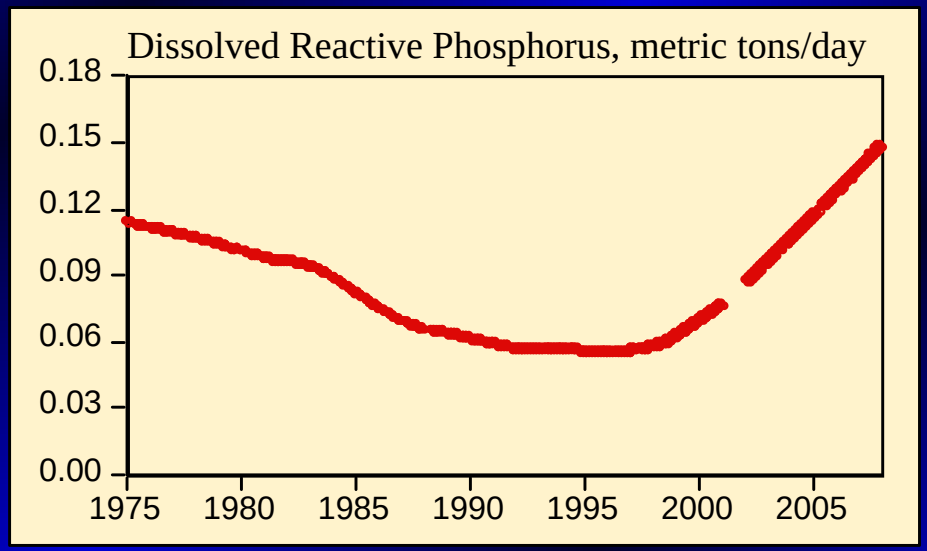


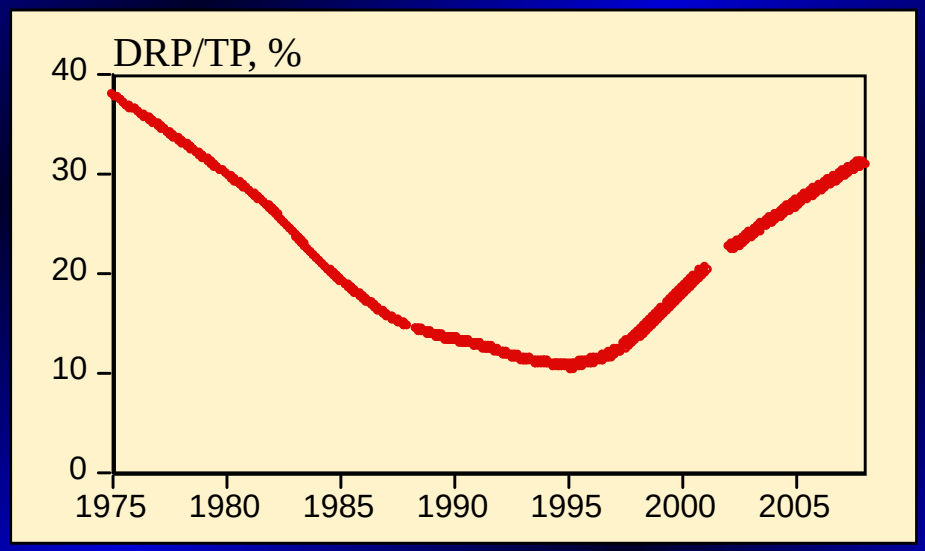
EPA-GLNPO

Tributary P trends 1975-2007



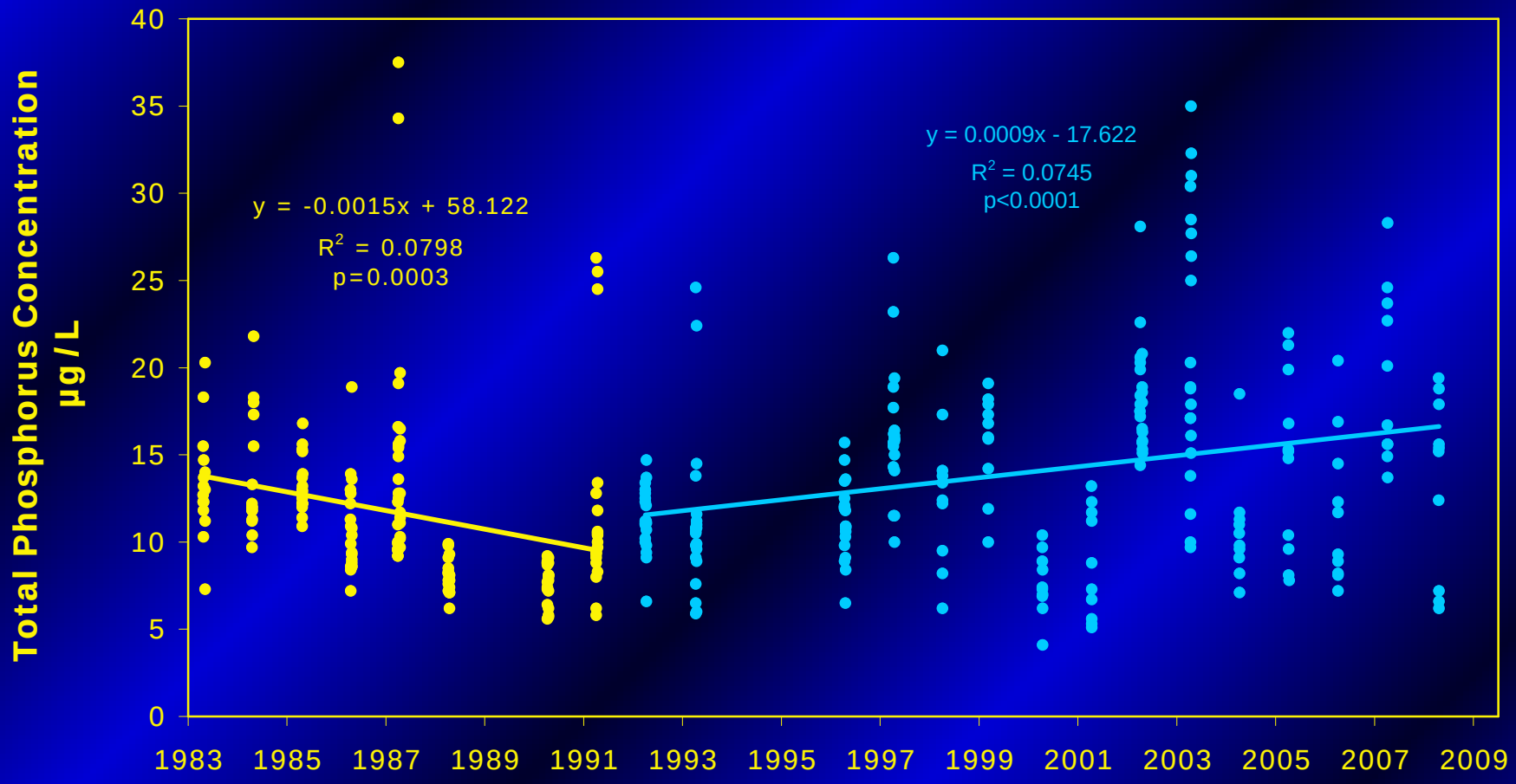






Sandusky River data

Central Basin Spring TP



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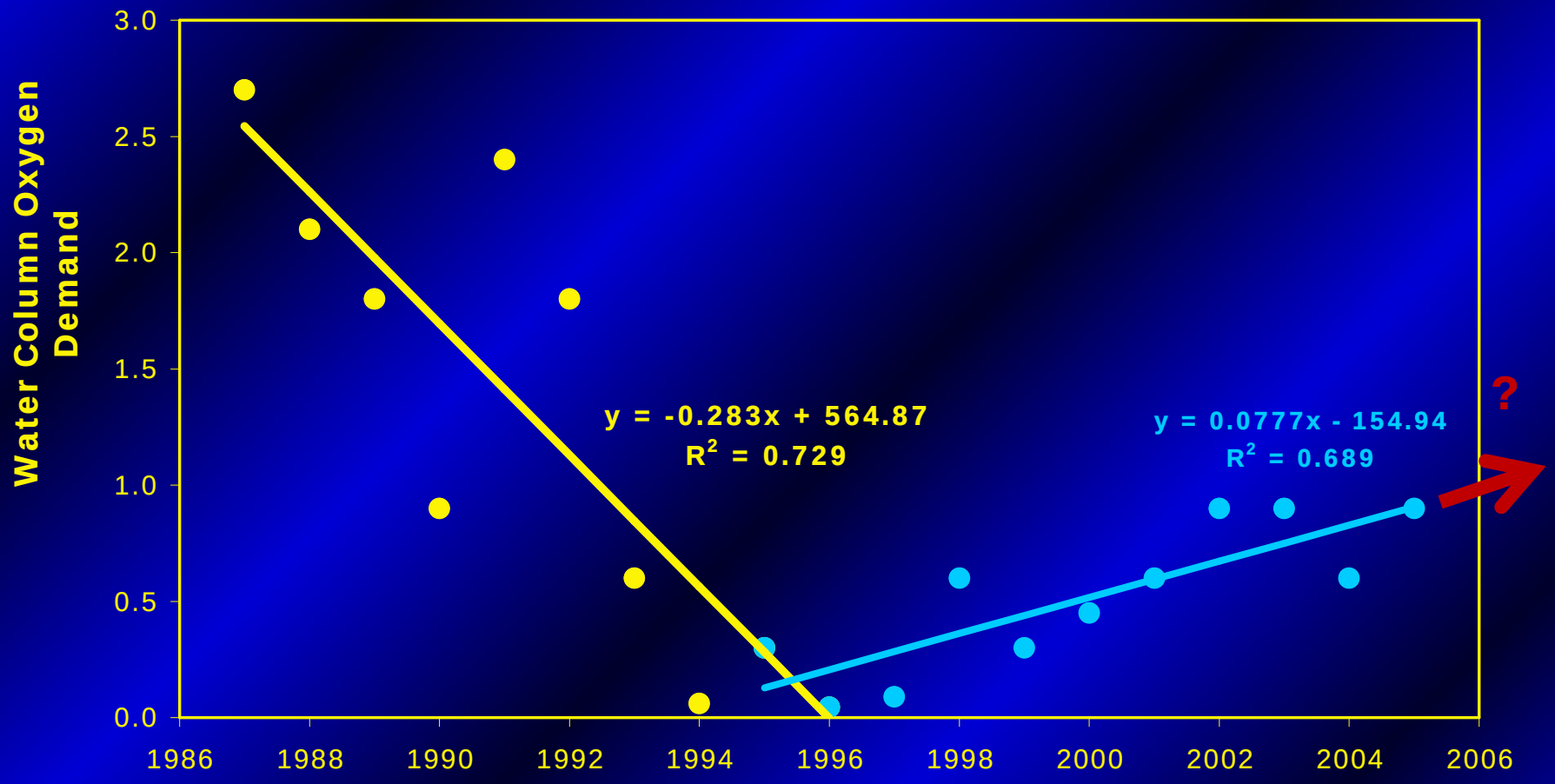


Dan Rucinski, LimnoTech

Western Basin Algae Problems

Microcystis

Western Basin Algae Problems

Microcystis

Western Basin Algae Problems

Microcystis

Western Basin Algae Problems

Cladophora

Lingbya

Western Basin Algae Problems

Cladophora and noxious "blue-green algae" are back with a vengeance!

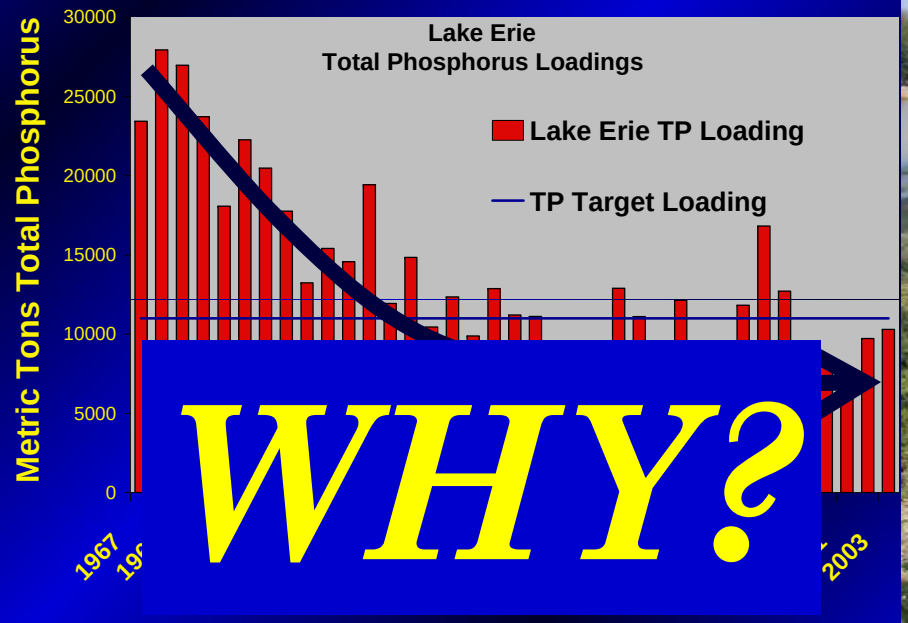
City of Toledo - $3000/day to treat drinking water for microcystin.

Microcystin 1000 ppb in Western Basin, 2000 ppb in Grand Lake St. Marys. WHO recommendations 1 ppb for drinking water (20 ppb for swimming)

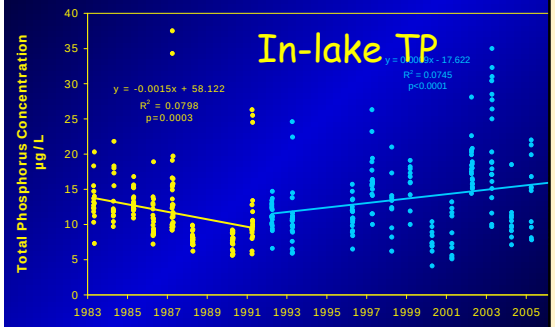
Where are the nutrients that drive this coming from?

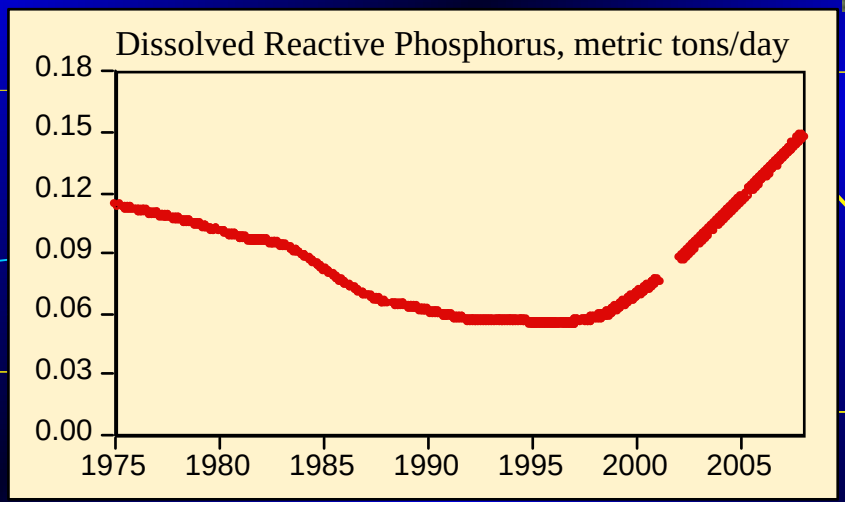
Tom Bridgeman, U. Toledo

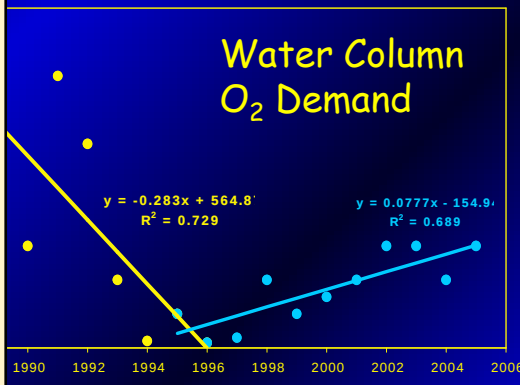
Shift in lake response



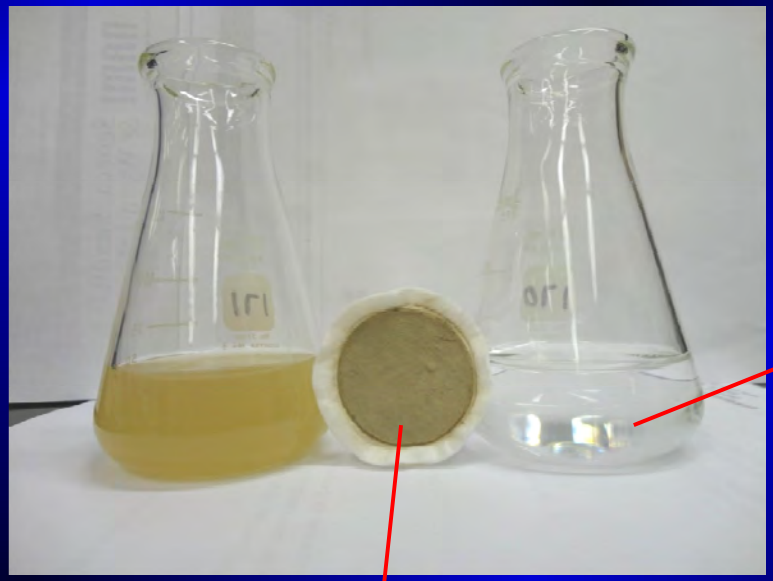
WHY?







Importance of DRP

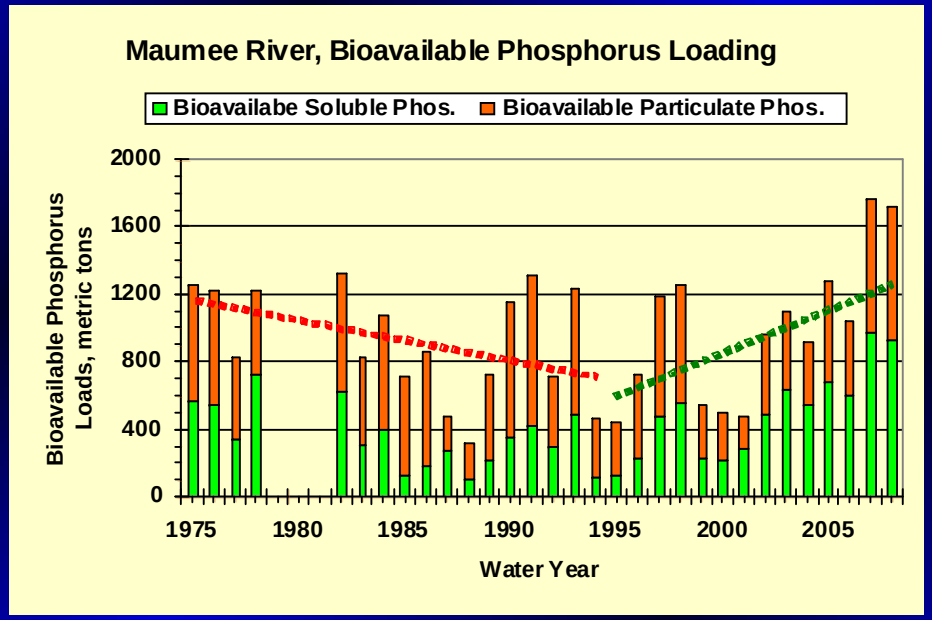


Dissolved P

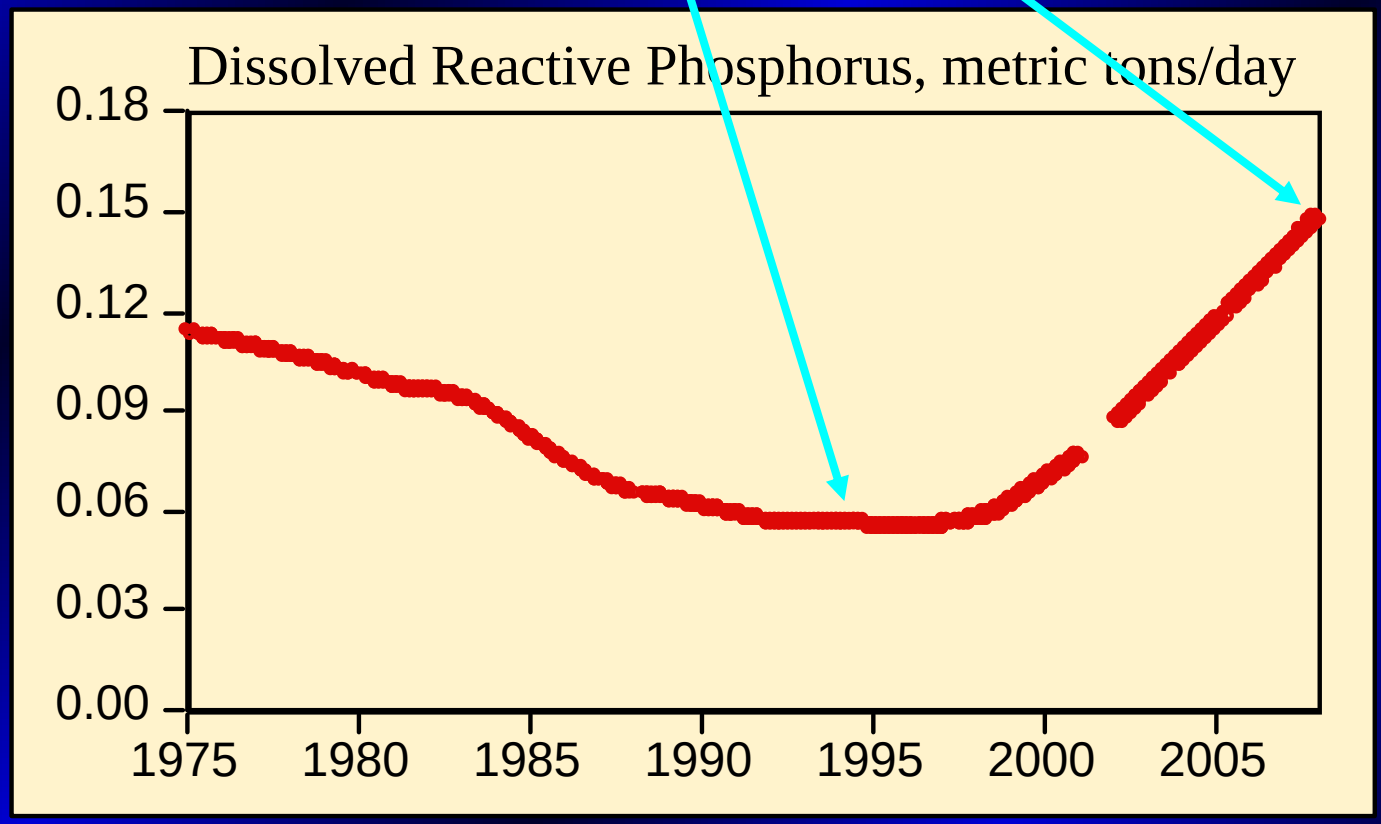
- 90% DRP
- DRP is 100% bioavailable for algal growth

Particulate P

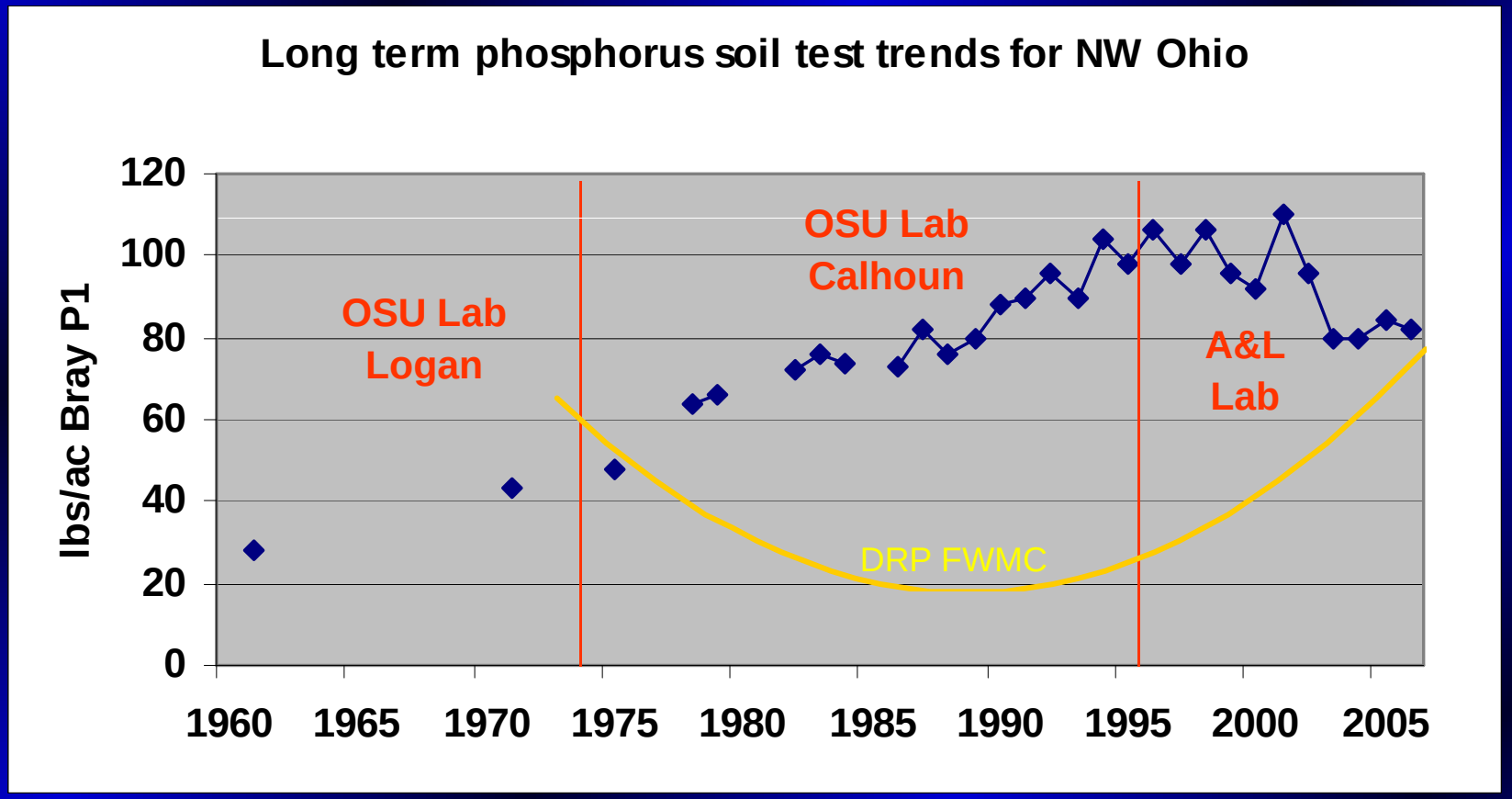
- ~30% bioavailable
- Tends to settle to bottom



Why has this happened?



P concentration in soil?



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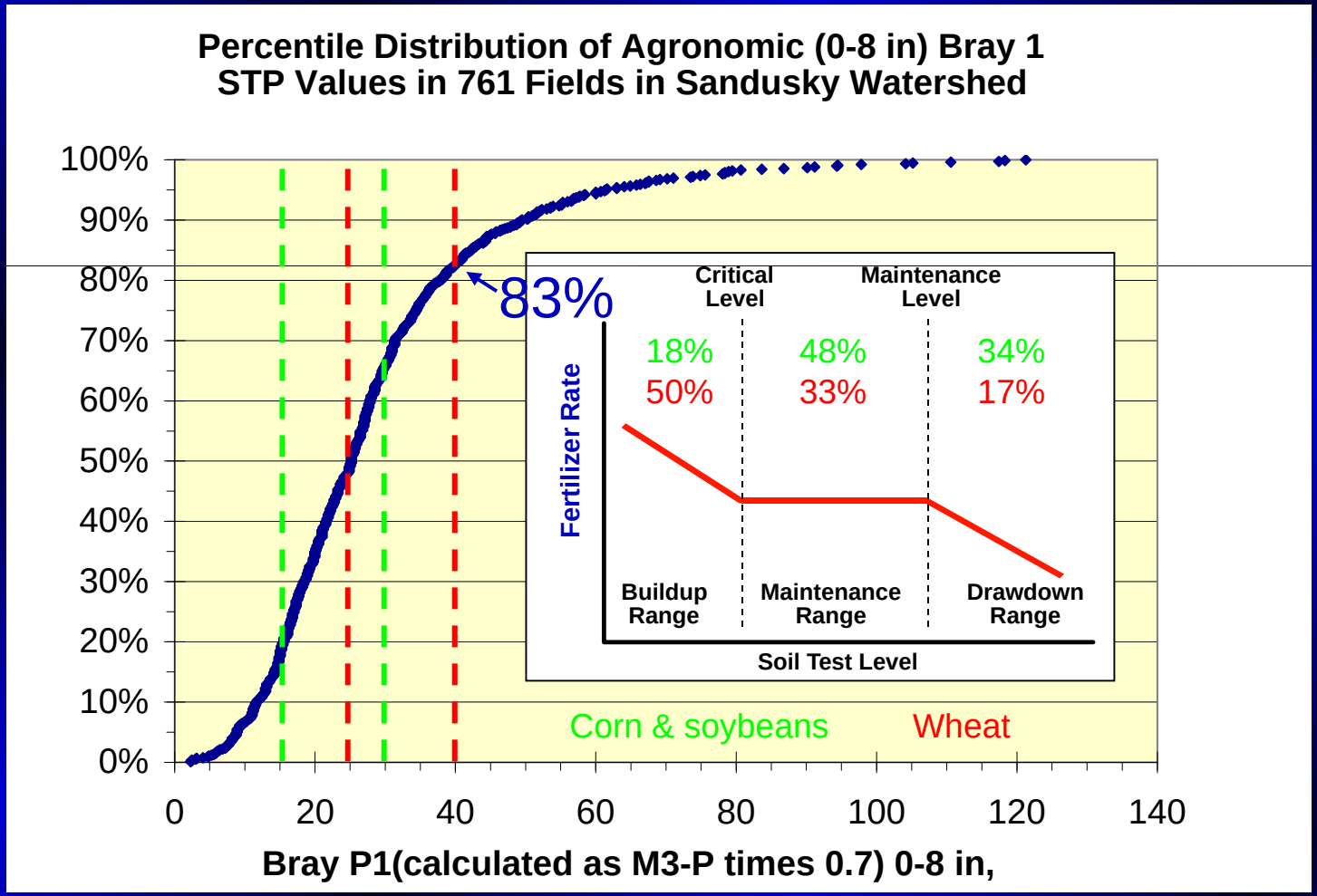
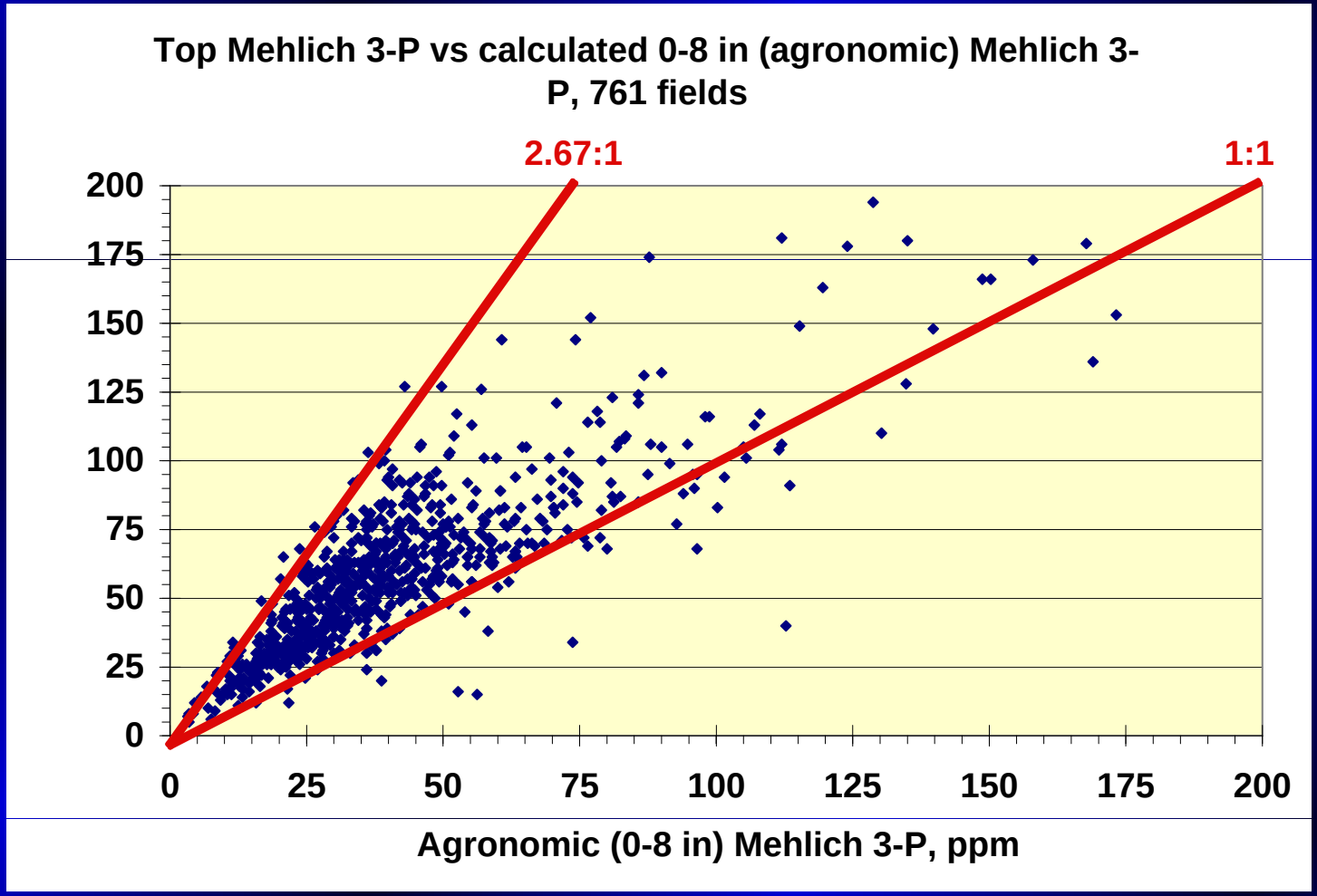
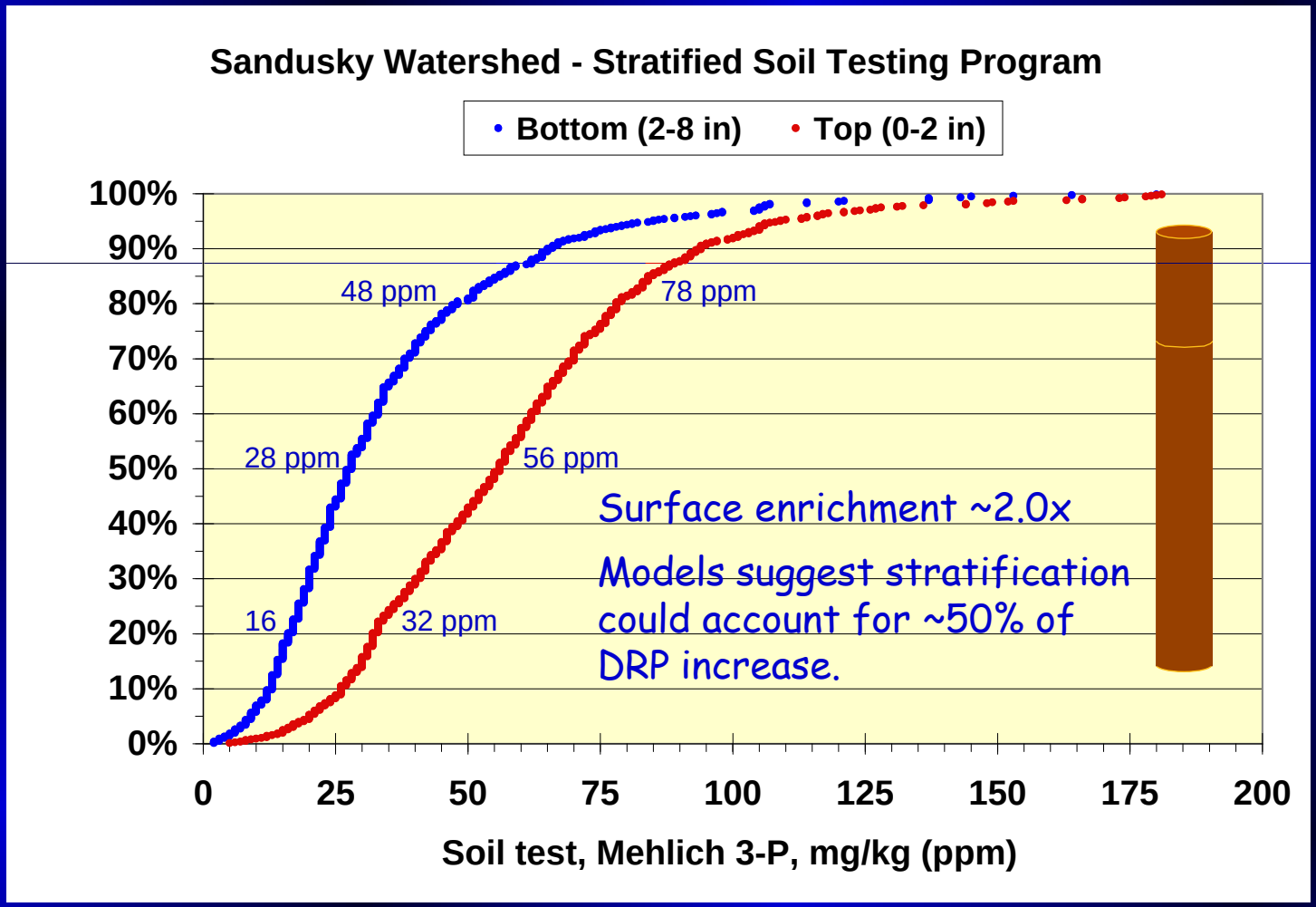


P stratification in soil



P stratification in soil

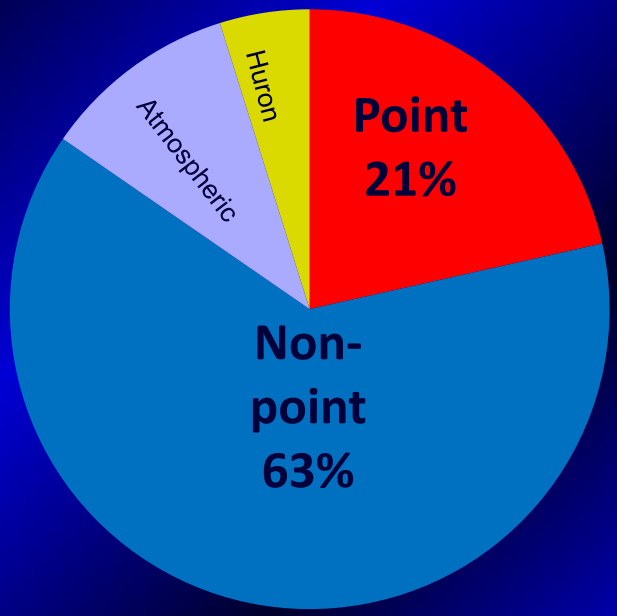


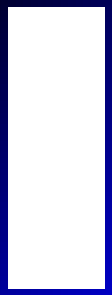
Other factors - fall application and weather

- Increasing trend to apply fertilizer/manure in fall/winter
- Often not incorporated
- Warmer winters => more rain, less snow and frozen ground => more P loss
- ≥50% of annual DRP load in three winter months

Where do we stand?

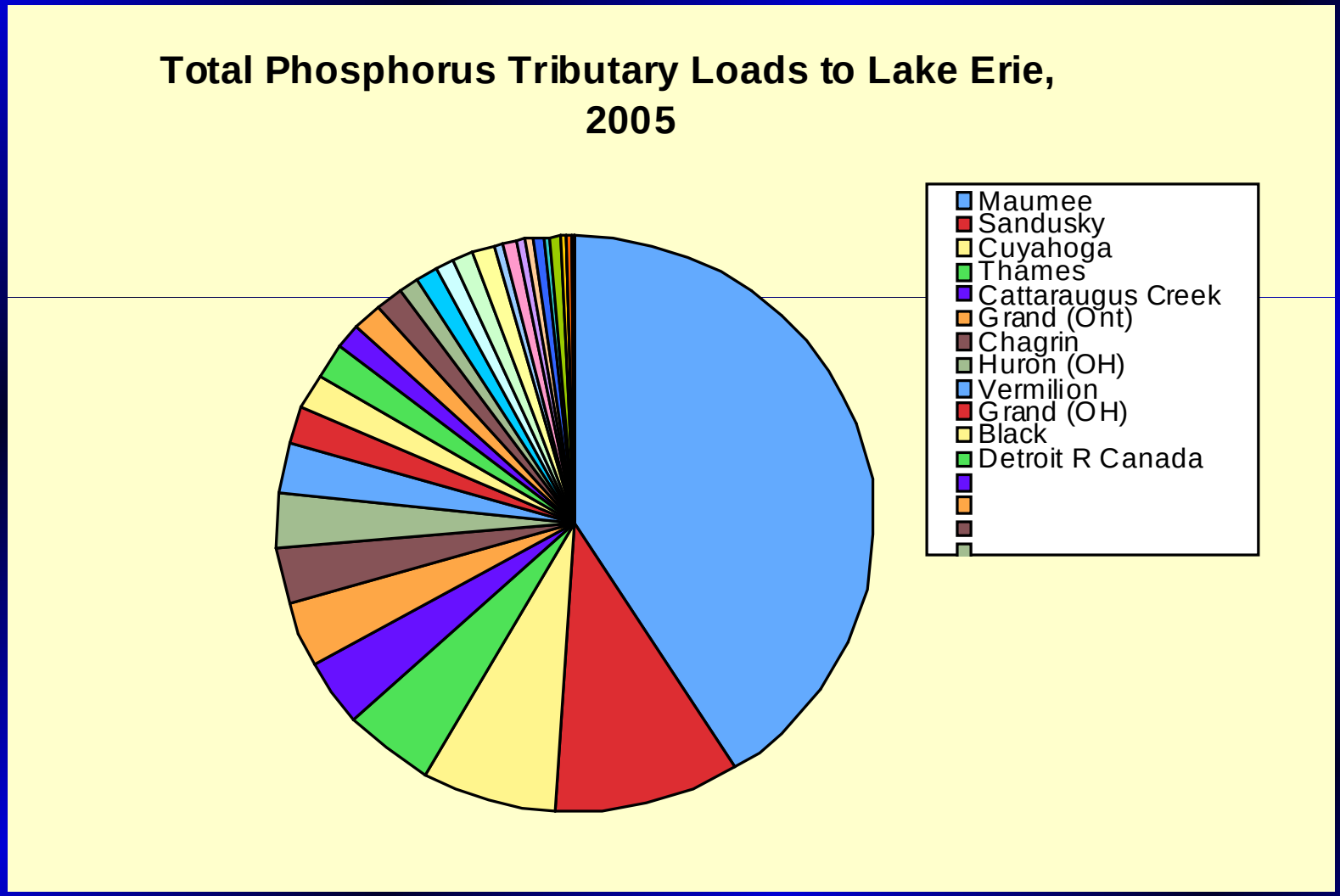
TP Loads to Lake Erie, 1981-2007





Average Load 10,240 metric tons

Where do we stand?



Where do we stand?

Parameter	Average annual load, Maumee River, 2000-2007
Water	189 billion cubic feet 1.28 cubic miles!
Suspended solids	944,000 tons
Total Phosphorus	2,200 tons
Total Nitrogen	44,700 tons
Dissolved Reactive Phosphorus	523 tons
Nitrate Nitrogen	34,500 tons
Chloride	175,000 tons

Big numbers, but hard to comprehend!

Where do we stand?

Parameter	Average load per acre, Maumee River, 2000-2007
Water	13"
Suspended solids	470 lb/acre
Total Phosphorus	1.1 lb/acre
Total Nitrogen	22 lb/acre
Dissolved Reactive Phosphorus	0.26 lb/acre
Nitrate Nitrogen	17 lb/acre
Chloride	86 lb/acre

Phosphorus numbers not very large, but with 4,000,000 acres, it adds up!

What about Detroit?!!

- Detroit River load (incl. Detroit STP) is approximately equal to Maumee average annual load
- … but diluted by vast quantities of water
- … so concentrations are much lower

- The Detroit load should be reduced
- … it will help with the hypoxia problem,
- … but it won't help with the algae problem.

What can be done?

- Know fertility levels and don't over-apply
- Watch the weather and don't apply when rain is likely
- Consider precision application, linked to yield variation within field
- Fertilize in spring if possible
- Incorporate fertilizer/manure!
- Don't apply to frozen ground, especially on snow
- Consider winter cover crops

What else can be done?

- Improve sewage treatment, prevent CSOs
- Phosphorus-free lawn fertilizer or no fertilizer at all
- Phosphorus-free dishwasher detergent
- Find alternative to orthophosphorus for corrosion control in drinking water

Lost resources...

- Nutrient losses from Maumee River watershed, 2007:
  - P: 3,500 tons N: 29,600 tons
- Cost to replace them at 2008 prices:
  - P: $9,100,000 N: $57,500,000
- Cost per acre receiving fertilizer:
  - $62/acre

A look to the future

- The crystal ball is murky, but…
- Projected increased intensity of storms will lead to increased erosion with associated loss of soil and attached nutrients
- Projected warmer winters may increase winter rain and loss of surface-applied nutrients
- Things likely to get worse, not better

A resource for more:

Ohio Lake Erie Phosphorus Task Force Report

www.epa.ohio.gov


The End

Ag Retailers and Farmers Working to Improve Resource Management

Mark Adelsperger
Resource Management Specialist
IPM Institute of North America
419 294-8960
madelsperger@ipminstitute.org

Who is IPM ?

- IPM is a non-profit organization funded on this project by The Great Lakes Protection Fund.
- Our task is to research how we can better build partnerships between SWCDs/NRCS, Ag Retailers and growers to create positive results in Nutrient Management Planning and implementation efforts.

Improvements needed

- In the Great Lakes Basin, 2.8 million acres, or 19% of cropland, are in great need of practices to reduce nutrient and sediment losses.
- An additional 5 million acres have a moderate level of need.
- Lost soil and nutrients – loss of $$ for farmers and threat of regulations if not resolved.

Ag Retail Has Solutions!

- Retailers have relationships with every farmer.
- Retailers have products and services that help:
  - Cover crop seed
  - Soil sampling and nutrient management planning
  - Grid sampling and precision application
  - Custom application of nutrients close to crop need
  - Custom banded, incorporated application
- USDA Natural Resource Conservation Service (NRCS) and Soil & Water Conservation Districts can't do the job themselves.

Science-based Approach

- What are the products and services that can make a difference?
- How many acres do we need of each to solve the Western Lake Erie Basin challenge?
- Let's get it done! And document our ability to do this on a voluntary basis.

Your help needed!

- Both within and outside of the Sandusky.
- Contact Mark Adelsperger
  - 419 294-8960
  - madelsperger@ipminstitute.org
- Collaborators:
  - Farmers
  - Ag retailers
  - Heidelberg University
  - Sandusky River Watershed Coalition
  - American Farmland Trust
  - IPM Institute of North America

Lake Erie Watershed Crop Nutrient Retailer's Meeting

Perrysburg, Ohio

29 February 2012

IPNI
INTERNATIONAL
PLANT NUTRITION
INSTITUTE

What do the 4Rs really mean?

Crop nutrient stewardship that reduces loss of dissolved phosphorus

Tom Bruulsema, PhD, CCA
Director, Northeast Region, North America Program

IPNI Mission

"to develop and promote scientific information about the responsible management of plant nutrition for the benefit of the human family."

- Agrium Inc.
- Arab Potash Company
- Belarusian Potash Company
- CF Industries Holdings, Inc.
- Great Salt Lake Minerals
- Incitec Pivot
- International Raw Materials LTD.
- Intrepid Potash, Inc.
- K+S KALI GmbH
- The Mosaic Company
- OCP S.A.
- PotashCorp
- Simplot
- Sinofert Holdings Limited
- SQM
- Uralkali
- Vale Fertilizantes S.A.

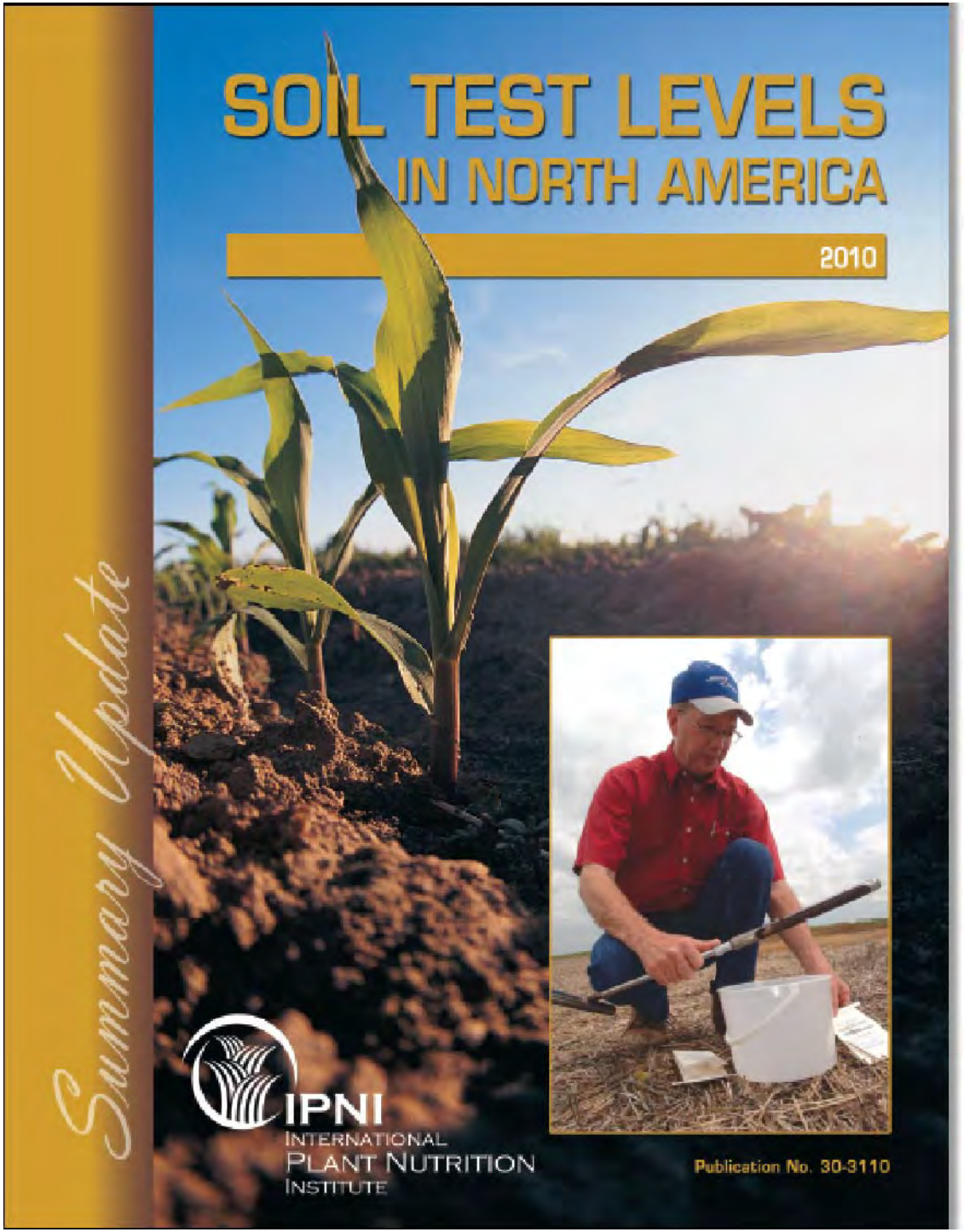
Affiliate Members

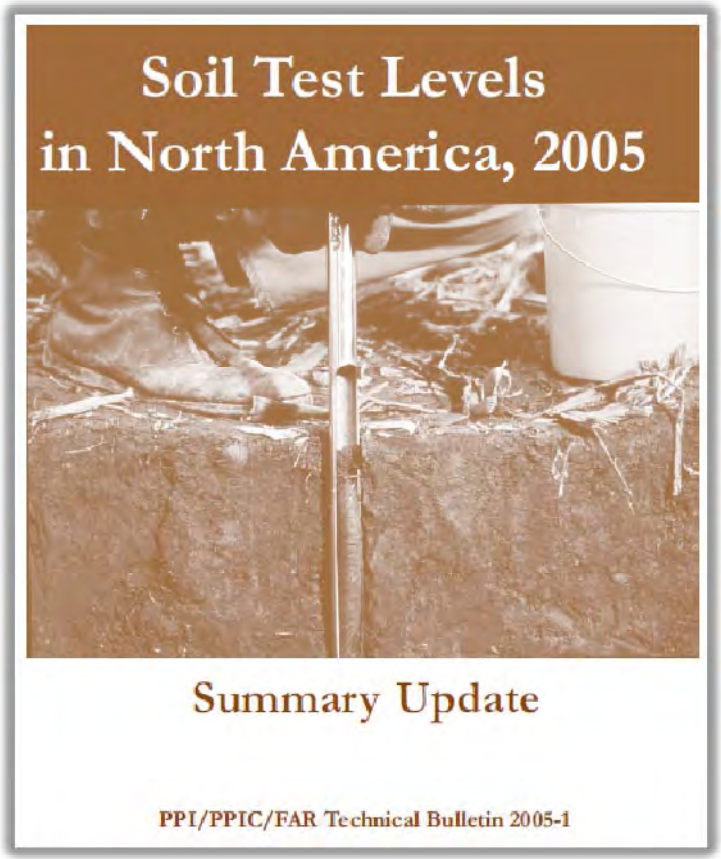
- Anda - Associação Nacional para Difusão de Adubos
- Arab Fertilizer Association (AFA)
- Canadian Fertilizer Institute (CFI)
- The Fertiliser Association of India
- International Fertilizer Industry Association (IFA)
- International Potash Institute (IPI)
- The Fertilizer Institute

Outline

- **Soil Test Summaries**
- **Crop Nutrient Balances**
- **4R Nutrient Stewardship**
  - Impact of source, rate, time, place on P loss
  - Tillage and placement tools
  - Putting P in the Right Place

Soil Test Summaries





IPNI

Soil test P distribution, 2001-2010

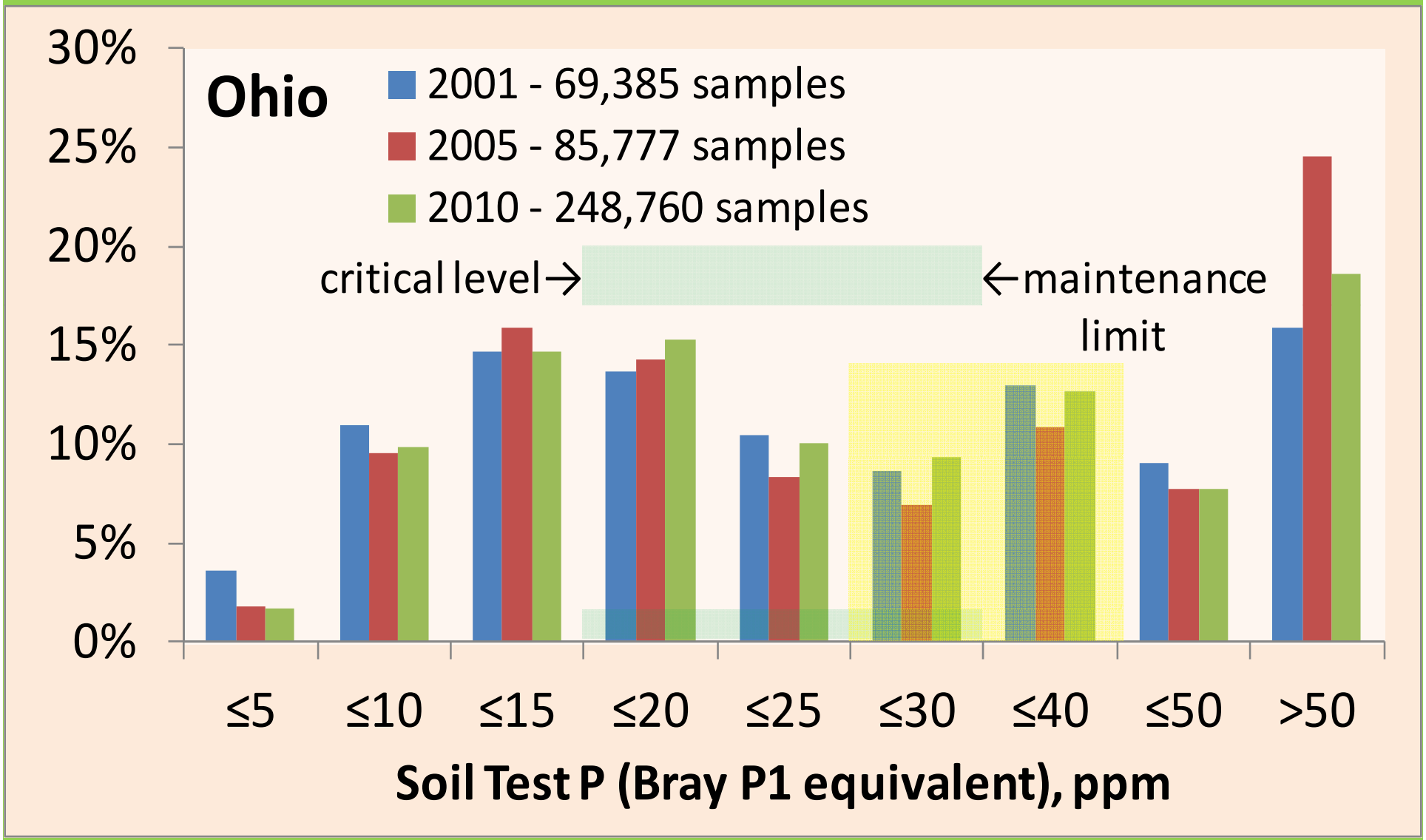
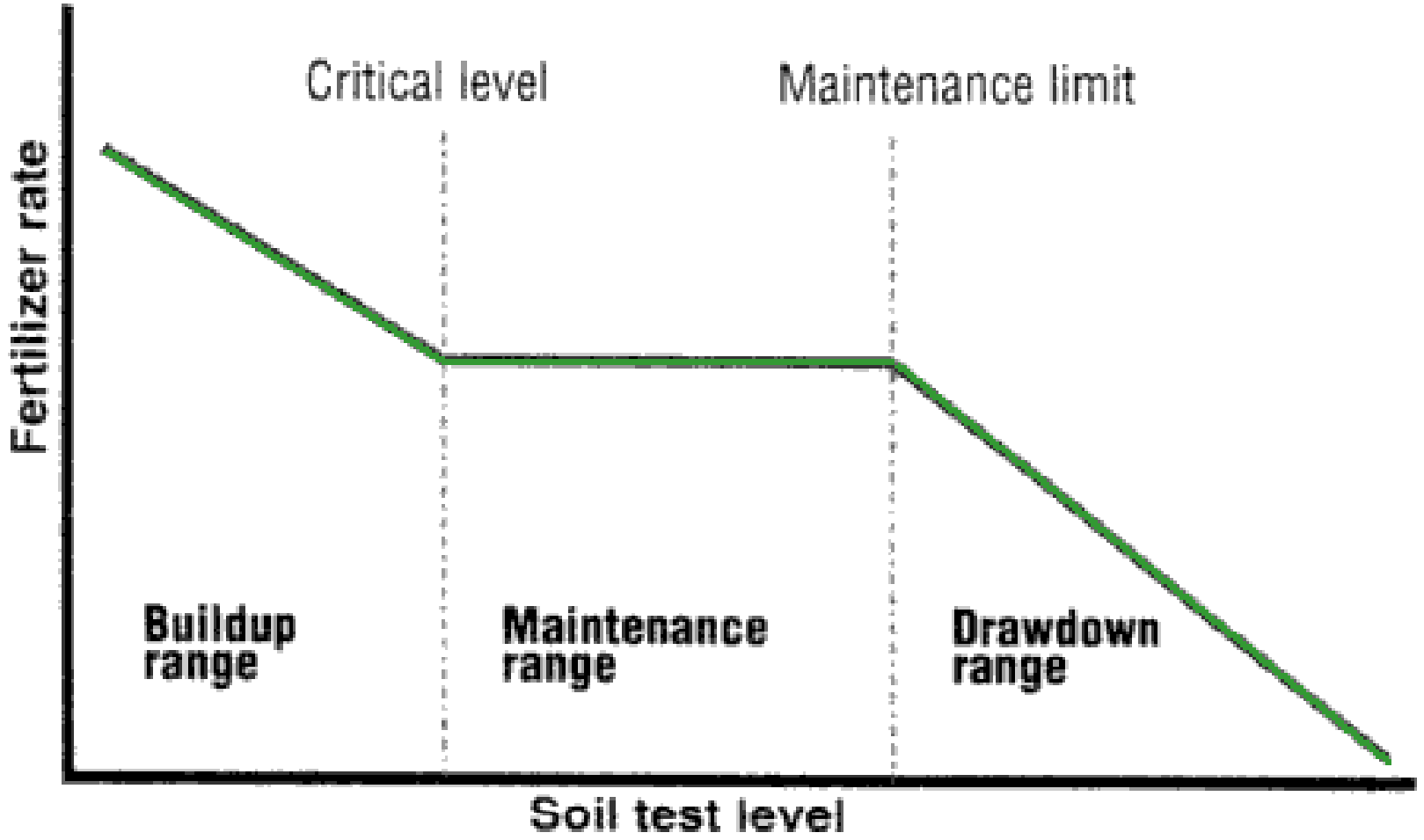
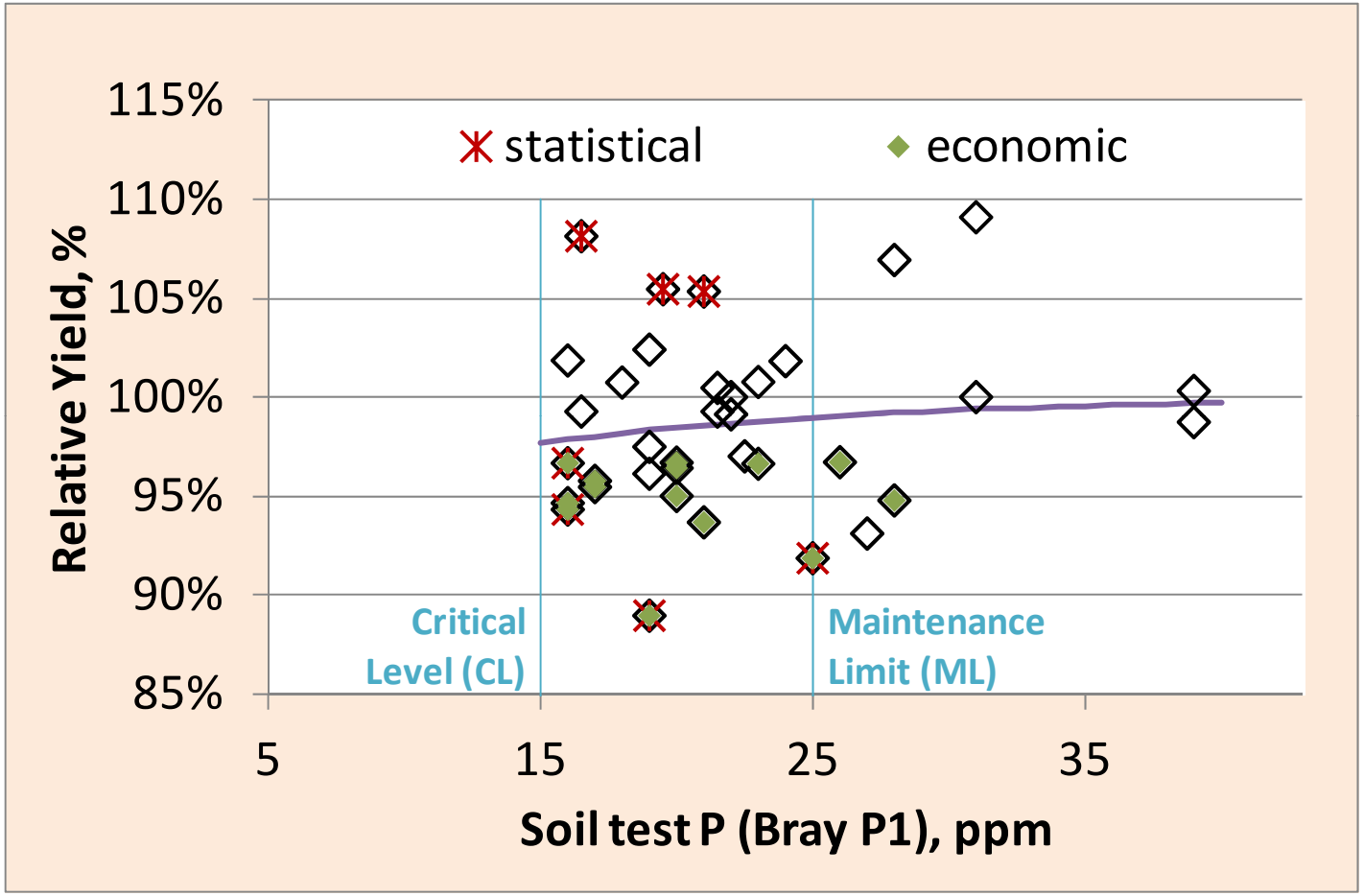


Figure 1

FERTILIZER RECOMMENDATION SCHEME USED IN THE TRI-STATE REGION



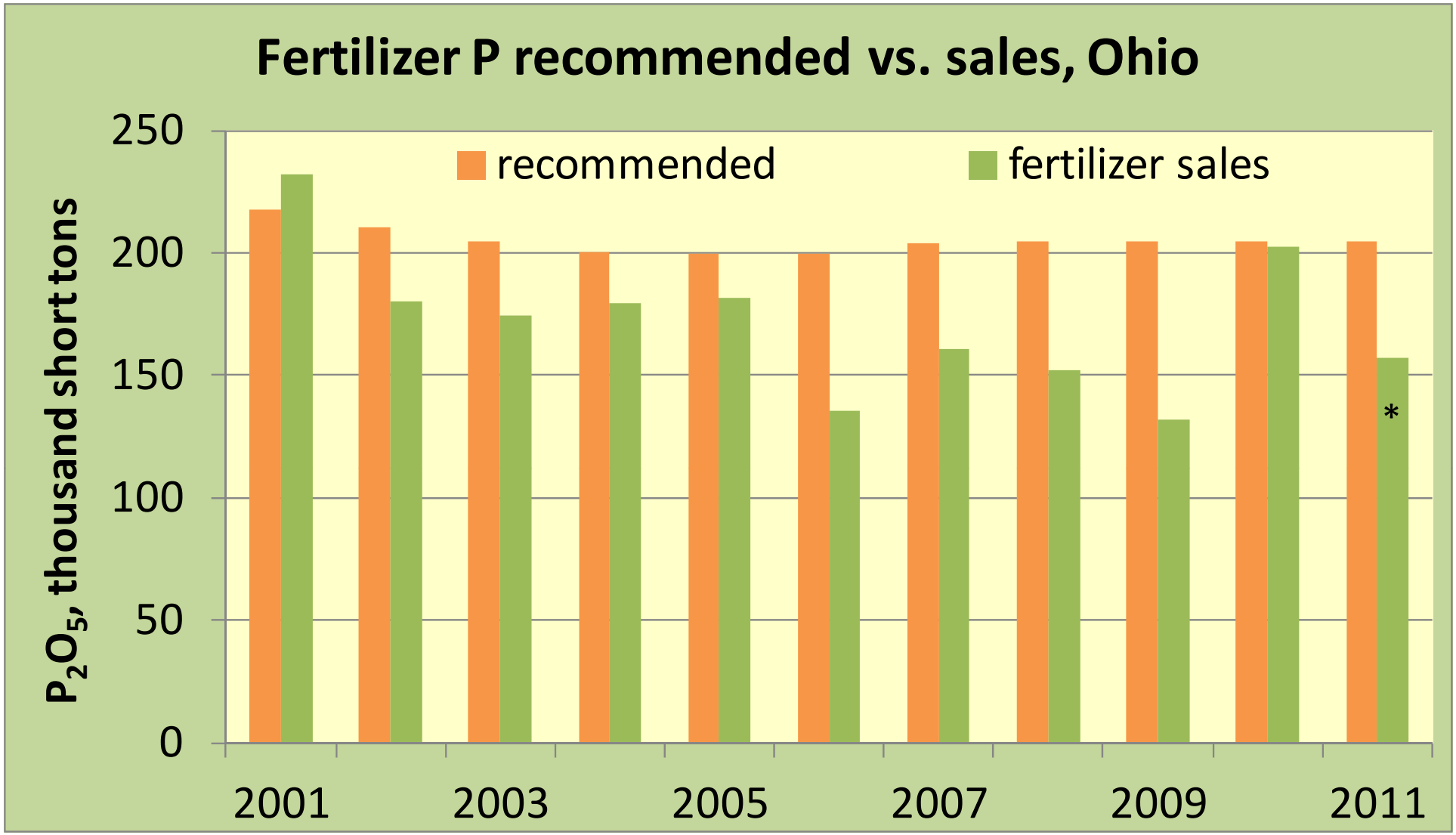
Soil test P calibration – Ohio (preliminary)



3 sites x 2 rotations x 6 years
CS and CCS rotations, 2006-2011
Fall broadcast fertilizer

Site	Average Yields, bu/A	
	Corn	Soybean
East Badger Farm	168	50
Western RS	202	51
Northwest RS	126	54

Mullen, RW, EM Lentz, CE Dygert. 2012.



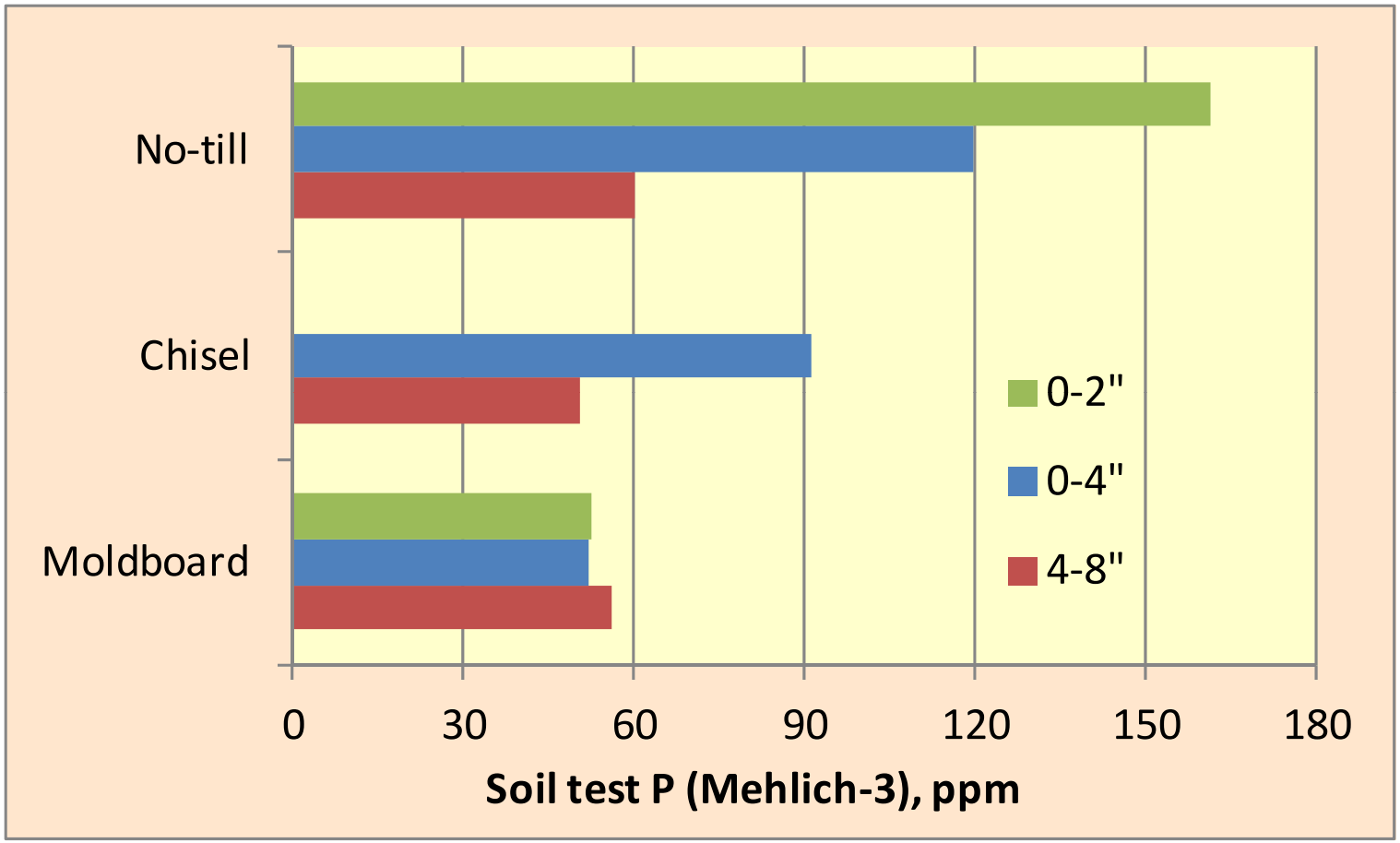
"recommended" includes amounts for corn, soybeans, cereals, forages (assuming half the lowest alfalfa rate), tobacco and sugarbeet, assuming soil test distribution in 3 categories: below, within and above the maintenance range.

"sales" are state total fertilizer (no manure); *2011 is estimated.

Soil Test Summary conclusions

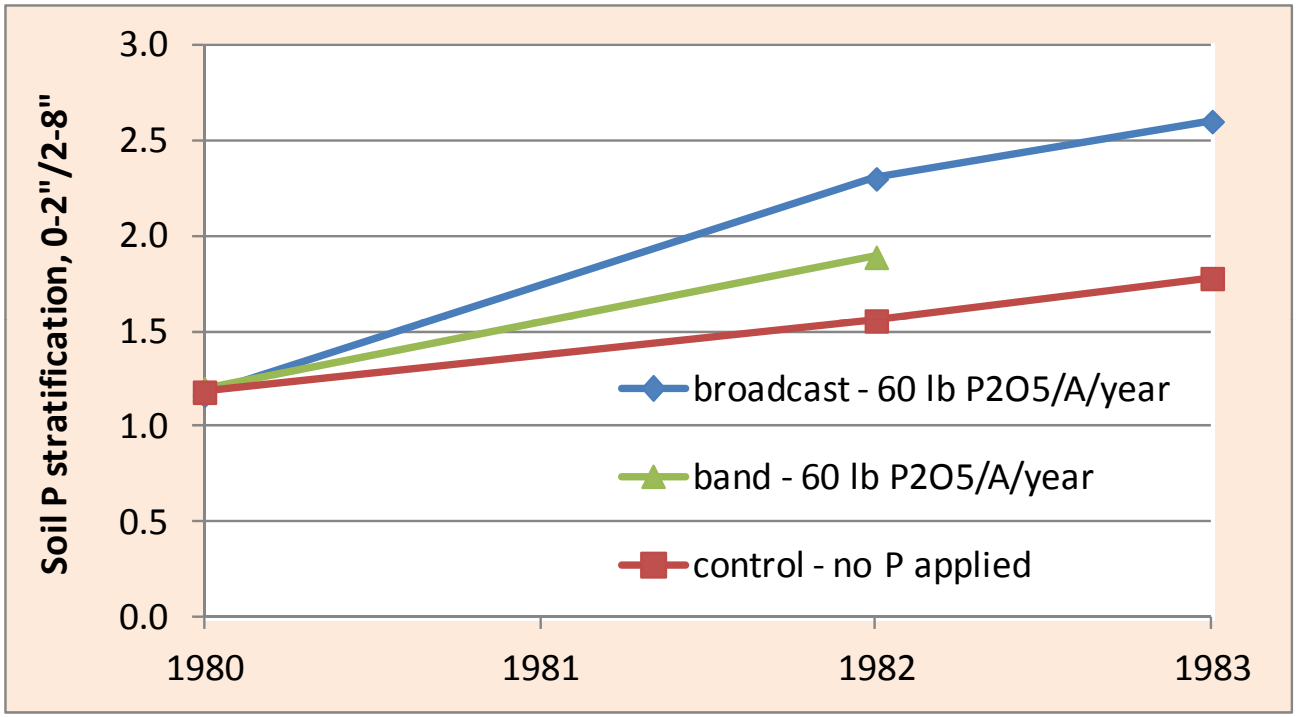
- Among states of the Northeast, Ohio has the smallest proportion of soils testing above the optimum range
- Since 2005 the proportion of soils testing over 50 ppm Bray P1 declined substantially.
- Fertilizer sales – *on average* – are not exceeding the amounts required to meet tri-state P recommendations
- Recent results confirm adequacy of tri-state P recommendations for corn and soybeans.

Soil test P stratifies when moldboard plowing stops

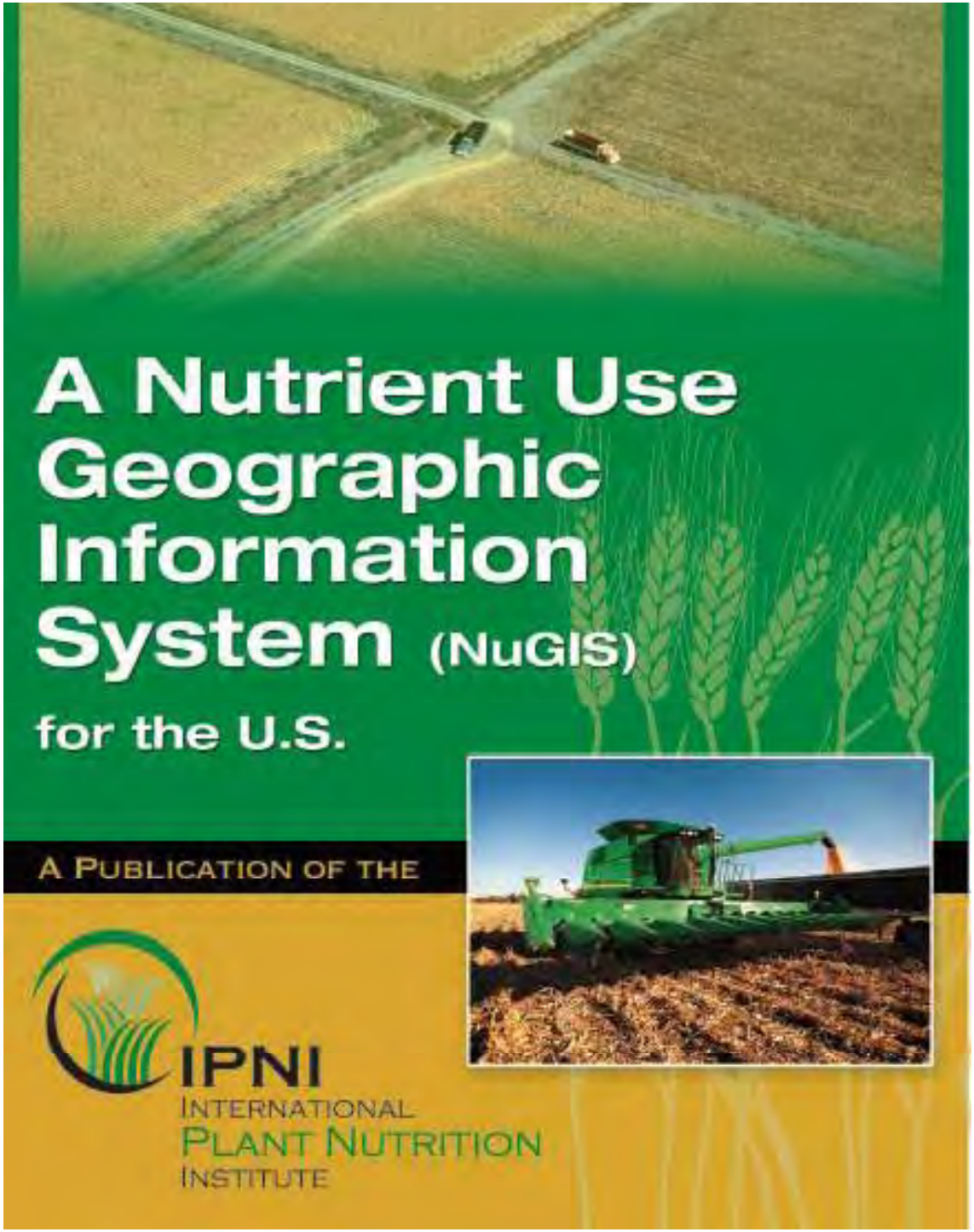


Soil test P distribution with depth in a long-term tillage experiment on a poorly drained Chalmers silty clay loam soil near West Lafayette, Indiana. Moldboard and chisel plots were plowed annually to a depth of 8”. Data from Gál (2005) and Vyn (2000).

Soil test P stratifies more with broadcast than with banding



Soil P stratification—the ratio of soil test P in the top 2” compared to that in the 2-8” depth—increased more with broadcast than with band application. Silt loam soil near Wooster, Ohio; continuous corn, no-till from spring 1980. Data from Eckert and Johnson (1985).



Crop Nutrient Balances

P in Lake Erie drainage basin

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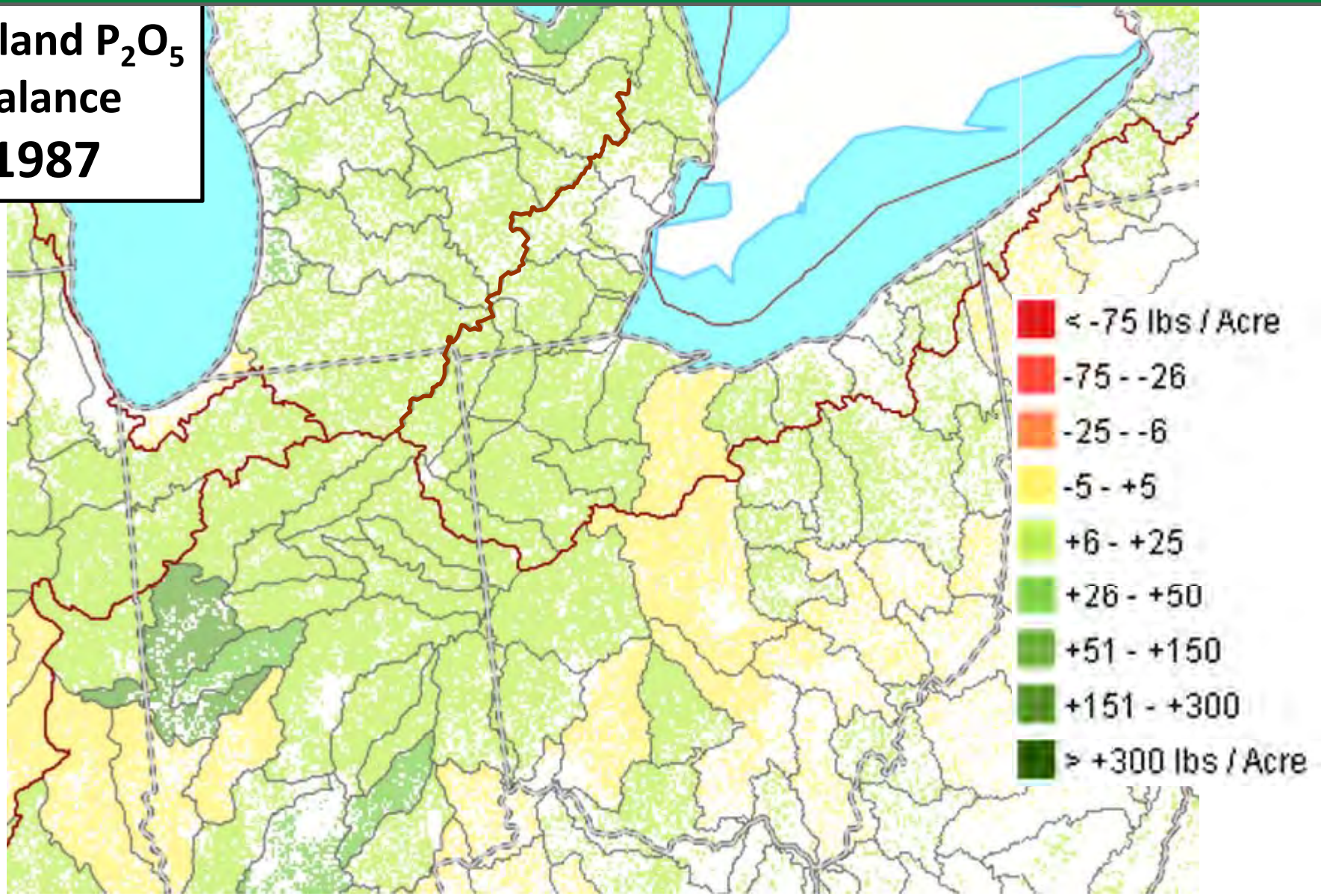
NuGIS

Nutrient Use Geographic Information System

Home | About NuGIS | Documentation | Source & Output Data | Map Gallery | Interactive Map | Weblinks | Logout

Cropland P_2O_5 Balance 1987



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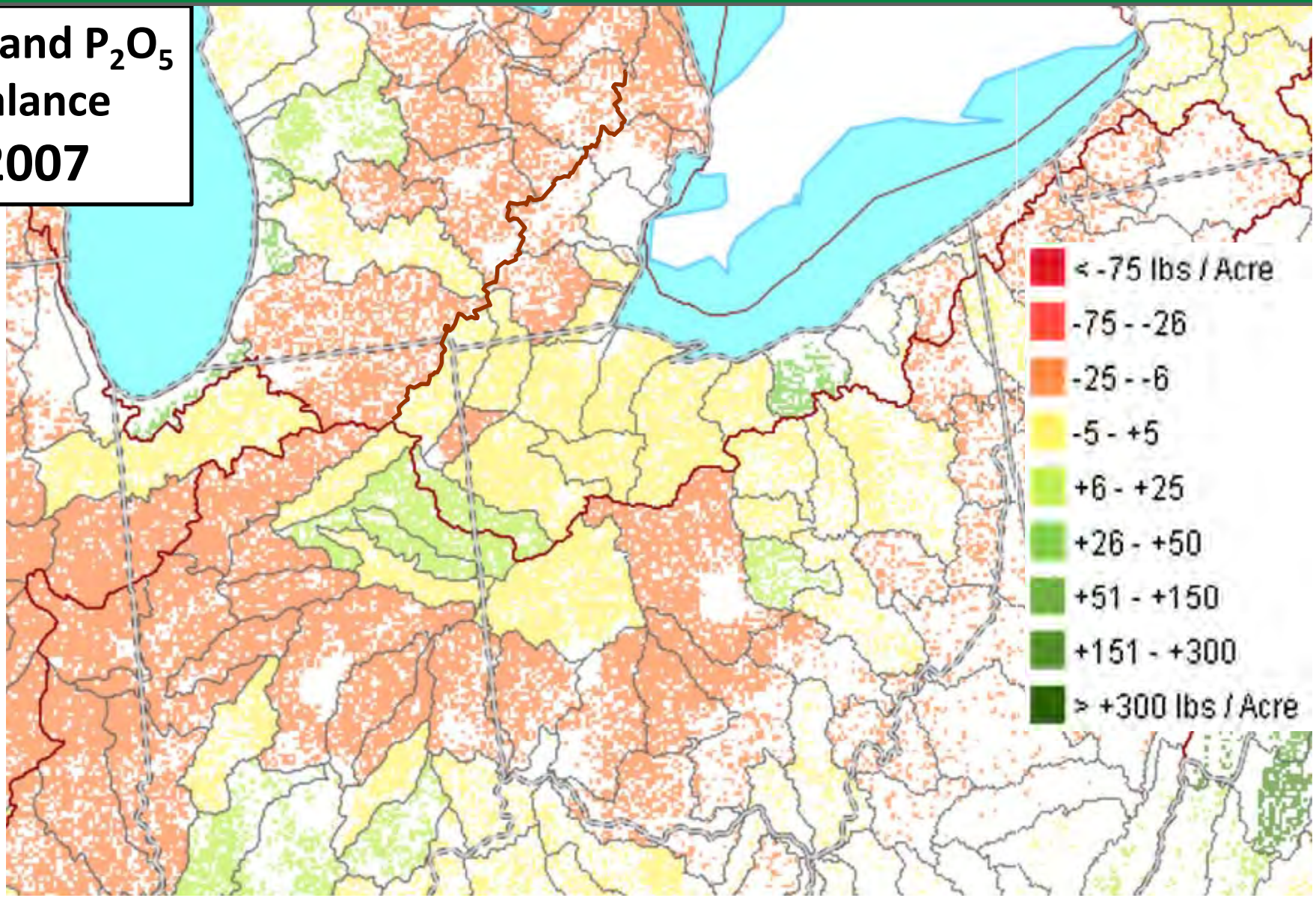
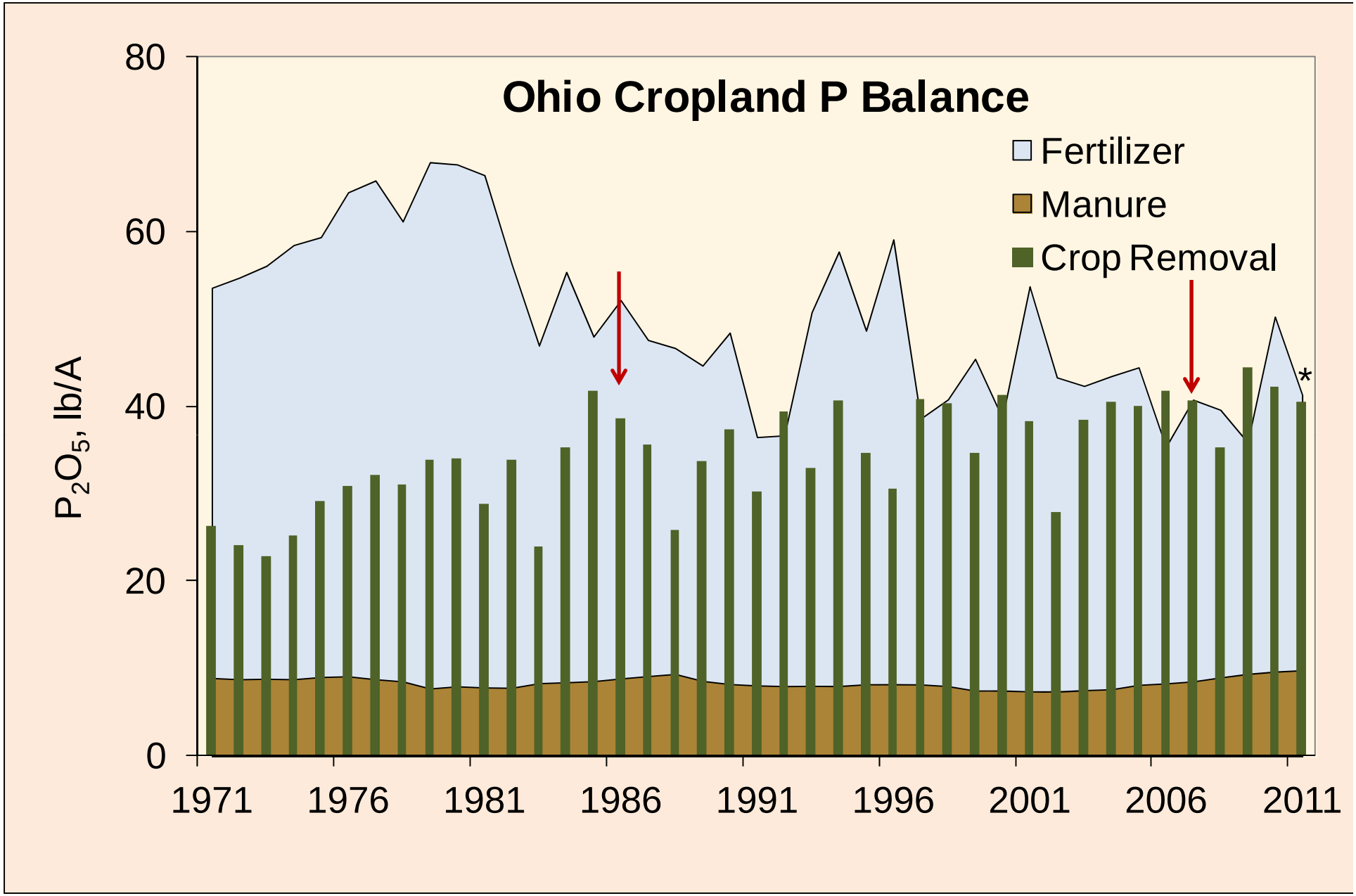
Cropland P_2O_5 Balance 2007





*Assumes fertilizer sales for 2011 = average of previous 5 years

Can J Soil Sci 91: 437–442.

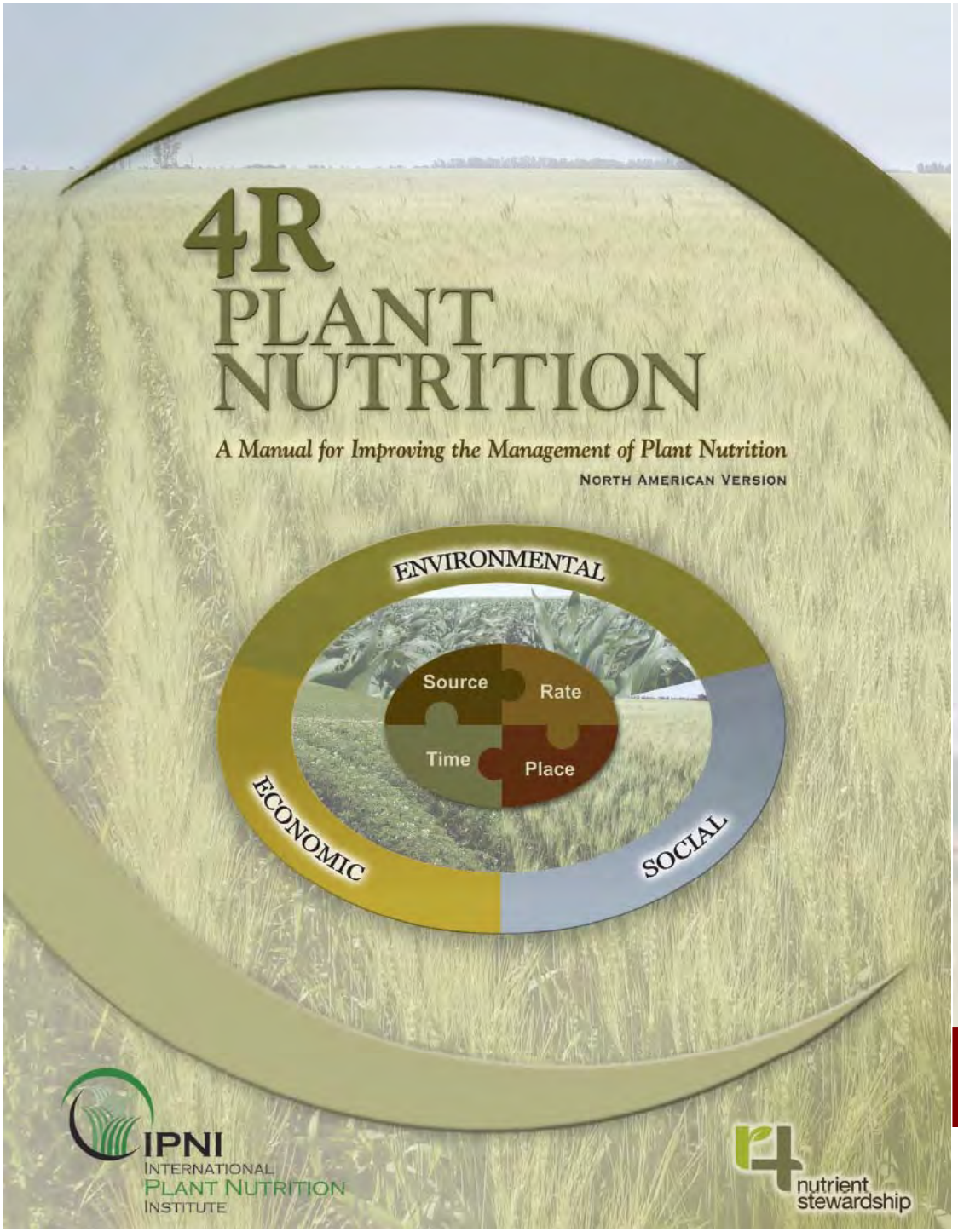
Crop Nutrient Balance conclusions

- Phosphorus surpluses of the past have trended toward balance.
- Increasing crop yields and decreasing manure P means that deficits are possible in the future

Scale

- Farms are getting fewer and larger.
- The proportion of Ohio cropland in farms **over 1,000 acres** in size:
- **12% in 1978**
- **25% in 1992**
- **35% in 2007**
- Is this a reason for less banding and more broadcasting?

(calculated from Census of Agriculture statistics)

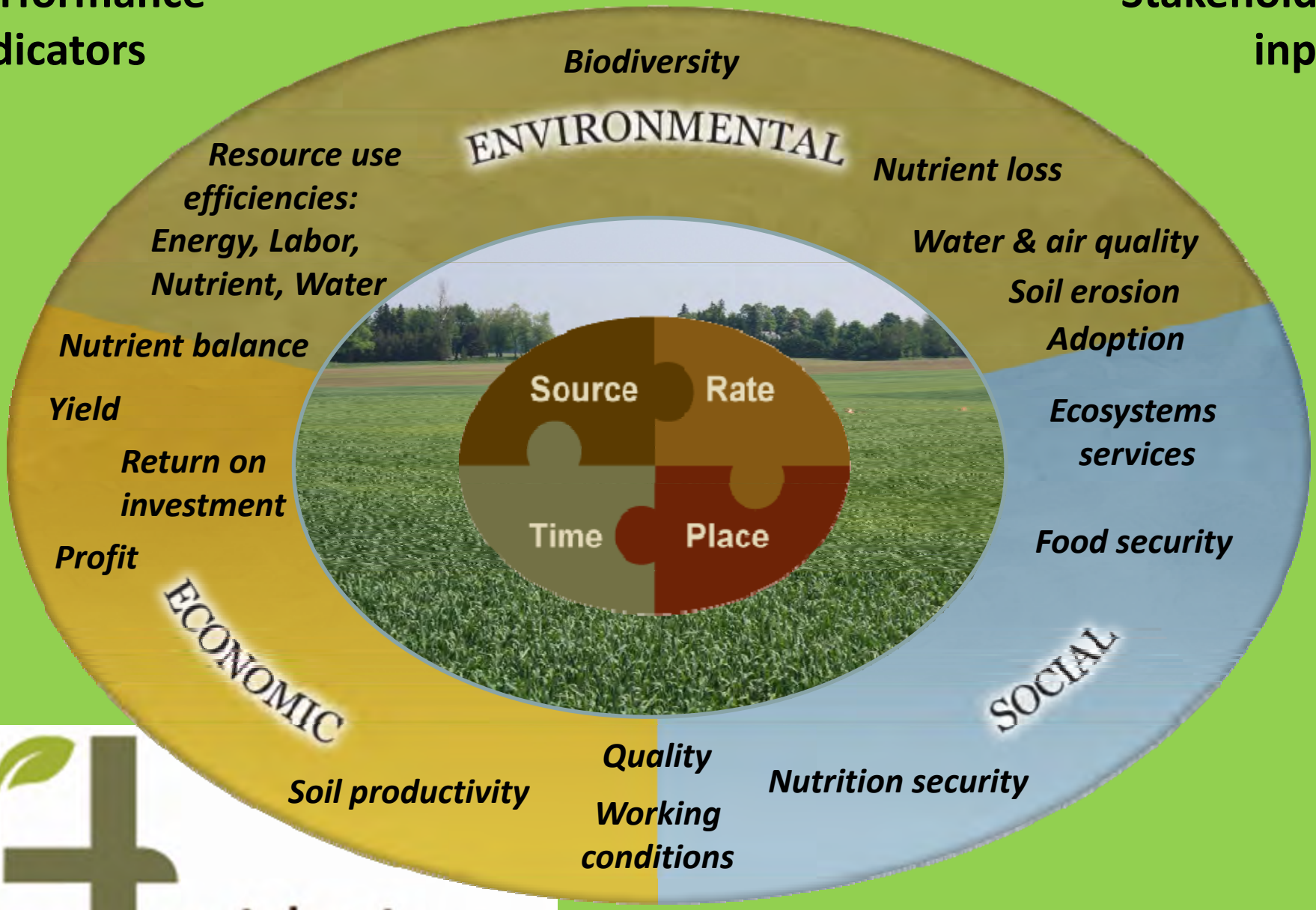


http://www.ipni.net/4r

IPNI

Performance indicators

Stakeholder input



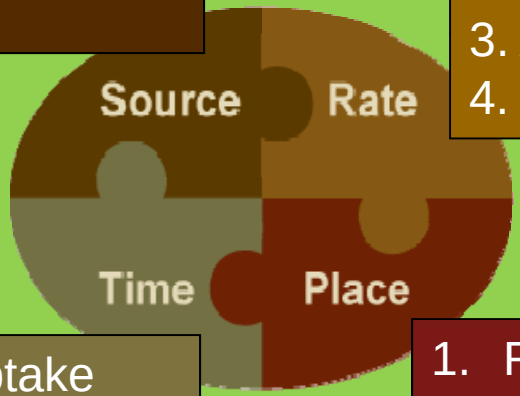
4 nutrient stewardship

IPNI

The basic scientific principles of managing crop nutrients are universal

1. Supply in plant available forms
2. Suit soil properties
3. Recognize synergisms among elements
4. Blend compatibility

1. Appropriately assess soil nutrient supply
2. Assess all available indigenous nutrient sources
3. Assess plant demand
4. Predict fertilizer use efficiency



1. Assess timing of crop uptake
2. Assess dynamics of soil nutrient supply
3. Recognize timing of weather factors
4. Evaluate logistics of operations

1. Recognize root-soil dynamics
2. Manage spatial variability
3. Fit needs of tillage system
4. Limit potential off-field transport

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Right Source

Scientific Principle:

- Ensure a balanced supply of each of the essential nutrients in plant-available form, utilizing all available sources.

Practices:

- Credit nutrients from manures and composts
- Credit N from previous crops
- Assess use of enhanced-efficiency sources

Right Rate

Scientific Principle:

- Assess soil nutrient supply and plant demand.

Practices:

- Soil test
- Balance crop removal
- Determine crop yield potential
- Assess price ratios

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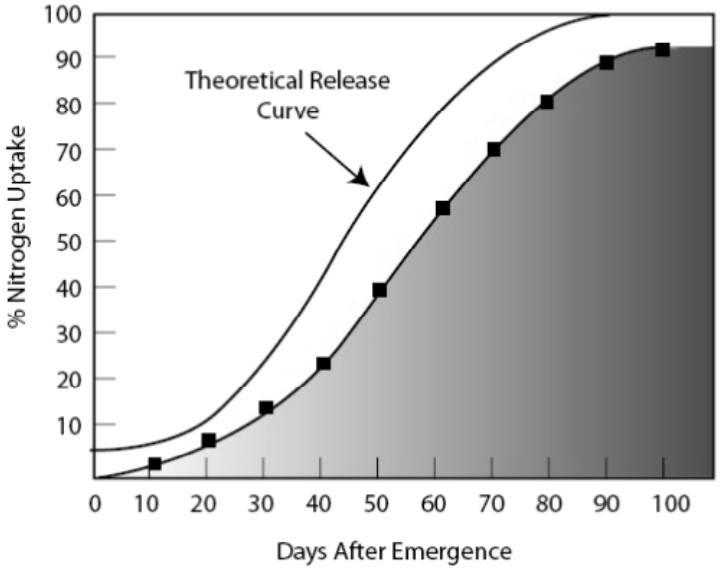
Right Time

Scientific Principle:

- Assess timing of crop uptake, soil nutrient supply, weather, loss risks and field operation logistics.

Practices:

- Split-application for sandy soils
- Scouting and tissue sampling
- Cover crops to capture nutrients
- Suit tillage and planting operations



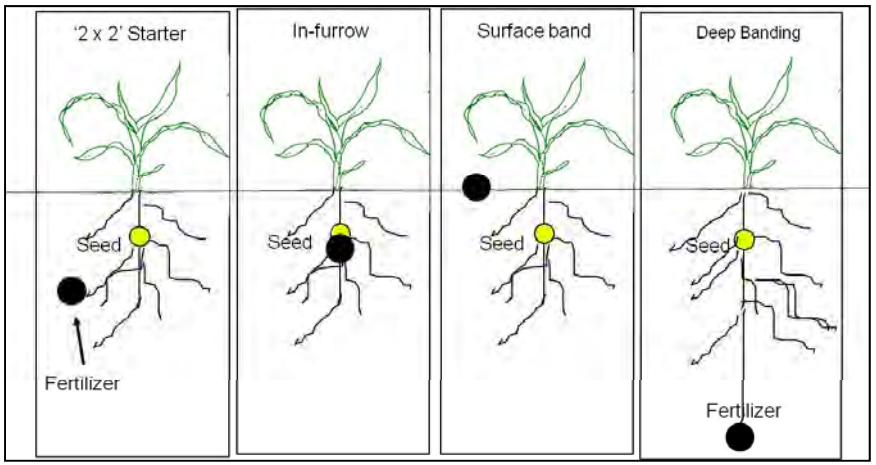
Right Place

Scientific Principle:

- Place nutrients where they are accessible to the crop.

Practices:

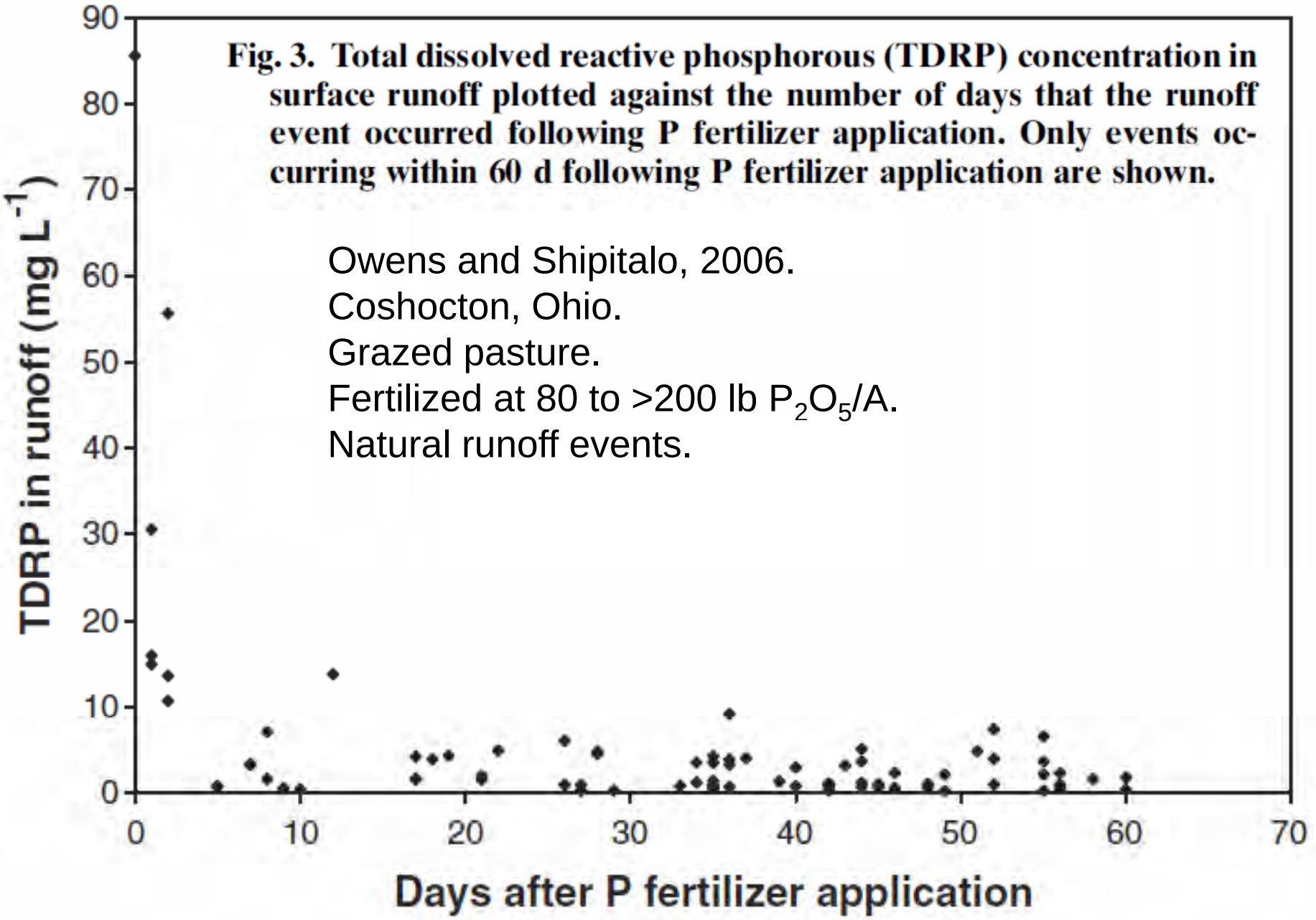
- Placement near seedlings
- Within-field management zones
- Apply soil survey information (drainage, etc.)
- Incorporate or inject



Applying 4R principles to P loss…

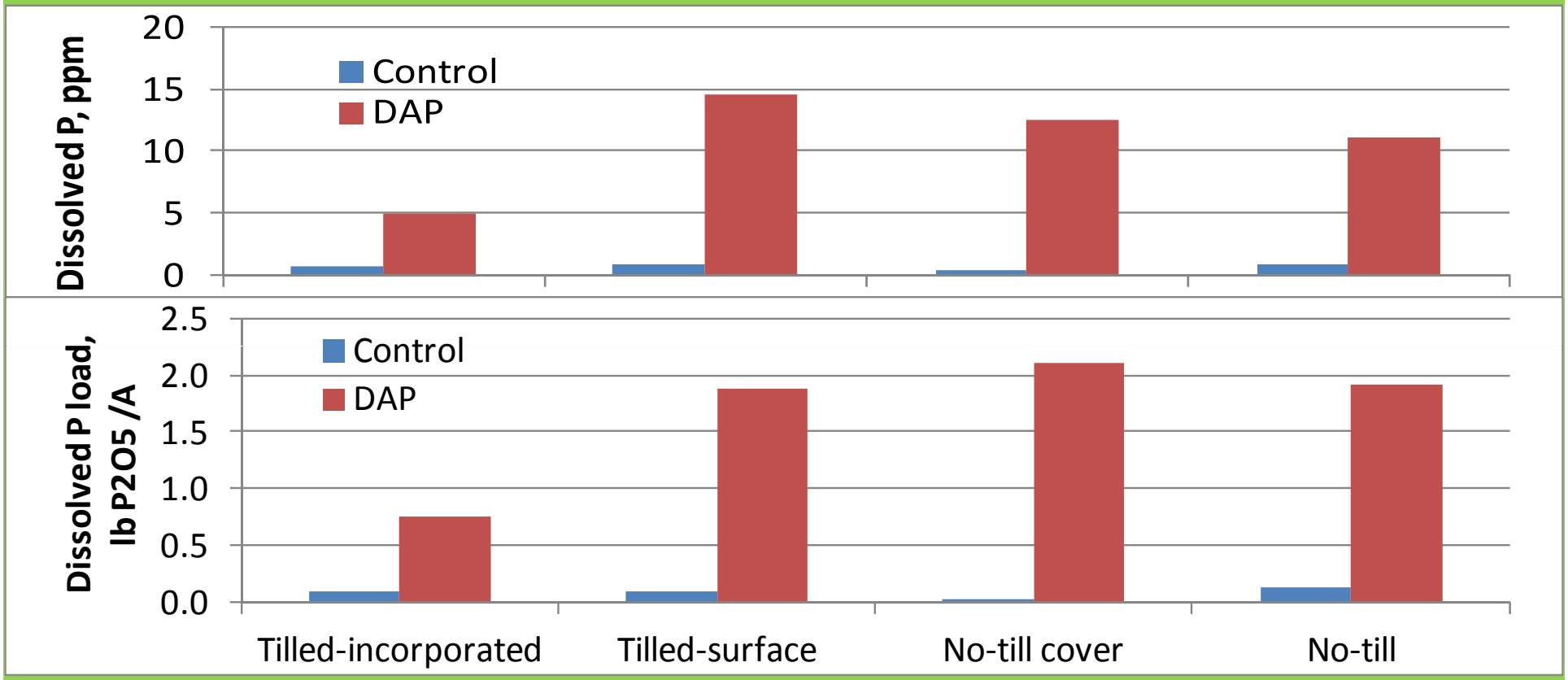
- The greatest volume of runoff (from surface or tile) likely comes from the flat, heavy clay soils.
- These are the soils with the fewest workable days, and thus where timeliness of planting is the most challenging.
- They are also the soils most likely to receive fall broadcast P, which may [often?] go unincorporated until spring.
- We need to think about viable source-rate-time-place alternatives for this situation, in combination with conservation tillage systems and soil stewardship that increases water infiltration, soil water holding capacity, thereby minimizing runoff.

IPNI



Owens and Shipitalo, 2006.
Coshocton, Ohio.
Grazed pasture.
Fertilized at 80 to >200 lb P_2O_5/A.
Natural runoff events.

Rainfall simulator study, NW Ohio, Nov 2009

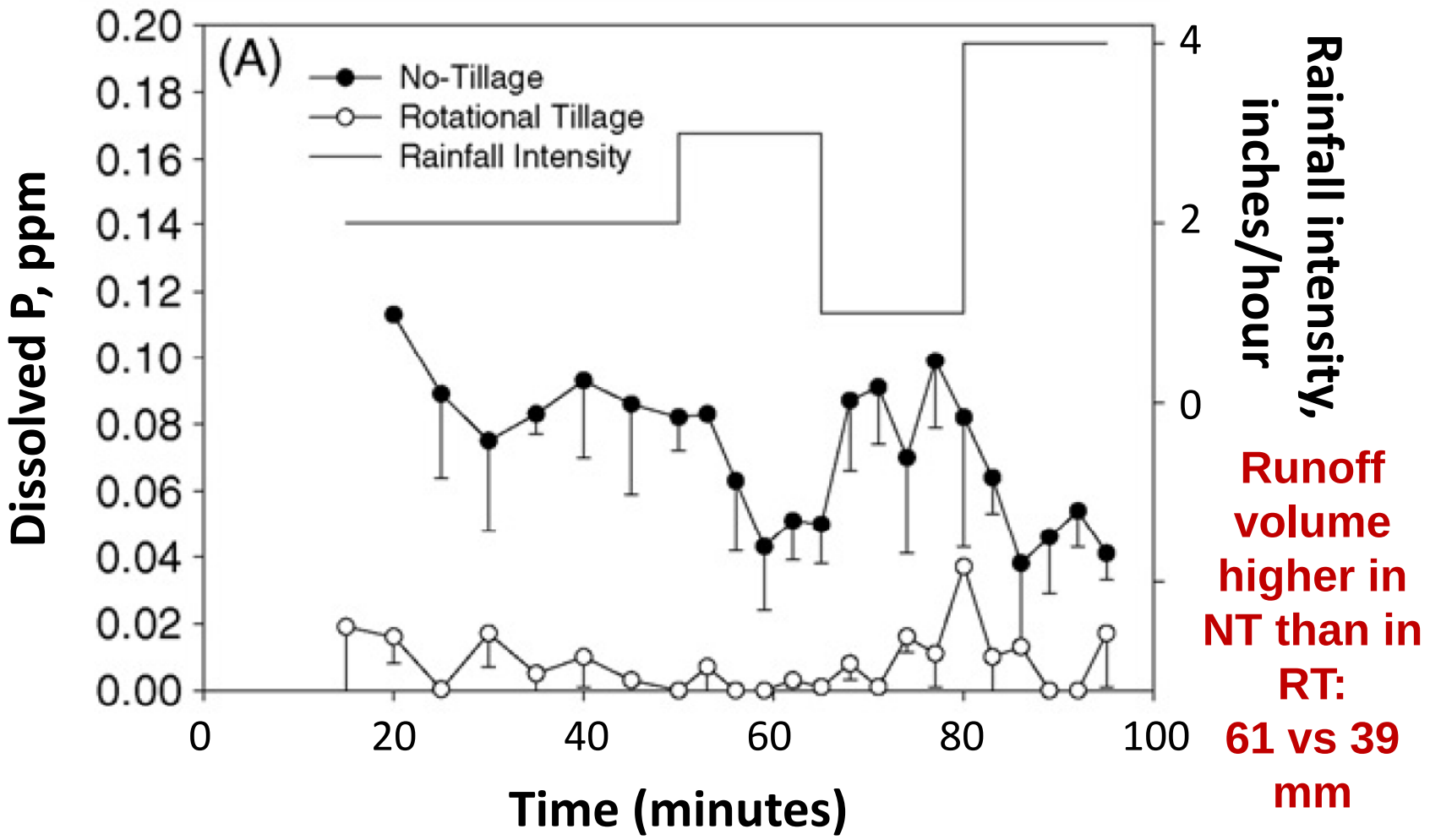


- **No-till >20 years; tillage = roto-tiller 4-6" deep**
- **P sources applied at 92 lb P_2O_5 per acre 7-12 days before rain**
- **Rain @ 2.4"/hour; first 30 minutes runoff**
- **Soil test P 40-50 ppm 0-2" and 11-13 ppm 0-8"**

Mullen and Dayton, 2011, unpublished

Rotational tillage & dissolved P – Waterloo, IN

before fertilizer application

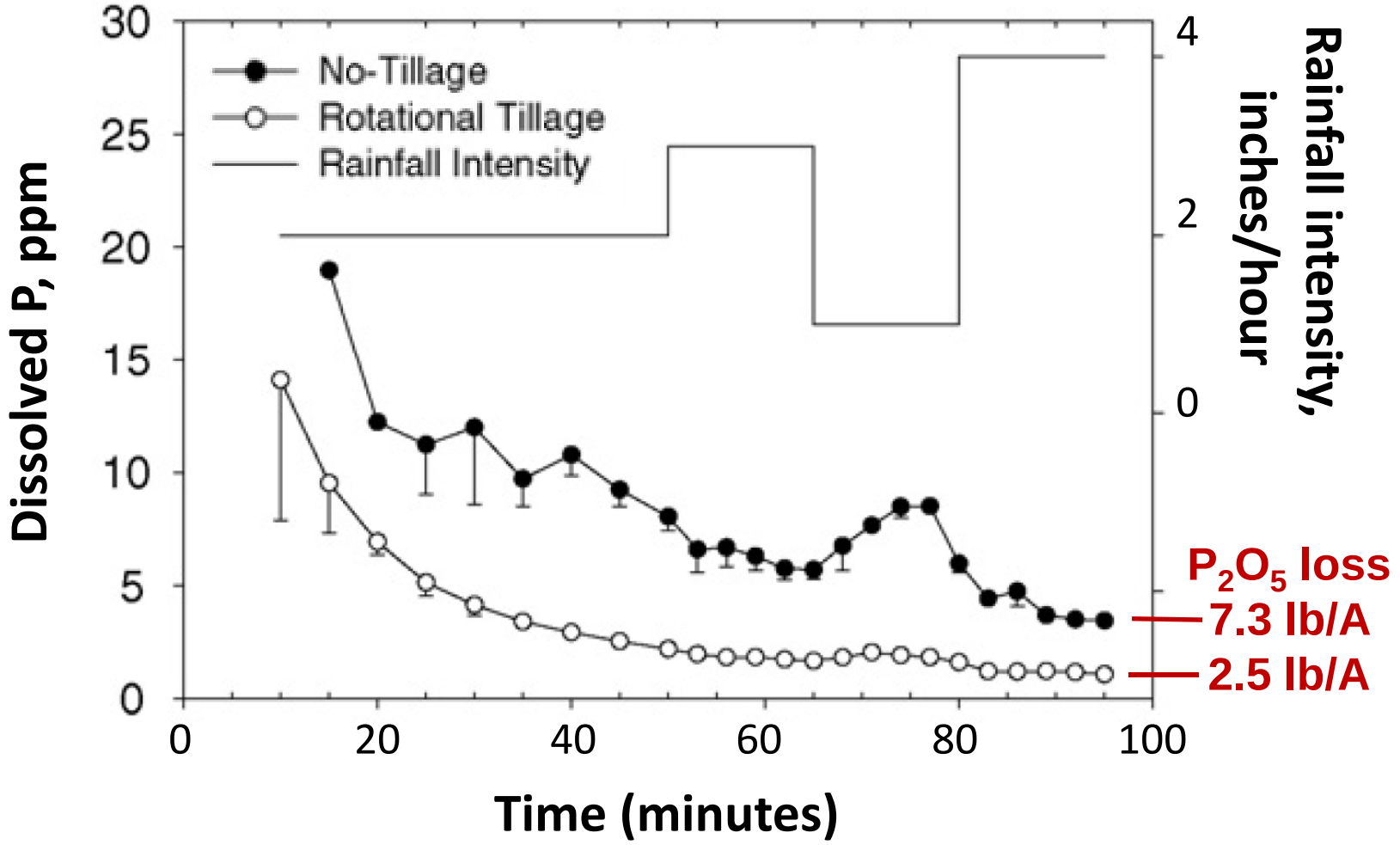


Runoff volume higher in NT than in RT: 61 vs 39 mm

15-year no-till sites, corn-soybean rotation. Tillage 12 April with "finisher" chisel plow to 6" depth. Residue cover 57% for NT and 20% for RT. Rainfall applied 22 June to 2 July. *Smith et al. 2007. Soil & Tillage Research 95:11–18*

Rotational tillage & dissolved P – Waterloo, IN

one day after 0-46-0 fertilizer surface applied @ 100 lb/A P_2O_5



15-year no-till sites, corn-soybean rotation. Tillage 12 April with "finisher" chisel plow to 6" depth. Residue cover 57% for NT and 20% for RT. Rainfall applied 22 June to 2 July. *Smith et al. 2007. Soil & Tillage Research 95:11–18*

Fertilizer and crop rotation influence dissolved P loss – Woodslee, Ontario

Crop	Surface runoff loss		Tile Drainage Water	
	Dissolved P loss, lb P_2O_5/A		Dissolved P, ppm	
Fertilizer:	Zero	NPK	Zero	NPK
Continuous corn	0.2	0.7	0.04	0.14
Rotation C-O-A-A	0.2	2.1	0.05	0.43
Bluegrass sod	0.3	6.7	0.05	1.10

- Plots established 1959. Data from 1980-81 (two-year average)
  Culley et al. 1983. J. Environ. Qual. 12:493-498.
- Poorly drained Brookston clay soil (similar to Hoytville soil in MI, IN, OH).
- NPK includes ~60 lb P_2O_5/A annually.
- >50% of the total P load through tiles; one-third particulate.
- Sod has ⅓ to ½ the runoff and 70% of the tile discharge of continuous corn.
- Similar DP results in tile drainage monitored 2001-2003 (*TQ Zhang, 2012*).
- 2002 Soil P levels (Olsen) <10 ppm with zero fertilizer;
  ~60, ~90, ~ 110 on CC, RC, sod, respectivley, with NPK.

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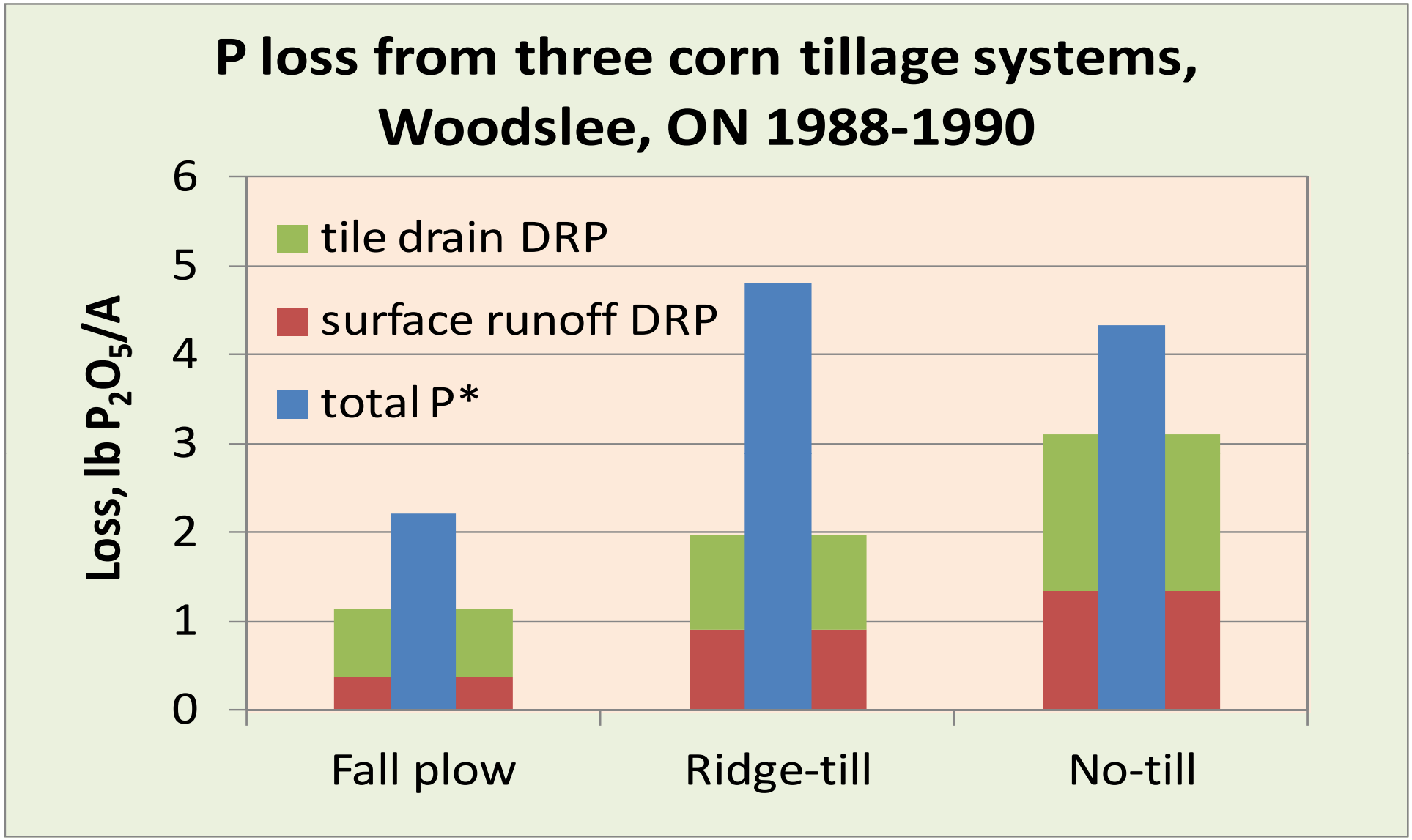
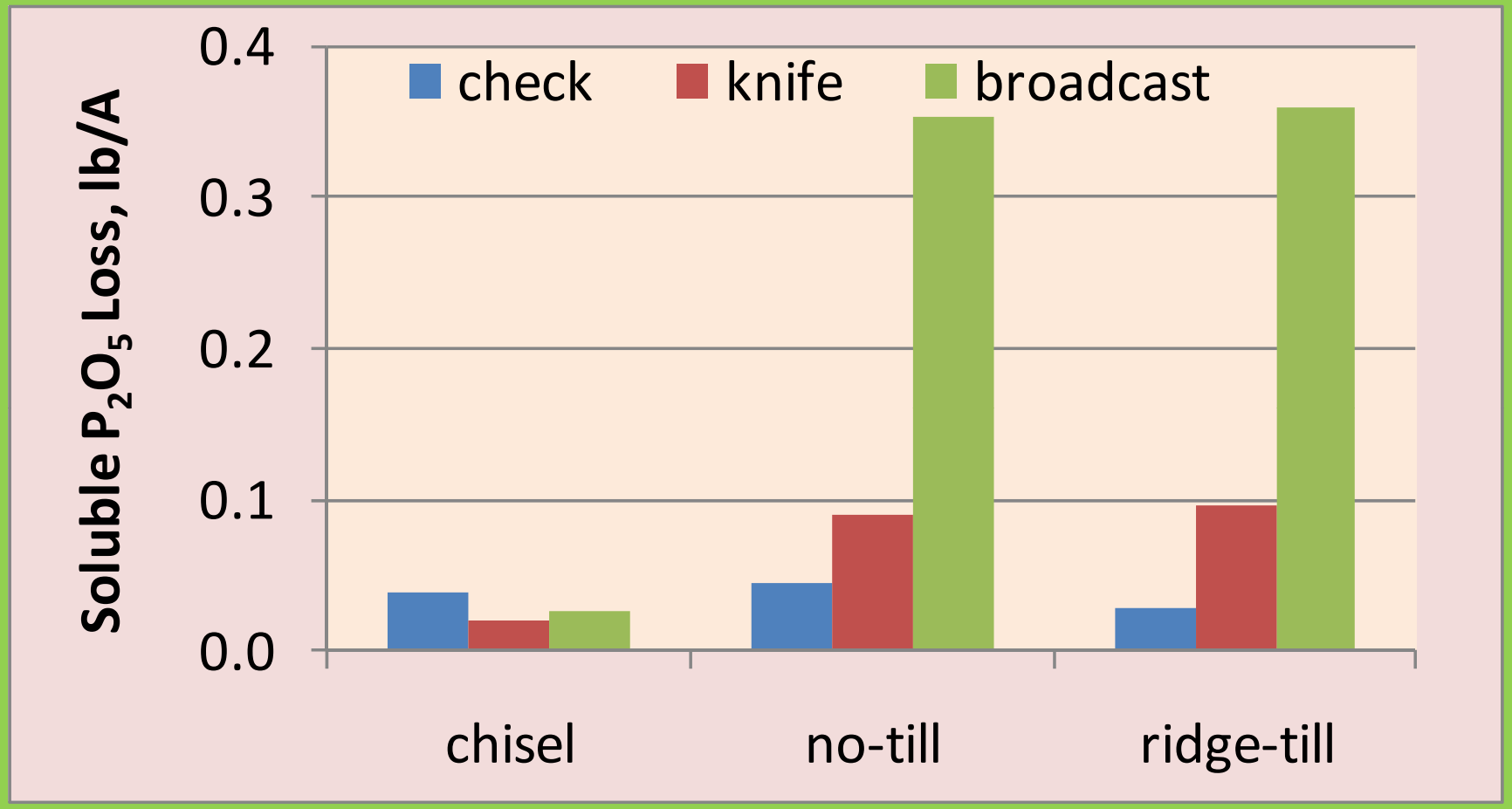


Continuous corn; Brookston clay loam; 3-year average
No-till had 40% more surface runoff water, 20% less tile drain water than plow
*estimated from 1990 data only
Gaynor and Findlay, 1995

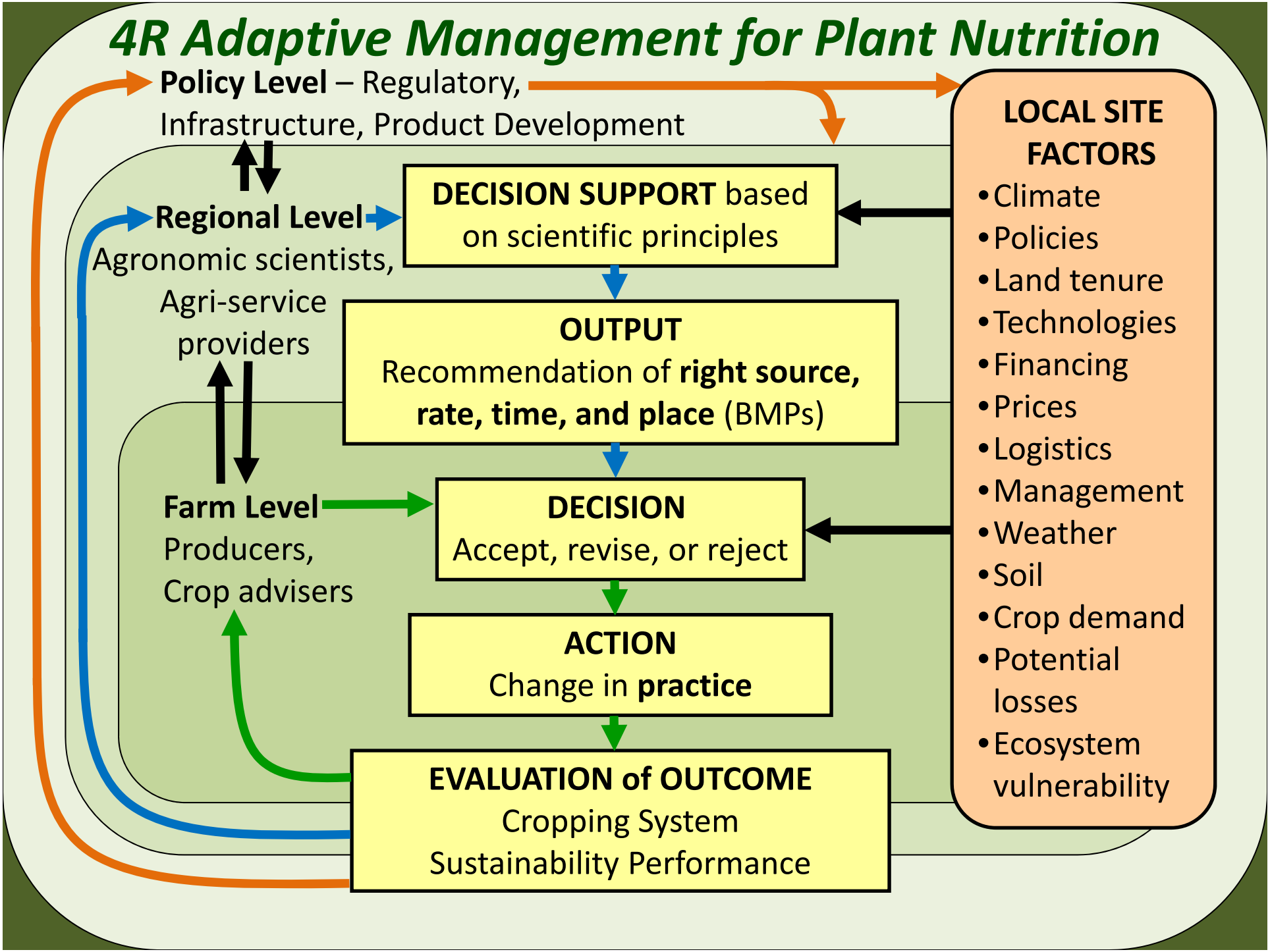
Fluid P – knifed-in versus broadcast



Annual runoff P losses as affected by tillage x placement in sorghum – soybean rotation. East-central Kansas.
Fluid applied @ 50 lb P_2O_5/A.

Kimmel et al. 2001. J. Environ. Qual. 30:1324-1330

Practice	Advantages	Limitations
S – MAP or DAP R – rotation removal T – fall P – broadcast	Minimal soil compaction if weather allows Allows timely planting in spring Lowest-cost fertilizer form Low cost of application	Risk of elevated P in runoff in late fall and winter Long time to react with soil: may reduce availability to crop Low N and P use efficiency
S – MAP or DAP R – rotation removal T – spring P – broadcast	Minimal soil compaction if weather allows Better N use efficiency	Risk of elevated P in spring runoff before incorporation Potential to delay planting Retailer spring delivery capacity
S – MAP or 10-34-0 R – one crop removal T – in planter P – 2” x 2” band	Lower risk of elevated P in runoff Most efficient use of N and P Less soil P stratification	Air carts? Fluid tanks? $ Wheat/soybean seeders? $ Potential to delay planting Retailer delivery capacity $ Cost of fluid versus granular $
S – MAP or DAP R – rotation removal T – fall P – banded in zone	Lower risk of elevated P in runoff Better N and P efficiency Maintain some residue cover Allows timely planting in spring Less soil P stratification	Cost of RTK GPS to guide zones $ New equipment $ More time required than broadcast


4R Adaptive Management for Plant Nutrition
Policy Level – Regulatory, Infrastructure, Product Development
Regional Level
Agronomic scientists, Agri-service providers
Farm Level
Producers, Crop advisers
DECISION SUPPORT based on scientific principles
OUTPUT
Recommendation of right source, rate, time, and place (BMPs)
DECISION
Accept, revise, or reject
ACTION
Change in practice
EVALUATION of OUTCOME
Cropping System Sustainability Performance
LOCAL SITE FACTORS
•Climate
•Policies
•Land tenure
•Technologies
•Financing
•Prices
•Logistics
•Management
•Weather
•Soil
•Crop demand
•Potential losses
•Ecosystem vulnerability

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Search... GO

WHAT ARE THE 4RS | IMPLEMENT THE 4RS | 4R TRAINING

4R CONSISTENT SYSTEMS

These systems are consistent with the 4Rs and can help you create a comprehensive 4R nutrient stewardship plan. Learn more about what it means for a nutrient management system to be 4R-Consistent.

WILBUR-ELLIS COMPANY
14300 Nicollet Ct., suite 203
Burnsville, MN 55306
ph: 952-898-5562

THE ANDERSONS, INC.
The Andersons, Inc PO Box 119
Maumee, OH 43537
ph: 800-537-3370

SIMPLOT
999 Main Street, Suite 300AVAIL
Boise, ID 83702

IMPLEMENT THE 4RS

4R Nutrient Stewardship represents an innovative approach to fertilizer best management practices (BMPs). The 4Rs imply there are four aspects to every fertilizer application and it provides a framework to assess whether a given crop has access to the necessary nutrients. Asking "Was the crop given the right source at the right rate, at the right time, and in the right place?" helps identify opportunities to improve fertilizer efficiency and prevent nutrient movement from each field.

To learn more, please download our brochure: Implementing 4R Nutrient Stewardship on the Farm Right Now

This is an example of an unpublished revision.

RIGHT SOURCE | RIGHT RATE | RIGHT TIME | RIGHT PLACE

PARTNERS WITH THE PRODUCTS AND SERVICES YOU NEED TO FOLLOW THIS PART OF YOUR 4R PLAN

The Fertilizer Institute
Nourish, Replenish, Grow

Canadian Fertilizer Institute
Institut Canadien des Engrais

IPNI International Plant Nutrition Institute

International Fertilizer Industry Association

The Fertilizer Institute | 425 Third Street, S.W., Suite 950 | Washington, D.C. 20024 | ph. 202.962.0490 | fax: 202.962.0577

4R Advocate Program

- Recognize producers and retailers utilizing 4Rs
- Engage producers and share success stories
- Inaugural program received 37 producer nominations from retailers across the US
- Winners get trip to Commodity Classic and will participate in TFI booth
- *Regional winner: Loyer Farms & Morral Companies*

nutrient stewardship

Nominations are due on November 30.

The Fertilizer Institute
Nourish, Replenish, Grow

2012 4R ADVOCATE PROGRAM

What is the 4R Advocate Program?

Raising awareness and adoption of 4R nutrient stewardship is a top priority for The Fertilizer Institute (TFI). Currently, TFI is educating members and growers about the 4Rs at agricultural trade shows, member company visits and other 4R speaking engagements.

While TFI believes that 4R messages from the fertilizer industry will be well received, the Institute recognizes that engaging agricultural producers and sharing 4R success stories from the field level will play a critical role in adoption of 4R nutrient stewardship practices.

As a result, TFI is launching a 4R Advocate program that it will use to recognize agricultural retailers and agricultural producers that are leading the way when it comes to implementing 4R nutrient stewardship on the farm. This program provides a good opportunity for TFI retail members to educate themselves and their growers on 4R nutrient stewardship.

How Will the Program Work?

As with many other aspects of TFI's 4R nutrient stewardship initiative, partnerships will be an essential component of the 4R Advocate program. In order to identify grower customers throughout the country who are working with agricultural retailers to utilize 4R consistent products and services, TFI will need input and support from its retail members. All TFI retail members are encouraged to complete the 4R Advocate program nomination form. Nominations will be accepted from September 2011–January 2012. At that time, TFI will turn over the applications it has received to a panel of judges that will be responsible for selecting a winner(s).

The 2012 4R Advocate winner(s) will be announced prior to the 2012 Commodity Classic, which will take place March 1-3 in Nashville, Tenn. The 4R Advocate winners and guests will receive a free trip to the Commodity Classic and will be recognized on the www.nutrientstewardship.com website. Nominating organizations will also receive recognition.

4R ADVOCATE PROGRAM NOMINATION

4R ADVOCATE NOMINEE INFORMATION

Name of agricultural Producer that is being nominated:

Phone Number: E-mail Address:

City: State:

Number of acres: Type of crops produced:

NOMINATING ORGANIZATION INFORMATION

Name of nominating agricultural retailer:

Phone Number: E-mail Address:

City: State:

Instructions:
To complete the nomination process, please fill out the 4R checklist on the back of this page. Nominating organizations are also responsible for developing a written submission regarding the agricultural producer that is being nominated. The written nomination should be 1,000 words or less and must address five key topics which are described on the back of this page.

If you have questions regarding the nomination process, please contact TFI Director of Stewardship Programs Lara Moody by telephone at (202) 515-2721 or via e-mail at lmoody@tfi.org. Completed nominations should be submitted to Lara via e-mail at lmoody@tfi.org.

The Fertilizer Institute

nutrient stewardship

Summary – how to reduce P loss with 4R?

- Lake Erie basin cropland **P balance** – OK *on average*.
- Lake Erie basin **soil test P** – some below, at & above optimum.
- **4R Nutrient Stewardship** to manage the P issue:
  - **Source:** Forms that suit placement in the soil. Account for manures applied.
  - **Rate:** Soil test. Replenish crop removal.
  - **Time:** Avoid applying to frozen or snow-covered soil during winter. Where possible, replace fall with spring.
  - **Place:** Place P in the soil for each crop. Design conservation tillage systems to deal with stratification.
- Practice **Adaptive Management**: work with partners to validate practices in the field. Recognize successes.

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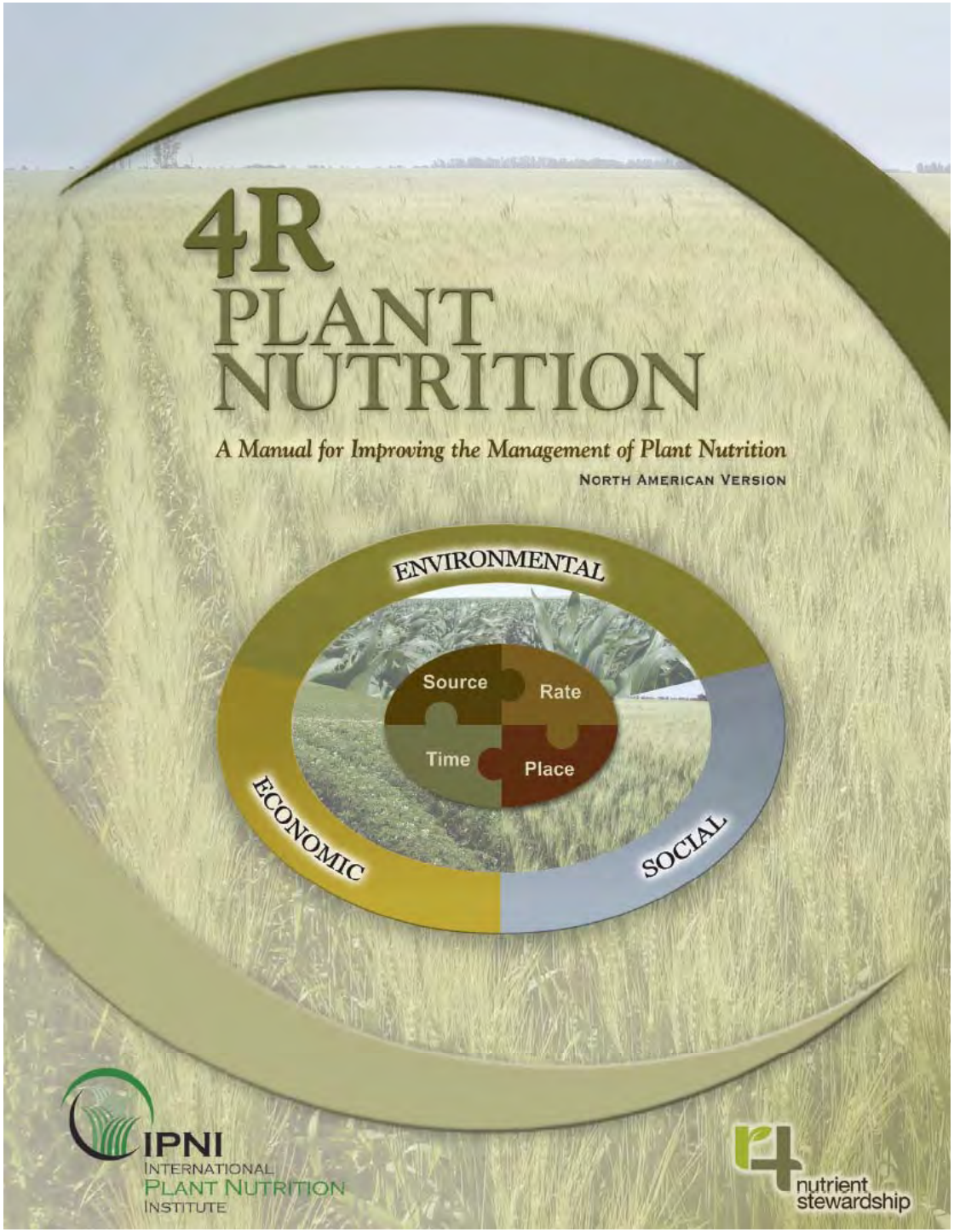


Comments Welcome

nane.ipni.net

nutrient stewardship

IPNI

Putting the Agronomics All Together

Greg LaBarge
Field Specialist Agronomic Systems
Ohio State University Extension

EMPOWERMENT THROUGH EDUCATION

THE OHIO STATE UNIVERSITY EXTENSION

Agriculture in Lake Erie Basin

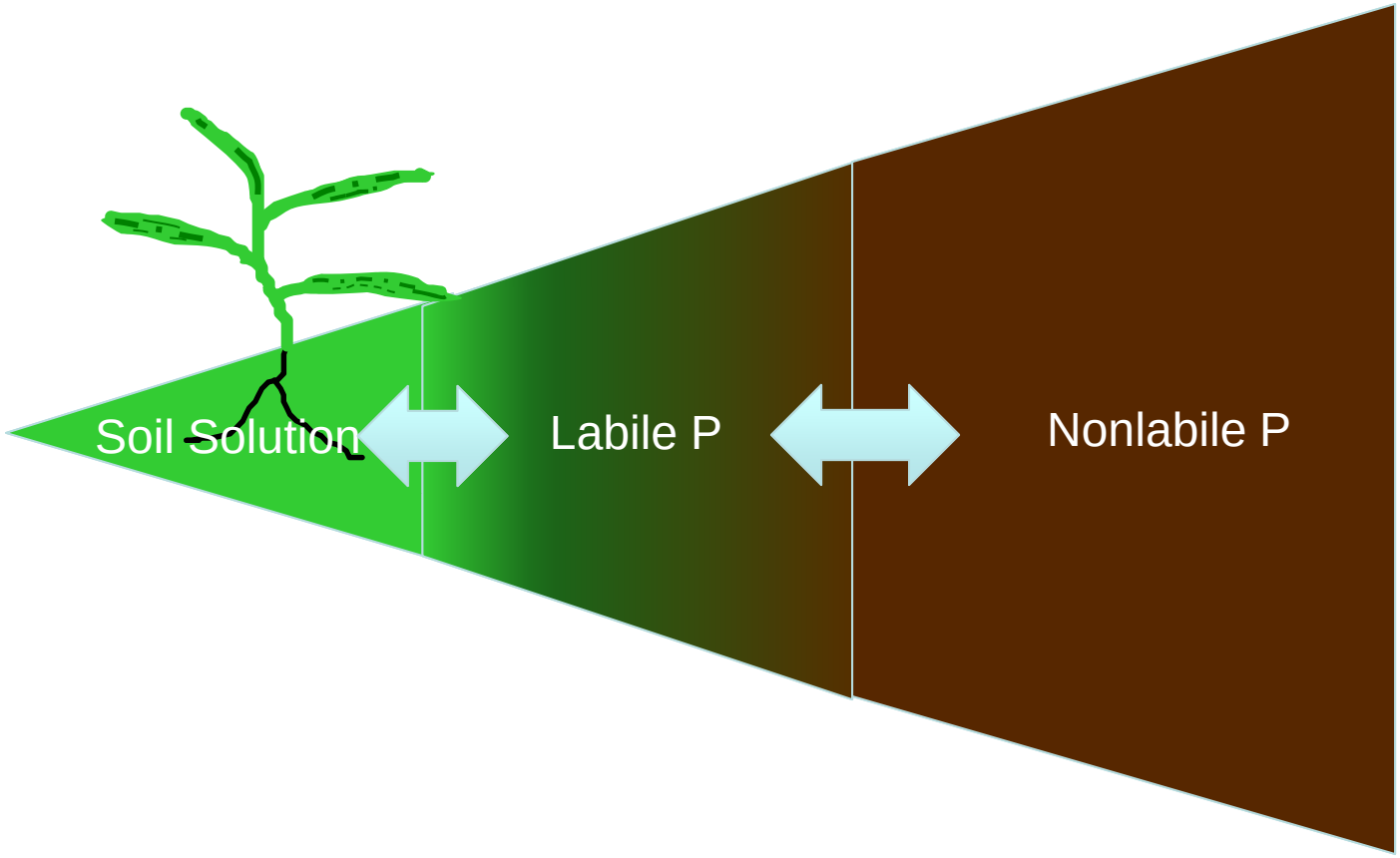
- 4.2 Million Acres Maumee Watershed
- 72% cropland in Western

- 4.9 Million Total
- 59.1% cropland

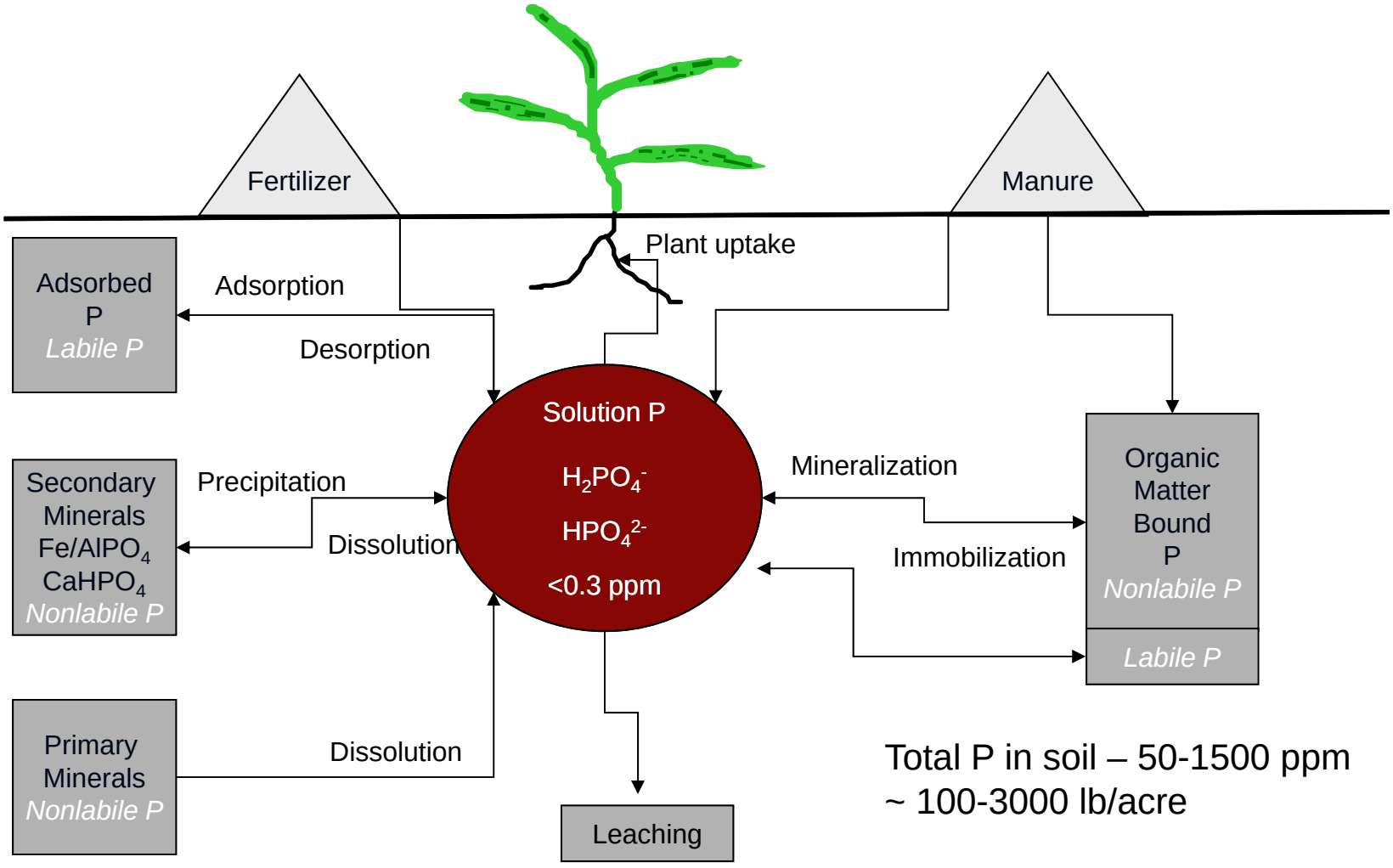
Overview

- Soil reactions of phosphorous
- Nutrient Movement
- Plant Uptake
- Do the tri-state recommendations still work
- Soil sampling

Three Important Soil P Fraction for Plant Nutrition

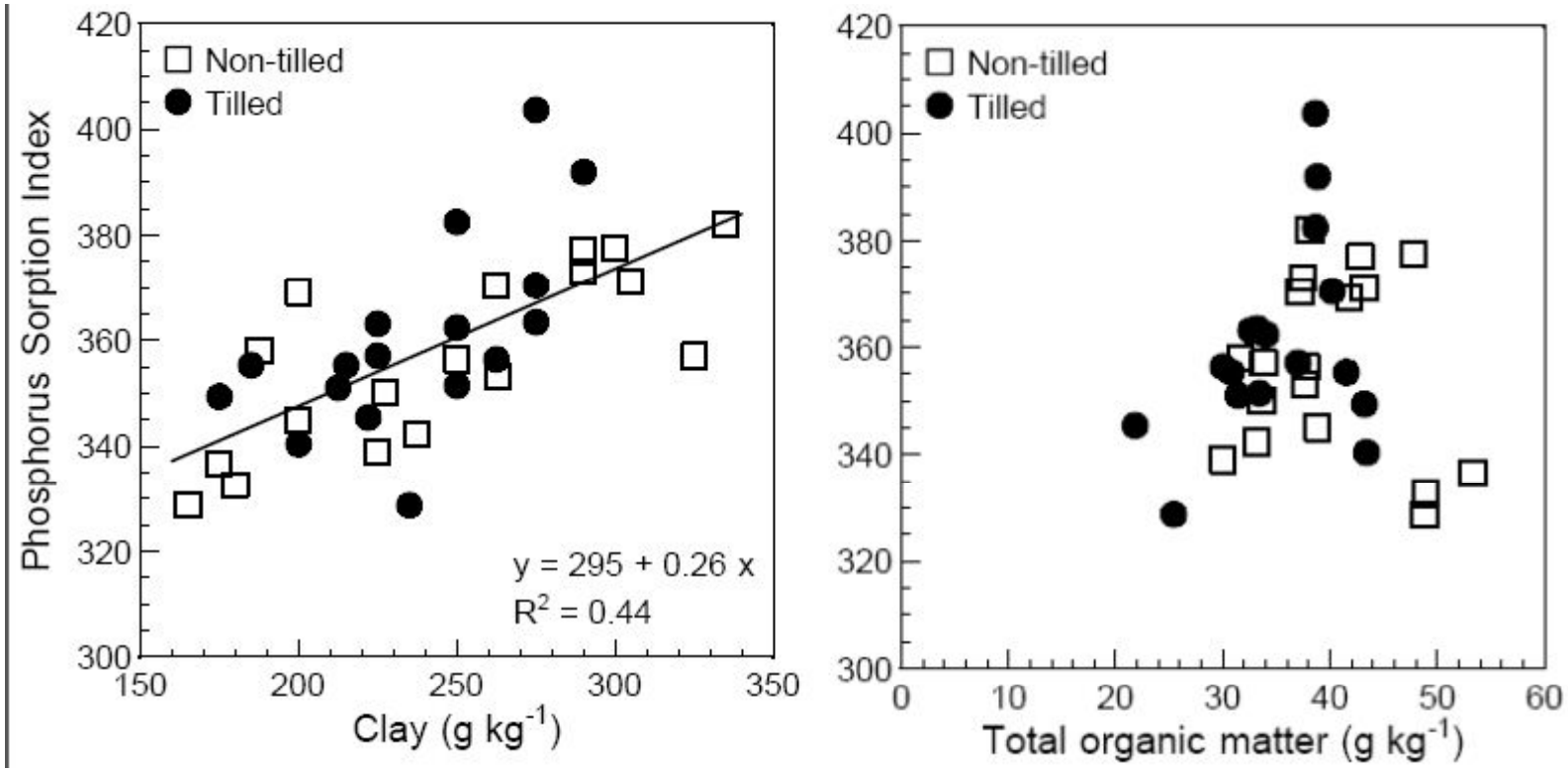


Nutrient Movement



Nutrient Movement

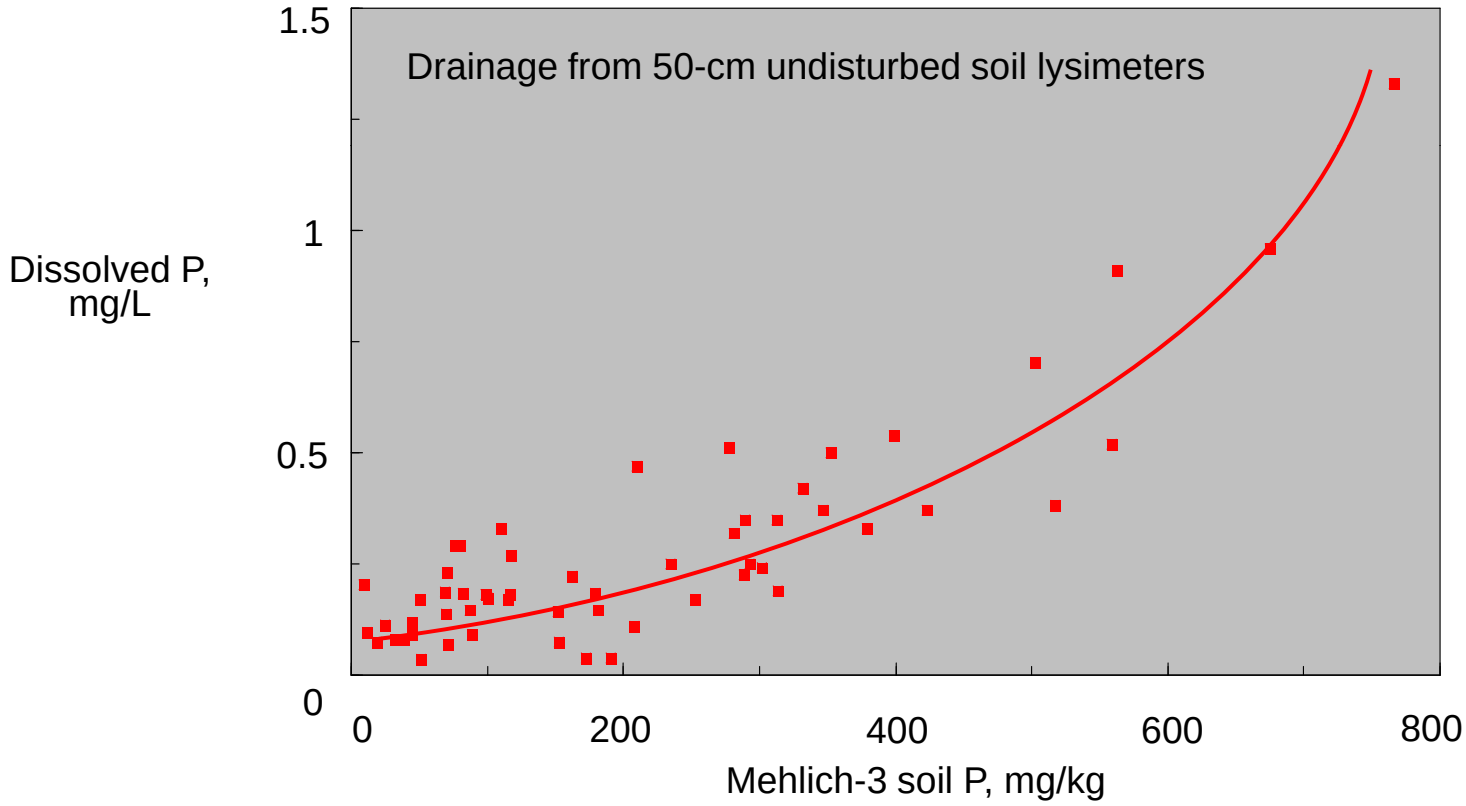
- Can they move?
  - Yes. Largest deciding factors are soil texture and nutrient concentration (tillage is a factor as well, obviously)



Boem et al., SSSAJ, 2008

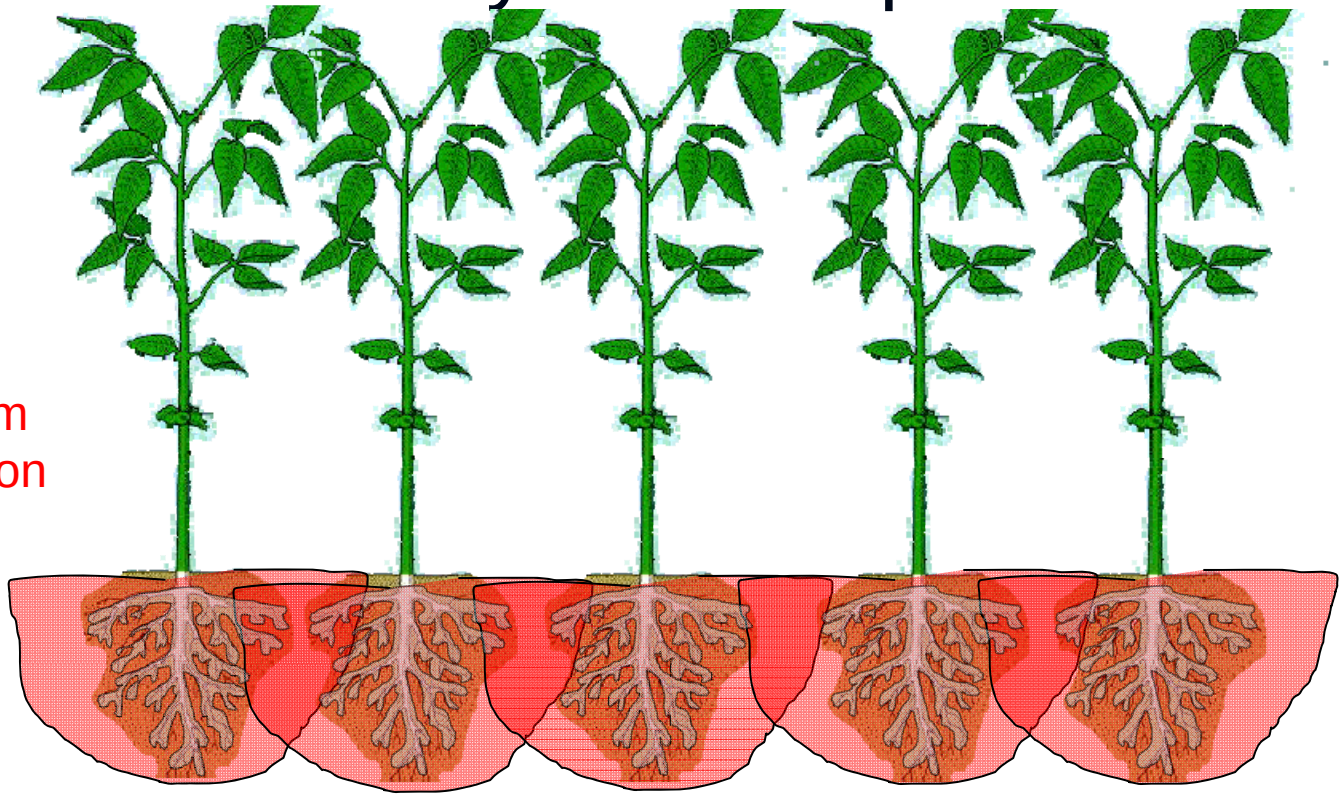
Nutrient Movement

- Nutrient concentration causing nutrient leaching



Nutrient Movement and Uptake

- Nutrient mobility and competition

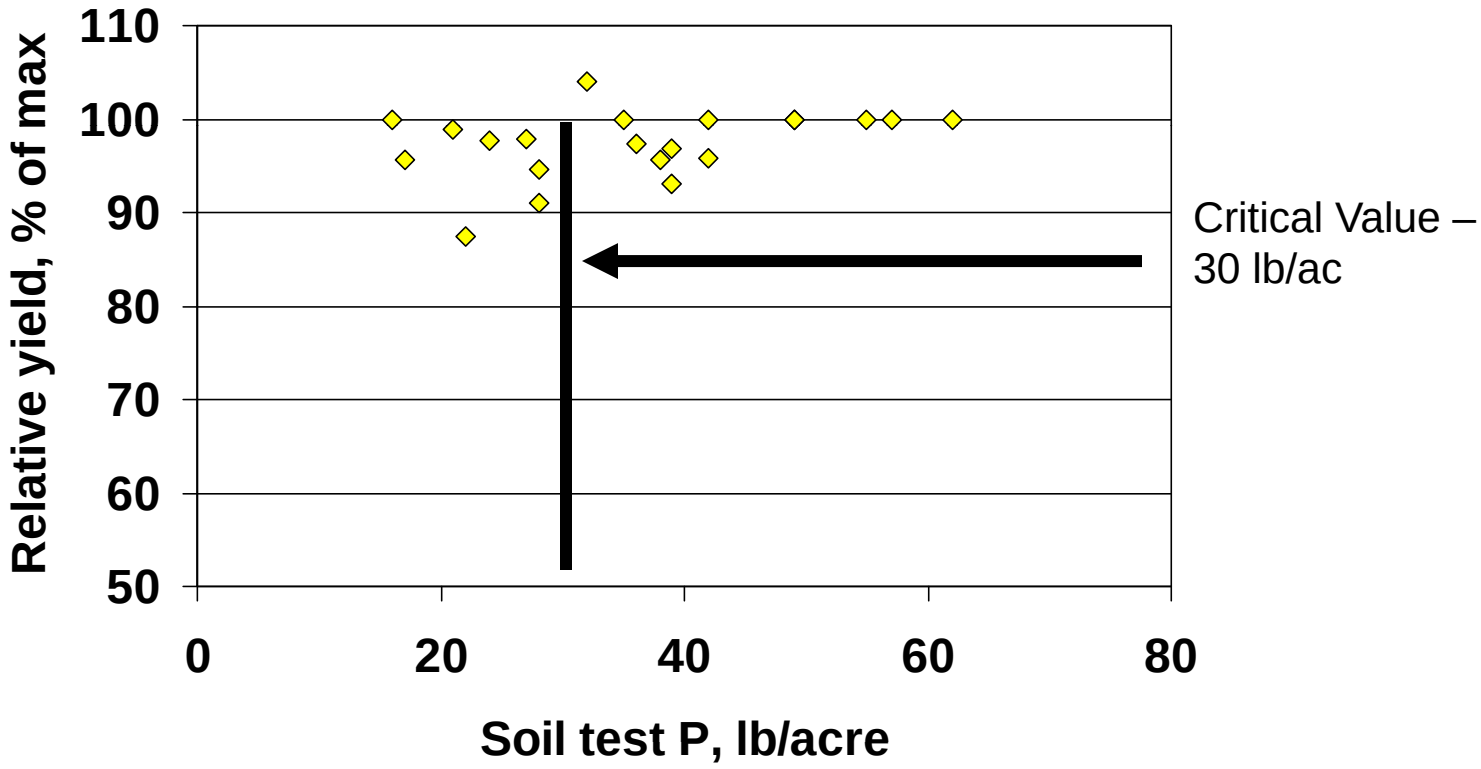


Nutrient Uptake

- Since they are available from a relatively small volume of soil, is there much competition between plants for these nutrients?
  - Think about a nodal root system for corn
- There may be some competition, but not like for a mobile nutrient like nitrogen
- This is important, due to a lack of competition between plants, the amount of nutrient required is not related to yield level
- All we need to do is achieve a nutrient concentration to ensure adequate availability!

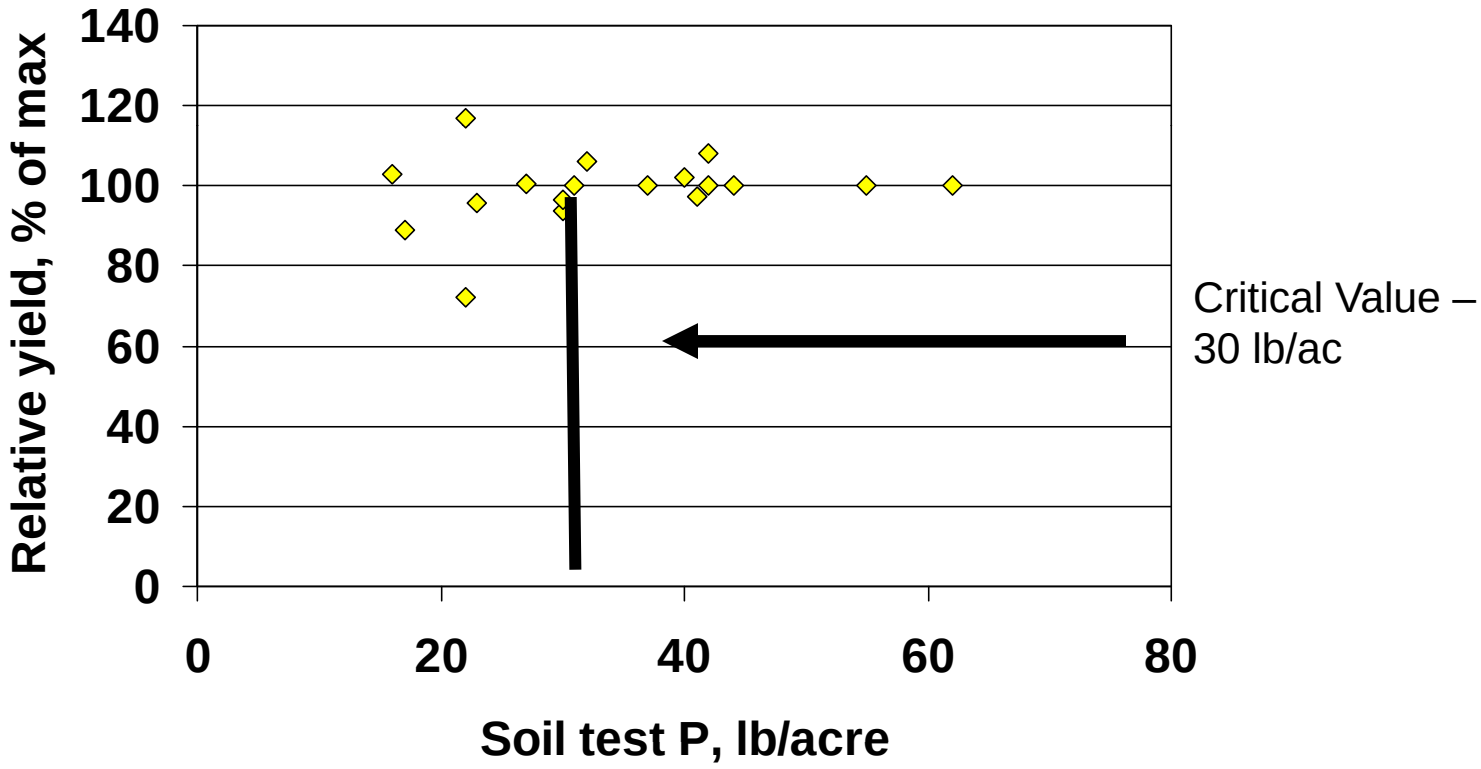
Critical Levels

- Ohio State data – relative corn yield and STP



Critical Levels

- Ohio State data – relative soybean yield and STP



Fertility Rates

Figure 1

FERTILIZER RECOMMENDATION SCHEME USED IN THE TRI-STATE REGION

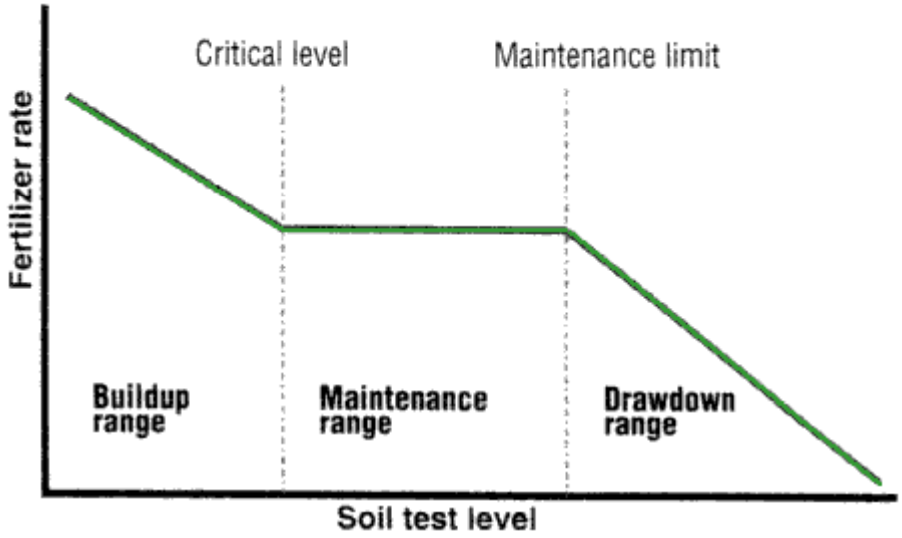
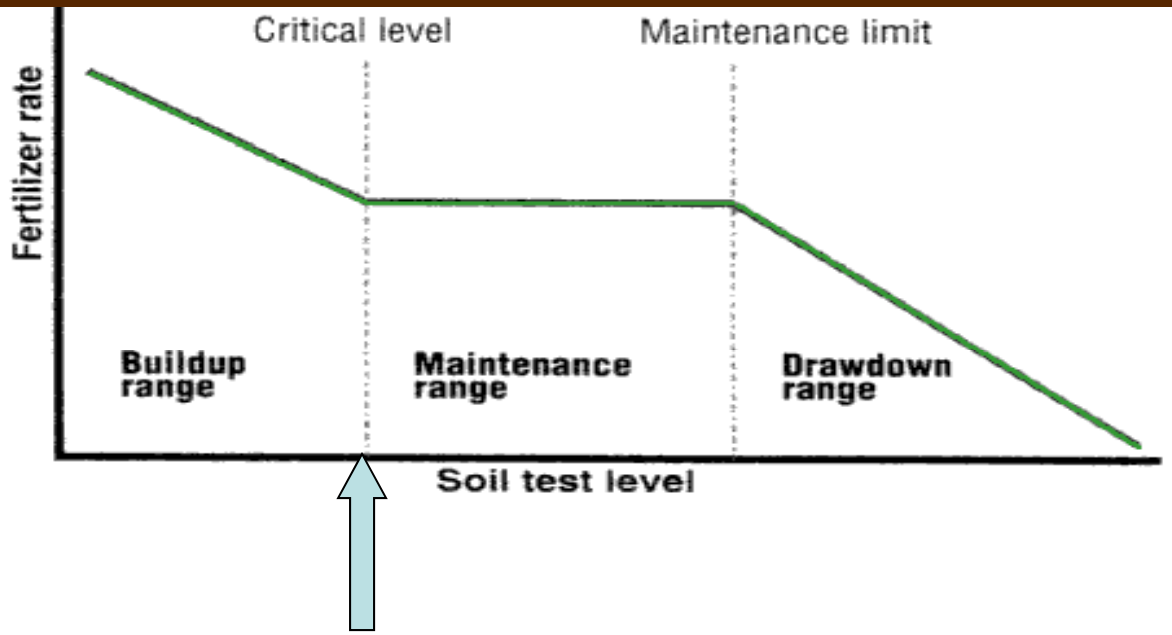


Figure 1

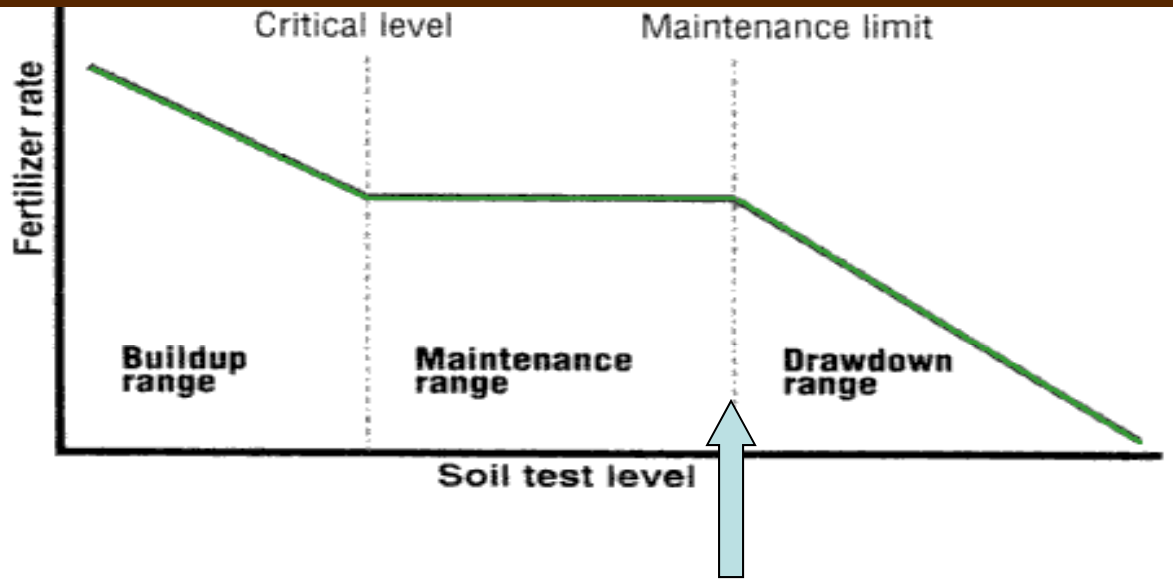
FERTILIZER RECOMMENDATION SCHEME USED IN THE TRI-STATE REGION



Crop	**P- Bray 1 (PPM)**	**P- Bray 1 (lbs/A)**
Corn & Soybeans	15	30
Wheat & Alfalfa	25	50

Figure 1

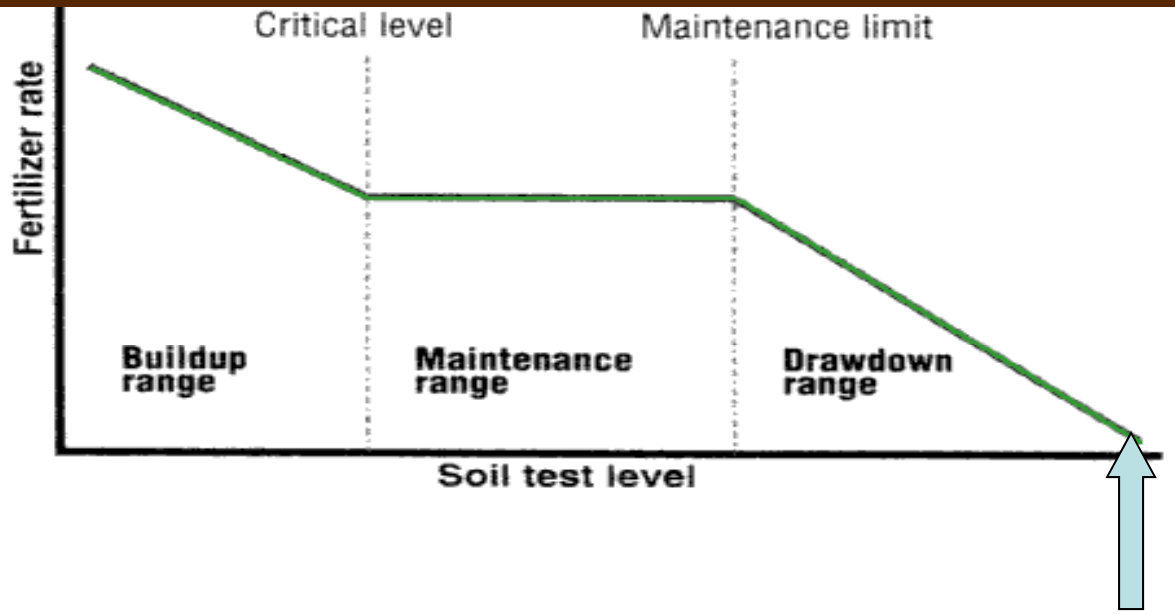
FERTILIZER RECOMMENDATION SCHEME USED IN THE TRI-STATE REGION



Crop	**P- Bray 1 (PPM)**	**P- Bray 1 (lbs/A)**
Corn & Soybeans	30	60
Wheat & Alfalfa	40	80

Figure 1

FERTILIZER RECOMMENDATION SCHEME USED IN THE TRI-STATE REGION



Crop	**P- Bray 1 (PPM)**	**P- Bray 1 (lbs/A)**
Corn & Soybeans	40	80
Wheat & Alfalfa	50	100

"What do you mean do not put any P on, won't my soil test drop?"

Two part answer.

First yes, soil test levels will drop, but if you are above the crop response range for the crop it really is not a problem crop production wise. If you are above 30 PPM there is no yield benefit and if you are way above this level there is an economic benefit to using this soil stored P.

"What do you mean do not put any P on, won't my soil test drop?“ Part 2

The second part of the answer is soil test do not drop 1 to 1 with crop removal. A 150 bushel corn crop removes (150 bushel * 0.37 Crop removal = 56 lbs). Phosphorous chemistry in the soil buffers the crop removal so that for each 15-20 lbs of P_2O_5 removal phosphorous levels in the soil are lowered 1 PPM. So our 150 bushel crop will lower the soil test at around 3-4 PPM.

Corn

Table 1. Fertilizer P Recommendations for Corn. (adapted from Tri-state Fertilizer Recommendations for Corn, Soybeans, Wheat and Alfalfa)

	Realistic Yield Goal (bu/acre)						
Soil Test Level	120	145	170	200	225	250	275
PPM (lb/acre)	**lbs P_2O_5/acre recommended**						
5 (10)	95	105	115	125	135	145	155
10 (20)	70	80	90	100	110	120	125
15-30 (30-60)	45	55	65	75	85	95	100
35 (70)	20	25	30	40	45	50	50
40 (80)	0	0	0	0	0	0	0

Soybean

Table 2. Fertilizer P Recommendations for Soybean. (adapted from Tri-state Fertilizer Recommendations for Corn, Soybeans, Wheat and Alfalfa)

	Realistic Yield Goal (bu/acre)						
Soil Test Level	30	40	50	60	70	80	90
PPM (lb/acre)	**lbs P_2O_5/acre recommended**						
5 (10)	75	80	90	100	105	115	125
10 (20)	50	55	65	75	80	90	100
15-30 (30-60)	25	30	40	50	55	65	70
35 (70)	10	15	25	25	30	35	35
40 (80)	0	0	0	0	0	0	0

Wheat

Table 3. Fertilizer P Recommendations for Wheat. (adapted from Tri-state Fertilizer Recommendations for Corn, Soybeans, Wheat and Alfalfa)

	Realistic Yield Goal (bu/acre)					
Soil Test Level	50	65	80	95	110	125
PPM (lb/acre)	**lbs P_2O_5/acre recommended**					
15 (30)	80	90	100	110	120	130
20 (40)	55	65	75	85	95	105
25-40 (50-80)	30	40	50	60	70	80
45 (90)	15	20	25	30	35	40
50 (100)	0	0	0	0	0	0

Equations

BUILDUP EQUATION

for P: lb P_2O_5/A to apply = [(CL - STL) x 5] (YP x CR)

MAINTENANCE EQUATION

for P: lb P_2O_5/A to apply = YP x CR

DRAWDOWN EQUATION

for P: lb P_2O_5/A to apply = (YP x CR) - [(YP x CR) x (STL - CL 15))/10]

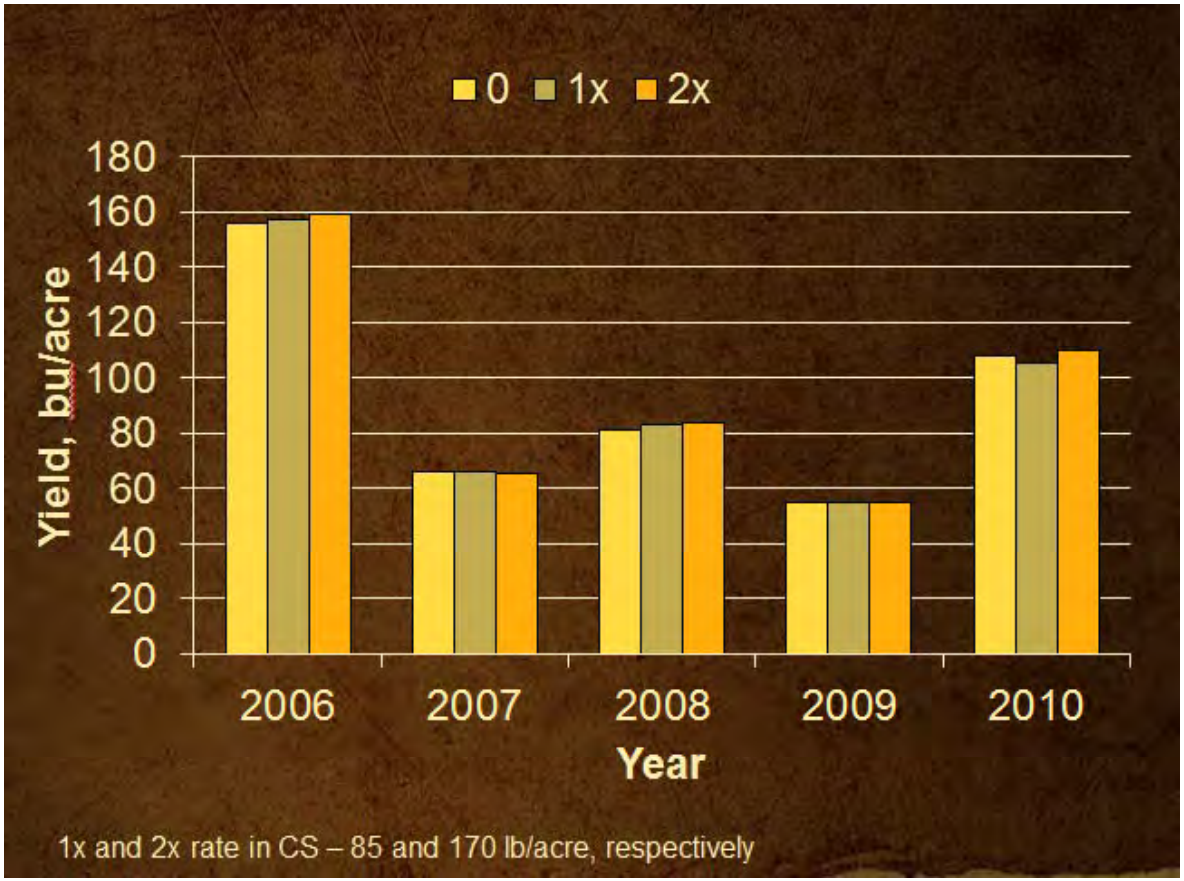
CL = critical soil test level (ppm)
STL = existing soil test level (ppm)
YP = crop yield potential (bu per acre for grains, tons per acre for forages)
CR = nutrient removed per unit yield (lb/unit)
CEC = soil cation exchange capacity (meq/100g)

Are Current Critical Levels Still Valid?

- Northwest Research Station near Custar, Ohio
- Initial soil test levels
  - P – 39 ppm; K – 272 ppm; CEC – 24 meq/100 g
  - Critical levels – 15 ppm (P) and 135 ppm (K)
- Would you expect much response at this location?

Are Current Critical Levels Still Valid?

- Phosphorus response in corn-soybean rotation



Are Current Critical Levels Still Valid?

- Phosphorus response in corn-corn-soybean rotation

Are Current Critical Levels Still Valid?

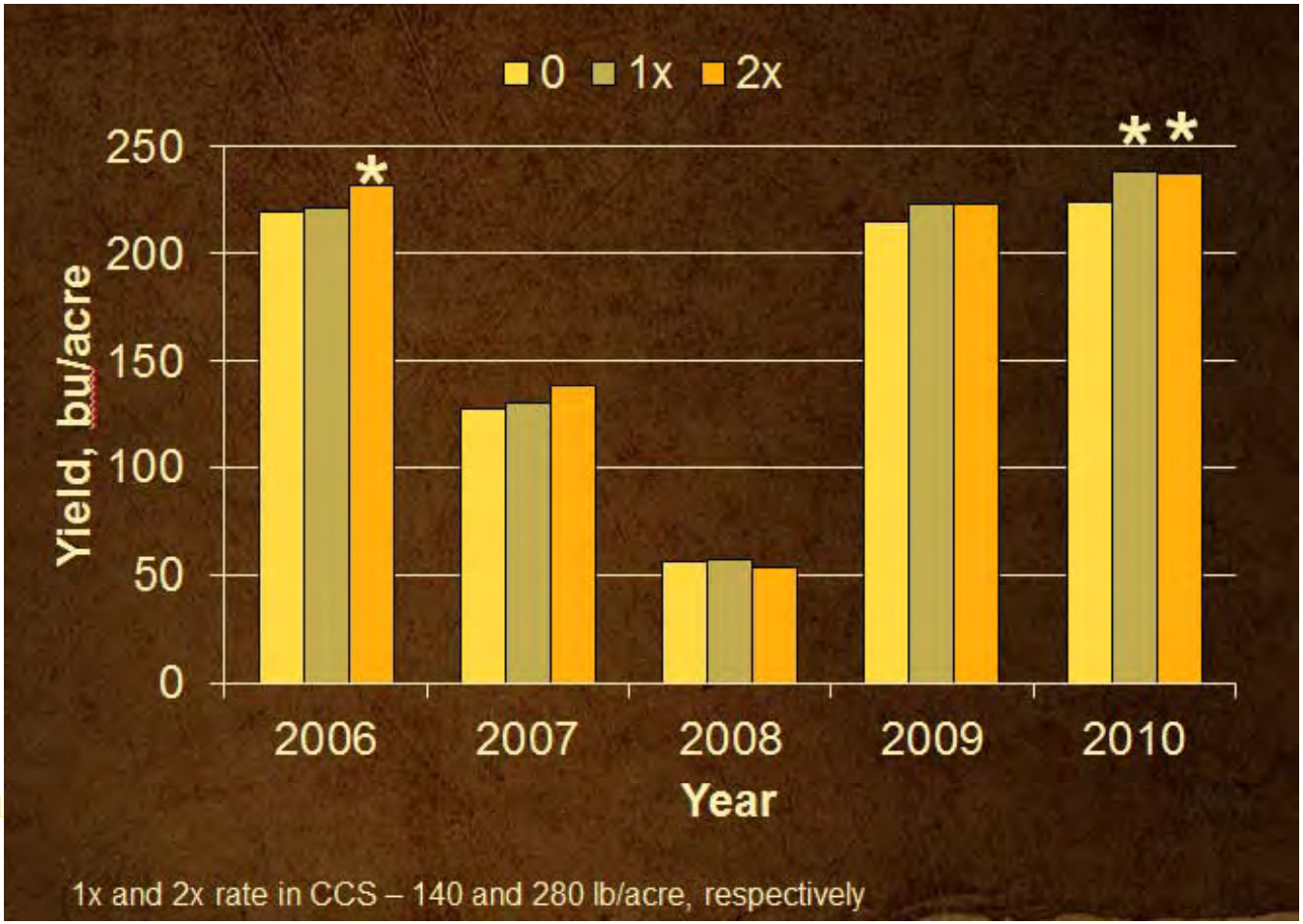
- Western Research Station near Springfield, Ohio
- Initial soil test levels
  - P – 20 ppm; K – 102 ppm; CEC – 14 meq/100 g
  - Critical levels – 15 ppm (P) and 110 ppm (K)
- Would you expect much response at this location?

Are Current Critical Levels Still Valid?

- Phosphorus response in corn-soybean rotation

Are Current Critical Levels Still Valid?

- Phosphorus response in corn-corn-soybean rotation

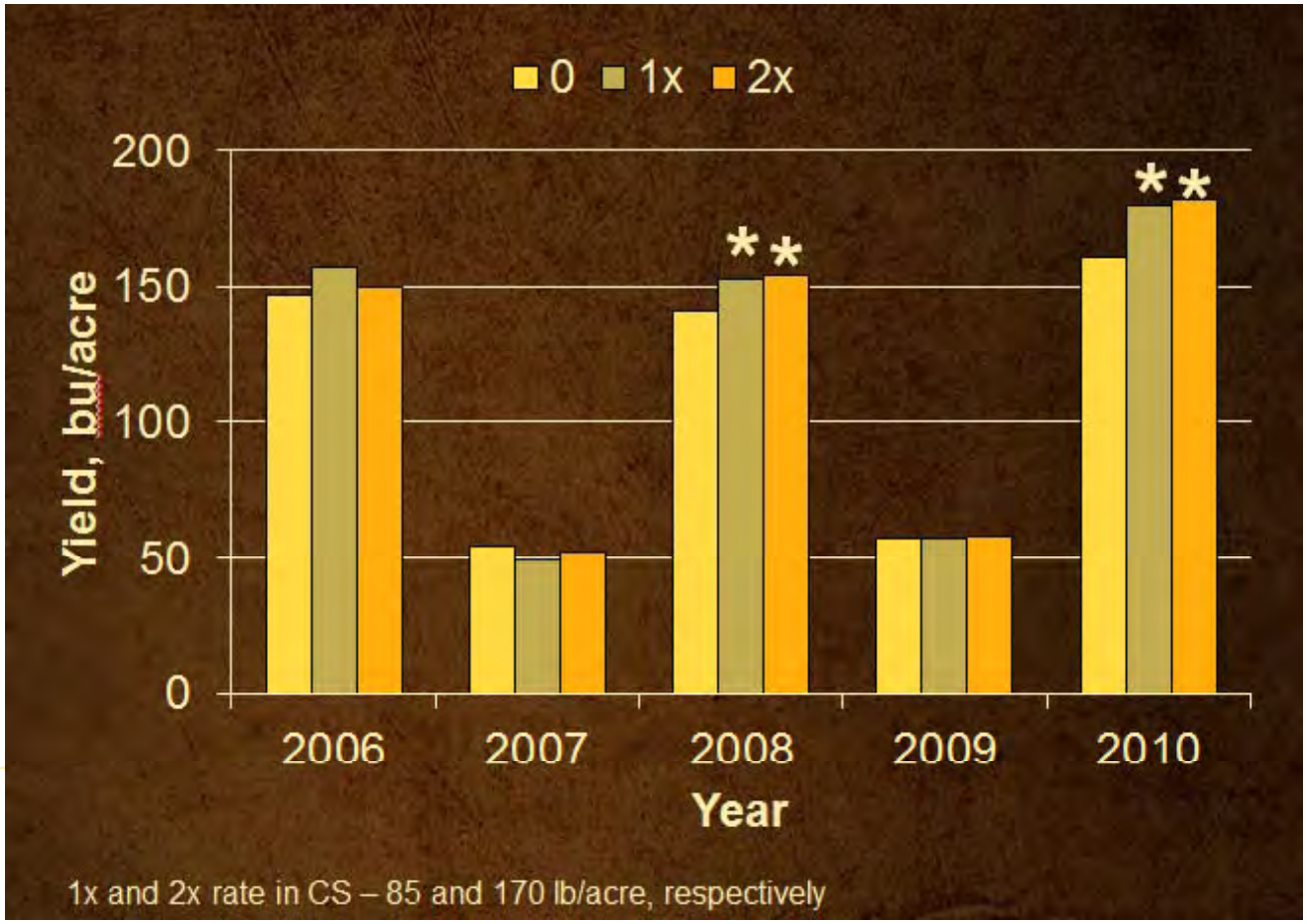


Are Current Critical Levels Still Valid?

- East Badger Farm near Wooster, OH
- Initial soil test levels
  - P – 17 ppm; K – 109 ppm; CEC – 11 meq/100 g
  - Critical levels – 15 ppm (P) and 103 ppm (K)
- Would you expect much response at this location?

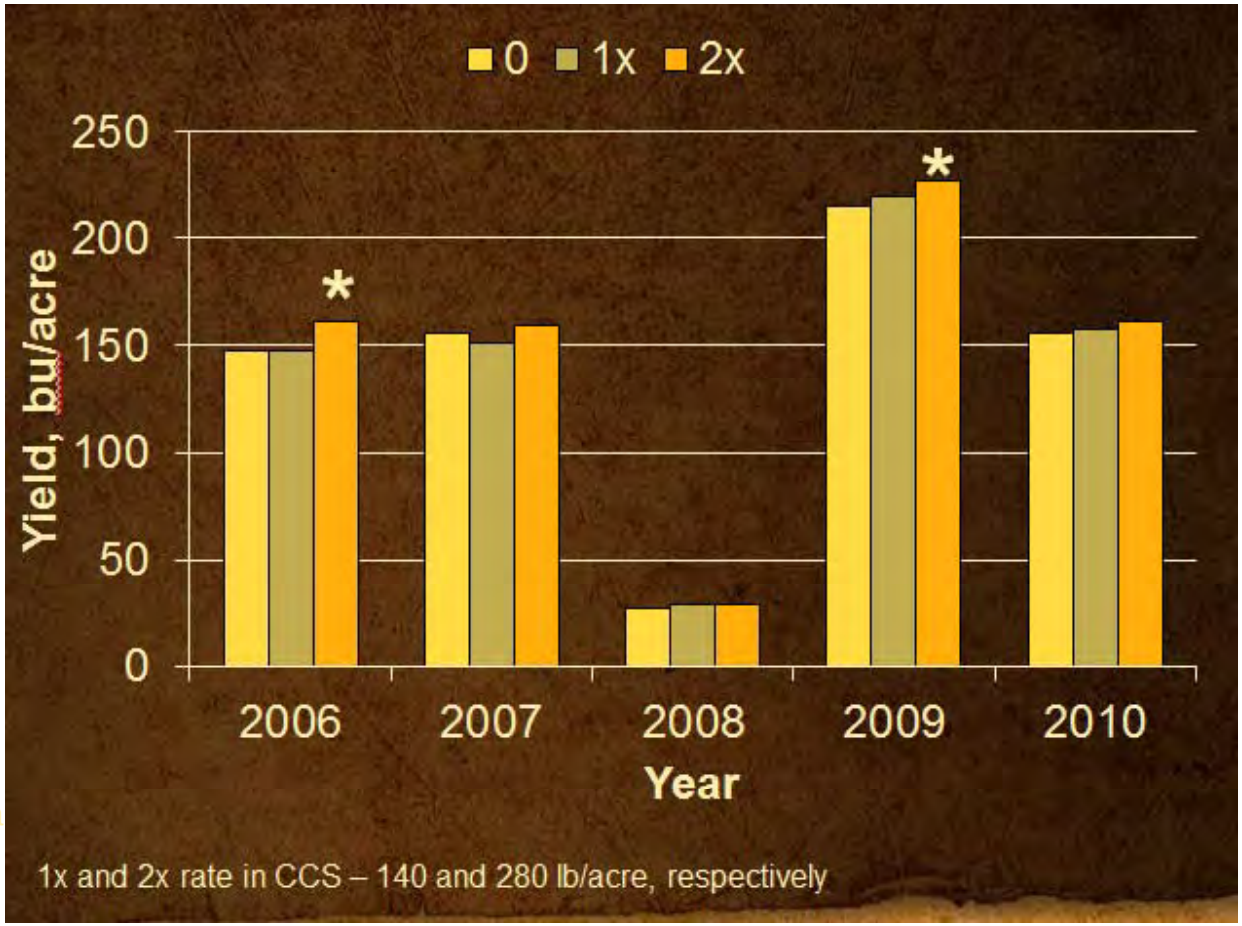
Are Current Critical Levels Still Valid?

- Phosphorus response in corn-soybean rotation



Are Current Critical Levels Still Valid?

- Phosphorus response in corn-corn-soybean rotation



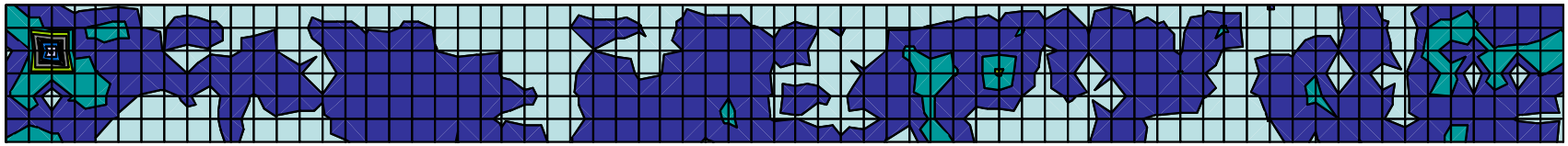
Soil Testing

- Critical to making good nutrient decisions
- Need a well taken sample that represents the sample area (yield response)
  - Depth of probe
  - 10-15 cores (Zones) or 5 cores (point)
- Adaptive Management
  - Yield response
  - Soil test movement

Spatial Variation

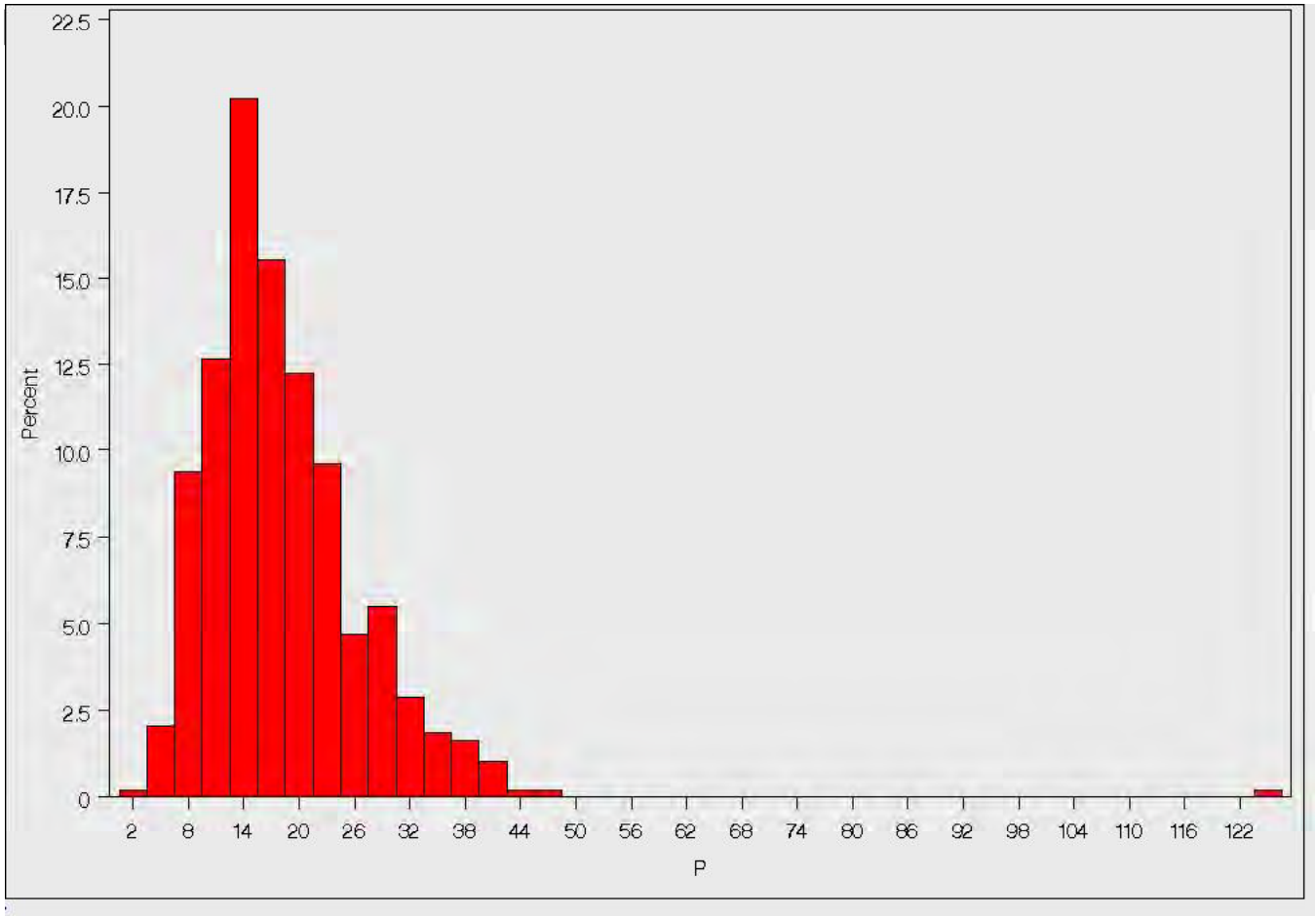
0-15 15-30 30-45 45-60 60-75 75-90 90-105 105-120 120-135

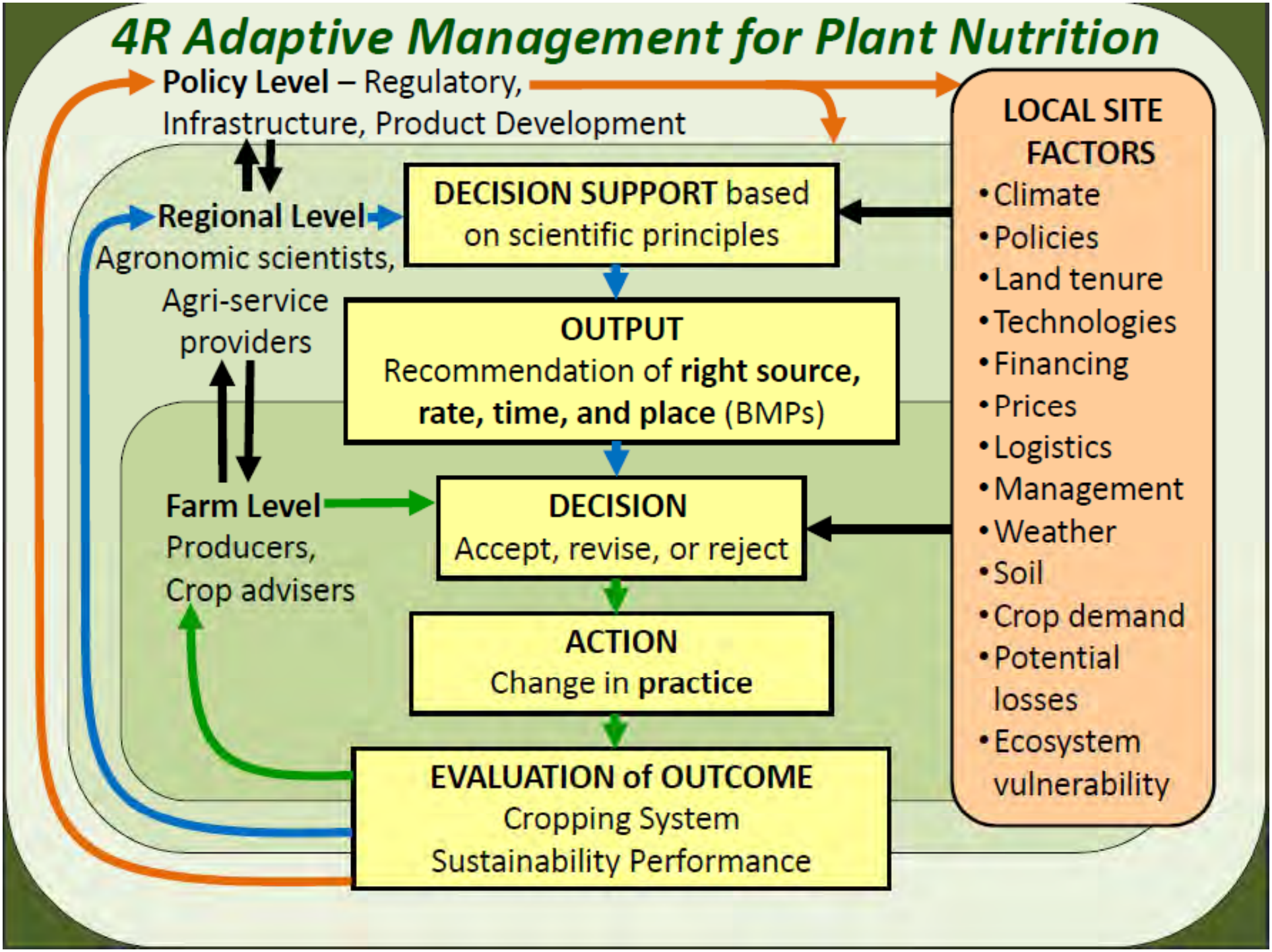
Soil test P



Nutrient Distribution

- Mean soil test P – 18 ppm
-




4R Adaptive Management for Plant Nutrition
Policy Level – Regulatory, Infrastructure, Product Development
Regional Level
Agronomic scientists, Agri-service providers
Farm Level
Producers, Crop advisers
DECISION SUPPORT based on scientific principles
OUTPUT
Recommendation of right source, rate, time, and place (BMPs)
DECISION
Accept, revise, or reject
ACTION
Change in practice
EVALUATION of OUTCOME
Cropping System Sustainability Performance
LOCAL SITE FACTORS
• Climate
• Policies
• Land tenure
• Technologies
• Financing
• Prices
• Logistics
• Management
• Weather
• Soil
• Crop demand
• Potential losses
• Ecosystem vulnerability

Nutrient Balance

	Units			
Soil Test Start	ppm	112		
Fertilizer			Yield	Removal
Year 1	lbs/A P205	78	210	0.37
Year 2	lbs/A P205	54	68	0.8
Year 3	lbs/A P205	71	192	0.37
Year 4	lbs/A P205	47	59	0.8
		250		
Crop Removal				
Year 1	lbs/A P205	26		
Year 2	lbs/A P205	0		
Year 3	lbs/A P205	26		
Year 4	lbs/A P205	0		
		52		
Soil Test End	ppm	88		
Net Usage	lbs/A P205	250		
period soil test change	ppm	-24		
lbs to change 1 ppm		-10		

Summary

- Manage nutrient pools to provide adequate soil solution concentrations
- Immobile nutrients need to obtain critical level of soil solution
- Tri state philosophy and recent validation
- Soil sampling
- Utilizing soil sampling and nutrient balances

Soil Health, Nutrient Management and the New 590 Standard

Mark Scarpitti, CCA
State Agronomist, Ohio NRCS

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mark.scarpitti@oh.usda.gov

Ohio Ag Business Association, February 29, 2012

Helping People Help the Land

There are several different resource concerns in Ohio

Most can be a put under the category of…

- Water Quality Concerns
- Soil Quality Concerns

When we talk about water quality concerns…

- Nutrients and pesticides in surface water
- Nutrients and pesticides in ground water
- Suspended sediment in surface water

So why are we seeing an increase in SRP?

The evidence points to…

- poor soil health and
- poor nutrient management practices

One indicator of poor soil health

Compaction

= Poor infiltration

= High runoff

= Higher “flashiness”

Blount soil showing severe compaction

(very low infiltration = very high runoff)

Blount soil under continuous NoTill showing good soil structure (and good infiltration)

Let’s look at some common practices that have a negative impact on soil health and water quality

Conventional Tillage

Moldboard plowing or multiple tillage passes that bury all residue from the previous crop.

Conventional Tillage

- Destroys soils structure
- Reduces infiltration
- Oxidizes soil organic matter
- Can cause compaction

Rotational Tillage?

Not actually a conservation practice

It is a term generally used for a producer who

- –NoTill one year (soybeans into corn stalks)
- –Conventional tillage or mulch tillage the next year

- •Destroys the soil structure gained with the NoTillage
- •Oxidizes organic matter
- •Reduces infiltration over continuous NoTillage

Long Term No-Till vs. Rotational Tillage

Both Fields are a Corn/Soybean Rotation

These pictures are of a newly emerging corn crop

NoTill soybeans then StripTill Corn

NoTill Soybeans then Tilled corn

Same rain event on May 15
¾" less than 1/8 mile apart

Poor Nutrient Management

Poor management of the…

- Amount
- Placement
- Form
- or Timing

of manure and commercial fertilizer

Poor Nutrient Management

Over the years we have seen an increase of…

- ✓ Fertilizer broadcast on the soil surface
- ✓ Custom application
- ✓ Fall and winter application
- ✓ Not incorporated

Combined with compaction, the fertilizer dissolves and runs off with the first rainfall event

Proper Nutrient Management

- Reduces nutrients in surface and ground water
- Improves the efficiency of crop uptake
- Improves profits

Proper Nutrient Management

Four R's of Nutrient Management

Right Source

Right Time

Right Place

Right Rate

Proper Nutrient Management

Phosphorus must contact the soil to be tied up

- ✓ Injected
- ✓ Banded
- ✓ Incorporated (if Broadcast)
- ✓ StripTill – with Controlled Traffic Farming
- ✓ Top dress on growing crop / cover crop (not dormant)

Surface application without incorporation causes nutrient loss due to runoff.

Proper Nutrient Management

Phosphorus must contact the soil to be tied up

- ✓ Injected
- ✓ Banded
- ✓ Incorporated (if Broadcast)
- ✓ StripTill – with Controlled Traffic Farming
- ✓ Top dress on growing crop / cover crop (not dormant)

This is especially true if fertilizer is broadcast or frozen or snow covered ground.

NRCS just updated the National 590 Nutrient Management standard.

Ohio NRCS will soon be updating the State 590 Standard to reflect the new national criteria.

NRCS just updated the National 590 Nutrient Management standard.

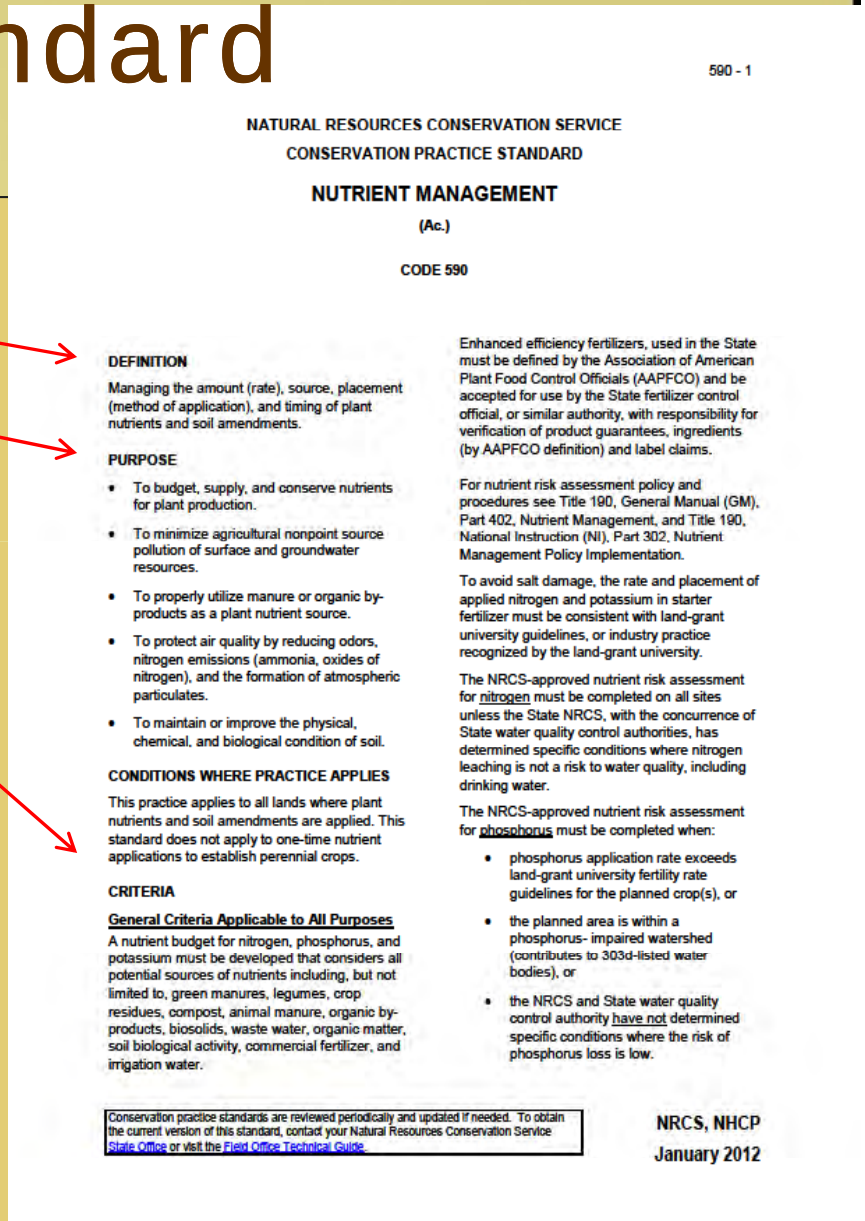
Ohio NRCS will soon be updating the State 590 Standard to reflect the new national criteria.

Will involve our partners

- ODA and ODNR both refer in ORC

Structure of a Standard

1. Definition
2. Purposes
3. Criteria
   - ✓ General Criteria
   - ✓ Additional Criteria for a specific purpose
4. Considerations
5. Plans and Specifications
6. Operation and Maintenance



590 - 1

NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

NUTRIENT MANAGEMENT

(Ac.)

CODE 590

DEFINITION

Managing the amount (rate), source, placement (method of application), and timing of plant nutrients and soil amendments.

PURPOSE

- To budget, supply, and conserve nutrients for plant production.
- To minimize agricultural nonpoint source pollution of surface and groundwater resources.
- To properly utilize manure or organic by-products as a plant nutrient source.
- To protect air quality by reducing odors, nitrogen emissions (ammonia, oxides of nitrogen), and the formation of atmospheric particulates.
- To maintain or improve the physical, chemical, and biological condition of soil.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to all lands where plant nutrients and soil amendments are applied. This standard does not apply to one-time nutrient applications to establish perennial crops.

CRITERIA

General Criteria Applicable to All Purposes

A nutrient budget for nitrogen, phosphorus, and potassium must be developed that considers all potential sources of nutrients including, but not limited to, green manures, legumes, crop residues, compost, animal manure, organic by-products, biosolids, waste water, organic matter, soil biological activity, commercial fertilizer, and irrigation water.

Enhanced efficiency fertilizers, used in the State must be defined by the Association of American Plant Food Control Officials (AAPFCO) and be accepted for use by the State fertilizer control official, or similar authority, with responsibility for verification of product guarantees, ingredients (by AAPFCO definition) and label claims.

For nutrient risk assessment policy and procedures see Title 190, General Manual (GM), Part 402, Nutrient Management, and Title 190, National Instruction (NI), Part 302, Nutrient Management Policy Implementation.

To avoid salt damage, the rate and placement of applied nitrogen and potassium in starter fertilizer must be consistent with land-grant university guidelines, or industry practice recognized by the land-grant university.

The NRCS-approved nutrient risk assessment for nitrogen must be completed on all sites unless the State NRCS, with the concurrence of State water quality control authorities, has determined specific conditions where nitrogen leaching is not a risk to water quality, including drinking water.

The NRCS-approved nutrient risk assessment for phosphorus must be completed when:

- phosphorus application rate exceeds land-grant university fertility rate guidelines for the planned crop(s), or
- the planned area is within a phosphorus- impaired watershed (contributes to 303d-listed water bodies), or
- the NRCS and State water quality control authority have not determined specific conditions where the risk of phosphorus loss is low.

Conservation practice standards are reviewed periodically and updated if needed. To obtain the current version of this standard, contact your Natural Resources Conservation Service State Office or visit the Field Office Technical Guide.

NRCS, NHCP

January 2012

National 590 Nutrient Management Standard

DEFINITION

Managing the…

- Amount (rate)
- Source
- Placement (method of application)
- Timing of plant nutrients

(4-Rs)

National 590 Nutrient Management Standard

PURPOSES

- To budget, supply, and conserve nutrients for plant production.
- To minimize agricultural nonpoint source pollution of surface and groundwater resources.
- To properly utilize manure or organic by-products as a plant nutrient source.
- To maintain or improve the physical, chemical, and biological condition of soil.

National 590 Nutrient Management Standard

CRITERIA
General Criteria Applicable to All Purposes

- A nutrient budget (plan) for nitrogen, phosphorus, and potassium must be developed that considers all potential sources of nutrients.

This is a big change…

ALL nutrients (including manure) are now under the 590 standard…

Manure used to be under 633 Waste Utilization

Change in definition of a “current soil test”…

Criteria:

- Current soil tests are those no older than 3 years.

Considerations:

- Soil test no older than 1 year when developing new plans.

Old standard
3 yrs for manure
5 yrs for fertilizer

National 590 Nutrient Management Standard

CRITERIA
Criteria Applicable to All Purposes

The NRCS-approved nutrient risk assessment for nitrogen must be completed on all sites unless...

...nitrogen leaching is not a risk to water quality, including drinking water.

National 590 Nutrient Management Standard

CRITERIA
Criteria Applicable to All Purposes

The Phosphorus Risk Index must be used when:

- Phosphorus application rate exceeds land-grant university recommendations.
- The planned area is within a phosphorus- impaired watershed.

Requiring the N and P risk assessments…

Is stricter than our current Ohio 590 standard

But is consistent with what we currently require with the Enhanced Nutrient Management Plans developed under the Ohio 590 Conservation Systems offered through EQIP.

Because of this emphasis on the P-Risk Index…

It is more important than ever to re-evaluate our current Ohio P-Risk Index to be sure it is predictive.

Another big change…

Nutrients must not be surface-applied on:

- Frozen and or snow-covered soils
- When the top 2 inches of soil are saturated from rainfall or snow melt.

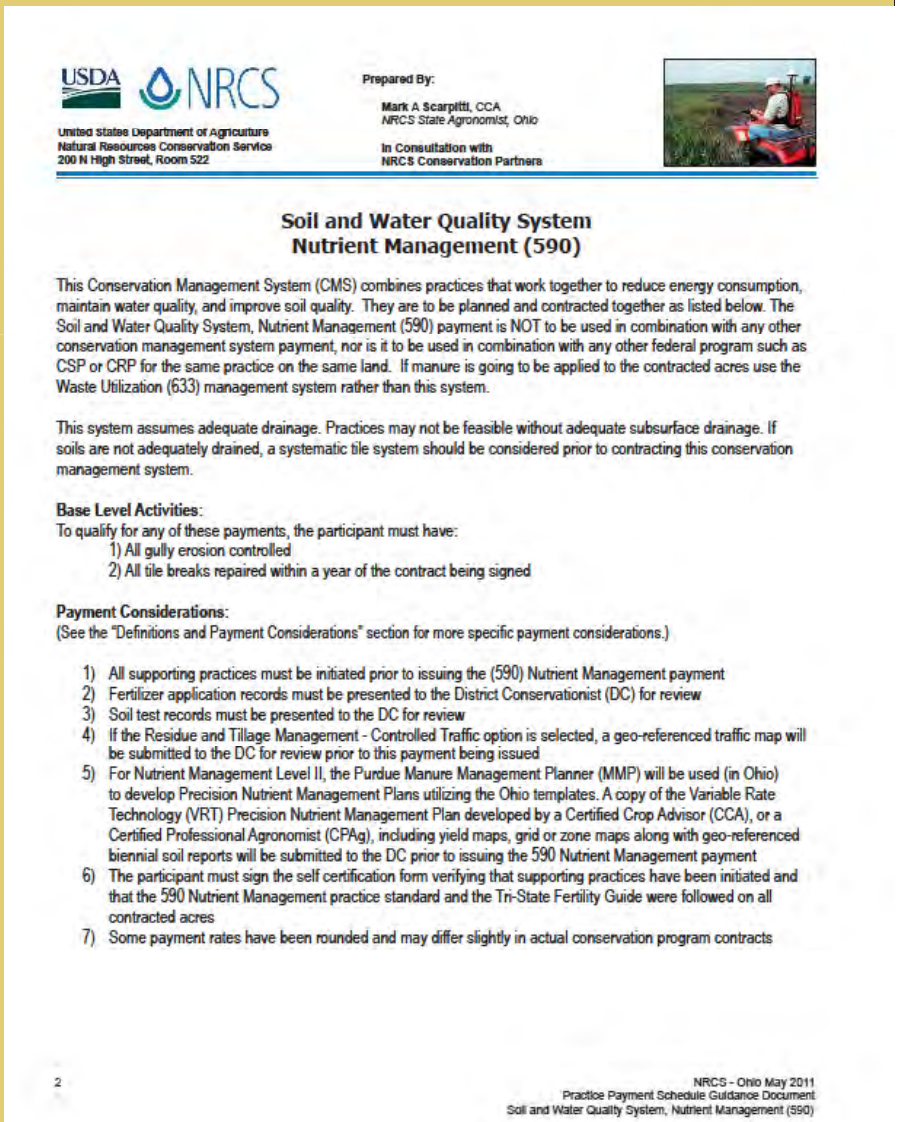
This includes both manure and fertilizer.

When nutrients in surface water are a problem…

The new 590 standard requires a system of practices that work together to avoid, control and trap excessive nutrients.

Conservation Management Systems

Requiring a system of practices is not currently part of the Ohio 590 standard but again we have been requiring this with the 590 Conservation System through EQIP.



USDA NRCS

United States Department of Agriculture
Natural Resources Conservation Service
200 N High Street, Room 522

Prepared By:
Mark A Scarpitti, CCA
NRCS State Agronomist, Ohio

In Consultation with
NRCS Conservation Partners

Soil and Water Quality System
Nutrient Management (590)

This Conservation Management System (CMS) combines practices that work together to reduce energy consumption, maintain water quality, and improve soil quality. They are to be planned and contracted together as listed below. The Soil and Water Quality System, Nutrient Management (590) payment is NOT to be used in combination with any other conservation management system payment, nor is it to be used in combination with any other federal program such as CSP or CRP for the same practice on the same land. If manure is going to be applied to the contracted acres use the Waste Utilization (633) management system rather than this system.

This system assumes adequate drainage. Practices may not be feasible without adequate subsurface drainage. If soils are not adequately drained, a systematic tile system should be considered prior to contracting this conservation management system.

Base Level Activities:
To qualify for any of these payments, the participant must have:
1) All gully erosion controlled
2) All tile breaks repaired within a year of the contract being signed

Payment Considerations:
(See the "Definitions and Payment Considerations" section for more specific payment considerations.)

1) All supporting practices must be initiated prior to issuing the (590) Nutrient Management payment
2) Fertilizer application records must be presented to the District Conservationist (DC) for review
3) Soil test records must be presented to the DC for review
4) If the Residue and Tillage Management - Controlled Traffic option is selected, a geo-referenced traffic map will be submitted to the DC for review prior to this payment being issued
5) For Nutrient Management Level II, the Purdue Manure Management Planner (MMP) will be used (in Ohio) to develop Precision Nutrient Management Plans utilizing the Ohio templates. A copy of the Variable Rate Technology (VRT) Precision Nutrient Management Plan developed by a Certified Crop Advisor (CCA), or a Certified Professional Agronomist (CPAg), including yield maps, grid or zone maps along with geo-referenced biennial soil reports will be submitted to the DC prior to issuing the 590 Nutrient Management payment
6) The participant must sign the self certification form verifying that supporting practices have been initiated and that the 590 Nutrient Management practice standard and the Tri-State Fertility Guide were followed on all contracted acres
7) Some payment rates have been rounded and may differ slightly in actual conservation program contracts

When nutrients in surface water are a problem…

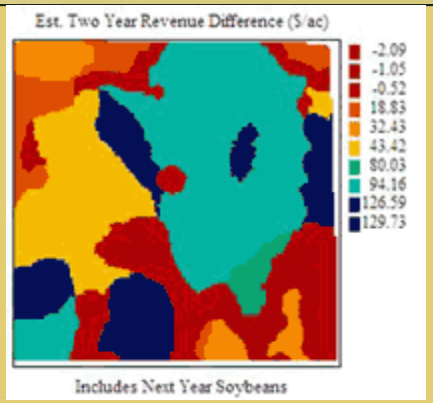
Nutrient efficiency / technologies strategies that are to be considered

1. Slow and controlled release fertilizers
2. Nitrification inhibitors and urease inhibitors
3. Enhanced efficiency fertilizers
4. Incorporation or injection
5. Timing and number of application
6. Soil nitrate and organic N testing
7. Coordination of nutrient applications with crop nutrient uptake
8. CSNT, PSNT, PSNT
9. Tissue testing chlorophyll meters, and spectral analysis technologies
10. Other land grant university recommended technologies that improve nutrient use efficiency and minimize surface or groundwater concerns.

Promotes Adaptive Nutrient Management

1. “A process used to plan, implement, evaluate, and adjust nutrient application strategies over time (multiple seasons).
2. Must follow prescribed NRCS protocols

Promotes Precision Nutrient Management



- Use variable-rate nitrogen...
- Use variable-rate phosphorus...
- Develop site-specific yield maps...
- Use the data to further diagnose low- and high- yield areas, or zones, and make the necessary management changes.

Again already a requirement in the 590 Conservation System through EQIP.

Proper Nutrient Management

- Reduces nutrients in surface and ground water
- Improves the efficiency of crop uptake
- Improves profits

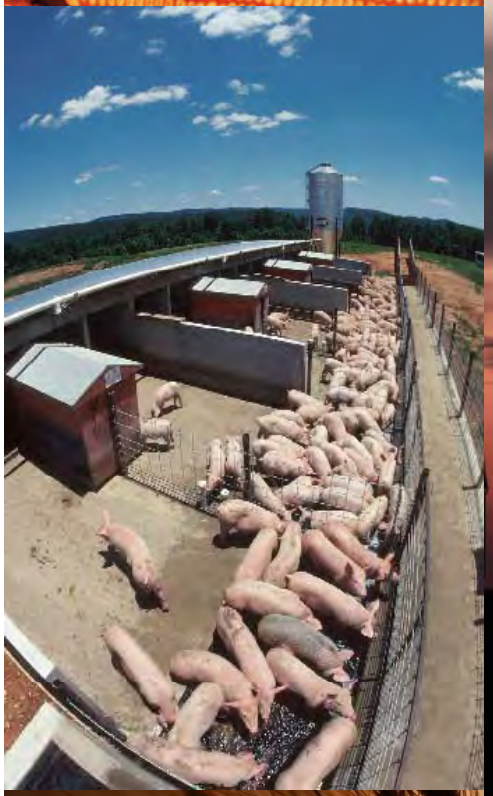
What is good for the environment...
is good for the producer

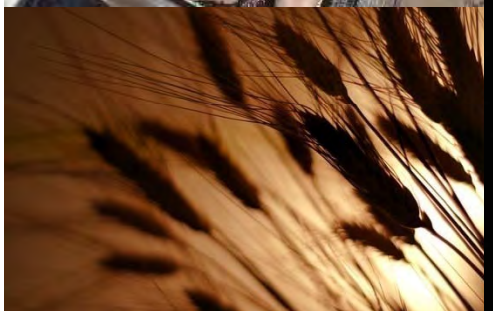
Everyone benefits from a sustainable system that improves soil and water quality...

as well as the bottom line.

Contact your local SWCD,
Your local NRCS District Conservationist
Or me for more information.

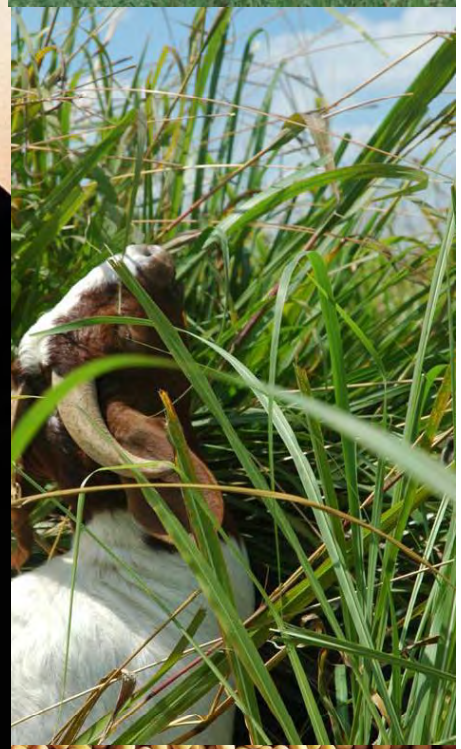
Helping People Help the Land





Agriculture…

It’s what feeds the world.




August 16, 2011

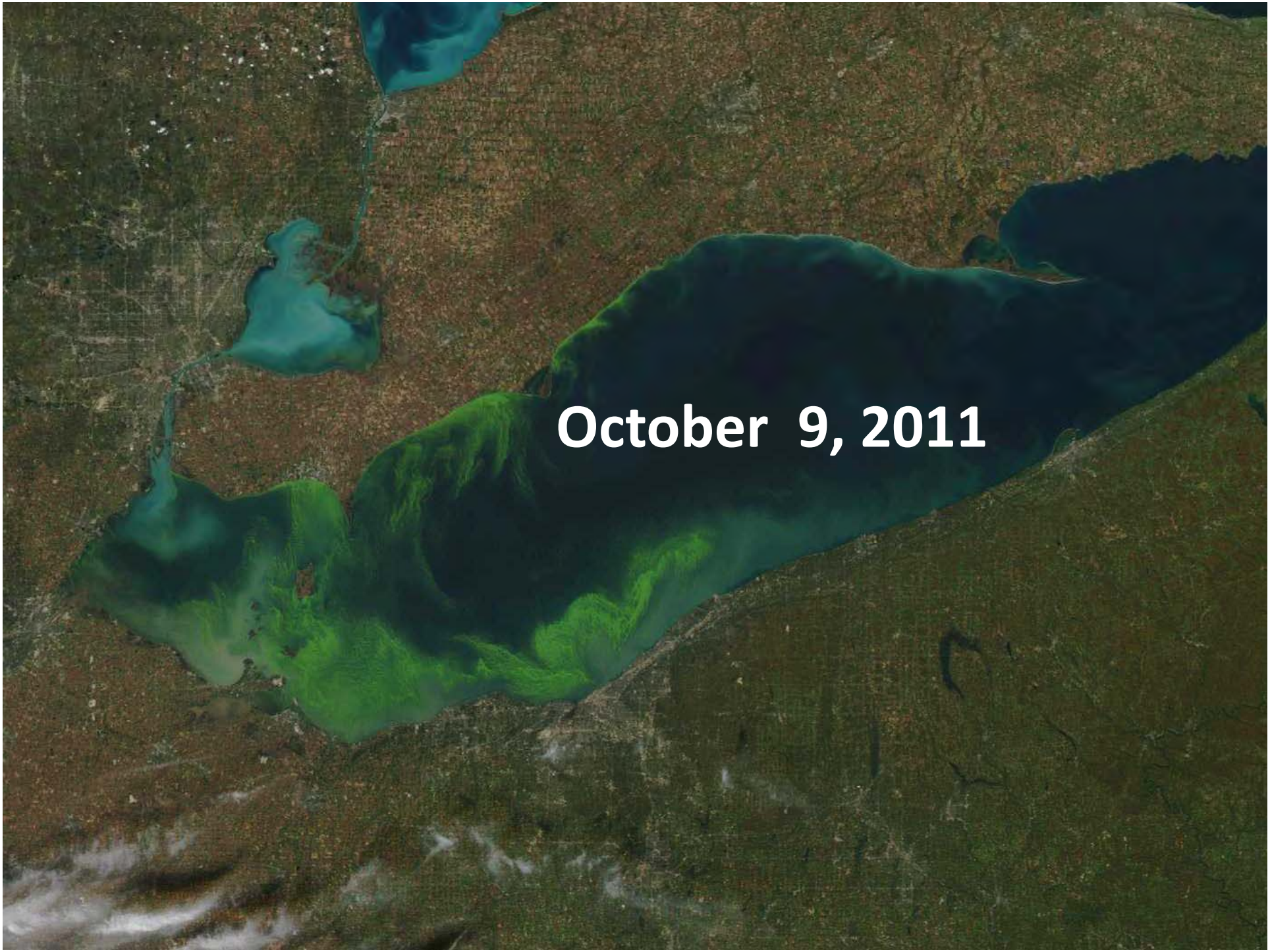

August 16, 2011


August 16, 2011


August 16, 2011


October 9, 2011


August 16, 2011


October 9, 2011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Toledo
Cleveland
January 20, 2012