Lawn Care Best Management Practices for Protecting Water Quality

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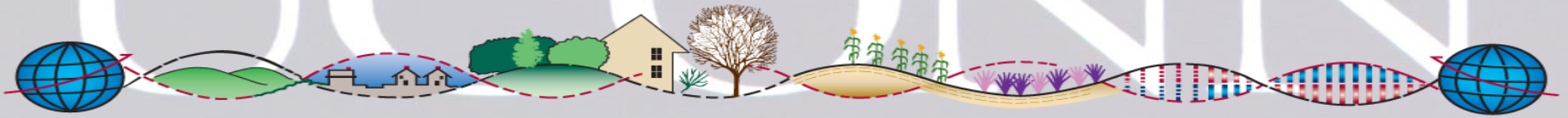
Landscaping for Water Quality in the Sunapee Area
New Hampshire Extension
Sunapee, NH
March 30, 2018



Reinforce Concept of Lawn BMP's and Water Quality

http://www.fourseasonssir.com/community/nh/lake-sunapee/sunapee/

Common Sense Lawn Practices and Water Quality

https://whereyouareplanted.com/fertilizer-on-your-sidewalk-helps-pollution-grow/

https://www.themasterslawncare.com/blog/do-i-really-need-sprinkler-rainfreeze-sensor

http://www.lakesuperiorstreams.org/understanding/impact_fertilizer.html

http://ecologywa.blogspot.com/2012/08/good-yard-care-practices-help-protect.html

http://lusciouslandscapes.blogspot.com/2015/03/revivin

https://www.yelp.com/biz/chesterfield-lawns-and-landscapes-chesterfield

Water Quality Perspective

- Nutrients
  - Phosphorus
  - Nitrogen
- Sediment
- Pesticides (not so much, although they should not be ignored!)

Current New Hampshire Regulations State Statute (RSA: 431) as modified in 2013

- **Lawn fertilizers sold retail shall not exceed 0.9 lbs. total N per 1,000ft^2 per application.**
- **At least 20% N must be slow release form.**
- **Lawn fertilizers sold retail shall not exceed 0.7 lbs. per 1,000ft^2 of soluble N per application.**
- **Shall not exceed annual application rate of 3.25 lbs. per 1,000ft^2 total N.**
- **Illegal to apply any fertilizer within 25 feet of reference or high water line. Only lime can be applied within 25 feet of reference line. Beyond 25 feet but within 50 feet, only low P and slow release N (SRN) fertilizers may be used.**

- **P sold retail should be used only on newly established or repaired lawns, or on lawns testing deficient in P.**

- **Annual applications may not exceed a rate of 1 pound per 1,000ft^2 of available P (P_2O_5).**

- **No fertilizer sold retail intended for use on newly established or repaired lawns, or for lawns testing deficient in P shall exceed an application rate of 1 pound per 1,000ft^2 annually of available P (P_2O_5).**

- **Illegal to apply any fertilizer within 25 feet of reference or high water line. Only lime can be applied within 25 feet of reference line. Beyond 25 feet but within 50 feet, only low P and slow release N (SRN) fertilizers may be used.**

https://extension.unh.edu/Sustainable-Landscapes-and-Turf/Environmental-Turf-Management

University of New Hampshire
Cooperative Extension

Food & Agriculture

AGRICULTURE FACT SHEET
Spring 2014

New Hampshire's Turf Fertilizer Law
What You Should Know

MARGARET HAGEN, Extension Field Specialist

Introduction

Nitrogen and phosphorus are nutrients essential for the growth of plants. However, an overabundance of these nutrients causes pollution in waterways. In New Hampshire, more than half of the nitrogen pollution to Great Bay can be traced back to urban and suburban nonpoint source pollution, including fertilizer runoff.* Nonpoint source (NPS) pollution, unlike pollution from industrial and sewage treatment plants, comes from many different sources. NPS pollution is caused by rainfall or snowmelt moving over and through the ground. As the runoff moves, it picks up and transports natural and human-made pollutants, finally depositing them into lakes, rivers, wetlands, coastal waters and ground waters.**

Once in our waterways, fertilizers designed to make our lawns lush and green may cause harmful algae blooms. As algae grow and then decompose, they block sunlight from reaching aquatic plants, rob the water of oxygen, and threaten underwater life. Algae blooms also reduce water clarity which can lead to fewer opportunities for fishing and swimming.

When fertilizers, either synthetic or organic, are applied in the proper amounts at appropriate times during the growing season, lawns will thrive and the risk of fertilizer nutrients entering our waterways will be reduced. Because of concerns over lawn fertilizer runoff, the New Hampshire legislature passed a bill in 2013 regulating the use of nitrogen and phosphorus in turf fertilizers that are sold at retail. The goal is to help homeowners maintain healthy lawns without applying unnecessary fertilizer.

FERTILIZE RESPONSIBLY

- **Nitrogen Content Reduced**
  Lawn fertilizers sold at retail shall not exceed 0.9 pound of total nitrogen applied per 1,000 square feet per application when applied according to the label. At least 20% of the nitrogen must be in slow release form.
- **Phosphorus-Free**
  Most NH soils provide all the phosphorus that a home lawn needs. Phosphorus sold at retail should be used only on newly established or repaired lawns, or on lawns testing deficient in phosphorus. Annual applications may not exceed a rate of 1 pound per 1,000 square feet of available phosphate.

When purchasing lawn fertilizers, the bag is labelled with a guaranteed analysis consisting of three numbers such as 22-0-3. These numbers stand for the percent, on a dry weight basis, of nitrogen, phosphorus (as phosphate), and potassium (as potash) contained in that fertilizer. These three nutrients are not available in sufficient quantities in many existing soils so we add them to the soil in

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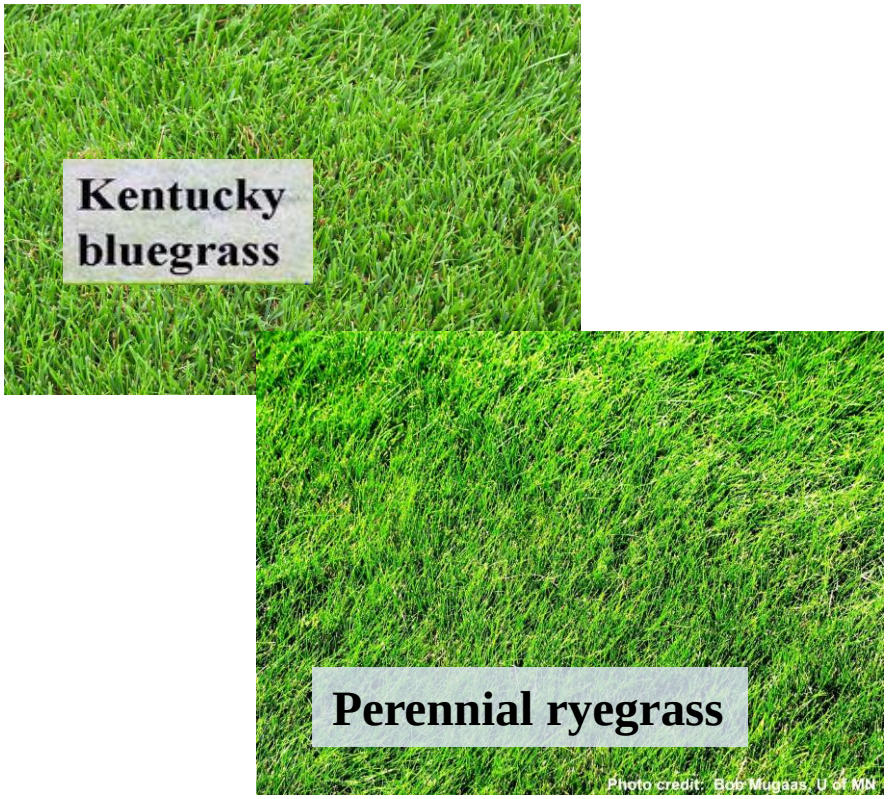
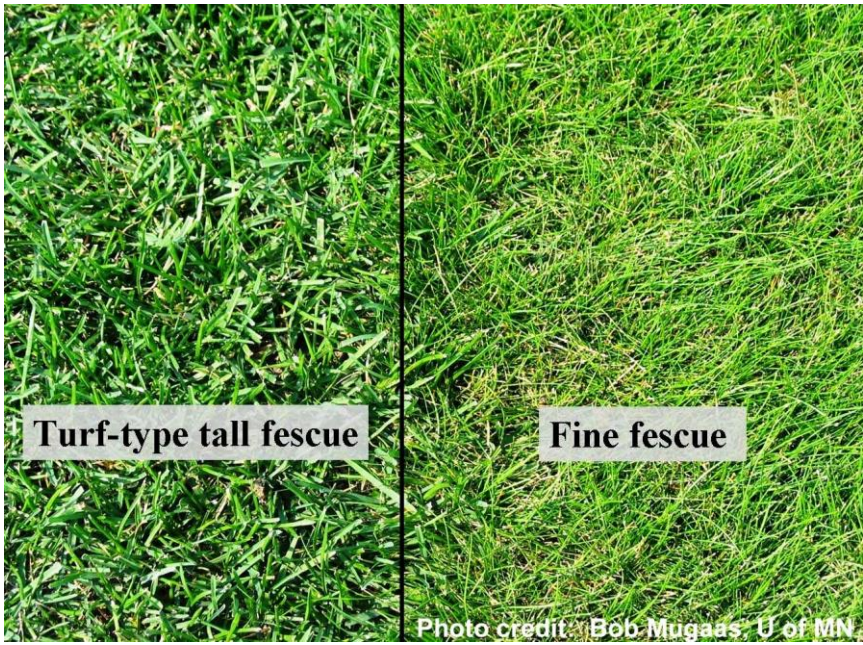
Addressing Water Quality for Turfgrass in the Landscape

- Selection of Species – Higher vs. Lower Maintenance Requirements
- Mowing Heights and Clippings Management
- Water Management – Follow the Water
- Nutrients
- Pesticides
- Sediment

Selection of Species – Higher vs. Lower Maintenance Requirements

- **Kentucky bluegrass and Perennial ryegrass vs. Fescues**



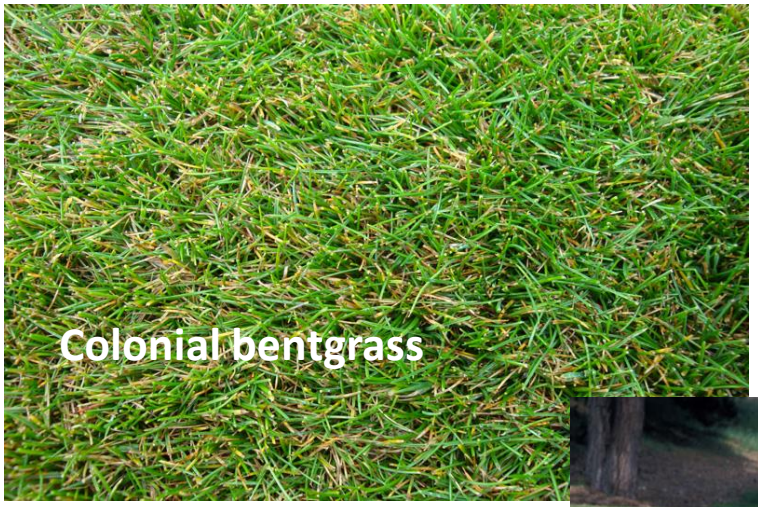


Creeping red, Chewings, and Sheep

http://www.extension.umn.edu/garden/landscaping/maint/ts-selecting-cool-season.htm

Alternative Low-Input Species

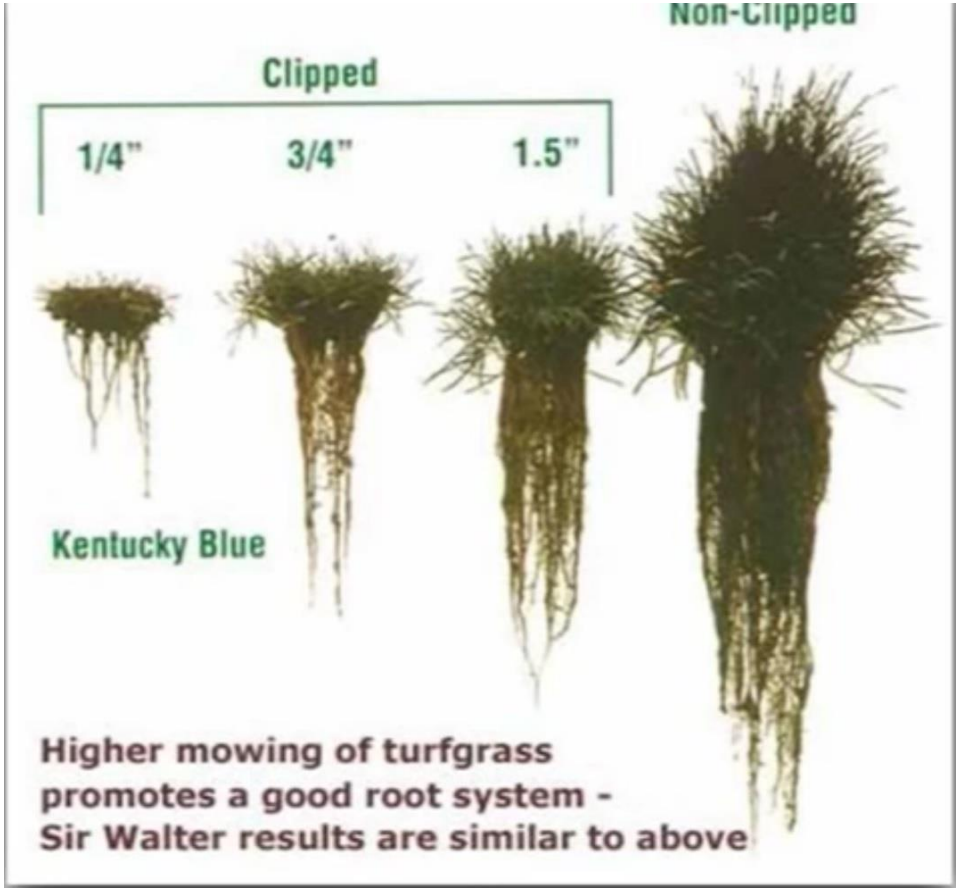
- Bentgrasses (*Agrostis* spp.)
  - Colonial bent (*A. tenuis* or *capillaris*)
  - Highland bent (*A. castellana*)
  - Redtop (*A. gigantia*)
- Junegrass (*Koeleria* spp.)
- Hairgrass (*Deschampsia* spp.)
- Poverty oatgrass (*Danthonia* spp.)
- Zoysiagrass (*Zoysia japonica*)?



http://www.finegolf.co.uk/what-is-fine-golf/green-keeping/fine-turf/
http://www.turfgrassproducts.com/seed.html
https://www.pinterest.com/pin/362891682452749587/
http://zoysias.com/
http://nativeson.com/annotated_catalog/grasscatalog.htm

Mowing Heights and Clippings Management

- **Cut it High – Let it Lie**



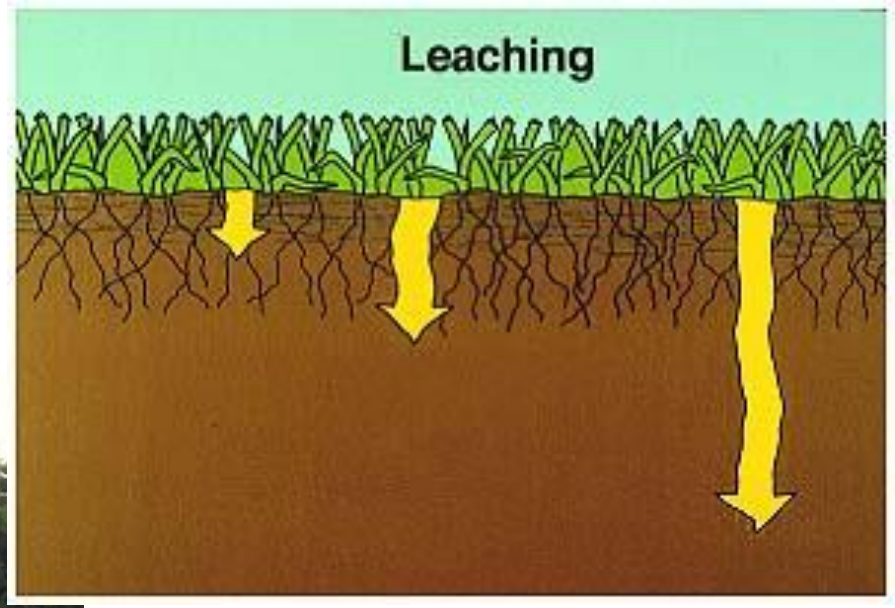
http://www.casperwy.gov/residents/environment_and_waste/yardwaste_and_composting
http://www.beaverlakesmart.org/blog/2015/05/lawn-management-for-protecting-water-quality/

- **Clippings back on Turf**

http://www.stormwater.allianceforthebay.org/take-action/habits-to-help/lawn-and-garden-care/attachment/olympus-digital-camera-2
http://www.cityofoxford.org/news/2014/06/reminder-keep-grass-clippings-out-streets-gutters-and-storm-drains

Water Management – Follow the Water

- **Water transport of Nutrients, Sediment, Pesticides**
  - ❑ **Leaching**
  - ❑ **Runoff**



http://www.personal.psu.edu/faculty/a/s/asm4/turfgrass/education/turgeon/lessons/lesson13/corefiles/links/pestdanger/leach1.html
https://www.neponset.org/happenings/think-twice-before-irrigating-your-lawn/

Reported range of turfgrass ET by species

Common Name	Scientific Name	ET[+] (mm day^{-1})	Inch/wk
Tall Fescue	*Festuca arundinacea*	7-13	2.0-3.8
Perennial Ryegrass	*Lolium perenne*	7-11	1.8-3.1
St. Augustinegrass	*Stenotaphrum secundatum*	6-11	
Seashore Paspalum	*Paspalum vaginatum*	6-8	
Bahiagrass	*Paspalum notatum*	6-8	
Kikuyugrass	*Pennisetum clandestinum*	6-9	
Creeping Bentgrass	*Agrostis Palustris*	6-10	
Centipedegrass	*Eremochloa ophiuroides*	5-9	
Bermudagrass	*Cynodon spp.*	4-9	
Zoysiagrass	*Zoysia spp.*	5-8	
Kentucky Bluegrass	*Poa pratensis*	4-7	1.1-1.8
Buffalograss	*Buchloe dactyloides*	3-6	1.5-2.0

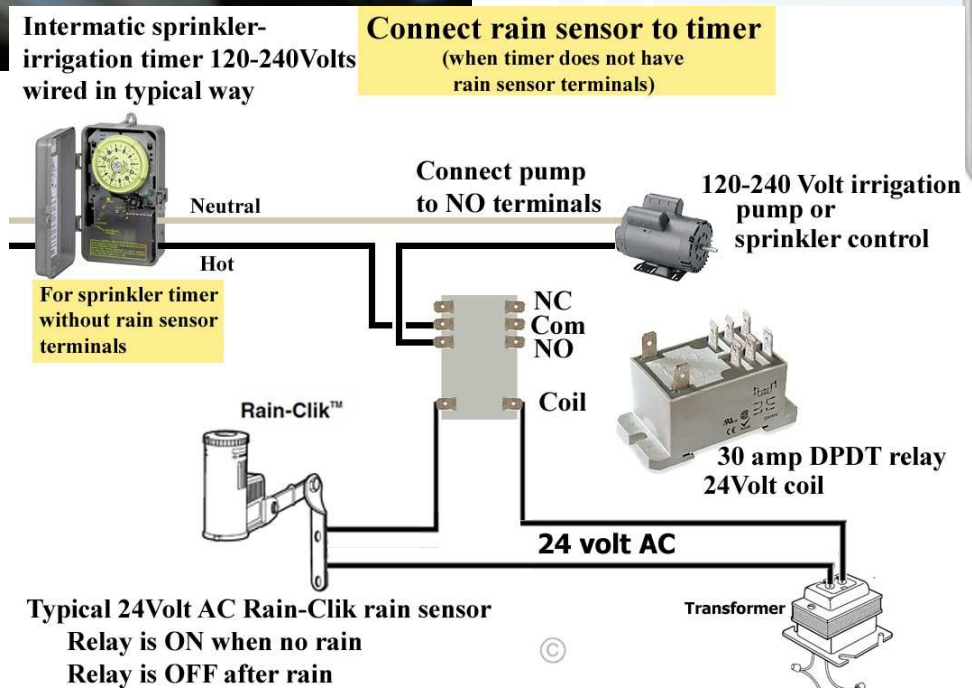
[+]Field grown under high evaporative demand conditions

https://www.slideshare.net/sherylwil/turf-drough-tresistance

- **Less Frequent and Deeper Watering**
- **Concept of Deficit Irrigation**

https://myturfandgarden.com/content/Lawn-Care-Basics.asp

• Rain Sensor Cut Offs



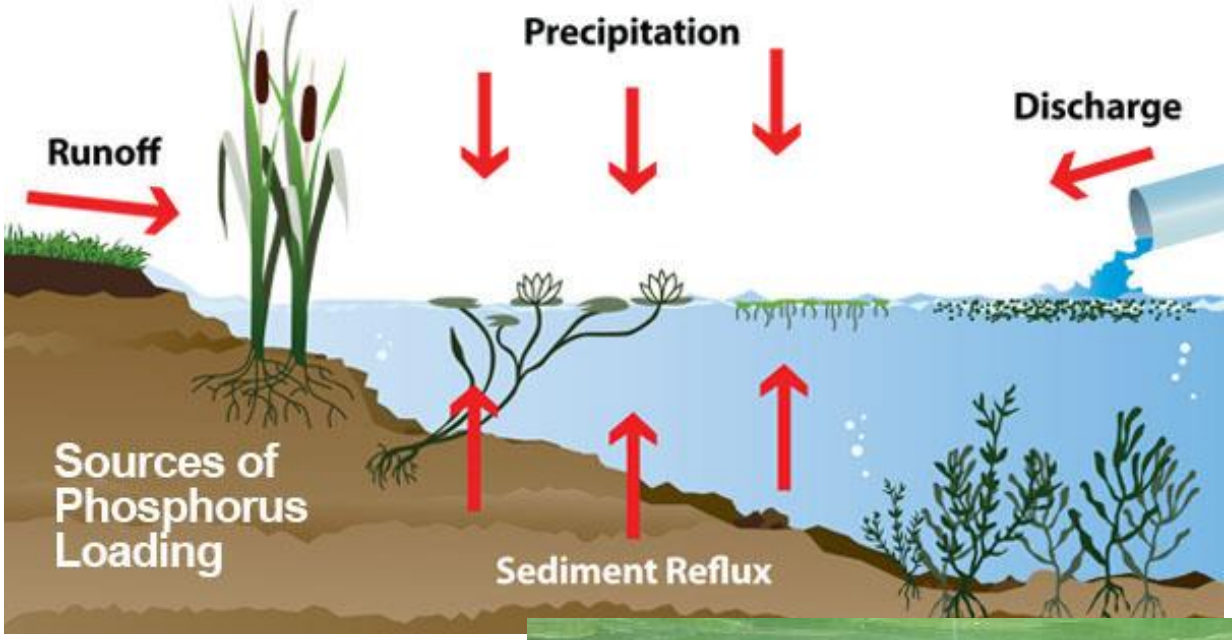
landscaping/rainsen.asp?utm_source=PublicWorks&utm_medium=RainSensor&utm_campaign=QuickLinks
http://www.rainbird.com/homeowner/products/timers/ESP-SMTe.htm
http://waterheatertimer.org/How-to-wire-Intermatic-sprinkler-timers.html

Nutrients

- **Both Phosphorus (P) and Nitrogen (N) need to be managed carefully!**
  - **Nitrogen enhances eutrophication caused by excess Phosphorus in fresh water lakes and ponds**
  - **Phosphorus enhances eutrophication caused by excess Nitrogen in estuaries and coastal salt-waters**

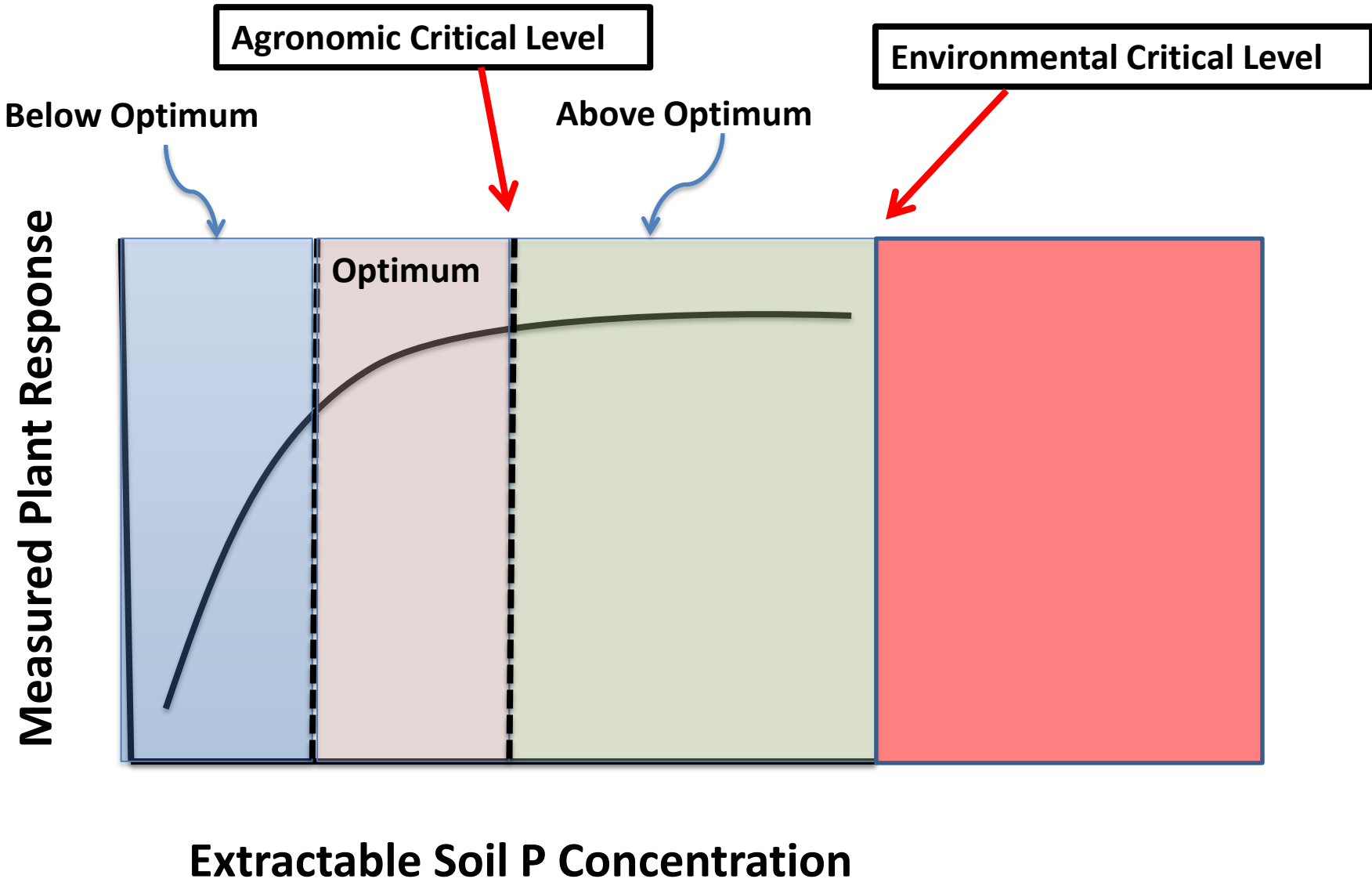
Conley et al., 2009. Controlling eutrophication: Nitrogen and phosphorus. Science 20 Feb., vo. 323:1014-1015; vol. 324:721-725

Phosphorus



http://www.solitudelakemanagement.com/a-proven-solution-for-reducing-phosphorus-pollution-in-ponds1

Plant Response to Soil Test Phosphorus



Soil Test – Don't Guess!

Test Data

pH - Soil (pH)	6.5			Optimum Range
Mehlich - Lime Test (Buffer pH)	6.25			
Calcium, Mehlich 3	1366.8	(ppm)	H	800 - 1200
Magnesium, Mehlich 3 (Mg)	362.0	(ppm)	VH	60 - 120
Potassium, Mehlich 3 (K)	146.0	(ppm)	L	170 - 280
Phosphorus, Mehlich 3 (P)	129.0	(ppm)	VH	30 - 50
Est. CEC	10.2			
Est. Base Sat.	100.0	%		
Est. Ca Sat.	66.8	%		
Est. Mg Sat.	29.5	%		
Est. K Sat.	3.7	%		

http://www.bbmaintenanceservices.com/soiltesting.htm

Optimum Range Key

VL - Very Low L - Low M - Medium H - High VH - Very High

Turf and Dissolved P in Runoff

- **Increasing Soil Test P does correspond to greater amounts of Dissolved P in runoff**

http://www.fairfaxcounty.gov/nvswcd/drainageproblem/control-runoff.htm

http://www.berkeleyside.com/2014/05/cal-city-of-berkeley-take-steps-to-curb-water-use/

http://turfblog.rutgers.edu/?p=856

- **High-intensity rainfall**
- **Over/misadjusted irrigation**
- **Frozen ground/snow melt**
- **Compacted soil**

http://ocean.njaes.rutgers.edu/UnderstandingSoilCompaction.html

http://www.diychatroom.com/f16/standing-water-after-snow-melt-heavy-rain-457777/

Just Because Fertilizer is Organic Doesn't Mean No Threat to Water Quality

- Once nutrients mineralized to ionic forms, they can runoff or leach.
- Doesn't matter if original source is synthetic or organic.
- Excess is Excess.

New England/Northeast Organic Farm Survey (Morris et al.)

- **Collect soil samples for routine fertility analysis in 2002 and 2003, and for nitrate in 2002 and 2004 from organic vegetable fields**
- **Collect field history of nutrient management on farm from each grower**
- **Not a random sample of farms**
- **5 states, ME, NH, MA, CT, NJ**
- **34 farms (4-7 farms/state)**
- **203 fields (1-9 fields/farm; most 5-6 fields/farm)**

Modified-Morgan Extractable P

P, lbs/ac	# of fields (n=203)	% of fields
< 14	65	32.0
14 to 20	31	15.3
21 to 39	51	25.1
> 40	56	27.6
Optimum range is 14 to 20		
Mean 68.2; median 21.5; range 1 to 99		

Soil P Values to Monitor Organic Amendment Additions

- **Soil Test P was significantly related to soil test K, Mg, Ca, and *soil OM***
- ***Soil OM* had the greatest influence on Soil P**
- **Soil test P significantly related to years in organic: fields > 16.3 yrs of application much greater P**

Nitrogen

http://www.sjrwmd.com/waterbodies/pollutionsources.html
http://befreshwaterfriendly.org/yard-savvy/

Nitrogen

- Application rates, timing, and formulations
- Slow vs. Fast Release forms
- Synthetic vs. Organic
- Timing – Fall Fertilization
- Fertilizer Substitution – Clovers and other legumes
- Maintain soil pH near neutral
- No- or Low-Fertilizer Buffer Strip Adjacent to Water Sources

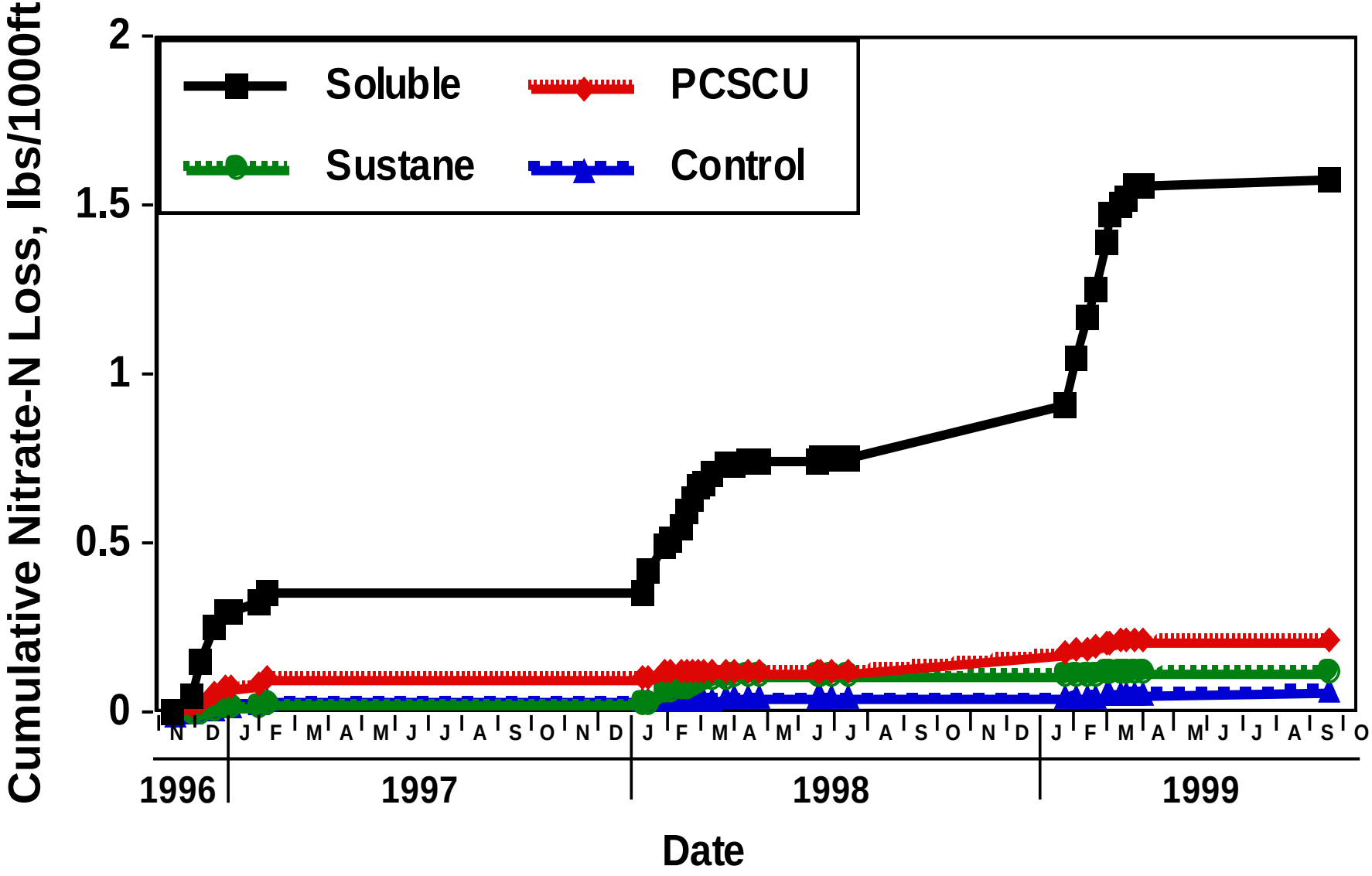
What Guides N Fertilization for Turfgrass?

- Historical; Routine
  - ❑ Usually 0.5-1.0 lb per 1000ft^2, 2-4 or more times a year for ***high-cut turf***
  - ❑ much lower rates and more frequently for ***low-cut turf***; every 10-14 days)
- Subjective Assessment (usually based on color and density; or sports surface performance)
- Expected needs of specific grass species
- Objective Tests are not routinely used

Without Objective Guide for Nitrogen

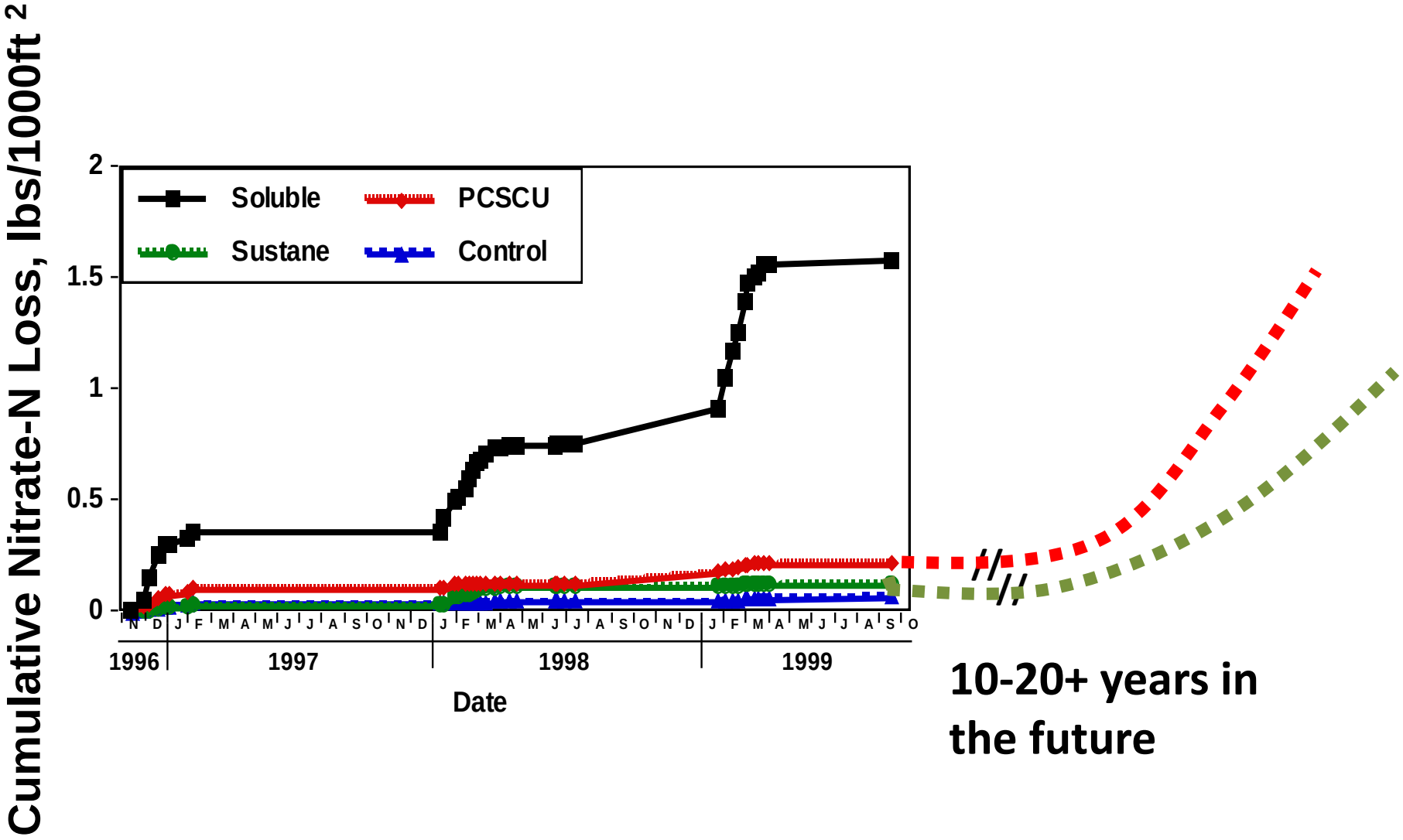
- For older established lawns, apply ½ to ⅓ (or less) of that recommended on fertilizer bag label.
- Reapply only when lawn response starts to fall below acceptability.
- Slow-release formulations are more preferable than soluble, fast-release formulations.

Nitrate Leaching as Function of Formulation



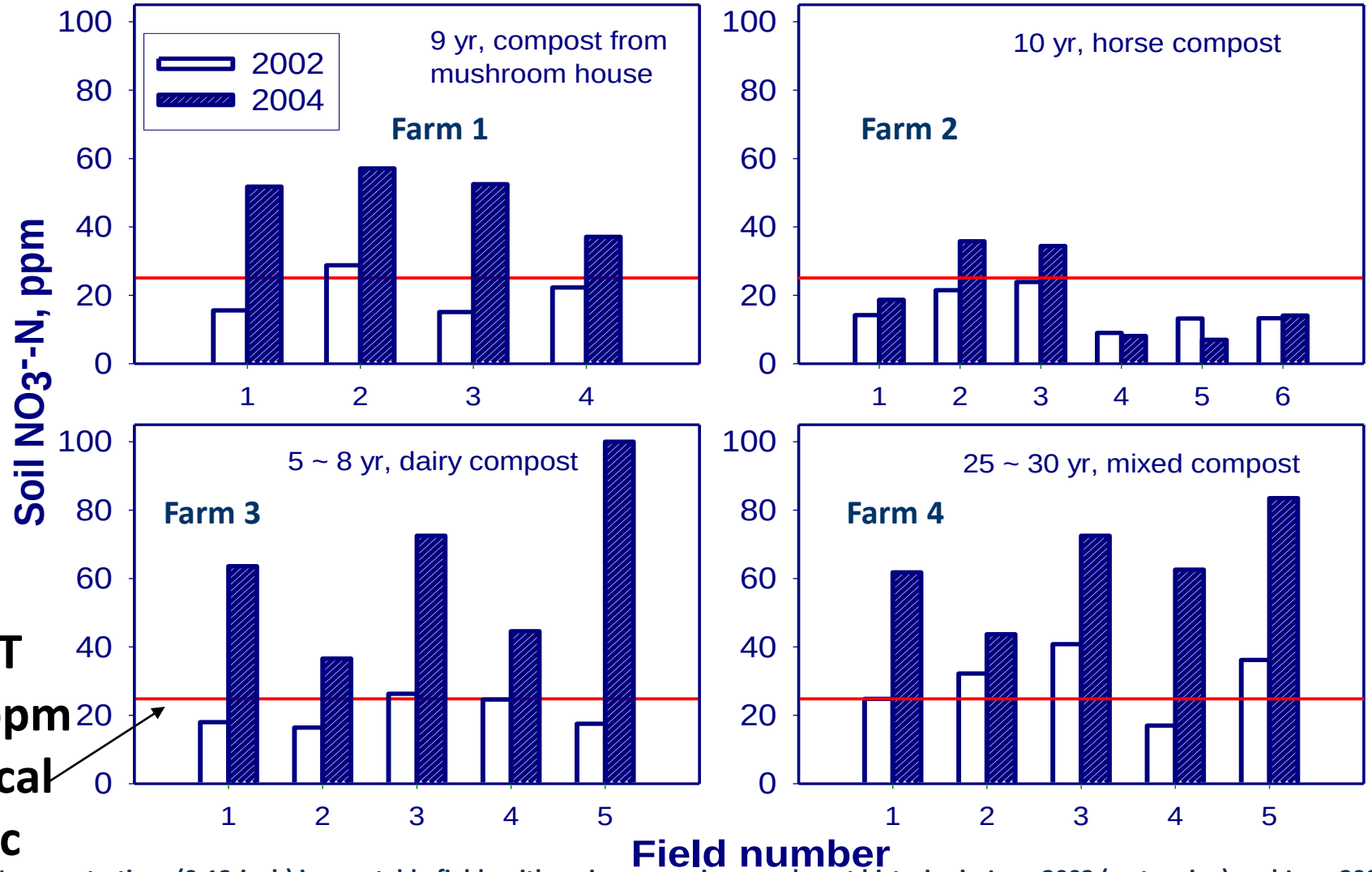
Guillard and Kopp (*J. Environ. Qual*. 33:1822-1827, 2004)

But, What are Long-Term Effects Of Slow-Release N?



Guillard and Kopp (*J. Environ. Qual*. 33:1822-1827, 2004)

New England/Northeast Organic Farm Survey (Morris et al.)



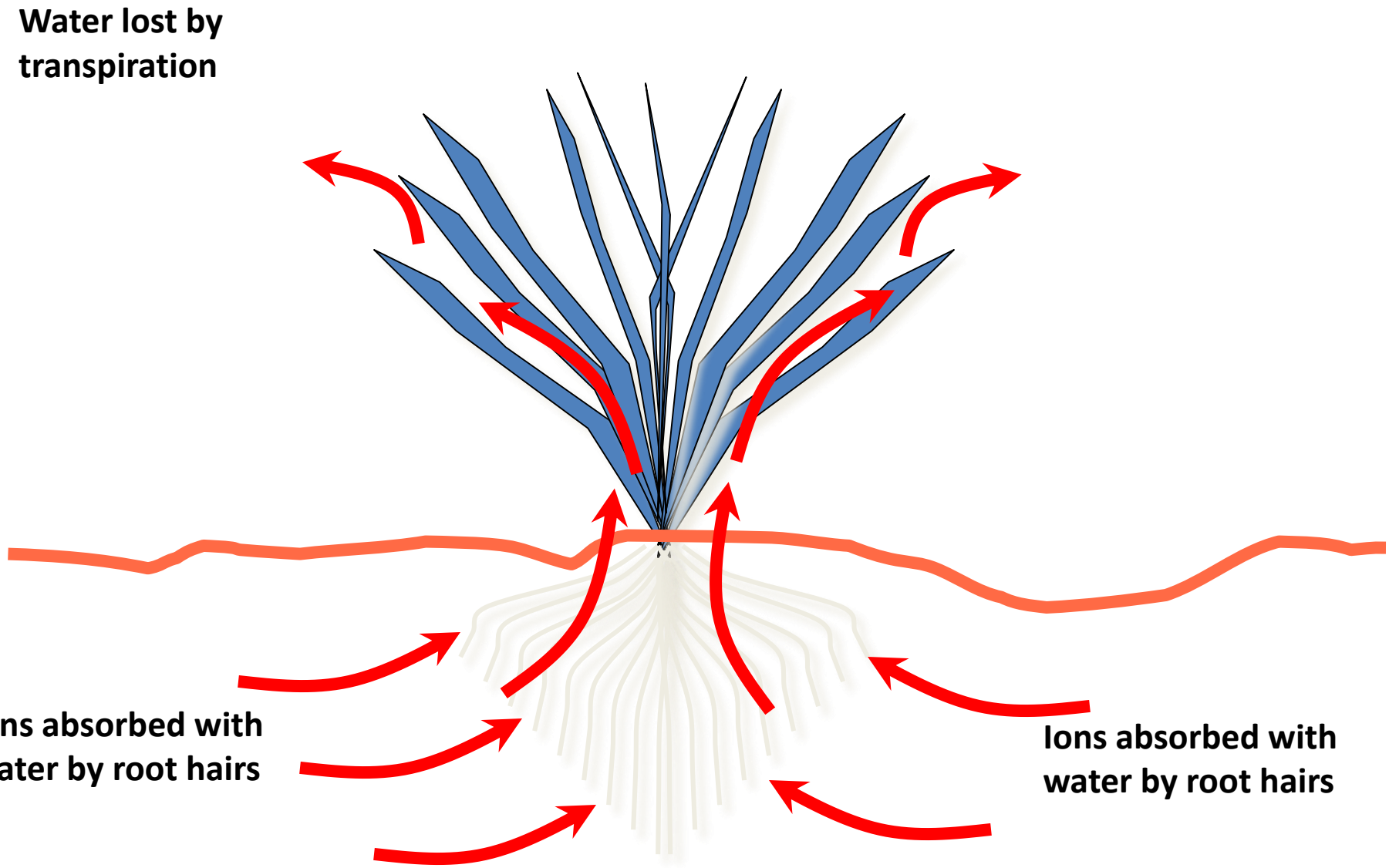
Soil nitrate-N concentrations (0-12-inch) in vegetable fields with various organic amendment histories in June 2002 (wet spring) and June 2004 (normal spring)

Fall Fertilization
Agronomic Benefits

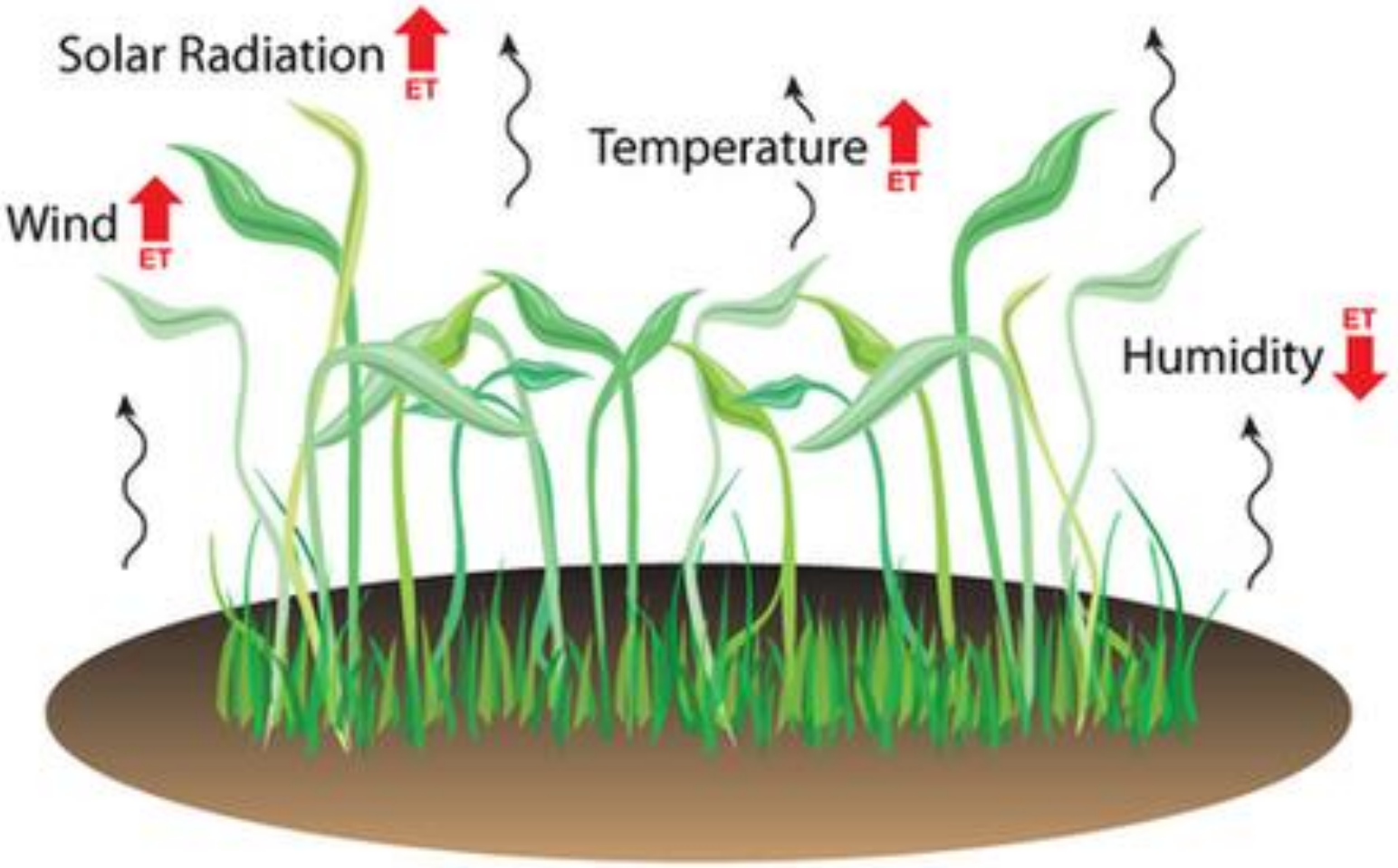
What Risk to Water Quality?

- Agronomic benefits limited with later fall application dates.
- Higher probability of N loss with later fall application dates.
- In my opinion fall fertilization represents greatest risk to water quality other than establishment and gross over-application.
- Earlier cutoff date, lower rates, or rethinking of practice must be considered.

Mechanism of Nitrogen Uptake Related to Transpiration and Mass Flow



What is Likelihood of Sufficiently High Transpiration Rates in Late Fall to Drive Uptake of Large Volume of Soil Water?



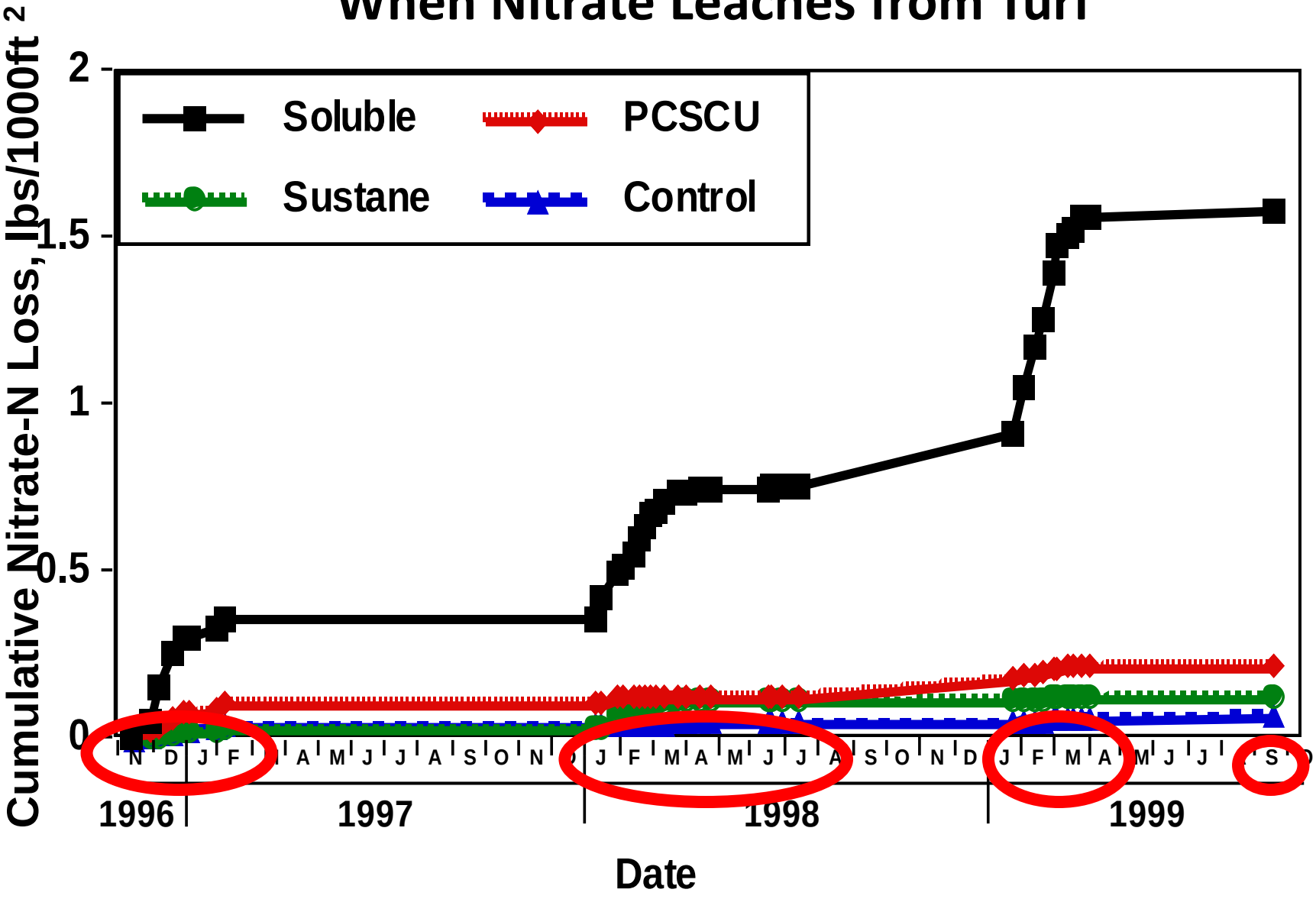
https://www.campbellsci.com/blog/evapotranspiration-101

Potential Evapotranspiration (average monthly; inches) 1981-2010

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Concord, NH	0.33	0.53	1.17	2.2	3.46	3.97	4.42	3.84	2.48	1.42	0.63	0.35
Caribou, ME	0.17	0.3	0.73	1.51	2.88	3.39	3.64	3.07	1.84	0.89	0.31	0.16
Bangor, ME	0.27	0.45	0.98	1.86	3.11	3.56	3.91	3.42	2.20	1.20	0.49	0.27
Burlington, VT	0.24	0.42	0.97	1.96	3.26	3.74	4.13	3.47	2.18	1.13	0.45	0.23
Portland, ME	0.33	0.52	1.08	1.91	3.09	3.61	4.08	3.54	2.30	1.29	0.58	0.34
Worcester, MA	0.33	0.51	1.12	2.03	3.2	3.59	4.03	3.49	2.27	1.31	0.59	0.33
Boston, MA	0.37	0.57	1.15	1.95	3.09	3.58	4.02	3.49	2.29	1.36	0.63	0.37
Hartford, CT	0.39	0.61	1.31	2.28	3.56	4.02	4.45	3.74	2.52	1.54	0.72	0.41

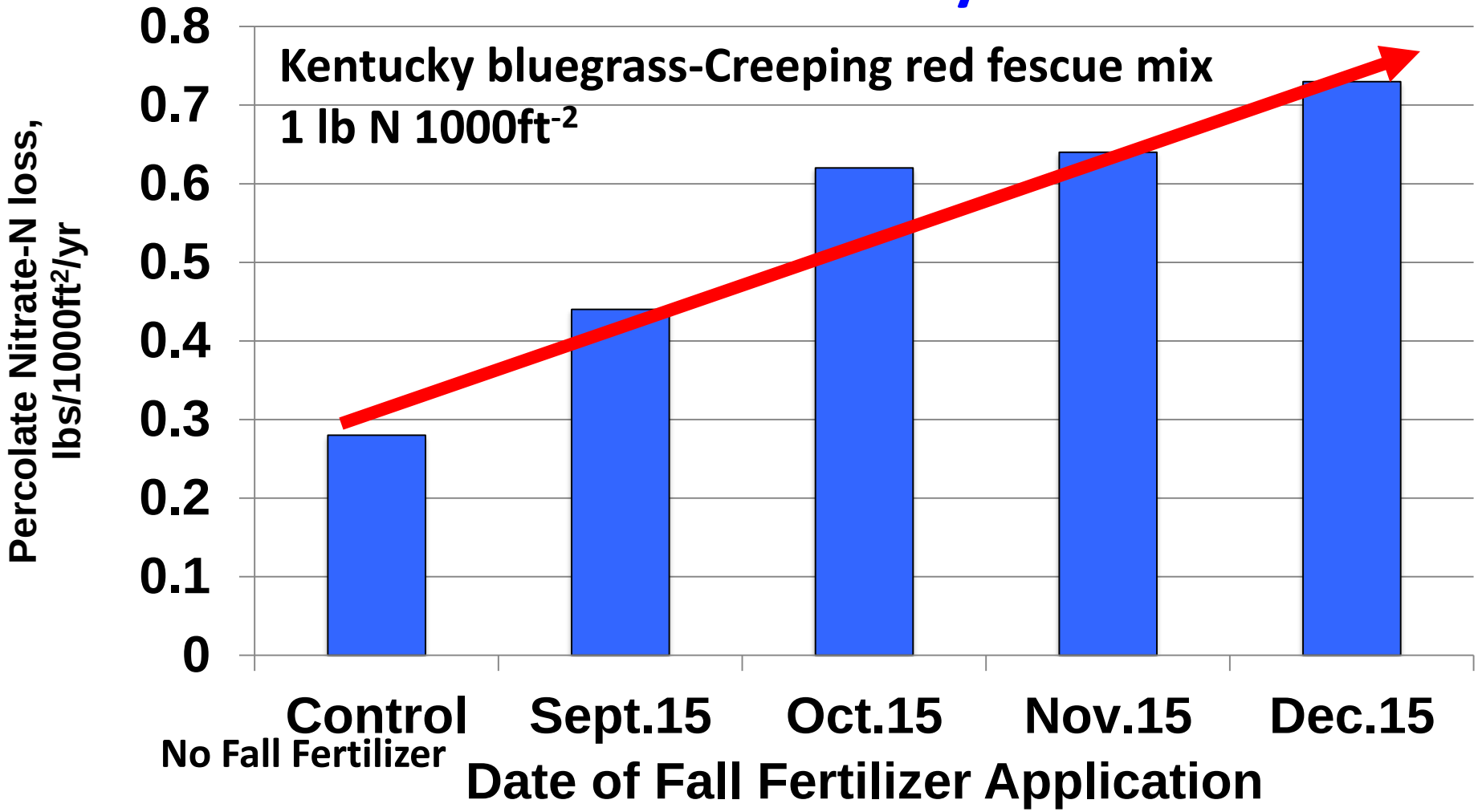
http://www.nrcc.cornell.edu/wxstation/pet/pet.html

When Nitrate Leaches from Turf



Guillard and Kopp (*J. Environ. Qual*. 33:1822-1827, 2004)

University of Connecticut



Mangiafico and Guillard
(*J. Environ. Qual.* 35:163-171, 2006)

University of Wisconsin

Lloyd et al. 2011, HORTSCIENCE 46(11):1545–1549

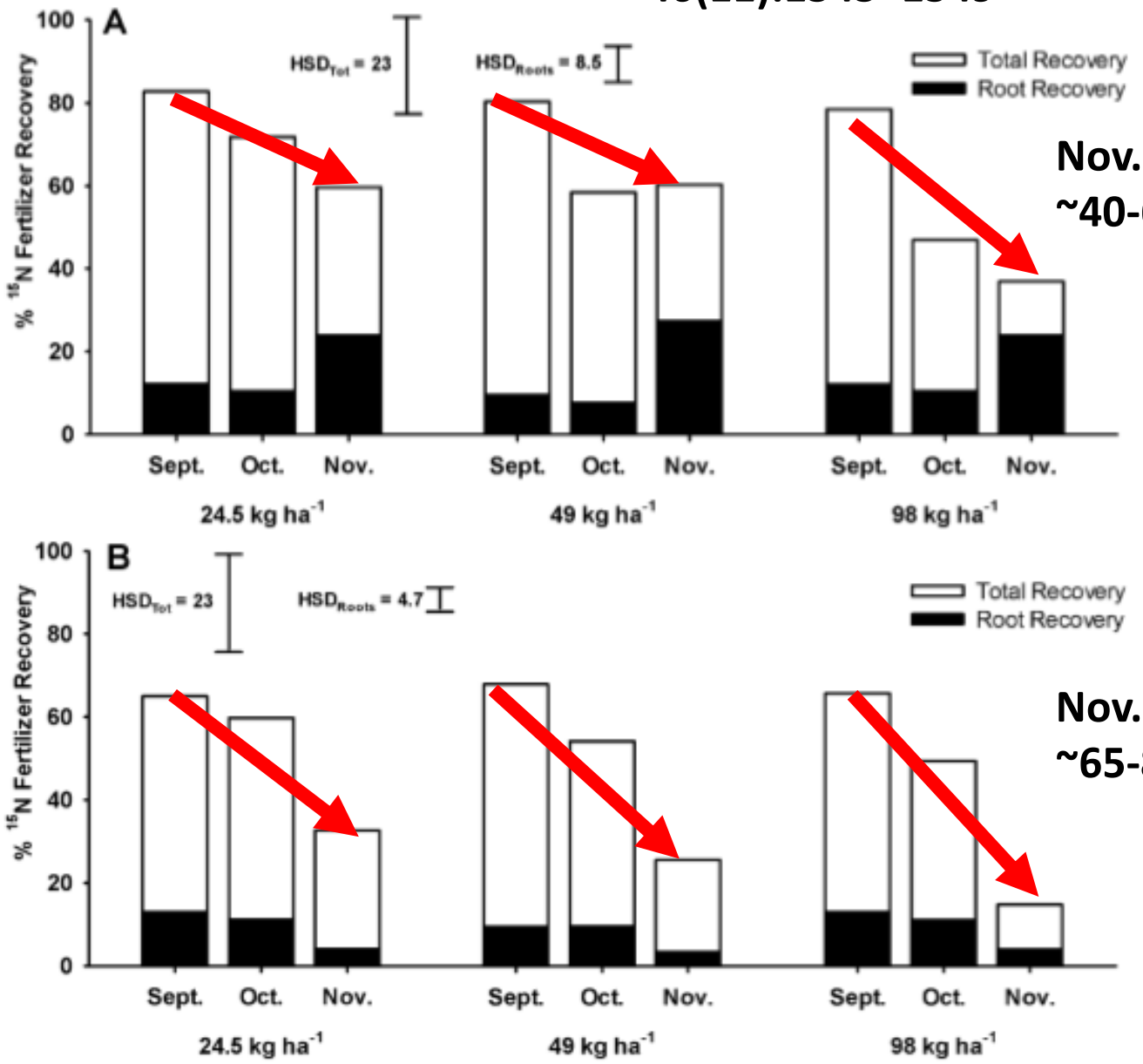
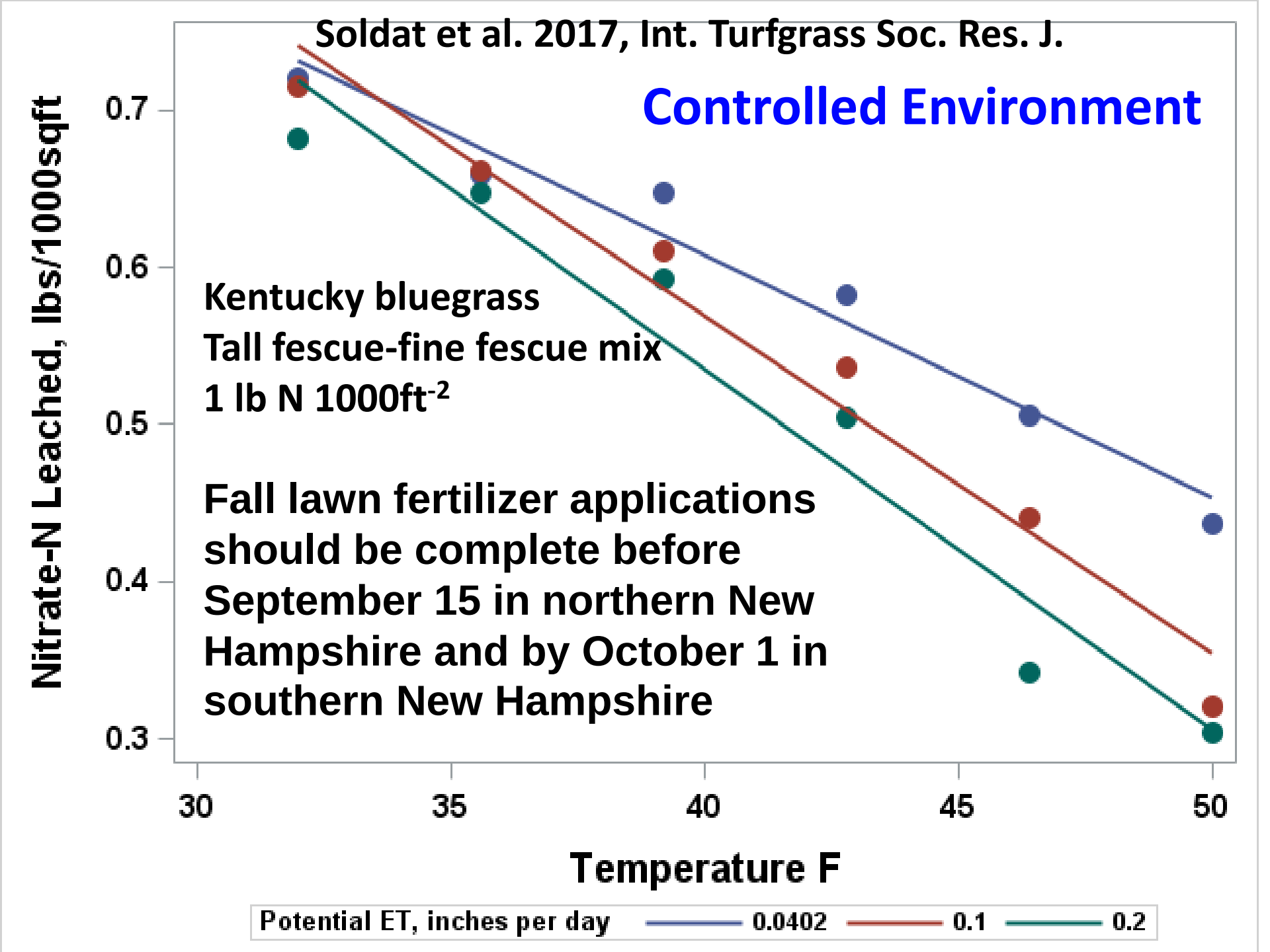


Fig. 1. Effect of temperature regimen and nitrogen application rate on ^{15}N fertilizer recovery in roots and roots + verdure (total) for (**A**) Run 1 and (**B**) Run 2. Roots and verdure were harvested 10 d after nitrogen application. Temperature regimens correspond to 15 Sept., 15 Oct., and 15 Nov. in Madison, WI.


Soldat et al. 2017, Int. Turfgrass Soc. Res. J.
Controlled Environment
Kentucky bluegrass
Tall fescue-fine fescue mix
1 lb N 1000ft-2
Fall lawn fertilizer applications should be complete before September 15 in northern New Hampshire and by October 1 in southern New Hampshire
Nitrate-N Leached, lbs/1000sqft
0.7
0.6
0.5
0.4
0.3
30
35
40
45
50
Temperature F
Potential ET, inches per day
0.0402
0.1
0.2

Fertilizer Substitution

- **Dutch/Micro White Clover (*Trifolium repens*)**

Estimated to provide 2.6 to 4.4 lbs N/1000ft^2/yr

Joost, 1996, Missouri Grazing Manual

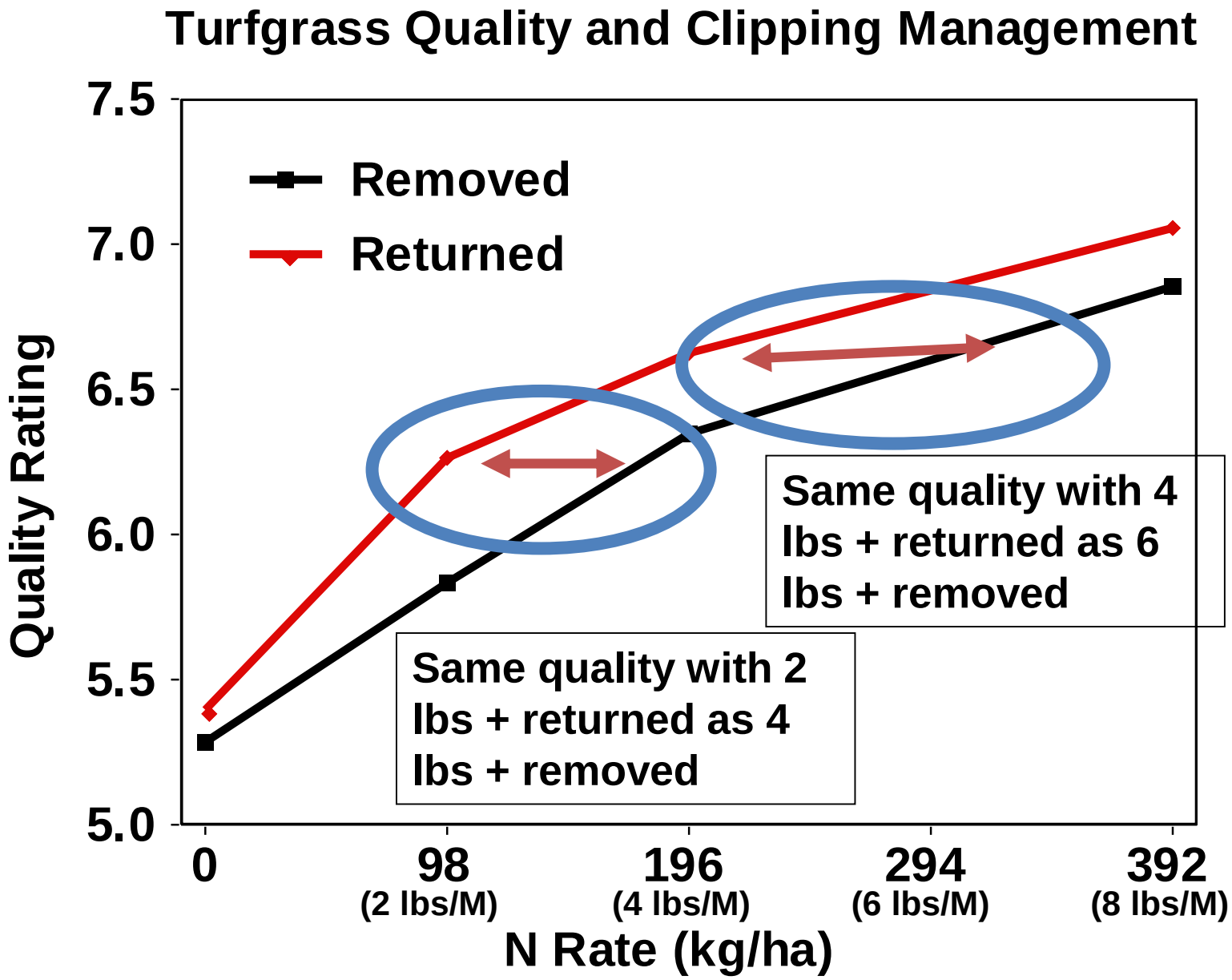
- **Grazing Birdsfoot trefoil (*Lotus corniculatus* var. *arvensis* 'Kalo')**

Estimated to provide 0.7 to 3.0 lbs N/1000ft^2/yr

Joost, 1996, Missouri Grazing Manual

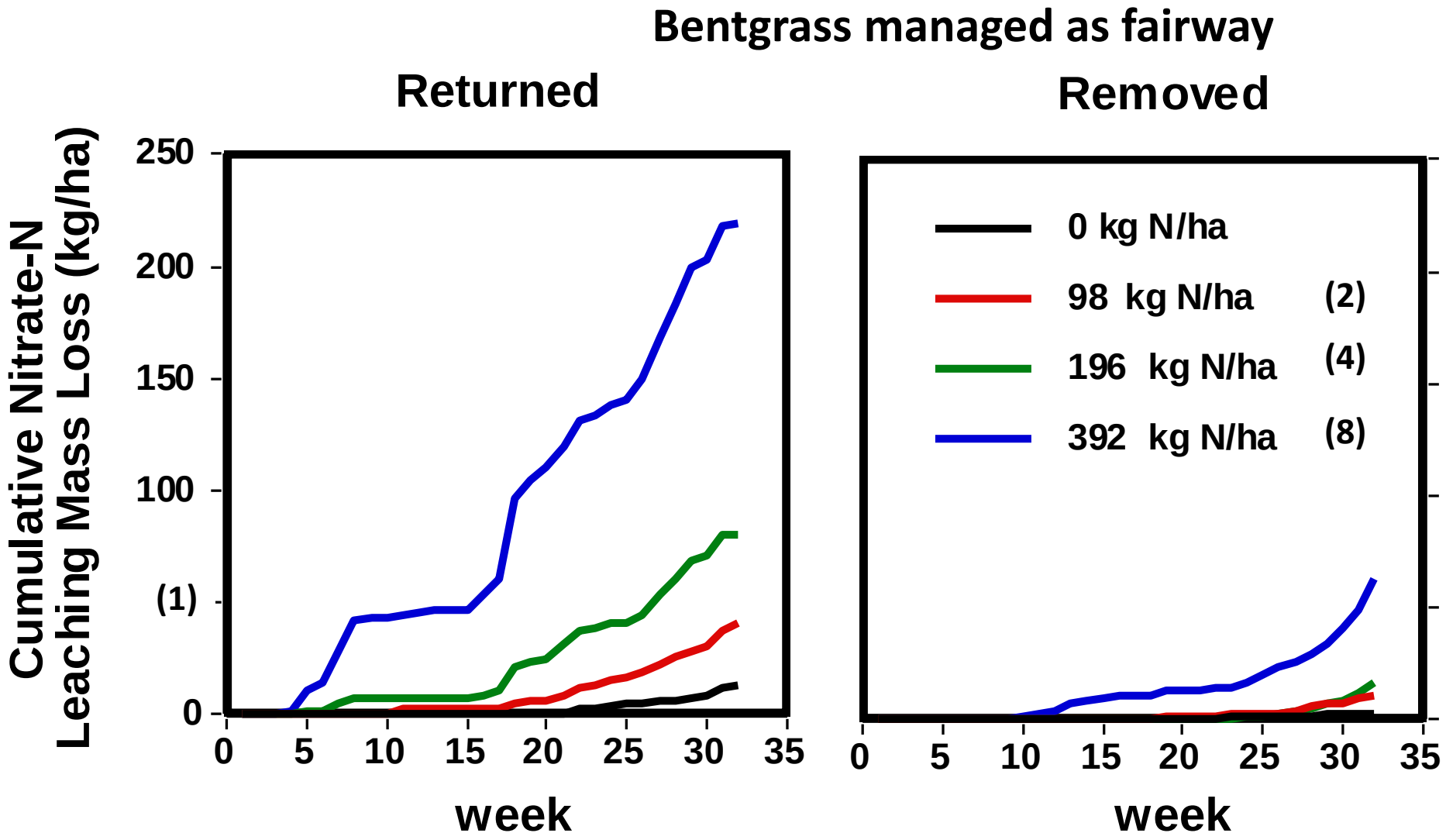
http://bygl.osu.edu/bygl_archive2015/content/birdsfoot-trefoil-foiling-appearance-turfgrass-0

- **Return the Clippings to the Turf**



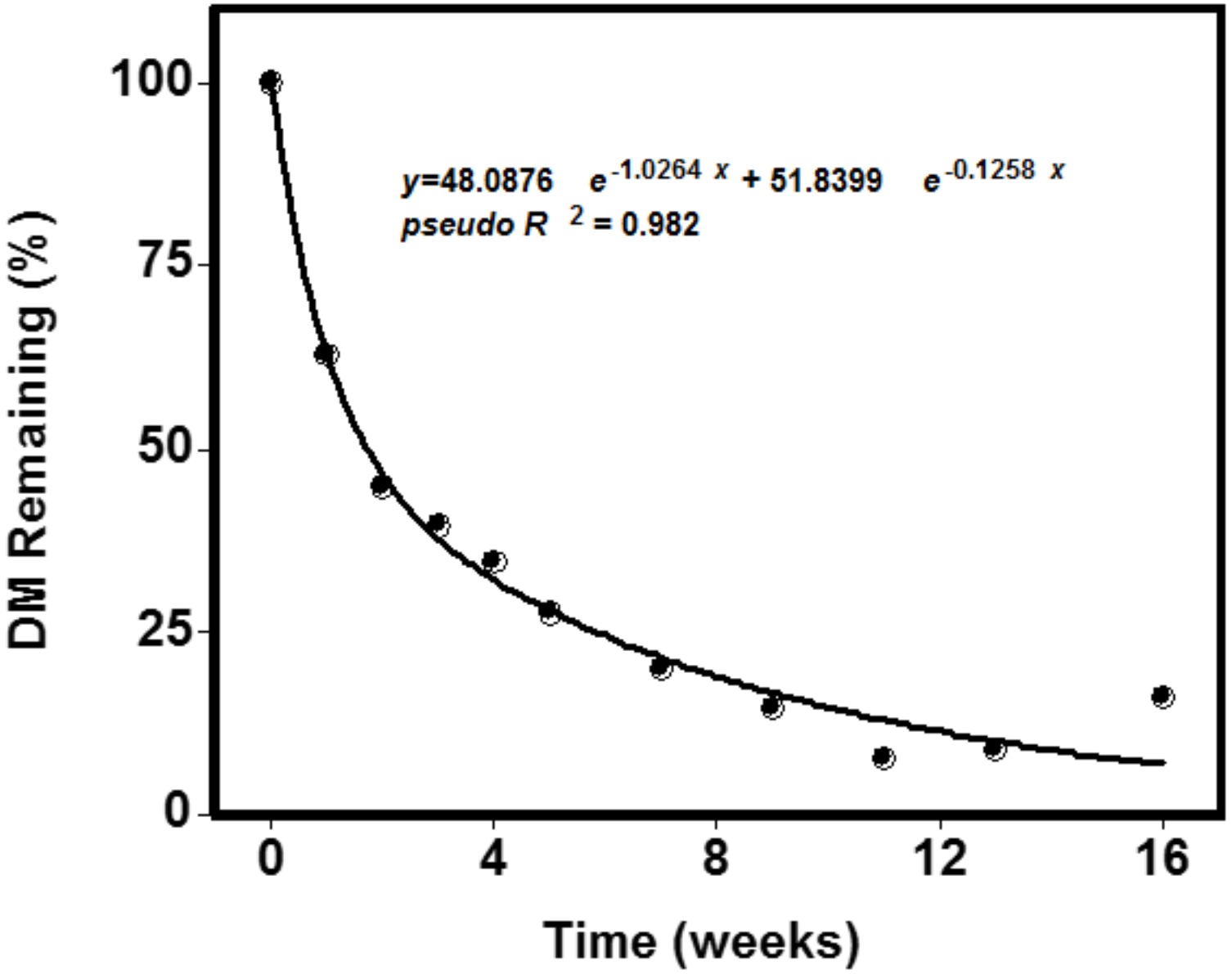
Kopp and Guillard (*Crop Sci.* 42:1225-1231, 2002)

- **When Clippings Returned, Reduce N Rates or total N Loading**



Kopp and Guillard (2005, *Intl. Turfgrass Soc. J.* 10:80-85)

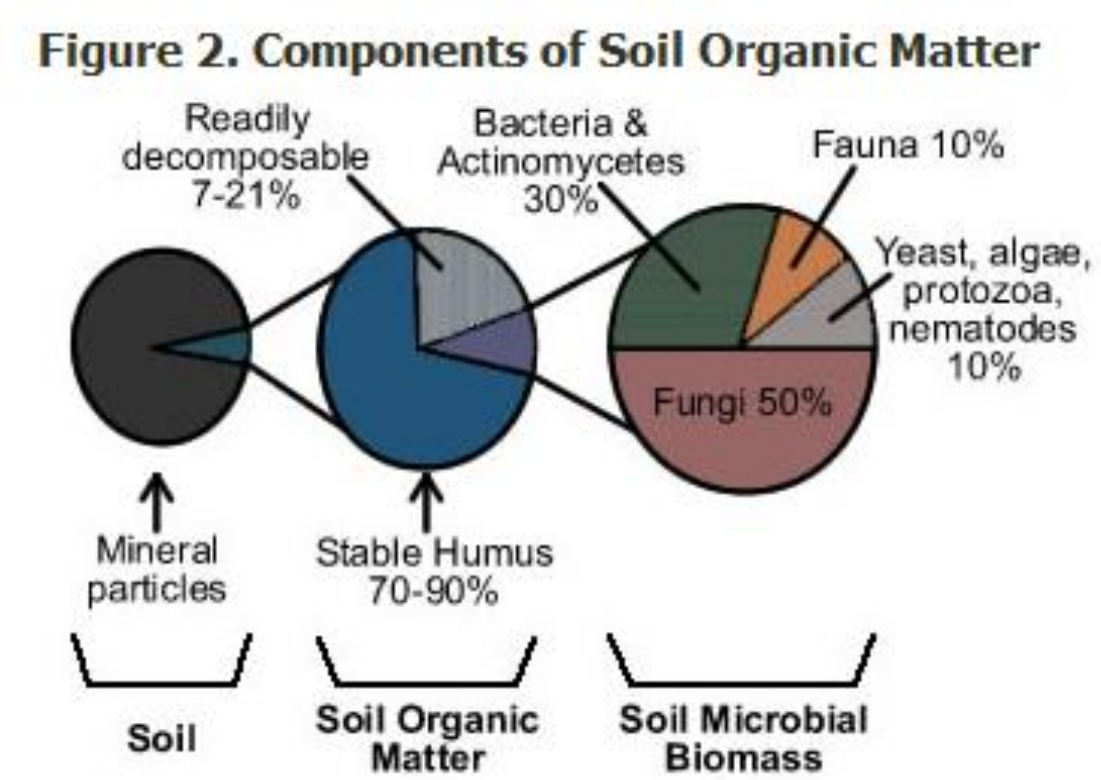
- **Returning Clippings Does Not Increase Thatch**



Kopp and Guillard (2004, Proceedings 4th International Crop Science Congress)

Maintain Soil pH Near Neutral

- 6.0 to 6.8 Ideal range
- Promotes soil organic matter mineralization



https://attra.ncat.org/attra-pub/viewhtml.php?id=240

Pesticides and Water Quality

- Combination Fertilizer & Pesticide Products
- IPM

- **Pesticide Runoff 29 Chemicals (Haith and Duffany, 2007)**
  - ❑ **Turf pesticides runoff losses varying from 0 to 2% of applied chemicals.**
  - ❑ **Pesticide runoff depends on the nature of the grass surfaces; greater vegetation mass produce less water runoff and also more strongly adsorb chemicals.**
  - ❑ **Pesticide runoff not uniformly distributed throughout year; most occurs in brief, infrequent events.**

- **Maintaining dense vegetation decreases runoff**
- **Buffer Zones**
- **Most of turf pesticide leaching – sand putting greens**

Sediments

- **Runoff Related to Vegetative Cover and Infiltration**

http://ocean.njaes.rutgers.edu/UnderstandingSoilCompaction.html

http://turfblog.rutgers.edu/?p=856

Concluding Thoughts

- Lawn BMP's for water quality do not have to be in conflict with profitable business model.
- Common sense should guide most of your lawn-care management decisions with respect to water quality.
- Your feedback and input critical for future research.

Questions?

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