

BMP

Best Management Practices

Where Leadership & Action Intersect

Keeping it Clean

Best Management Practices (BMPs)

for Sediment and Nutrient

Management on your Golf Course

Beth Guertal, Ph.D.

Professor

Auburn University, AL

GCSAA

USGA

What's the general topic today?

- Managing water movement from your course.
- How to do that to reduce sediment loss.
- How to do that to reduce nutrient loss.
- What are the key nutrients we are talking about?
- Quantifying those numbers so your course gets 'credit' for implementing nutrient management BMPs.

The Basics of Erosion & Sediment Movement

Three basic steps to create a problem:

- Detachment
- Transport
- Deposition











Erosion by Water
3 Categories (of severity)

- Sheet
- Rill (Interrill)
- Gully

The separations are really a crop production thing.

















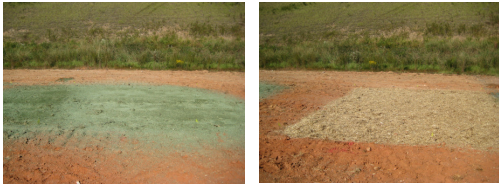


Reducing Sediment Loss in Turfgrass Systems

- Slow water movement.
- Improve infiltration.
- Provide a protective cover to the surface.
 - Vegetative covers
 - Mulches
 - Non organic covers
- Get things growing.

Hydromulches versus Other Mulches

- Hydromulch materials may be made from paper, wood fiber, or other cellulose materials.
- One industry standard in roadside work is loose straw.
- Steeper slopes – mulch blankets made from a variety of fibers.





Erosion Control Blanket (ECB)



- Applicable for slopes and channels
- Also used when other methods alone will not offer enough protection.

ECBs are classified for temporary and permanent uses. (*Erosion Control Technology Council*)



Mulch Blankets

- Highly variable – from ~3 months of utility to years.





Diversions, Fences

- Slow flow from an area.
- Reduce sediment in the flow.
- Stop soil erosion.
- Can be artificial or natural.









Buffer Strips



Buffer Strips in Turfgrass

- Mowing height and length [2.4 or 4.9 m (7.4 or 15 ft)] of the buffer is not as important as you may think – ANY buffer reduced P in runoff (high of 9.6 mg P/L to 1.2 mg P/L) (Cole *et al.*, 1997).
- Turfgrass cultivation (VM, core aeration) has little effect on P movement in runoff.

More Buffer Work in Turf

- Graduated buffer height – 25 (1 in) to 38 (1.5 in) to 51 mm (2 in), compared to a constant 51 mm (2 in) reduced P in runoff by ~14%. (Moss *et al.*, 2005).
- Buffer of KY Bluegrass (fertilized @ 3.1 kg P/ha/yr (0.06 lb P/M)) versus prairie species – no difference in total P in runoff. (Steinke *et al.*, 2007).

QUIZ: What kind of erosion is this?



- a. Gully
- b. Rill
- c. Sheet
- d. Really bad kind



Where do water and nutrients go?

- Into the plant
- Into soil
- Loss to microbial biomass, organic matter
- Loss to air
- Into water – movement as runoff and/or leachate

Nutrients of Environmental Concern (Ones that we also apply)

- Nitrogen
- Phosphorus

Environmental Terms

- Leachate – loss downward out of rooting zone, possibly to groundwater, via downward movement of water. **NITROGEN**
- Runoff – loss to surface bodies of water via moving water. Can be as dissolved or attached to sediment. **PHOSPHORUS**

Phosphorus

- The portion your turfgrass takes up and uses is a very small part of the total soil P.
- Excessive P? – proven loss in runoff both as dissolved P and as P attached to sediment.
- Not as much as an issue in leachate loss.
- Excess P in surface water causes eutrophication – algae growth, decreased oxygen.

What happens when your soil-test P gets too high?
Loss of P in Runoff.....



Forms of P in Water & Sediment – Boring, but it matters

- Soluble P – P dissolved in water, typically a filtered sample
- Total P – P in water plus that attached to sediment (runoff not filtered)
- Orthophosphate – soluble P (may also be called dissolved or reactive P)
- Bioavailable P - dissolved and particulate P

What Does this Mean?

- P can leave your site in two ways:
1) dissolved in water, and
2) attached to sediment.
- SO – we need to reduce BOTH sediment and water loss to keep P in place.

EPA Water Quality Criteria for P

- 0.025 mg L⁻¹ in lakes/reservoirs
- 0.05 mg L⁻¹ in streams draining into lakes or reservoirs
- 0.1 mg L⁻¹ in streams or flowing waters not directly discharging into lakes or reservoirs

This would be P in water.

1 ppm = mg L⁻¹

Rice and Horgan, 2011
USEPA, 1986

Large Scale Studies on Golf Courses

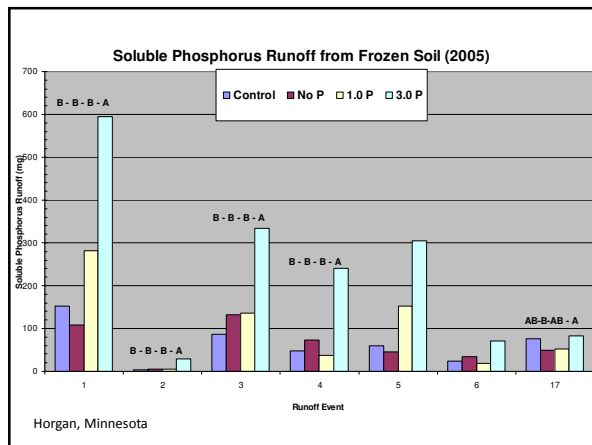
- Typically take an entire golf course, and look at P from an inflow and outflow point, and at places within the course.
- Five coastal NC golf courses – each sampled at least yearly. (*Mallin and Wheeler, 2000*).
- Two of 5 courses had significantly > P in outflow when compared to upper end water.
- Minimum was 0.003 mg P/L and maximum was 0.063 mg P/L. (EPA limit is 0.1 mg/L)

Another Large Scale Study

- Austin, TX – 5 years, stream bisected the course.
- Storm water transported 0.51 kg P/ha/yr – 6.2% of the P applied in that period (1/2 lb P/A or 0.01 lb P/M).
- Median P – 0.13 mg P/L – golf course contributed 0.03 mg/L of that P. (*King et al., 2007*).

Runoff Is The Issue



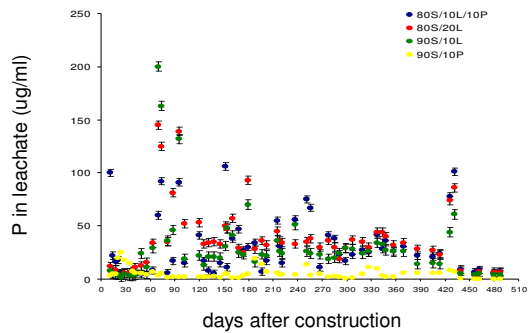


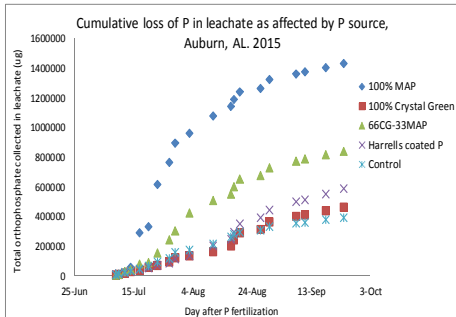
In really sandy soils P will move downward (leach)



What happens when your soil-test P gets too high?

Loss of P as leachate in very sandy soils...



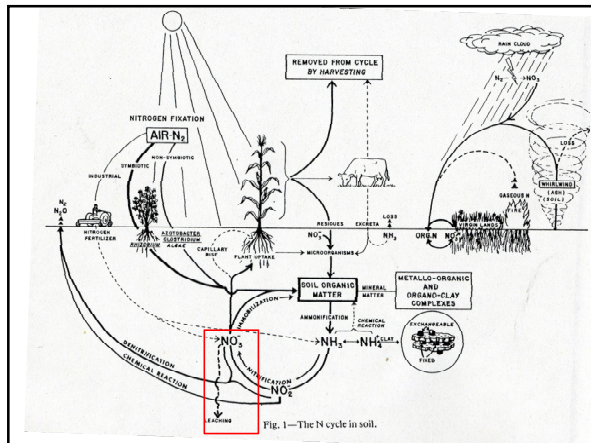


Runoff of P – Some Conclusions

- Bare soil/thin turf – prone for greater loss via P-sediment erosion.
- Greater P losses if irrigation/rainfall follows immediately after application.
- P in runoff in snowmelt can be highly significant.
- Inclusion of buffer strips significantly reduces P in runoff.
- Aerification does not seem to affect the magnitude of P loss.

Nitrogen Pollution

- Nitrogen leaching is the concern
- Leaching is movement out of the rooting zone, possibly to groundwater
- Loss of plant-available N, possible human health hazards
- Greatest health hazard is to babies and nursing mothers



Leaching

- Loss of N out of root zone as the mobile cation nitrate.
- We care because:
 - 1) we lose plant-available N, and
 - 2) there are some negative public health effects.
- Avoid over-application and overwatering, especially in sandy soils.

'Oregon Plans to Target Nitrate Pollution'

'Canyon residents urged to test their well water'

'Minnesotans have a chance to get water tested for nitrates'

Nitrate in Groundwater:

'Infants for whom formula may be prepared with well water remain a high-risk group for nitrate poisoning. This clinical report reinforces the need for testing of well water for nitrate content'.

Greer and Shannon, PEDIATRICS Vol. 116 No. 3 September 2005

'A 1950 report listed 144 cases of infant methemoglobinemia with 14 deaths in one 30-month period in Minnesota. Infant deaths resulting from misdiagnosis of this preventable, treatable intoxication were still occurring as recently as 1986 in South Dakota. In this state, about 39% of dug or bored wells were unsafe due to high nitrate content, compared with 22% of drilled wells and 16% of driven wells. Properly constructed wells more than 30 m deep are more likely to be safe'.

Johnson and Krass, Am J Ind Med. 1990;18(4):449-56

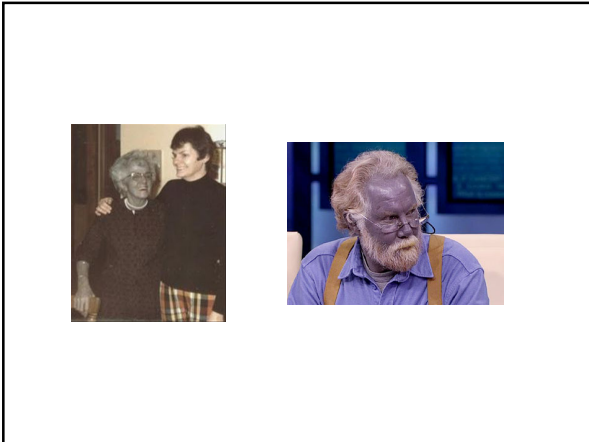
EPA Standard for nitrate in drinking water?

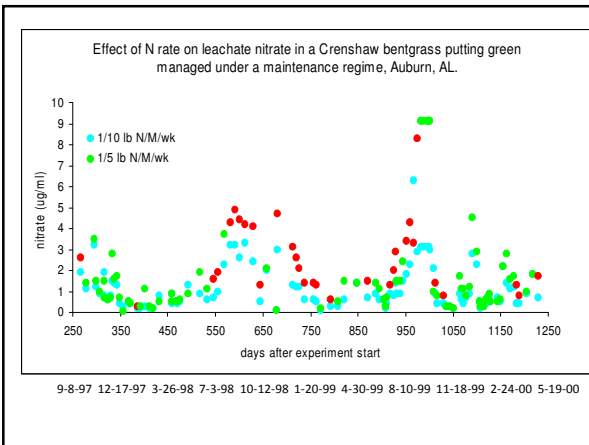
- 10 ppm nitrate-N ($\text{NO}_3\text{-N}$)
- That is the SAME as 10 ug/mL

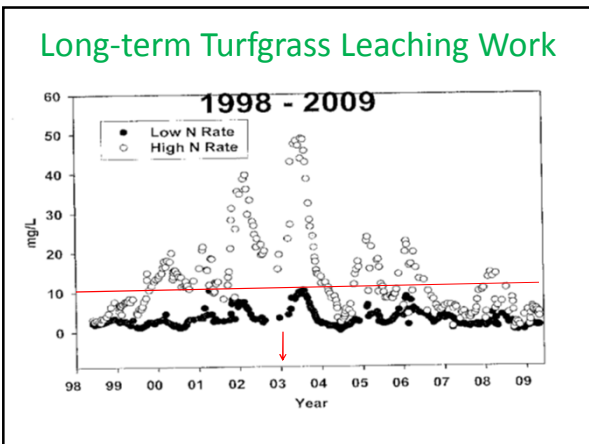
Above that? There is a risk for nursing babies, pregnant mothers and babies drinking formula in which high nitrate-N water may be used.

Stupid Historical Science

The Fugates, a family that lived in the hills of Kentucky, commonly known as the "Blue Fugates" or the Blue People of Kentucky, are notable for having been carriers of a genetic trait that led to the disease **methemoglobinemia**, which gives sufferers blue-tinged skin.





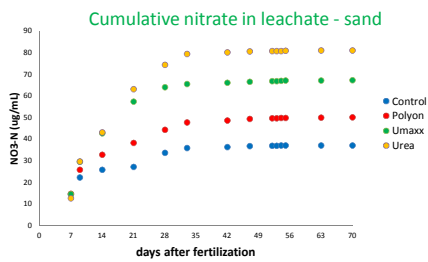


How to Limit Nitrate Leaching?

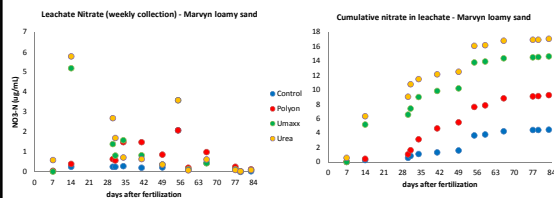
- Watch irrigation amounts.
- Use slow release sources.
- Use sources with nitrification inhibitors (DC).
- Foliar.
- Don't overapply N.
- Wetting agents.

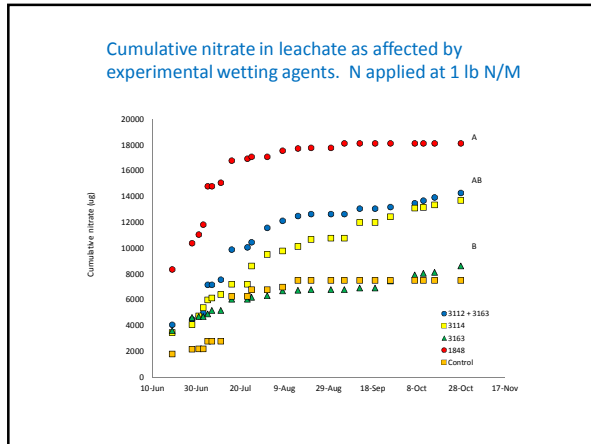
Leaching

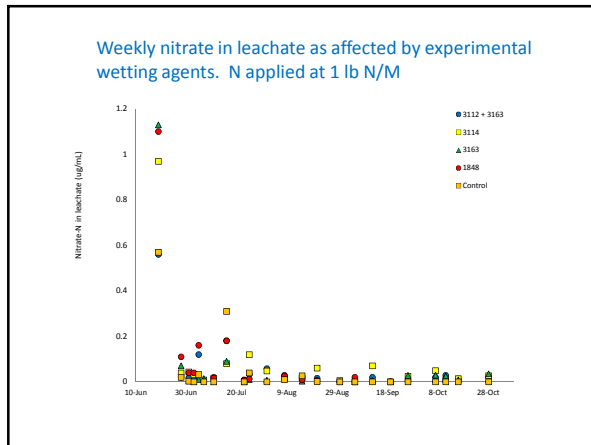
- Loss of N out of root zone as nitrate.
- We care because: 1) we lose plant-available N, and, 2) there are some negative public health effects.
- Avoid over-application and overwatering, especially in sandy soils.



Nitrate-N in Leachate – Marvyn loamy sand - 2009







The Simple Things for Reducing Sediment Loss and Protecting Water Quality

- Turfgrass is your friend – vegetative cover.
- Decrease runoff below erosive velocities.
- Increase infiltration.
- Stop sediment loss.
- Don't overfertilize and water.
- Talk to the people around you who are not professionals like you are!

Another Quiz!

This picture is an example of?

- A. N in runoff
- B. P in runoff
- C. Sediment problems
- D. There is not a problem here.



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THANKS for joining us today! Questions?

Beth Guertal, Ph.D.
Professor
Auburn University, AL



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Upcoming Webinars

Aug. 27 @ noon
H-2B 101: Is the H-2B program a viable solution to peak-season, labor shortage?
Ceridwen J. Koski and Reilly K. Ward

Sept. 6 @ 10 a.m.
Turf Troubleshooting: Problem Solving for Golf Course Superintendents
Jim Kerns, Ph.D.

Sept. 13 @ noon
Name that Part – Why Turfgrass Biology Matters
Beth Guertal, Ph.D.
Our first title in the ASCS Prep series, taking place every other Thursday through Jan. 17, 2019

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