Righ'ting Regulations: Phosphorus

Biofest 2017

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Acknowledgments  Standing on the shoulders of giants.

• Andrew Carpenter, Northern Tilth
• Geoff Kuter, Agresource
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• Herschel (Chip) Elliott, PhD, Penn State University.
• Craig Cogger, PhD, Washington State University
• George O’Connor, PhD, University of Florida
• Sally Brown, PhD, University of Washington
• Katie Campbell-Nelson, Univ. of MA / Amherst Extension

and more...  THANK YOU ALL.
Decades of efforts to control P (and N)

- Agricultural nutrient management planning
  - Focus on N (leaching/groundwater) & P (runoff, surface water)
  - NRCS Code 590 – January 2012

- Turf & lawn fertilizer regulations are more recent
  - Focused mostly on P
  - Key provision: soil test must show need before P is applied
  - ~15 in Mid-west & Northeast, also WA
  - Some exempt biosolids
  - NEIWPCCE ➔ model state regulation
Don’t “P” on Your Lawn!
and other lawn care tips for green lawns, not green lakes

MD's Lawn Fertilizer Law

Be Wise
don’t over-fertilize
Why is Phosphorus bad for our lakes?

Our pristine lakes are at risk of algae blooms and poor water quality from recent overuse of unnecessary fertilizers.
Common state regulation themes:

- Require soil testing & agronomic application rates (based on P if P is above optimum)
- Prohibit or restrict application to
  - impervious surfaces
  - frozen or snow-covered ground
  - during specified winter months (seasonal restrictions)
- restrictions on retail sales of P-containing fertilizers
- signage and/or labeling requirements
What changed our level of concern:

**MDAR Plant Nutrient Management**

- Chapter 262, laws of 2012 (https://malegislature.gov/Laws/SessionLaws/Acts/2012/Chapter262) 330 CMR 31.00
- 2 Fact Sheets
  - Turf & Lawns
  - Agriculture
- UMass Amherst Extension Guidelines
A laudable goal: “330 CMR 31.00 establishes...limitations on the application of plant nutrients to lawns and non-agricultural turf....”

A laudable goal: “further ensure that plant nutrients are applied to agricultural land... to provide sufficient nutrients for plant growth while minimizing the impacts of the nutrients on water resources....”

A less obvious driver: “These state-wide limitations on plant nutrient applications will enhance the ability of municipalities to maximize the credits provided in the National Pollution Discharge Elimination System permits issued by the United States Environmental Protection Agency.”
Where do biosolids & other residuals fit in?

- The MA Plant Nutrient regulation is poorly written
- Definitions are confusing
- Biosolids/residuals were not really considered in its crafting.
- UMass guidance is relied on – but it does not address residuals much
Where are high-P soils? What ME soil tests show:

- For all samples from 2014, the soil P test levels were:
  - 32% = above optimum
  - 63% = optimum or above optimum

- For organic gardens & crops*:
  - 45% = above optimum
  - 68% = optimum or above optimum

- For “chemical fertilizer” home gardens*:
  - 46% = above optimum
  - 72% = optimum or above optimum

- For lawn & turf*:
  - 44% = above optimum
  - 58% = optimum or above optimum

* ~2/3 of these markets for organic residuals could be off-limits if the MDAR regulation is enforced as it is now written.
Phosphorus ppm ranges

- Agronomic
- Gardener
- Lawn and Turf
- Fruit
- Ornamental
- Other
- Vegetable

UMass Optimum = 14 ppm

Slide courtesy of Katie Campbell-Nelson, UMass Extension
Some regulations ignore...

- P is an abundant, natural, necessary element for all life. There are soils naturally high in P!
- P dynamics in soils are complex. Depends on pH, Al, Fe, Ca, etc. levels also.
- Potential to reach surface waters is driven by many factors: slope, distance, buffers, etc.
- There are myriad well-documented benefits of adding organic residuals to soils – including reducing P availability and movement!
We communicated with MDAR

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March 17, 2017

Dear Mr. Young:

Thank you for your letter dated March 2, 2017, expressing your concerns regarding the proposed amendments to 330 CMR 31.00, Application Requirements for Agricultural Land and Land Not Used for Agricultural Purposes...
We helped UMass Extension on a workshop

Presentations from November 2, 2016 Symposium “Managing Phosphorus in Organic Residuals Applied to Soils”:

Critical soil phosphorus levels

Agronomic critical level (ACL)  Environmental critical level (ECL)

Yield or Relative Yield

Soil Test Level

Low  Medium  Above Optimum

Below Optimum  Optimum

Figure 12-3. Response curve used to divide soil test levels into below optimum, optimum, and above optimum categories.
Source P Solubility

Mean PWEP (% of Pₜ)

- **TSP**
  - n=2
  - 85.2 ± 2.5

- **Dairy**
  - n=5
  - 52.1 ± 6.2

- **Poultry**
  - n=8
  - 20.7 ± 1.2

- **Conventional Biosolids**
  - 2.7 ± 0.2

- **Aerobic**
  - n=8
  - 2.7 ± 0.2

- **Anaerobic**
  - n=11
  - 2.2 ± 0.2

Bars indicate one standard error. Reported mean PWEP values followed by the same letter are not significantly different (p < 0.05).

Source P Solubility

Brandt et al., 2004

Slide courtesy of Dr. Herschel Elliott, Penn State Univ.
**P Runoff Comparison: Manure vs Biosolids**

- Mean Dairy Manure
- Mean Bellefonte Cake
- Mean PWD Cake
- Mean University Cake
- Mean PWD Compost
- Unamended Control Soil

**Graph:**
- **Dissolved P (mg L\(^{-1}\))**
- **Berks High-P**
- **Berks Low-P**

**Notes:**
- Increasing Fe\(_{\text{aq}}\) + Al\(_{\text{aq}}\) in P-Source
- Error Bars represent one standard deviation.

*Slide courtesy of Dr. Herschel Elliott, Penn State Univ.*
The workshop was a partial success.

UMass Extension Vegetable Newsletter, December 2016:
“Phosphorus becomes a threat to the environment when there is a combination of source AND transfer.... For example, there is high risk of pollution from P applications on frozen ground, on slopes greater than 7% or within 25 ft. of a water source. In these scenarios, a field with low or below optimum P levels may actually pose a greater risk of pollution than a high-P field, especially if P was applied right before heavy rains.... Soils with above optimum P are not a threat to environmental contamination if there is low overland water movement or soil erosion.”
The workshop was a partial success.

UMass Extension Vegetable Newsletter, December 2016:

“Reduce the amount of P that is imported into our region and onto our soils by using local sources of organic residuals rather than purchasing P fertilizer where possible. Organic residuals such as compost have the added benefit of increasing soil organic matter and water holding capacity which will also reduce P runoff.”
What we’re doing now:

- Considering research project to help inform UMass and guidance
- Or maybe we should write our own professional guidance (which can be used if UMass Extension guidance is missing).
- Continuing to monitor regulations
What you can do:

- Give input to your states’ nutrient regulations
- Use best management practices for P applied in biosolids and other organic residuals
- Encourage use of local recycled P before importing more fertilizer P
Ratio of phosphorus removed to phosphorus applied, 2007

Summarized by USGS hydrologic regions

What you can do: Remove P at WWTF

Removing P at the WWTF makes the biosolids a more balanced fertilizer and allows use of the P in concentrated form on soils where it is needed.

Struvite and other P minerals can be precipitated at wastewater treatment plants, usually by a treatment process applied to a digestate dewatering side-stream. This is a growing trend (Chicago has taken the lead).
Phosphorus Forum 2018

February 27, 2018 | Tempe, AZ

Addressing critical issues in phosphorus sustainability

PHOSPHORUSALLIANCE.ORG

https://phosphorusalliance.org/
Thank you.

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