Maintaining a Delicate Balance

Eliminating phosphorus contamination with organic soil management

By Drew Toher

To date, 12 states have adopted or implemented laws restricting the use of synthetic phosphorus fertilizers. These new laws are a reaction to serious environmental problems created by an overabundance of phosphorus compounds in aquatic environments. Follow this guide to learn about the source of this problem, and what actions can be taken to protect local ecosystems.

Protecting our Environment from Non-Point Source Pollution

Phosphorus, the middle number listed in the N-P-K (Nitrogen - Phosphorus – Potassium) on the back of commercial fertilizer packages, is a critical nutrient for plant growth and development. However, it is also a major source of non-point pollution in U.S waterways. Non-point contamination, as opposed to point source pollution from industrial operations, occurs as a result of runoff from diffuse sources moving into rivers, lakes, streams, wetlands or groundwater.[1] Unnaturally high levels of phosphorus in aquatic ecosystems create a cascade of effects that compromise the diversity, stability, and resiliency of the natural environment. High phosphorus loads increase water turbidity, spur toxic algae blooms, and decrease light penetration. Once algae dies off, aerobic bacteria consume the dead algae, resulting in dangerously low oxygen levels, which further decreases biodiversity and can stress or even kill aquatic wildlife.[2] The increasing frequency of "dead zones"[3] in and around the U.S is further indication that this environmental problem must be addressed.

The residential use of lawn fertilizers is responsible for a significant amount of this non-point pollution. To help alleviate the contamination this causes in local waterways, states are moving toward the adoption and implementation of synthetic phosphorus fertilizer bans. In the process, there is considerable misinformation concerning which fertilizers are best for the environment and our overall health. While many in turf management say natural sources of soil nutrients reduce hazardous runoff, the chemical industry claims that the source of phosphorus in a fertilizer is irrelevant, and phosphorus bans should apply to both synthetic and organic sources. However, like many answers to environmental problems, the solution is often found not solely in a product replacement or the preference for one product choice over another, but in the overall management system that protects and nurtures the soil microbial environment.

Phosphorus in soil is not considered a very "mobile" nutrient because soil has a large capacity to retain phosphorus compounds.[4] Consequently, a significant amount of nonpoint phosphorus pollution is a result of soil erosion and over-applications of phosphorus. Preventing soil erosion and preforming soil tests should be a focal point for lawmakers and concerned citizens working to stop phosphorus pollution. In this context, the source of a fertilizer is extremely relevant to these efforts. While organic production methods build a lawn's capacity to hold soil, synthetic systems weaken this ability. From a holistic soil management perspective, it becomes evident that organic management yields the optimum environmental safeguards, while nurturing healthy plants.

Soil Fertilization: Making Sense of the Different Approaches

The Truly Organic Approach

The goal of an organic production system, whether in agriculture or turf management, is to feed the soil by utilizing methods

BEYOND PESTICIDES
701 E Street, SE ■ Washington DC 20003
202-543-5450 phone ■ 202-543-4791 fax
info@beyondpesticides.org ■ www.beyondpesticides.org

that build organic matter and encourage microbial diversity. This is achieved through cultural practices such as mowing, aeration, irrigation, and over-seeding, without the use of synthetic inputs such as chemical fertilizers, insecticides, herbicides, or fungicides.[5] To adhere to organic inputs, only fertilizers or soil amendments approved by the Organic Materials Review Institute (OMRI) are guaranteed to comply with the rigorous standards of the *Organic Foods Production Act* (OFPA). (See box on right.)

In building organic matter with compost and other organic nutrients, natural phosphorus becomes mineralized and available to the plant. By breaking down slowly in the soil through beneficial microbial activity, organic fertilization provides turf with a slow release of nutrients throughout the growing season. Gentle increases in the soil's fertility enhance its ability to store nutrients, resulting in decreased runoff, erosion, and leaching of nutrients into groundwater.[6] Organic fertilizers create lush verdant lawns that require less overall maintenance. Additionally, their use ensures that materials of unknown toxicity are not being applied. Developing a holistic organic soil management program will ultimately avoid the contamination problems associated with synthetic phosphorus fertilizers, protecting environmental health.

OMRI and the OFPA

OMRI (Organic Materials Review Institute), is an independent non-profit organization that evaluates fertilizers in accordance with current National Organic Standards. Look for the "OMRI Listed" label to ensure that a product contains natural materials and/or synthetically derived micronutrients reviewed and allowed by the National Organic Standards Board. OMRI products must follow legal guidelines under OFPA [7 U.S.C. 6508], which state, "For a farm to be certified…producers on such farm shall not – 1) use any fertilizers containing synthetic ingredients or any commercially blended fertilizers containing materials prohibited under this title or under the applicable state organic certification program; or 2) use as a source of nitrogen: phosphorus lime potash or any materials that are inconsistent with the applicable organic certification program."[8]

While OMRI-listed soil amendments are surely the way to go if soil needs a phosphorus correction, even they can cause environmental problems if over-applied.[7] Therefore, a soil test and close adherence to application recommendations are required. Note that all states exempt compost from their phosphorus bans, with an understanding that the judicious use of it, compost/manure tea, or grass/leaf mulches as top dressings for maintenance purposes should not be a problem. However, proper care is important with the use of dried or pelletized natural fertilizers. They must be applied to the lawn at the rates recommended by a soil test. For more detailed information on managing lawns organically, see Beyond Pesticides factsheet: bit.ly/RTGalv.

"Organic"/ "Natural" Fertilizers

Unlike the USDA organic symbol that can be found on food products, "organic" and "natural" claims on packaged lawn care fertilizers are not subject to the requirements of OFPA. These labels can be misleading because state and federal laws do not regulate "organic" or "natural" claims in fertilizers. For a fertilizer package to include these words, the product is only required to contain natural carbon, meaning these products could still include toxic and persistent chemicals, excessive heavy metals, personal care products, or residual pharmaceuticals. When in doubt, read the product's label.

Avoid "natural" and "organic" products with the following components that can make their way into environment and harm native species:

- *Biosolids:* Biosolids, or sewage sludge, are dried microbes originally employed to process municipal wastewater. These

The Package Says "Organic" . . . But, It's Biosolids. What's Up with That?

With the growth in organic farming, the number of packaged fertilizers marketed to organic farmers has also grown. Fertilizer labeling laws are enacted state-by-state in the United States. The regulators of fertilizer labeling laws are organized through the Association of American Plant Food Control Officials (AAPFCO). Most states follow the AAPFCO model language, which defines organic fertilizer as [a] material containing carbon and one or more elements other than hydrogen and oxygen essential for plant growth (AAPFCO, 2008).[13] This definition permits fertilizers to be labeled as "organic" even if they do not necessarily comply with the USDA National Organic Program (NOP) standards to produce organic food. As a result, sewage sludge, urea, and blended fertilizers that contain organic matter and a variety of synthetic fertilizers that contain some carbon may bear the organic term but will result in the loss of the NOP certification of an organic field for three years, if applied. There is a tentative definition for organic input that more closely follows the NOP standard. However, that tentative definition has not yet been adopted by most states, coordination of state officials with USDA and certifiers will be a challenge, and the other conflicting uses of the word organic on fertilizers are expected to continue to cause confusion for farmers and the public.

This image, captured in October 2011, shows one of the worst algae blooms that Lake Erie has experienced in decades. Photo Courtesy NASA.

products, particularly "Class B biosolids," have been found to contain pesticides, detergents, estrogenic hormones, dioxins, PCBs, and heavy metals - all of which can leach into groundwater or be taken up into plants. They can also contribute to antibiotic resistance in bacteria on fields that have had biosolid fertilizer applications.[9] Moreover, a 2002 study revealed a high prevalence of *Staphylococcus aureus* inflections in residents that lived within close proximity to biosolid treated agricultural fields due to exposure from blowing winds.[10]

- *Synthetic Chemical Wetting Agents:* Forgo purchasing any product that markets itself as organic, yet contains a synthetic wetting agent.[11] These products, also known as soil surfactants, can contain compounds which EPA considers carcinogenic. If the label doesn't list the chemical makeup of the wetting agent, avoid that product.
- *Products with Inert Ingredients:* Avoid any "natural" products that don't list all of their ingredients. These products could be formulated with toxic synthetic chemicals, and it's always good practice to know what you're applying around your home.[12]

The conventional, chemical approach

Synthetic fertilizers should be avoided due to the multitude of adverse environmental effects that result from the use of these chemicals.[14] Applying synthetic fertilizers to a lawn pumps nutrients into the soil faster than the turf can absorb them, resulting in much of the groundwater leaching and runoff detrimental to aquatic environments. Excessive applications of synthetic fertilizers also cause microbes in the soil to go into a feeding frenzy, devouring all the available carbon material they can find. Continuous applications of these fertilizers exhaust soil life,[15] leading to barren, sterile land. Dry, compacted, hardpan soil is the result of, in part, decreased microbial activity and these salt-based synthetic chemicals.[16] These soils produce course, patchy lawns, which require more water to maintain, and erode quickly. Sterile soil also reduces a plant's ability to ward off disease and pestilence, increasing dependency on toxic pesticides.

Petroleum and natural gas are basic feedstocks that are used in large quantities in the production of synthetic fertilizer, which is an integral part of the pesticide treadmill in chemical intensive agriculture and land management. The dependency on these non-renewable resources, with the known hazards associated with extraction, processing and refining, leads to environmental contamination that adds to the identified adverse effects associated with synthetic fertilizer use. The synthetic N-P-K approach to fertilization brings with it distinct production and use hazards that are associated with each of these ingredients, and overall is a significant contributor to greenhouse gas emissions,[17] water contamination, and adverse impacts on wildlife and human health.

States Act to Protect Natural Resources

In the absence of overarching federal regulations, states are acting unilaterally to address their phosphorus problems. Twelve states, including Illinois, Maine, Maryland, Michigan, Minnesota, New Jersey, New York, Vermont, Virginia, Washington, Wisconsin and Florida (which only requires select counties to participate) enacted laws within the last five years that restrict the residential and commercial use and sale of phosphorus-containing fertilizers. Connecticut and Pennsylvania are currently considering legislation.

In general, these laws prohibit phosphorus fertilizer applications unless they are used to establish or repair new turf, or cure a lack of phosphorus based on a soil test. Several states also restrict the use of these fertilizers within a certain proximity to a body of water, and on impervious, frozen, or saturated surfaces. Many state laws exempt from the ban agricultural land, commercial or sod farms, golf courses, or gardens.

While the state laws are right to restrict phosphorus use leading to contamination, Beyond Pesticides does not find any of the adopted state laws to be adequate in eliminating dependency on synthetic fertilizers that are not needed, or are not essential, to meet fertility requirements. As a result, Beyond Pesticides urges the discontinuation of their use, given the range of environmental problems associated with its production and use, and seeks the

Table 1. Comparing States' Phosphorus Lawn Fertilizer Bans

(Source: Kristen Miller, Office of Legislative Research, Connecticut General Assembly, http://www.cga.ct.gov/2012/rpt/2012-R-0076.htm)

State	Year Passed/ Effective Dates	Exempt Applicators and Allowed Phosphorus Fertilizer Uses	Compost and Un-processed Manure Exempt?	Processed (Pelletized) Organic Fertilizers Exempt?	Application to Paved or Impervious Surfaces	Setbacks from Water (Buffer Zones)	Application to Paved or Saturated Soils	Restrictions on Phosphorus lawn fertilizer sales
Beyond Pesticides' Ideal Phosphorus Ban		No exemptions for synthetic phosphorus fertilizer applications.	Yes, but sewage sludge not exempt	Yes, but only if OMRI certified	Prohibited	25 ft	Prohibited	Sale of synthetic lawn fertilizer prohibited. Post educational signs around nonsynthetic fertilizers explaining environmental problems with synthetic fertilizers and how the alternatives work in an organic system.
Illinios	2010/2010	Golf courses; Commercial and sod farms; Agricultural lands and production; Right-of-ways; Phosphorus deficiency; Establish new turf; Lawn repair.	Yes	Yes	Prohibited, must clean up if inadvertent	3 to 15 ft	Prohibited	No restrictions
Maine	2007/2008	Agriculture; Phosphorus deficiency; Establish new turf; Sod farms; Turf repair; Gardening.	Yes	No	No restrictions	None	No restrictions	Post signs about fertilizer use at point of sale.
Maryland	2011/ 2011-2013	Agricultural purposes; Commercial and sod farms; Phosphorus deficiency; Establish new turf; Turf repair.	Yes - But only if a soil test indicates it is necessary	No	Prohibited	10 to 15 ft	Prohibited from Nov. 16 to Feb. 29 or on frozen ground	Must sell low phosphorus fertilizer for lawns unless organic and sold to professional.
Michigan	2010/ 2012	Golf courses; Commercial farm land; Phosphorus deficiency; Establish new turf.	Yes	No	Must clean up if applied	3 to 15 ft	Prohibited	No restrictions
Minnesota	2002/ 2004	Golf courses; Sod farms; Agricultural lands and production; Phosphorus deficiency; Establish new turf.	Yes	No	Prohibited, must clean up if applied	None	No restrictions	No restrictions
New Jersey	2010/ 2011, 2013	Golf courses; Commercial Farms; Phosphorus deficiency; Establish new turf; Turf repair.	Yes	Yes- but only if it contains no more than .25 pounds of phosphorus per 1,000 square ft.	Prohibited, must clean up if inadvertent	10 to 15 ft	Prohibited during heavy rain or when predicted, on saturated or frozen ground, or from Nov. 16 - Feb. 29 (Dec. 2 - Feb. 29 for professionals)	Sale prohibited to consumers unless for deficiency, new turf, or turf repair.
New York	2010/ 2012	Gardens; Agricultural lands and production; Sod farms; Phosphorus deficiency; Establish new turf.	Yes	No	Prohibited, must clean up if applied	3 to 20 ft	Prohibited between Dec. 1 and Apr. 1	Display phosphorus fertilizer separately; Post educational signs.
Vermont	2011/ 2011, 2012	Golf courses; Sod farms; Agricultural lands and production; Phosphorus deficiency; Establish new turf.	Yes, but sewage sludge not exempt	Yes	Prohibited, must clean up if applied	25 ft	Prohibited from Oct. 16 to Mar. 31 or on frozen ground	Display phosphorus fertilizer separately; Post educational signs.
Virginia	2011/ 2013	Golf Course Management plan; Phosphorus deficiency; Establish new turf; Turf repair; Agricultural use.	Yes	Yes	Package label prohibits certain uses	None	Package label prohibits certain uses	Sale of lawn maintenance fertilizer prohibited; Can sell existing stock.
Washington	2011/ 2013	Establish new turf; Turf repair; Phosphorus deficiency; Gardens; Sod farms; Agricultural land or production.	Yes, but sewage sludge not exempt	No	Prohibited	None	Prohibited on frozen ground	Sale prohibited unless for an allowed use and properly labeled; Can sell existing stock.
Wisconsin	2009/ 2010	Sod farms; Agricultural land and production; Phosphorus deficiency; Establish new turf.	Yes	Yes	Prohibited, must clean up if inadvertent	None	Prohibited on frozen ground	No display but may post sign; Must sell only for specific purposes.

adoption of organic soil fertility practices that provide an environmental benefit. A comparison of the state policies are contained in Table 1 (on the previous page). As a part of the adoption of state law phasing out synthetic fertilizers, Beyond Pesticides urges states to work with retailers to provide consumers with point of purchase information on sound organic soil fertility practices and products that are protective of the environment.

Do These Laws Work?

Until recently, there was no proof that these bans would have much of an impact on the health of aquatic environments. However, a 2011 study following the effects of a phosphorus ban by the town of Ann Arbor, Michigan[18] supplied critical evidence of the policy's effect. The study, entitled "Reduced additions to river phosphorus for three years following implementation of a lawn fertilizer ordinance," published by researchers at the University of Michigan in *Lake and Reservoir Management*, revealed average decreases in soluble-reactive phosphorus by upwards of 52%, dissolved phosphorus by 35%, and total phosphorus by 25% in the Huron River compared to an upstream control group. Researchers concluded, "The jurisdiction of Ann Arbor, Michigan, seems to be contributing less nonpoint source P to the Huron River than it did before implementation of its lawn fertilizer ordinance." Peer-reviewed evidence of the effectiveness of these fertilizer bans affords policy makers with the scientific basis to implement these regulations.[19]

Helpful Tip!

Save money and maintain your lawn with real natural, organic fertilizers by mulching it with grass clippings and/or shredded leaves. You can also turn your food scraps into fertilizer by starting a worm bin or traditional compost pile. See Beyond Pesticides factsheets on Starting a Compost Pile and Making Compost Tea for more information, available online at http://bit.ly/120W5Ty.

What You Can Do

While the application of phosphorus fertilizers is common as a means of feeding nutrients to plants, organic approaches use cultural practices and soil amendments to feed the soil, and as a result create an adequate amount of plant-available phosphorus. Individuals can reduce their impact on local waterways and aquatic wildlife by following some simple guidelines:

- *Get a Phosphorus Ban in Your Community* – Organize a local coalition of environmental health advocates and policy makers. Contact Beyond Pesticides for organizing information and a copy of our model policy.
- *Prevent Soil Erosion* – Preventing soil erosion keeps phosphorus from entering local rivers, lakes, and streams. Mulch bare soil with straw or wood chips, and edge your yard with native trees and shrubs to prevent the loss of topsoil. Also, be careful not to over-water your lawn.[20]
- *Only use phosphorus based fertilizers on your lawn if a soil test[21] indicates it's necessary* – Test your lawn every 2-3 years. If your soil test does indicate a phosphorus deficiency, make sure to follow application instructions from your extension office carefully in order to avoid over-fertilization. Although phosphorus is not a highly "mobile" nutrient, soils already saturated with phosphorus are more prone to groundwater leaching and contamination of local waterways. When fertilizing is necessary, be sure to use non-synthetic sources of phosphorus, as it breaks down slower and supplies nutrients to your lawn over a longer period of time.
- *Keep fertilizer, leaves, and grass clippings off of impermeable surfaces and on your lawn* – When left on impermeable surfaces, these materials have a greater chance of running off into local waterways where they degrade and contribute to excessive nutrient loads. When applying phosphorus fertilizers, try to incorporate them into your lawn's soil. Leave grass clippings on your lawn as mulch to ensure the nutrients already in your soil are recycled for future plant growth. Never apply fertilizer to frozen ground.
- *Fertilize away from ponds, rivers, lakes, and streams* – Be careful when applying fertilizers near water. Create a buffer of at least 25 ft. in order to minimize runoff. Additionally, keep an eye on the weather forecast in order to prevent applying fertilizer before a heavy downpour, as heavy rain can cause recently applied fertilizers to runoff before being incorporated into the soil.
- *Pick up after your pet* – Picking up pet waste helps prevent further contamination of local waterways and also protects public health.[22]
- *Keep a healthy lawn* – By maintaining a healthy lawn through proper care, you can cut down on your overall fertilizer needs. Beyond Pesticides Lawns and Landscapes webpage has all the information you need to maintain a healthy lawn.

Endnotes

1. U.S Environmental Protection Agency. Basic Information. http://www.epa.gov/owow_keep/NPS/whatis.html
2. Linda Ph.D Chalker-Scott. Puyallup Research and Extension Center, Washington State University. "The Myth of Phosphate Fertilizer: Phosphate fertilizers will stimulate root growth of transplanted trees and shrubs." http://www.puyallup.wsu.edu/~linda%20chalker-scott/horticultural%20myths_files/Myths/Phosphate.pdf
3. The Chesapeake Bay Foundation. "Nitrogen and Phosphorus." 2012. http://www.cbf.org/how-we-save-the-bay/issues/dead-zones/nitrogen-phosphorus
4. Lowell Busman, John Lamb, Gyles Randall, George Rehm, and Michael Schmitt. University of Minnesota Extension. "The Nature of Phosphorus in Soils." 2002.http://www.extension.umn.edu/distribution/cropsystems/dc6795.html
5. Beyond Pesticides. "Pesticide Free Zone Sign Owner's Manual." http://beyondpesticides.org/lawn/documents/PFZOwnersManual.pdf
6. Mariangela Diacono and Francesco Montemurro. Long-Term Effects of Organic Amendments on Soil Fertility. *Sustainable Agriculture* Volume 2, Part 6, Pages 761-786. 2011. http://www.springerlink.com/content/t251lq24715477n5/
7. Thomas M. Blessington, David L. Clement, and Kevin G. Williams. Central Maryland Research and Education Center. University of Maryland. "Organic and Inorganic Fertilizers." http://environmentalhorticulture.umd.edu/ProductionInformation/Organics.pdf
8. *Organic Foods Production Act.* Title XXI of the Food Agriculture, Conservation, and Trade Act. [7 U.S.C. 6508], http://www.ams.usda.gov/AMSv1.0/getfile?dDocName=STELPRDC5060370
9. BioMed Central. "Antibiotic-resistant Bacteria Found In Fertilizer, Finds Study Of Swedish Sewage Sludge." *ScienceDaily,* 28 May 2009http://www.sciencedaily.com/releases/2009/05/090528203737.htm
10. University Of Georgia. "Researchers Link Increased Risk Of Illness To Sewage Sludge Used As Fertilizer." *ScienceDaily*, 30 Jul. 2002. http://www.sciencedaily.com/releases/2002/07/020730075144.htm
11. Purdue University. "Organic Vegetable Management." p.6. August, 2003. http://www.extension.purdue.edu/extmedia/ID/ID_316.pdf
12. Beyond Pesticides. "What's in a Pesticide?" http://www.beyondpesticides.org/infoservices/pcos/ingredients.php
13. American Association of Plant Food Control Offices. "AAFPCO Product Label Guide." 2012. http://www.aapfco.org/pdf/label_guide_2012.pdf
14. Mariangela Diacono and Francesco Montemurro. Long-Term Effects of Organic Amendments on Soil Fertility. *Sustainable Agriculture* Volume 2, Part 6, Pages 761-786. 2011. http://www.springerlink.com/content/t251lq24715477n5/
15. Heide Hermary. "Effects of Some Synthetic Fertilizers on the Soil Ecosystem." March 2007. http://www.organiclandcare.org/files/education/pesticides_and_fertilizers/Effects%20of%20some%20synthetic%20fertilizers.pdf
16. Appropriate Transfer Technology for Rural Areas. "Sustainable Soil Management: Soil System Guide."July 1999. http://www.soilandhealth.org/01aglibrary/010117attrasoilmanual/010117attra.html#conventional
17. IPCC Fourth Assessment Report: Climate Change 2007. Working Group III: Mitigation of Climate Change. "7.4.3.2 Fertilizer manufacture." http://www.ipcc.ch/publications_and_data/ar4/wg3/en/ch7s7-4-3-2.html
18. City of Ann Arbor, MI. ORDINANCE NO. 1-06, Chapter 70. 2006. http://www.a2gov.org/government/publicservices/systems_planning/Environment/Documents/spu_env_phosphorus_ordinance_2006-01.pdf
19. John T. Lehman, Douglas W. Bell, Jon P. Doubek, and Kahli E. McDonald. Department of Ecology and Evolutionary Biology.University of Michigan, Ann Arbor. "Reduced additions to river phosphorus for three years following implementation of a lawn fertilizer ordinance." *Lake and Reservoir Management*. 2011 http://www.umich.edu/~hrstudy/Reports/LRM2011.pdf
20. Robert Mugaas. University of Minnesota Extension. "Responsible Fertilizer Practices for Lawns." 2012. http://www.extension.umn.edu/distribution/horticulture/dg6551.html
21. For information on how to perform a soil test, see: University of Georgia. "Soil Testing for Home Lawns, Gardens, and Wildlife Food Plots." http://www.caes.uga.edu/publications/pubDetail.cfm?pk_id=7440
22. "Use phosphorus-free lawn fertilizer to protect Minnesota lakes and rivers." Factsheet. 2012. http://cfpub.epa.gov/npstbx/files/reducewaste-phosphorus.pdf

BEYOND PESTICIDES
701 E Street, SE ■ Washington DC 20003
202-543-5450 phone ■ 202-543-4791 fax
info@beyondpesticides.org ■ www.beyondpesticides.org