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New Best Management for Phosphorus in the Water

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Abstract: *Phosphorus (P) is a macronutrient required by all life forms. P occurs in the environment naturally and may be introduced during farming and household activities in the form of fertilizers. Extension can play a critical role in helping to reduce commercial and household impacts of excess P in soils. Agents can help clients using education and introducing them to best management practices, including a phosphorus removal structure. It is a passive filtration system that removes P from runoff and drainage ditches before it reaches sensitive water bodies.*

Introduction

Extension and Phosphorus (P) in the Water

Phosphorus (P) is a naturally occurring element (atomic number 15). It is a macronutrient required by all life forms and is necessary for crop and plant production. Phosphorus is mined as relatively insoluble apatite and processed into more soluble forms that are used as fertilizers. Unfortunately, this P may build up in soils if applications exceed plant needs for many years, which can potentially become a non-point source of P to surface water bodies (Penn, McGrath, Rounds, Fox, & Heeren, 2011).

Extension may play a critical role in helping to reduce commercial and household impacts of excess P in soils. P may come from agricultural, horticultural, urban, and recreational land. Agriculture (Ag) agents can consider working with commercial entities, while Family and Consumer Sciences (FCS) agents may work with homeowners. Specifically, the agents can start by completing on-site assessments of the potential risks and sources, using checklist questions to identify problem areas, if any. Education would be a natural outgrowth of this process. This topic also provides the unique opportunity for Ag and FCS to work together with consumers who live and work on the same piece of property, which is often the case with agricultural producers and their families. This approach fits well with holistic healthy homes and environments programming.

Why We Care About Phosphorus in the Water

Phosphorus is a growth limiting nutrient. Plants require P to complete their life cycle, but in amounts smaller than needed for algae. Transport of P from soils to surface waters can provide the small amount of P necessary for aquatic plants and algae to thrive, which leads to the process of eutrophication (U.S. Environmental Protection Agency, 2012). The National Academy of Sciences defined eutrophication as well nourished; the natural or artificial addition of nutrients to water; and may be considered pollution when the effects are not wanted

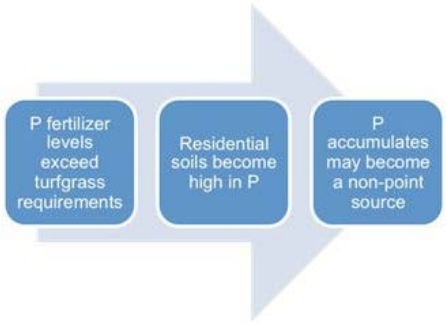
(*Eutrophication: Causes, consequences, correctives, 1969*). High levels may result in odors, problems with water treatment processes (drinking water), recreation, and fish kills.

Surface runoff delivers P in particulate and dissolved forms. Among these forms, dissolved P is 100 percent biologically available to aquatic life and its transport is most difficult to prevent. While particulate P transport can be reduced by erosion control (A.N Sharpley, Smith, Jones, Berg, & Coleman, 1992), there are no best management practices (BMPs) that will directly reduce dissolved P transport in the short-term from high P soils.

A major source of dissolved P to surface runoff includes soils high in P and recently fertilized soils (A.N. Sharpley, Kleinman, McDowell, Gitau, & Bryant, 2002). Others identify lawn fertilizer a large source of P in stormwater runoff (Bierman, Horgan, Rosen, Hollman, & Pagliari, 2010). From a residential perspective, Hefner, Robertson, Coulter, and Stevens (2009) identified obstacles facing homeowners in nutrient management. The authors reveal that consumers found it difficult to make appropriate fertilizer choices due to numerous options available and inaccurate area measurements.

Figure 1.

Example of Elevated Phosphorus Caused by Residential Use



Useful Tool

Traditional best management practices, including stormwater retention basins, do not adequately remove dissolved P from water (Sharpley et al., 1992). To remove dissolved P, consider using a new best management practice (BMP), that is, a P removal structure. The structure is a cost-effective way to remove P and reduce environmental impacts. Additionally, Penn, Bryant, Kleinman, and Allen (2007) indicate that the amount of P removed from the water can be easily measured, relative to the amount removed from more traditional BMPs.

A source of P must be identified before constructing a P removal structure. Common hotspots include the following:. On the household level: over fertilized lawns, neighborhoods with over fertilized lawns; On the commercial level: poultry production, cattle feedlots, and golf courses.

The P removal structure is a passive filtration system that is effective at removing P from runoff and drainage ditches before it reaches sensitive water bodies. The P removal structure is a structure filled with a P sorbing material. P sorbing materials can be readily found and include several no or low cost industrial by-products. Examples of excellent P sorbing materials include water treatment residuals, acid mine residuals, fly ash, and steel slag.

Figure 2 represents a P removal structure in an urban area. Runoff water channels into structure. Water is exposed to the P sorbing material and is filtered. Filtered water then drains out of structure. The total cost to build was $2,200 (Steel and welder time: $2,000; 3 tons steel slag: Free; Cost to sieve and transport slag: $200). This relatively small structure (2.6 x 3.3 m), filled with steel slag, was able to remove about 25% of all P flowing into it from a 150 acre watershed during a 6-month period (Penn et al., 2012). The structure must be periodically maintained. For example, the sorbent material has to be removed and replaced periodically depending on the unique characteristics of the site.

Figure 2.

Phosphorous Removal Structure

Putting the Tool to Work

Interested in constructing a P removal structure for your community? Use community partners to identify a hotspot, and test water to be certain there are elevated P levels. Use free resources such as industrial by-products to bring costs down. Software tools will soon be available to help measure impacts.

Green is the color of the day. Many communities are interested in creating or maintaining a "green" image. The key to project success is educating and partnering with communities and homeowners about the benefits to adopt a "greening" strategy, even when there is no economic incentive to do so. Extension can serve as catalyst, facilitating pollution prevention strategies and behavior change.

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