Proper Fertilization Helps Turfgrass Fulfill its Role in Protecting the Environment

By George Hochmuth

Based on requests for information about the science behind turfgrass BMPs, scientists in Florida reviewed the national literature to learn more about research on fertilization of turfgrass and potential problems with nutrient losses from turfgrass systems. One goal was to determine if there were scientific reports regarding a summer-restricted period against fertilization. The resulting paper "Urban Water Quality and Fertilizer Ordinances: Avoiding Unintended Consequences: A Review of the Scientific Literature" was published in Florida Extension literature (Hochmuth, G. et al. 2011), which was followed by a peer-reviewed article (Hochmuth, G. et al. 2012). This article summarizes some of the major findings of these papers along with a few of the major supporting publications.

Turfgrass is an important plant in the urban environment for maintaining aesthetic and economic value for residential, commercial, and recreational properties. In most areas of the country and especially in Florida, fertilizer is required to maintain healthy turfgrass. Warm-season types of turfgrass have been studied in Florida for their nutrient requirements and BMPs have been written for fertilization and irrigation. The BMPs are based on many years of research and are designed to provide for healthy turfgrass while protecting local water bodies from nutrient pollution due to lost fertilizer. Even though BMPs have been written and have been recommended statewide, there are some counties and municipalities in Florida that have opted to enact more strict local ordinances including prohibitions on fertilization of turfgrass in the summer months from June 1 through September 30. Florida is not the only state to have statewide or local guidelines for fertilizer use on turfgrass, but there are differing approaches among states and localities.

Eutrophication of our inland and coastal water bodies is a real concern and nutrient enrichment is associated with human activities. Point (e.g., waste water treatment) and nonpoint (agriculture and urban nutrient sources) can contribute N and P to water bodies through leaching and runoff. These nutrients may contribute to the degradation of the designated use for a water body. Total Maximum Daily Loads would be determined for the impaired water body and a Basin Management Action Plan would be employed to return the water body to it desired water quality level. Clearly this process would be expensive and time-consuming. Managing nutrient loss at the source would be a preferred approach and that is the intention of BMPs.

In residential areas there are numerous sources of nutrients including atmospheric deposition, pet waste, tree and plant leaf litter, and fertilizers. This review included research for all of these nutrient sources focusing on urban fertilization. Nitrogen, P and K fertilizers are commonly applied to lawns to achieve a desired level of plant growth and aesthetic value. Studies in Florida have documented the presence of fertilizer-derived nutrients in water bodies (Jones et al., 1996; Tampa Bay Estuary Program, 2008). While these studies show fertilizer nutrients are being found in urban water bodies, they do not conclude whether the nutrients were lost predominantly from landscapes fertilized properly according to BMPs or from improperly fertilized landscapes.

Abbreviations and Notes: N = nitrogen; P = phosphorus; K = potassium; BMPs = best management practices; ppm = parts per million.

Research demonstrates that appropriate fertilization is a major factor to maintaining healthy turfgrass that is able to efficiently take up nutrients and reduce nutrient loss from residential landscapes.

Beard and Green (1994) grouped turfgrass into *functional* (e.g., preventing erosion, preventing weeds), *recreational* (sports fields), and *aesthetic* (beauty and value-added homes and properties) functions. Healthy turfgrass can be described as turfgrass that maintains complete coverage of the soil and adds aesthetic beauty and value for the home site. In our scientific review we asked the question "does healthy turfgrass play a role in preventing nutrient loss from the urban environment?"

Numerous research studies in several states find that healthy turfgrass can efficiently take up nutrients and reduce nutrient loss from the landscape. Published books (Beard and Kenna, 2008; Nett et al., 2008) have summarized the research literature on turfgrass systems and their care, with attention to environmental impacts. Research shows that fertilizer-derived nutrients can be lost from the urban landscape under certain circumstances. For example, runoff losses were most likely when fertilizer is applied just before or during heavy rainfall

(Soldat and Petrovic, 2008), when fertilizer was applied before the turf root system is established (Erickson et al., 2010; Trenholm et al., 2011), or when fertilizer was applied in excess of research-based recommendations (Trenholm et al., 2011). In a study in Minnesota with Kentucky bluegrass, zero, low, and high P (and a zero control) fertilization programs were imposed during the year (Bierman et al., 2010). The researchers measured runoff volume and P loads moving off the research site plots. Where N and K fertilizers were supplied (better turfgrass growth), P in the runoff increased as the P rate increased. Phosphorus runoff from the unfertilized plots (no N and K and lower plant growth) was greater than from fertilized turf. The researchers attributed the increased P runoff to poorer growth of the turfgrass in the unfertilized plots. Phosphorus runoff was greater when P was applied in the fall, when plant growth slows and plants entered dormancy. These researchers concluded that P should not be applied in the fall or when soils already are high in P content, and that P runoff was reduced with healthy, fertilized (N and K) turfgrass.

In a 6-year study in Wisconsin, Kussow (2008) evaluated management practices that affect N and P losses from upper Midwest U.S. lawns. Annual nitrate-N leachate concentrations were typically between 2 and 4 ppm and the quantity of N leached was about 3 lb/A, which was intermediate between losses from agricultural and natural areas in the upper Midwest. The most important factor for increasing runoff loss of N and P was runoff depth. Next in importance was failure to fertilize for a healthy lawn.

Leached N averaged 0.23% of the total N applied over two years for Kentucky bluegrass (Miltner et al., 1996). Total recovery of N was 64 and 81% for Spring and Fall, respectively, pointing to potential gaseous losses of N making up the difference. Research showed that the active growth period is the time when the grasses have the greatest ability to take up nutrients, due to larger, denser, and more actively growing root and shoot systems.

These studies and others show that maintaining healthy turfgrass with appropriate fertilization is a major factor in reducing nutrient loss from residential landscapes. The research also points to possible negative unintended consequences for not following appropriate fertilization practices in residential lawns.

The authors reviewed the status of statewide and local regulations for fertilization practices in the U.S. For example, Minnesota had the first statewide rule for P fertilization in urban environments. Other states with rules include Michigan, Maryland, Wisconsin, and New Jersey. The rules in these states, unlike Florida, do not ban fertilization in the period of active turfgrass growth. Rather, they typically control fertilizer application through the use of BMPs, including the use of a soil test to predict P needs, the use of set-backs (buffers) from water bodies, advice on keeping fertilizer off impermeable surfaces, controls on total amounts of fertilizer per application and for the season, bans on fertilization in the winter when the ground is frozen or when the turfgrass is not actively growing, and allowing fertilization of newly planted turf seeds or sod. The ordinances in other states are therefore much like the Florida Department of Environmental Protection Green Industries BMPs and the state model ordinance (FDEP, 2008).

From our literature review and analysis, the following conclusions can be made:

- Coastal and urban eutrophication is a problem and is, at least in part, related to many urban land-based activities. Sources of nutrients involved with eutrophication are numerous and the interactions with harmful algal blooms are complex.
- Based on an analysis of national research, turfgrass has a large capacity for nutrient absorption. Unfertilized turfgrass will lead to increased runoff and nutrient losses as turfgrass health and density decline over time due to insufficient nutrient supply.
- BMPs for fertilization have been shown to be effective in reducing pollution of water bodies.
- Developing nutrient BMPs involves an iterative process based on science and must be sustained to develop continually advancing knowledge.
- The BMP solution avoids the "one-size-fits-all" approach because BMPs, by definition, provide for adjustments in the practices depending on local conditions and science-based recommendations.
- All published scientific research should be part of a comprehensive and complete discussion of approaches to reduce urban nutrient losses. All stakeholders should actively engage in this process.
- Research publications point to the importance of a continued education effort to inform homeowners about how their landscape practices impact water quality. Continuing the effort to educate the public about the BMPs, as determined by scientific research, is of the utmost importance. BC

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