Science to Support Fertilizer Controls

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"Fertilizer is good for the father and bad for the sons."
–Dutch saying

In response to the prodding of Dr. Eric Brown, a community college instructor and employee of Massey Lawn Care Services, below is the literature to support my guest editorial on lawn fertilizer and water quality. True agri*culturists* would say *"Fertilizer is good for the father and bad for the sons,"* because in time, the results are bad for the soil and bad for the crop. We must wean our lawns off of chemical fertilizers and develop alternatives if we want to have healthy waterways.

1) Lawn fertilizer is a significant source of nitrogen

At the national scale, estimates of nitrogen loads from fertilizer use ranged from 20% to 25% (Howarth *et al*, 1996; Howarth *et al* 2002). In small-scale turf grass plot studies, nitrogen losses ranged from 25% (Frank *et al* 2006) to 33% (Engelsjord 2004), about the same amount of nitrogen lost (25-37%) in a study of varying citrus fertilizer treatments in a control study (Quinones *et al* 2007). At a watershed scale, a Lake Tarpon (Florida) study estimated that residential fertilizer contributed 79% of the nitrogen load to the lake, significantly more than the amount contributed by the area's septic tanks, (Leggette, Brashears and Graham, Inc. 2004). MACTEC (2007) estimated that 42% of nitrogen loading to the Wekiva River was from residential fertilizer, which was later reduced to 20% after it was discovered that homeowners who apply fertilizer themselves apply much less nitrogen to the lawn than professional applicators (MACTEC 2009, FDEP 2009).

2) Fertilizer gets absorbed in the soil where it can stay indefinitely until the system reaches carrying capacity.

The largest storage of nitrogen in is the soil, rocks, organics, and bacteria of the lithosphere (Reddy, University of Florida Biogeochemistry Introductory Course). Soil and the organic matter act as a nitrogen sponge or "sink" to absorb lawn fertilizer and the soil's ability to retain the nitrogen depends on many different things (Raciti *et al* 2008). Higher nitrogen losses in agricultural fields were related to heavy rain events likely due to residual fertilizer on soil organic matter (Ventura et al 2008).

3) At a watershed scale, the amount of nitrogen losses will change over time relative to vegetative growth and decay. This is well-established and substantiated in the literature

as nutrient succession theory (Vitousek and Reiners, 1975). Nutrient succession explains how additional nutrients will cycle through the landscape. Initially, the addition of nutrients to the system will be wasted because there isn't enough vegetation and organics to use it up. Then, as vegetation and soil organic matter increases, more of the added nutrients are used up and less are lost. As the system reaches its carrying capacity and starts to die (or is cut), the nutrient inputs accumulate in the soil and the amount of nitrogen lost increases. It is just a matter of time before the nitrogen ends up a product of waste or decay and then dissolved in solution with the next heavy rain event. There are many experiments that show this trend, including one by Trenholm (2012) who found that initial nitrate losses were as high as 73% but then dropped considerably with losses as low as 1% in the following year as the vegetation, soil, and bacteria started accumulating the nitrogen. Nutrient succession explains that given enough time, the nitrogen outputs would increase.

4) Chemical fertilizer is actually detrimental to the soil and can result in a "chemically dependent lawn."

Recent literature demonstrates that chemical fertilizers may actually destroy soil carbon and harm the soil so that plants can no longer make their own nutrients (Engelsjord *et al,* 2004; Frank *et al,* 2006; Mulvaney, Khan, & Ellsworth 2013). Their results confirm a Dutch proverb; *"Fertilizer is good for the father and bad for the sons."*

Evidence to Support Strong Urban Turf Grass Fertilizer Provisions

The following summarizes the research needs described by the Florida Consumer Fertilizer Task Force, the results of the limited research that was conducted in response to that need, evidence from real world case studies where strong fertilizers have been in effect since 2007, and citations of relevant scientific literature. The Florida Consumer Fertilizer Task Force reviewed the scientific literature on the topic and recommended five (5) research projects that should be conducted to evaluate the effectiveness of ordinance provisions. Consider the evidence from all of them:

1. In situ or "real-world" assessment of fertilizer nutrient leaching and runoff from existing urban residential lawns. Note: this assessment was attempted to augment the Cisar et al. (2000) "Ft. Lauderdale" experimental study, for several residential lawns in Sarasota, but results were not reported.

Research has not been completed. Cisar at al demonstrated that slow release nitrogen leached the least during the summer rainy season compared to quick release products, but results weren't released. I am working with a team to assess storm water runoff in four Tampa Bay communities and results are forthcoming.

2. Experimental and in situ assessment of nutrient leaching and runoff from ground cover, native landscapes, and other alternative landscapes. These landscapes should be assessed for nutrient loss in conditions of fertilization augmentation and where no fertilization is necessary.

No research conducted.

3. A detailed mass balance or "box model" study to assess the ultimate sinks, fate and chemical transformations of N and P in turf, soil, and shallow groundwater systems.

No research conducted.

4. Consumer behavior studies to assess residential urban turf irrigation rates, actual fertilizer application rates, and other factors with respect to understanding urban turf management by consumers. Analyses may be nested in a residential subdivision approach to attain trends within communities in addition to statewide trends between communities across the state.

Residential Fertilizer Study (Souto et al 2007-2011) collected subdivision, regional, and statewide, consumer fertilizer information demonstrating that:

- Homeowners who applied fertilizer to the lawn themselves applied much less nitrogen (N) than the IFAS recommended rates on average. If they applied the most commonly sold lawn fertilizer product which is 6% N, they applied less than 1 pound/1000 square feet where the Professionals were applying 3.5 lbs N /1000 square feet.
- Homeowners applied fertilizer mostly in April, May and October. When asked why they didn't apply in the summer, they said things like "It's too hot," "The grass would burn," "It would wash away," or "the grass is already growing too fast."
- Half of Florida's fertilized lawns are managed by homeowners who are following the seasonal restriction intuitively. They are happy with their landscapes.
- Homeowners did not "pile on" extra fertilizer in the spring and fall if they were not permitted to apply in the summer due to local ordinances. They weren't applying fertilizer in the summer at all.

5. Assessment of the fate of urea-nitrogen in fertilizer leachate and runoff in urban turf landscapes. Although urea-N is widely known to rapidly transform into inorganic nitrogen in the soil environment, whereby it can be rapidly assimilated by turf, what proportion of the urea-N may actually be lost in leachate and runoff."

Research completed by IFAS only addressed nitrate in leachate as summarized below.

Trenholm research (2012) investigates leachate in controlled experimental design not the urban landscape as recommended. The experiment compared nitrate in leachate when urea fertilizer was applied to grass during the dormant and growing seasons to conclude

that grass takes up more fertilizer when it is growing, not dormant. This research asks a simple and somewhat obvious question relating to grass dormancy and leaching. The researcher should not conclude that leaching and uptake are the same, as no biomass nitrogen content was measured, which would indicate "uptake" rates. The researcher should not conclude that there is less fertilizer run-off in the summer from the leaching rates. The research does not consider the soils where nitrogen can be stored indefinitely; it doesn't consider the fertilizer taken up by the grass which will be cut and end up breaking down in the soil or possibly the storm drain; and it doesn't consider all of the forms of nitrogen such as ammonium (NH4) or organic nitrogen. Although the research cost $7 M and was set up as a controlled experimental design, the research failed to construct a nitrogen mass balance to account for the nitrogen to understand where it went. For this reason, the results cannot be applied to real-world landscapes and it is why the only peer-review scientific journal article that came out of the research included the following statement:

"While it is outside the scope of this research to determine if impairment of ground or surface waters will result from application of the currently recommended N rates, this research indicates that these rates will produce minimal NO3–N leaching."

The truth is that no storm water fertilizer run-off research has ever been conducted, nor any in-situ or "real world" assessments of fertilizer nutrient leaching and runoff. Some researchers at the University of Florida (UF) will have you believe that applying fertilizer during the rainy season is the best time based on the limited research described above. For years, this same institution supported the fertilizer best management practice of not applying fertilizer during the rainy season. I don't see any evidence from the limited research that supports changing this practice.

Residential lawn fertilizer is a significant source of nitrogen to receiving waters.

- In Northeast, US – research demonstrated that 25% of nitrogen going to receiving waters (in general) was from residential turf grass fertilizer.
- MACTEC (2009) found that at least 20% of the nitrogen input to the Wekiva River was from residential turf grass fertilizer, which was equal to load estimates from 6,000 septic tanks in the same area.
- In Pinellas County, researchers found that 79% of the nitrogen loading to Lake Tarpon was from residential fertilizer use (Leggette, Brashears & Graham, Inc., 2004)

There is no evidence that the fertilizer industry has suffered as a result of more restrictive ordinances.

Fertilizer manufacturers responded quickly to develop products that can be applied during the seasonal restriction (There are over 120 products available on the market). Scott's fertilizer marketing new 50% slow release products

Florida-owned fertilizer companies benefitted most by capitalizing on new products that can applied in Florida during the rainy season. These products include micronutrients such as iron, magnesium, and other beneficial plant needs, they just don't have N or P.

Before the Pinellas County ordinance, 2% of lawn fertilizers at Home Depot were Florida-based companies, after the ordinance passed, 70% of the lawn fertilizers were Florida-based company products.

Tru-Green opened a new residential lawn care center in Tampa, and hired 175 new workers to help support the new emerging market.

Professional landscape managers developed new business models to address homeowner needs for different fertilizers during the restricted season.

Garden Masters of SW Florida manages over 10,000 customers in 5 counties. After Sarasota County passed ordinance in 2007, they had to "scramble in the first year" to get products developed and find adequate suppliers. Developed a new business plan to set prices based on "maintenance of a vibrant lawn" and not on "price per visit").

- Reduced fertilizer use by 200 tonnes/year and chemical costs decreased dramatically.
- Fewer fungus and insect problems
- Owner said that if the Sarasota County ordinance was repealed, he would stay with his new business model, which is saving him money and providing a better service to his customers.

Palmer Ranch is a golf course community in Sarasota County which manages 29 acres of St. Augustine turf grass. With new ordinance, manager started conducting soil, irrigation, and vegetative tissue analyses to understand nutrient needs and adjusted fertilizer accordingly. In three years, they saw an immediate improvement in turf quality and saved the organization over $225,000 in three years, reducing turf replacement costs from $90,477 to $760/year.

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