State regulations, organic lawn management, and nutrient accumulation in soils

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Abstract
State statutes and regulations concerning land use decisions are often created with no consultation with soil scientists. The state of Connecticut passed a statute banning pesticide applications on athletic fields at Kindergarten through eighth grade schools. The expectation was that organic practices would be used to manage the turfgrass. The state Department of Environmental Protection started a program of education for school officials about organic turfgrass management with an advocacy group promoting organic practices. Much of the education recommended application of amendments to the soil to improve the soil-food-web with the expectation of improved turfgrass growth, and disease and insect resistance. Many of the recommended amendments were expensive. School officials requested university soil scientists be part of the educational committee. Soil scientists informed the committee that many of the recommended practices had no scientific data to validate their efficacy, and some practices would saturate the soil with phosphorus. Implementation of the statute has been delayed while a suitable, scientific-based solution is developed. The process used by the soil scientists to educate school officials, environmental advocacy groups, and regulatory personal will be described and publications used to educate about what is known and not known about the soil-food-web will be shown.

Key Words
Soil-food-web, soil phosphorus, organic practices, turfgrass, state statutes, soil scientists.

Introduction
Soil scientists can provide much needed information to legislators, government regulatory agencies and organizations involved in making decisions about the use of land. Land use decisions are complex and require input from many different perspectives. Historically land use decisions have been made primarily by using the advice of engineers, biologists, and economists. Many decisions, however, could be improved by the inclusion of the expertise of soil scientists. One relatively new and popular topic for making land use decisions is a requirement for organic land care management. Organic land care management uses the ideas of Sir Albert Howard (Howard 1943) and J.I. Rodale (Rodale 1942) to manage turfgrass and landscape plants (NOFA CT 2009). Organic land care management is often thought of primarily as a method to eliminate the use of conventional pesticides, which are considered by many people, including those promoting organic practices, to be toxic and unnecessarily harmful to the environment and to humans. A concern about the application of pesticides to turfgrass on athletic fields at schools in Connecticut prompted the passage of a law banning all pesticide use on school grounds, including athletic fields, at kindergarten through eighth grade schools (State of Connecticut, HB 5234 2007).

No soil scientists were consulted during the discussion and debate about the new state statute probably because the discussion and debate were about the effects of pesticide use on children and the environment. The discussion about the new statute included an expectation that organic lawn care would be substituted for conventional lawn care. Organic lawn care is based on the premise that if the soil is managed properly the need for pesticides will be eliminated (Heckman 2007). The biologists, environmentalists, toxicologists and others who testified about the benefits and need for the ban on pesticides had no knowledge about the effect of good soil management on the need for pesticides on turf. Information about the management of nutrients, especially phosphorus, to avoid accumulation of nutrients and subsequent loss of environmentally harmful concentrations of nutrients from the soil was absent from the discussion.

This paper is a case study about how the legislative and regulatory process to improve land use decisions can be improved by including soil scientists in the process. We also provide a summary of recommended organic lawn care practices, many that are meant to improve the soil-food-web, and a summary of the scientific data about how modification of the soil-food-web can enhance the growth of turf.

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Methods
We completed a literature search of information about the practices and amendments recommended by practitioners of organic lawn care. Information about how recommended organic lawn care practices can enhance the soil-food-web, and how the enhancement may or may not protect turf from insects and disease were searched for and compiled.

Results
The state of Connecticut's Department of Environmental Protection (DEP) obtained a grant with a non-profit organization in the state, the Northeast Organic Farmers Association, who promotes organic land care practices (NOFA 2009). The grant provided money for the non-profit to develop education programs for town employees who manage athletic fields at Kindergarten through eighth grade schools, and to perform demonstration trials on athletic fields of two towns who volunteered to work with the DEP and NOFA. The demonstration trials compared conventional management of turf using soluble fertilizers and conventional pesticides with organic management of turf without using soluble fertilizers and conventional pesticides. The demonstrations consisted of two athletic fields in one town having half of each field treated with conventional practices and the other half treated with organic practices. Two professors of turf from the University of Connecticut were asked to evaluate the performance of the fields without knowing which treatment was used on which half of the fields. The other town had a similar trial with one athletic field having half the field managed with conventional practices and the other half with organic practices. There was no unbiased evaluation of the practices at the second town.

The demonstration trials were only partly successful. The town with two fields in the demonstration did not implement the most important organic practice, topdressing with compost, to only the organic fields, but also applied the compost to the conventionally managed fields. The town with only one field in the demonstration reported that there was little difference in the condition of the fields after two seasons of differential management. There were two main problems with the implementation of organic turf management on the athletic fields. The expense of buying and applying the recommended organic amendments was substantially greater than the expense of conventional practices, and the demonstration trials were not conducted in a manner that allowed a valid comparison. Part of the problem with the organic practices was that organic practitioners mistakenly asked for the wrong analysis for the compost the towns used for topdressing the fields. The analysis requested was for a soil sample and not for a compost sample. The procedures used to analyse soil samples provide extractable nutrient concentrations while the procedures used for compost provide total nutrient content. The total nutrient content is always much greater than the extractable concentration of a compost sample. This mistake caused much confusion because the rates of application were to be based on the analysis of the compost. The rates applied were instead based on the typical application of compost recommended by organic practitioners, which is 2 to 4 mm applied in the spring and in the fall. Applying this much compost annually to turf often will increase the soil phosphorus content to levels that are environmentally harmful. One of the demonstration fields already had an excessive amount of phosphorus in the soil from previous applications of phosphorus and no compost should have been applied to the field.

Many town employees in the state were informed of the high cost of the recommended organic practices by their colleagues at the two towns hosting the demonstration trials. Some of the employees called Tom Morris and another soil scientist at the University of Connecticut to discuss the recommended organic turf practices. The senior author obtained a copy of the recommended organic practices. A review of the literature was performed to obtain scientific literature about the effectiveness of the recommended organic practices. The senior author contacted the DEP and asked to be included on the advisory committee for the educational program and for the demonstration trials. The advisory committee had scientists on the committee, but none were soil scientists. This lack of knowledge about soils and soil fertility was a severe limitation of the program. This limitation was causing some of the town employees, especially those with formal training in soils and turf management, to think that the DEP was no longer basing their programs on science. The DEP agreed to include the senior author on the committee. We had a meeting to discuss how to ensure that the educational program and the recommendations from NOFA were based on science and not on the opinion of the organic practitioners. The DEP and NOFA agreed the program should be based on science and that we should develop a joint educational program with the participation of DEP, NOFA and University of Connecticut.

The advisory committee developed three new educational workshops with the turf management section of the University of Connecticut's Department of Plant Science and Landscape Architecture. The workshops were a mix of practical advice from the organic practitioners and science-based advice from the university. This change was much appreciated by the town employees who would be required to manage turf without pesticides. Two of the most important ideas that developed from the discussions of the advisory committee after soil scientists were added to the committee were that a review of the literature was needed to evaluate the recommended organic practices and that the law only required elimination of pesticides and not the elimination of soluble fertilizers. The total reliance by DEP in the beginning of the education program on NOFA, which is an organization that believes that soluble fertilizers are detrimental to soil microbiological life, gave the impression to town employees that fertilizers were also banned.

The review of the literature showed that there was scant scientific information about the effectiveness of organic turf practices. Unfortunately, there is little to no scientific information published in referred journal articles that provide unbiased information about the effectiveness of most practices recommended by the organic practitioners. Most of the practices were recommended by a private laboratory that specializes in providing recommendations for organic turf management. The laboratory is the Soil Food Web at: http://www.soilfoodweb.com/. We could not find information in the scientific literature about the practices recommended by the Soil Food Web laboratory. We especially looked for the field trials comparing the recommended products or practices with either conventional amendments or practices, or to a no treatment control. Only a few scientific papers could be found that made comparisons of this type for the practices recommended by the Soil Food Web. Most of the recommendations seemed to be based on the owner of the laboratory's opinion that was based in ecosystem theory of soil ecosystems (Ingham *et al.* 1985) or on general studies showing differences in soil microbial populations between different ecosystems, such as grassland (Hunt *et al.* 1987) and forest soils (Ingham *et al.* 1986). Scant scientific information about the effectiveness of practices promoted by practitioners of organic land care indicates that this area should be targeted for funding.

Conclusion

The process to create and pass the state statute banning pesticides on athletic fields of Kindergarten through eighth grade schools was flawed because it was based on the assumption that organic management of turf would be sufficient to maintain the quality of turf needed for safe participation in athletic competition by children. The scientific evidence is scant about whether this assumption is true or not. There is anecdotal evidence that turf can be maintained using organic methods for a few years, but there is no scientific or anecdotal evidence about whether turf can be maintained for the long-term at sufficient quality for safe athletic competition by children. The process to create an education and demonstration program about organic turf management did not include soil scientists. This oversight resulted in the presentation of misinformation in the education program and incorrect methods in the demonstration program. Soil scientists should be included in decisions about most land use decisions. Even when soil scientists are included on committees about organic land care, however, there are few scientific publications available to provide a scientific basis for recommendations made by organic practitioners. Including a soil scientist on committees involving implementation of organic land care practices will at least allow the delineation of what is known and not known about the scientific basis for organic land care.

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