COMPOST USERS FORUM

Illustrating suppression of Pythium root rot on creeping bentgrass in compost-amended soil, above photos show effects 14 days after inoculation of no compost (left) and 20 percent compost, v:v (right).

Compost-Induced Suppression Of Turf Grass Diseases

This first part of a detailed report shows how composted products promote healthy turf grass, suppress disease development and reduce need for costly fungicide and fertilizer inputs.

Part I

Eric B. Nelson and Michael J. Boehm

UNTIL the 1940s, composts served as one of the principal sources of fertilizer used on golf courses and athletic fields. The utilization of composts declined dramatically, however, with the advent of synthetic, urea-based fertilizers, and organic fertilizers such as Milorganite, which offered more consistent and predictive nutrient release characteristics. After nearly 60 years of heavy reliance on chemical inputs, we find ourselves in the midst of a resurgence in the use of organic matter amendments and topdressings for managing high quality turf grass. Recent research on the use of composts on turf grass has focused on the suppression of turf grass diseases, the potential for reducing fungicide and fertilizer inputs, and the effects of composts on the physical, chemical and microbiological properties of soils.

Currently there are between 20 and 30 million acres of turf grass in the United States, consisting of lawns, parks, golf courses, sod farms, industrial and institutional grounds, right-of-ways, etc. Fungal diseases represent one of the most important limiting factors to maintaining the aesthetics and functional quality of turf grass plantings. Managing diseases is particularly difficult on golf course turf where agronomically unrealistic cutting heights, high traffic and compaction, and low nutrient inputs to maintain unnecessarily high green speeds, have placed unprecedented stresses on turf grass plants, making them highly susceptible to infection.

The application of fungicides has historically been the major tactic for controlling diseases on high quality turf grasses. Because of the ideal conditions for disease development, golf course turf grasses receive more fungicide inputs than any other agricultural or horticultural crop, with total dollars spent exceeding 20 percent of the total U.S. fungicide market. The vast majority of those

applications are to golf course putting greens and tees, making the amount of fungicide applied per unit area quite high.

In recent years there has been a visible trend toward nonchemical disease control strategies as a means of reducing the environmental load of pesticides. Not only are turf grass managers seeking alternatives to fungicides, but also an increasing number of research laboratories around the world are now focusing studies on nonchemical methods of disease control. Among the more important disease management strategies emerging from these studies is the utilization of composted materials for management of turf grass diseases.

Organic Amendments In Turf Grass Management

Intensively managed turf grasses, such as golf turf, have traditionally been grown on soils modified through the addition of both organic and inorganic amendments. This is done to minimize compaction and other plant stresses, and to improve plant-soil relationships for the enhancement of turf grass growth. Today, turf on golf course putting greens is commonly grown on completely artificial growth media similar to those used in the floriculture and nursery industries.

Newly constructed or renovated golf course putting greens are typically built according to specifications outlined by the United States Golf Association, which call for root zone mixes that consist largely of sand mixed with some form of organic matter, usually peat. Topdressing mixes, which are used to smooth putting surfaces, manage thatch, and, over time, modify underlying soil conditions, consist of similarly-combined components. Under these manufactured growing conditions, a key element to optimum turf grass culture is high quality organic amendments. These amendments serve to increase water and nutrient retention, decrease bulk density, increase microbial activity, and increase soil strength in root zone profiles that otherwise consist largely of sand.

Peats have been the most common types of amendments used in turf grass management. The three most frequently used types of peat include: 1) Moss peats derived from *Sphagnum, Hypnum*, and other mosses; 2) Reed-sedge peats formed from reeds, sedges, marsh grasses, cattails, and other swamp plants; and 3) Dark peat humus which is in advanced stages of decomposition.

Table 1. Organic amendments and turf grass disease control

Amendment	Diseases Controlled	Percent Control[a]
Municipal and Industrial Sludges		
Activated sewage sludge	Dollar spot	99
Composted municipal biosolids	Brown patch	42
	Dollar spot	40
	Pythium root rot	63
	Red Thread	51
	Typhula blight	70
Composted brewery sludge	Brown patch	25
	Dollar spot	15
	Pythium root rot	68
	Red Thread	36
	Typhula blight	70
Animal Manures		
Composted cow or horse manure	Brown patch	25
	Dollar spot	73
	Pythium root rot	31
	Red thread	9
	Typhula blight	55
Composted poultry litter	Brown patch	75
	Dollar spot	55
	Necrotic ringspot	86
	Pythium root rot	94
	Red thread	79
	Typhula blight	15
Horticultural Wastes		
Composted yard trimmings	Brown patch	39
	Dollar spot	5
	Red thread	0
Composted grass clippings	Brown patch	50-80
Spent mushroom compost	Brown patch	25
	Dollar spot	0
	Red thread	0
Uncomposted Natural Organic Fertilizers[b]		
Animal and plant meals	Brown patch	75
	Dollar spot	74
	Necrotic ringspot	96
	Pythium root rot	56
	Red Thread	57
	Typhula blight	0
Peats		
Reed-sedge peat	Pythium root rot	68

[a] Percentages represent the maximum values published. Considerable variation in suppressiveness exists among different compost feedstocks, different batches of the same feedstock, and at different sites.
[b] Animal and plant meals consist of soybean meal, feather meal, blood meal, bone meal, etc.

Studies on the physical properties of these amendments have shown that moss peats generally retain much more water than is available to the plant whereas the humus-type peats have other undesirable physical properties. Reed sedge peats, therefore, are the most desirable with respect to their physical properties.

Although the disease-suppressive properties of some peat-amended growing media used in the floriculture and nursery industries are well recognized, little is known of these properties relative to turf grass culture. Disease suppressiveness has not been observed on golf course putting green amended with *Sphagnum*-type peats. However, amending sand-based putting green profiles with reed-sedge peat has been shown to induce suppressiveness to Pythium root rot of creeping bentgrass caused by *Pythium graminicola*.

Utilization Of Composts For Turf Grass Disease Control

Turf grass managers have recently turned to a variety of organic amendments as natural organic

fertilizers for use on high maintenance turf. These types of fertilizers are prepared from a range of organic wastes such as dehydrated sludges, composted and uncomposted plant and animal meals, composted animal manures, and composted industrial by-products. Benefits of using such natural organic fertilizers include reduced thatch buildup, reduced soil compaction, reduced nitrate and pesticide movement, increased levels of soil organic matter, and reductions in the incidence and severity of certain turf grass diseases.

Natural organic fertilizers were shown as early as the mid-to-late 1960s to be suppressive to turf grass diseases. Natural organic fertilizers prepared from activated sewage sludge were more effective in suppressing dollar spot disease of creeping bentgrass caused by *Sclerotinia homoeocarpa* than were common inorganic nitrogen sources. Reduced dollar spot incidence was greater than could be explained just from the nitrogen applications alone, suggesting that other chemical and/or biological factors might be involved in dollar spot suppression.

In addition to activated sludges, uncomposted natural organic fertilizers composed of plant and animal meals are also highly suppressive to dollar spot disease, providing greater than 75 percent disease control (Table 1). These types of amendments have also been suppressive to other important turf grass diseases but have had no effects or even increased the severity of others. With these materials, the suppressiveness observed is due, in part, to elevated soil populations of bacteria and fungi, but may also be related to increased water holding capacity or improved nitrogen nutrition.

A considerable amount of frustration has come with the use of natural organic fertilizers in turf grass management. This has been due to variable turf grass responses following the application of such amendments, and the unpredictable behavior of these amendments when incorporated into or applied onto turf grass soils. Even though a wide variety of natural organic fertilizers give rise to positive plant growth responses and also reduce the incidence and severity of turf grass diseases, occasionally variable and at times negative results are obtained. Among the more consistent and predictable types of amendments for eliciting positive effects on turf grass plants have been composted materials.

Composted amendments have been among the most consistently effective in reducing the severity of turf grass diseases. Composts commonly applied to established turf grasses or used in sod production include those prepared from animal manures (e.g., poultry, cow, and horse manures), municipal biosolids, industrial sludges, leaves and yard trimmings, grass clippings, food residuals, and mixed solid waste (MSW). Results of studies conducted over the past 15 years have clearly shown the potential for compost amendments to reduce the severity and incidence of a wide variety of turf grass diseases, particularly when applied either as a topdressing, a winter cover, a root zone amendment, or as an aqueous extract (compost tea).

Topdressing Amendments

Golf course superintendents routinely topdress putting greens with a thin layer of sand, sand/organic matter, or sand/organic matter/soil mixtures. The purpose of topdressing is primarily to smooth putting surfaces and to manage thatch, but also to gradually modify underlying

soil properties and aid in the recovery of turf from injury. Among the goals of amending topdressing mixes with composts are to increase the nutrient and water holding capacities of sand-based growth media and also to replace traditional organic topdressing components such as *Sphagnum* peat with more microbiologically-active materials such as composts. Many *Sphagnum*-based mixes contain little or no disease suppressive activity. Numerous studies with container media have verified this property.

Monthly applications of topdressings composed of as little as 20 percent compost by volume and applied at rates of 10 lbs compost/1000 ft^2 can be effective in suppressing foliar as well as root diseases of turf grasses. Foliar diseases such as dollar spot (*Sclerotinia homoeocarpa*), brown patch (*Rhizoctonia solani*), Pythium blight (*Pythium aphanidermatum*), Typhula blight (*Typhula incarnata*), and red thread (*Laetisaria fuciformis*) have been effectively reduced following topdressing applications of various composted materials. Additionally, reductions in severity of root diseases such as summer patch (*Magnaporthe poae*), Pythium root rot (*Pythium graminicola*), and necrotic ringspot (*Leptophaeria korrae*) have also been observed in sites receiving compost-amended topdressings. The levels of disease control vary widely, ranging from zero to 94 percent, depending on the target disease, the compost feedstock, and the manner and degree to which the material is composted (see Table 1). Some specificity in disease control in which one disease is suppressed while another remains relatively unaffected has also been observed.

Amending topdressing mixes with composts increases the nutrient and water holding capacities of sand-based growth media.

Whereas the short-term magnitude of turf grass disease control using compost-amended topdressings may not match that typically achieved with fungicide applications, the longer-term level of control often equals or exceeds that attainable with fungicide applications. The level of turf grass quality is also greatly enhanced over what one would typically achieve with fungicide applications. The reasons for this are undoubtedly due to many undescribed mechanisms of growth enhancement and pest suppression. In some cases, the improved quality following compost applications can be evident years after compost applications cease.

Root-Zone Amendments

Soil organic amendments have been used for centuries in soil and crop management and have been an integral part of turf grass management for decades. Aside from pre-plant soil modification, the addition of soil organic amendments to mature turf grass stands is somewhat problematic. The difficulty of amending turf grass soils without damaging plants is largely overcome by aerification procedures wherein small holes are punched through the sod surface, allowing greater oxygen infiltration into the root zone and enhancing root growth. Applying topdressing immediately after aerification allows the material to fill the aerification holes and reach greater depths in the soil profile. Repeated aerification and topdressing over a period of several years will facilitate the incorporation of organic amendments into the underlying soil and the gradual modification of the root-zone profile.

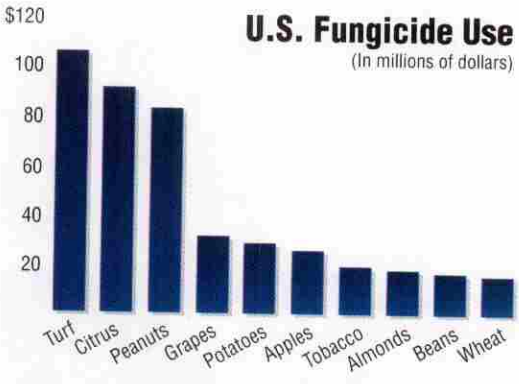
Organic root-zone amendments have the potential to induce much higher levels of disease suppression, particularly for root-infecting pathogens, than topdressing amendments since greater quantities of material can be placed in the root zone. Additionally, pre-plant organic

amendments to root zones such as those in sand-based golf course putting greens may have dramatic impact on turf grass establishment as well as long-term disease control efficacy. In studies conducted at Cornell University, we discovered that amending sand-based greens with municipal biosolids compost, brewery sludge compost, or reed sedge peat greatly enhanced seedling establishment (presumably through the suppression of Pythium damping-off) and induced a high level of suppression of Pythium root rot disease.

Effects of suppression on dollar spot turf damage with topdressing applications of biosolids compost is shown in plot C (top left).

In our studies, these amendments provided complete control six months after incorporation and retained their suppressive properties for up to four years. In other studies conducted at The Ohio State University, incorporation of composted biosolids into soils prior to turf grass establishment reduced subsequent development of leaf rust caused by *Puccinia* spp on perennial ryegrass.

One of the concerns of using compost amendments in this way, particularly on sand-based greens having a perched water table, is that over time as the organic materials decompose, the smaller particles may clog pores, interfering with the drainage properties of the root zone profile. There has also been a perceived phytotoxicity hazard from the by-products of anaerobic decomposition of organic materials in the perched water table zone of USGA-type golf greens. To date, however, there has been no long-term research to address these issues. However, as a general guideline, organic materials and incorporation rates should be chosen such that the organic matter content of the root zone does not exceed 3.5 percent. The organic matter content (determined by loss on ignition) of the compost amendment should exceed 60 percent if possible. This will help to maintain physical and biological conditions more favorable in the root zone so that many of the problems mentioned above may be avoided.



Turf Covers

Typically in the late autumn across the northern tier of the United States and across Canada, once cool-season turf grasses become dormant, golf course superintendents routinely apply fungicides for control of snow mold diseases caused by *Typhula* spp. (*Typhula* blight) and *Microdochium nivale* (pink snow mold). In addition to fungicide applications, some golf course superintendents cover greens with protective covers to prevent desiccation and ice damage to the putting surface. Covering greens also alleviates some early season disease problems such as Pythium root rot (*P. graminicola*), cool-season brown patch (*R. solani* and *R. cerealis*), and anthracnose basal rot (*Colletotrichum graminicola*) since protected turf comes out of dormancy in a less-stressed condition and is not as predisposed to diseases as uncovered turf.

Results of preliminary studies have indicated that a dormant application of certain composts to golf course putting greens in the late autumn can protect turf from snow mold damage. Experimental plots treated with either a turkey litter compost (Sustâne) or cow manure compost in late November at rates of 200 lbs/1000 ft^2 (depth of approximately one-half inch) gave rise to higher quality the following spring as compared to noncovered plots. Whereas significant levels of *Typhula* blight developed in noncovered plots, those treated with either compost stayed essentially disease free throughout the winter.

The improved quality and disease suppression may be due to a number of factors. First, the insulating properties of the compost, combined with its dark heat-absorbing properties, may help to retain soil heat and at the same time, absorb additional heat on sunny winter days. Second, the compost may harbor many different microbes and also stimulate the activity of native soil microbes. In our studies, higher levels of soil bacteria were observed in plots that had been treated with the composted turkey litter the previous fall than in noncovered plots or plots treated with composted cow manure. The increased levels of bacteria were evident as late as mid-July the following season. It is possible that elevated temperatures under a compost cover may promote microbial activity, even during the winter months, all of which should discourage the development of snow mold diseases and reduce the risk of winter turf grass damage. Although this type of application strategy has promise in providing long-term disease control at least through spring and early summer when turf is susceptible to a number of disease problems, further research is needed to define the nature of the microbial and disease suppression response.

Organic materials and incorporation rates should be chosen such that the organic matter content of the root zone does not exceed 3.5 percent.

Part II of this report discusses the use of compost extracts and compost teas for disease suppression and explains the mechanisms of disease suppression with composted amendments and the impact of various types of compost on microbial communities. It also examines the future of compost use for turf grass disease control. ■