

USING COMPOSTS *to Improve Turf Performance*



PENNSTATE



Cooperative Extension
College of Agricultural Sciences

USING COMPOSTS

to Improve Turf Performance

If you have been searching for ways to improve turf performance in marginal or poor soils, consider using compost as a soil amendment. In clay soils, good quality compost will improve structure, reduce surface crusting and compaction, promote drainage, and provide nutrients. In sandy soils, compost increases water and nutrient retention, supplies nutrients, and increases microbial activity. These improvements promote faster turf establishment, improved turf density and color, increased root growth, and less need for fertilizer and irrigation.

In many cases, compost production sites are located near areas of intensive turf use, providing a readily available and reasonably priced source of organic matter. Depending on your location, compost may be less expensive than topsoil and peat. When considering costs, keep in mind that compost usually produces better turf than equal or greater amounts of topsoil.

SELECTING A COMPOST— SOME GUIDELINES

Before selecting a compost, realize that not all products are alike. Composts are made from many different materials, including household refuse (municipal solid waste), leaves and grass clippings (yard trimmings), sewage sludge (biosolids), animal manure, paper mill by-products, and food residuals, to name a few. Compost quality varies depending on the source and how it is produced.

Because of differences in quality among composts, it is important to have some basis for determining suitability for use on turf. Ideally, the product in question has been field tested at a university and/or has been used successfully by other turf managers. Using a compost with a proven track record can take some of the guesswork out of the selection process, provided that the product is consistent from batch to batch.

Whether you are using a field-tested product or one that has never been used on turf, obtain a sample of the compost prior to use and examine it for undesirable objects and peculiar or offensive odors. If the producer does not have an analysis of chemical and physical properties, submit a representative sample to a laboratory that will conduct appropriate tests and provide recommendations that you can understand.

The following are some basic guidelines for evaluating the suitability of a compost for use on turf:

■ **Appearance**

Although the appearance of compost will differ slightly among products, the color should resemble a dark topsoil and have a light, crumbly structure. It should be free of large stones, large pieces of wood, trash (especially glass), and other objectionable objects.

■ **Particle size**

The size of compost particles can vary depending on the method of application and how the turf is used. For use in surface applications on athletic fields or lawns, a compost should be able to pass through a 3/8-inch screen. Composts with slightly larger particles can be used as soil amendments if thoroughly tilled into the soil prior to seeding or sodding.

■ **Odor**

A good quality compost should have an “earthy” aroma (similar to that of a forest) and should not emit peculiar or offensive odors, such as those associated with ammonia or sulfur. These odors may be an indication that the



Figure 1. Composts should be free of large stones, large pieces of wood, trash (especially glass), and other objectionable objects.

■ **Weed seeds**

If the product has been properly composted and stored, weed seed contamination will not be a problem. The composting process should destroy nearly all viable seeds. Occasionally, temperature control in some composting operations is not monitored adequately, and some weed seeds survive. Another source of contamination is weeds growing on compost piles that have been stored outdoors for

long periods. If these weeds are not controlled, they can deposit seeds in the compost.

Although a few weed seeds do not necessarily preclude

the use of a compost as a soil amendment for turf, composts containing large amounts of weed seeds are unacceptable. If possible,

inspect the production site to make sure that weeds are not growing in or around the compost piles.

■ **Moisture content**

The moisture content of a compost is important when uniform application and good mixing with soil is desired. Composts with moisture contents between 30 and 50 percent are usually ideal for handling, surface applications, and soil incorporation.

Wet composts (greater than 60 percent moisture content) tend to form clumps and do not spread evenly when applied to turf surfaces. Tilling wet material into soil may result in poor mixing and poor establishment. Wet composts also are heavy and difficult to handle.

Dry composts (less than 20 percent moisture content) are easy to handle and spread easily, but may produce excessive dust. On windy days, this dust may leave a film on the windows or siding of

Using a compost with a proven track record can take some of the guesswork out of the selection process.

compost is not mature (not fully composted). Immature composts may have adverse effects on turf and should not be used.

nearby buildings. The dust also may be inhaled or may get into the eyes of the equipment operator. Dry composts that are high in organic matter tend to “float” on the soil surface during attempts to incorporate them. In this case, the equipment operator may have to spend more time and effort working the material into the soil.

■ **Organic matter and ash content**

When using compost as an organic matter supplement, keep in mind that not all of the product is organic. In fact, some products contain less than 50 percent by weight of organic matter. Organic matter content can be determined by a lab test, but the most common procedure employed by laboratories considers everything that is combustible as organic matter (including wood chips, bark, leaves, and plastic). Hence, a lab test may not tell you everything about the *quality* of the organic matter. Although it is impossible to determine how much organic matter is present simply by looking at the product, a visual examination may tell you if the compost contains mostly decomposed, humus-like material or undecomposed organic matter, such as wood.

Some test labs report a value called “ash content.” Ash is the mineral matter that remains after the compost sample has been subjected to extremely high temperatures in a furnace. Assuming that everything burned off in the furnace is organic matter, the percentage of ash in the sample can be subtracted from 100 to provide an estimate of percent organic matter. For example, an ash content of 20 percent indicates that



Figure 2. Try to find a product that is consistent from batch to batch and preferably one that has been used successfully by other turf managers.

there is an estimated 80 percent organic matter in the sample. Keep in mind that this process only *estimates* organic matter. In reality it measures weight loss of any material that is combustible at high temperatures.

■ **Carbon-to-nitrogen ratio**

The amount of carbon (C) relative to the amount of nitrogen (N) in a compost is an important indicator of nitrogen availability. The carbon-to-nitrogen (C:N) ratio of a compost should equal or fall below 30:1. If it's above 30:1, soil microorganisms can immobilize nitrogen, making it unavailable to the turf. Fortunately, most commercial composts have C:N ratios below 30:1.

■ **Nutrients**

When compared with fertilizers, composts generally contain low amounts of nutrients. Whereas a small amount of quick-release nitrogen (ammonium) is present in some composts, most nitrogen is in the organic form and is slowly available to turf. Studies of biosolids composts show that only about 10 percent of the nitrogen is available to plants during the first growing season. Little is known about the nitrogen release characteristics of other composts.

Other nutrients, such as phosphorus, potassium, calcium, and magnesium can be present in significant quantities in composts. Some

composts, however, may contain very low concentrations of one or more of these nutrients, and fertilizer supplements may be required to meet the turf's nutrient needs.

When using compost as an organic matter supplement, keep in mind that not all of the product is organic.

Typically, large amounts of compost must be applied to supply all or most of turf's nutrient requirements. This is difficult to achieve with surface applications since only a small amount of material can be applied in a single application. However, a 1- to 2-inch layer of compost tilled 4 to 6 inches into a soil can supply all of the nutrients necessary for turf growth and development for an entire year and possibly longer. The amounts of nutrients supplied by a compost depend on the source (animal manure composts are typically higher in plant nutrients than yard trimmings composts) and the availability of the nutrients. More research is needed to determine the availability of nutrients from different composts.

■ pH

Most composts have a pH of between 6.0 and 8.0, a range favorable for turf root growth.

A few composts, however, fall outside of this range. The pH of a compost may be detrimental to turf when very high (greater than 8.5) or very low (less than 5.5). Extremes in pH may result in reduced availability of some plant nutrients and/or toxicity problems. In a turf establishment study at Penn State, seedling inhibition occurred following incorporation of a 2-inch layer of poultry manure compost (pH of

9.1) into a clay loam soil. It is likely that the high pH and presence of ammonium in the compost caused ammonia toxicity and subsequent death of the seedlings. Fortunately, most soils are buffered against rapid and drastic changes in pH, and even composts with extremes in pH may not alter the overall soil

lished maximum levels of metals in biosolids composts that are to be used for land application. Composts used for turf usually have to meet the same standards set for other crops. There are several biosolids composts that have been used successfully on turf in Pennsylvania that fall below the maximum allowable metal concentrations for land application.

■ Soluble salts

High concentrations of soluble salts may be present in certain types of compost, such as those made with spent mushroom substrates or animal manures. Excessive soluble salts can cause injury to turf by reducing water absorption, by toxicity, or by a combination of both of these factors. A common question among turf managers concerning soluble salts is: at what salt concentration will turf injury occur? The answer is that it depends on the type of salt, the salt tolerance of the turf species or variety, and the method of application.

Most soil laboratories can analyze composts

for salt content. However, the salt concentration by itself may be somewhat misleading since the type of salt may be more important in determining potential plant injury. For example, salts containing sodium are more toxic to turfgrasses than potassium salts.

Turfgrass species and varieties vary in their tolerance to soluble salts. Salt-sensitive grasses such as

Guidelines for choosing a compost.

Appearance, size, and odor

Color	Brown to black
Size (surface applications)	1/4 to 3/8 inch
Size (incorporated)	1/4 to 1/2 inch
Odor	"Earthy"

Physical properties

Moisture content	30 to 50 percent
Organic matter	Greater than 30 percent
Ash content	Less than 70 percent

Chemical properties

Carbon: nitrogen ratio	Below or equal to 30:1
Nitrogen	0.5 to 3.0 percent
Phosphorus	Greater than 0.2 percent
Potassium	Greater than 0.2 percent
pH	6.0 to 8.0
Metals	Determined by state and federal agencies.
Soluble salts	Depends on turf species, type of salt, concentration, and application method. Consult test lab or other expert to determine how this will affect the turf.

Note: Use this information only as a general guide. Some composts have properties that do not fall within these guidelines yet are acceptable in certain situations. Others, though they may fit these criteria, may have serious drawbacks.

pH a great deal. To be on the safe side, however, try using materials with a pH as near to neutral (7.0) as possible.

■ Metals

Composts made from biosolids often have higher metal concentrations than those made from other sources. State and federal government agencies have estab-



Figure 3. Composts are typically applied to the soil surface at a 1- or 2-inch layer, then incorporated into the soil with rotary tilling equipment.

Kentucky bluegrass may be injured at concentrations of about 3 mmhos/cm in the germination and seedling stage (turfgrasses are particularly vulnerable in the early stages of growth). A moderately salt-tolerant grass, such as tall fescue, may not be injured unless the compost has a higher salt level (greater than 6 mmhos/cm).

The method of compost application may also influence the degree of salt injury. When composts are incorporated into soils, the salt concentrations are greatly diluted. Irrigation further diminishes salt concentrations by leaching them out of the root zone. In a recent establishment study at Penn State, a spent mushroom substrate compost with a soluble salt content of 8.10 mmhos/cm was incorpo-

rated into a clay loam soil and irrigated daily until Kentucky bluegrass seeds germinated (approximately 20 days). Despite this high salt concentration, no noticeable seed-

***A 1- or 2-inch layer
of compost tilled
4 to 6 inches into a
soil can supply
all the nutrients
necessary for turf
growth and
development for an
entire year.***

ling inhibition occurred, presumably due to the dilution effect of soil incorporation and leaching. The salts were primarily composed of potassium and calcium, and the results might have been different if high levels of sodium were present.

Surface applications of high-salt composts may cause injury to established grasses, especially during hot weather. Always irrigate to leach salts from the compost/soil mix immediately following surface applications to avoid the possibility of salt injury.

SUMMARY OF GUIDELINES

The preceding paragraphs serve only as a *general* guide. Some composts may meet these criteria but could have other properties that make them unsuitable for turf

use. Others may have properties that do not fall within these guidelines, yet are acceptable for use in some situations. When choosing a compost as a soil amendment prior to seeding or for surface application, it is important that you are familiar with the product and how it will affect the turf. Try to find a product that is consistent from batch to batch—preferably one that has been thoroughly researched and/or used successfully by other turf managers.

If you are unfamiliar with the product, be sure to examine it for color, objectionable objects, particle sizes, and odors. It may be worthwhile to visit the site where the compost is stored to make sure it is not contaminated with weeds or weed seeds. Other important considerations are moisture

content, organic matter content, C:N ratio, nutrients, pH, metals, and soluble salts.

METHODS OF APPLYING COMPOST

■ Soil incorporation prior to turf establishment

In most cases, composts are applied to the soil surface at a rate of between a 1-inch layer (approximately 3.1 cubic yards per 1,000 ft²) and a 2-inch layer (about 6.2 cubic

yards per 1,000 ft²), then incorporated into the soil to a depth of 4 to 6 inches. In order to obtain maximum performance from your application, make sure that the compost is thoroughly mixed with the soil and is not forming a layer at the soil surface. Depending on the product, this may require several passes with a rototiller. The lower rate (1-inch layer) is better suited for marginally good soils, and the higher rate (2-inch layer) for very sandy soils, clay soils, or subsoils low in organic matter. We have

those made from yard trimmings or municipal solid wastes) may require additional phosphorus and potassium as well as starter fertilizer for vigorous seedling growth. Although many composts can raise the pH of slightly acid soils, soils with a very low pH (below 5.5) may require additional lime. If you plan to use a compost with a high soluble salt concentration, make sure to thoroughly irrigate the site after incorporation and prior to seed germination in order to leach the salts.

Suggested amounts of compost (in cubic yards) per unit area to apply to established turf as surface applications or to till into soil prior to establishment.

Unit area in square feet	Inches of compost applied				
	Surface application	Tilled into soil			
	1/4	1/2	1	1 1/2	2
1,000	1*	2	3	5	6
5,000	4	8	15	23	31
10,000	8	15	31	46	62
20,000	15	31	62	93	123
30,000	23	43	93	139	185
40,000	31	62	123	185	247

*Amounts of compost in cubic yards rounded to nearest whole numbers.

found that if more than two inches are applied, it may be difficult to mix the material 4 to 6 inches into the soil. On clay or compacted soils, it is helpful to rototill the soil first, then apply and incorporate the compost.

Although high nutrient-containing composts, such as biosolids composts or composted animal manures, can usually supply enough nutrients for good establishment, some composts (such as

those made from yard trimmings or municipal solid wastes) may require additional phosphorus and potassium as well as starter fertilizer for vigorous seedling growth.

Since compost is light and bulky, a spreader with a large hopper is preferred. Modified manure spreaders with conveyor belts and brushes mounted on the back are ideal for spreading compost over large areas. Conventional tractor-mounted fertilizer spreaders have been used successfully but may require many refills. If spreaders

■ Surface applications on established turf

Composts are frequently used as surface applications (topdressings) on established turf. This practice provides a means of gradually incorporating organic matter into the soil without causing extensive disruption of the surface. The two most limiting factors associ-



Figure 4. Modified spreaders with conveyor belts and brushes mounted on the back are ideal for surface applications of compost.

are not available, compost can be applied to the surface by spreading piles into a thin layer with a York rake or a grading blade. For applications over small areas, the compost can be spread with a shovel and worked into the turf with a leaf rake.

When applying compost as a topdressing, it is important to apply a thin layer (about 1/4 inch) and work it into the soil. Successive applications of thick layers without soil incorporation will result in a build-up of organic matter at the soil surface, which may cause rapid drying of turf roots and may form a layer that restricts root growth into the soil. The best way to incorporate compost into the soil is through aeration. A good method is to apply the compost first, followed by several passes with an aerator

equipped with hollow tines and a heavy drag mat attached. The drag mat will break up the cores and mix the compost with the soil, dragging some of the mix back into the holes. This operation is

best performed during cool and moist seasons when grass is actively growing. Aeration and dragging can be stressful to turf during hot, dry weather.

Prepared by Peter Landschoot,
professor of turfgrass management

***Applications
of thick layers
without soil
incorporation
will result in a
buildup of
organic matter at
the soil surface.***

NOTES

An **OUTREACH** program of the College of Agricultural Sciences

Penn State College of Agricultural Sciences research and extension are funded in part by Pennsylvania counties, the Commonwealth of Pennsylvania, and the U.S. Department of Agriculture.

Visit Penn State Extension on the web: **extension.psu.edu**

This publication is available from the Publications Distribution Center, The Pennsylvania State University, 112 Agricultural Administration Building, University Park, PA 16802. For information telephone 814-865-6713.

Where trade names appear, no discrimination is intended, and no endorsement by Penn State Cooperative Extension is implied.

This publication is available in alternative media on request.

The Pennsylvania State University is committed to the policy that all persons shall have equal access to programs, facilities, admission, and employment without regard to personal characteristics not related to ability, performance, or qualifications as determined by University policy or by state or federal authorities. It is the policy of the University to maintain an academic and work environment free of discrimination, including harassment. The Pennsylvania State University prohibits discrimination and harassment against any person because of age, ancestry, color, disability or handicap, national origin, race, religious creed, sex, sexual orientation, gender identity, or veteran status. Discrimination or harassment against faculty, staff, or students will not be tolerated at The Pennsylvania State University. Direct all inquiries regarding the nondiscrimination policy to the Affirmative Action Director, The Pennsylvania State University, 328 Boucke Building, University Park, PA 16802-2801; Tel 814-865-4700/V, 814-863-1150/TTY.

Produced by Ag Communications and Marketing

© The Pennsylvania State University 2009

CODE # UC123 R2.3M8/11mpc4127

