Evaluating Organic Amendments For Sand-Based Turf Systems

By Charles R. Dixon

Natural turfgrass surfaces are experiencing a comeback in several sports applications, including soccer, football, baseball, and thoroughbred horse racing. The success or failure of this movement will depend upon proper construction and maintenance of the turfgrass system.

The main type of turfgrass system leading the comeback is the sand-based rootzone. The golf industry has been one important source of sand-based technology. The United States Golf Association (USGA) method of constructing putting greens has been adapted to provide a high-performance surface for a wide variety of sports. With proper management and good construction materials, a USGA turfgrass system delivers a well drained, quality surface that is healthy and suitable for many types of sports activities.

Turfgrass systems that are not healthy can be a financial burden to the owner and/or a threat to the local environment. Because of the demands placed on high performance sports turf surfaces, a sound agronomic approach should be employed during construction that takes into consideration geographic location and available materials. Facilities constructed with the wrong technological approach or with poor quality materials can be a serious problem for the participants of the sport as well as the owners.

Lab evaluations concerning the selection of construction materials and the testing of materials during construction need to be performed by qualified individuals to make sure that the facility is installed correctly. For sand-based systems, the evaluations should include the sand, as well as all amendments.

Sometimes the initial cost of the materials, regardless of the quality, is the criterion used by decision makers to evaluate and select rootzone components. With such a limited selection process, serious technical mistakes can be made that impair the establishment of the turf system and result in poor quality turfgrass that is expensive to maintain. Inferior materials, selected by untrained individuals with an economic bias, may leave a problem that can plague superintendents and groundskeepers for many years. A full-scope evaluation of all materials will lower the risk of poor performance or total failure.

Components of Four Amendments As Received

Component	Reed-Sedge	Can. Sphagnum	Rice Hull Comp.	Fir Bark
Moisture	41.6	31.3	41.0	42.9
Carbon	53.4	66.4	46.3	49.6
Nitrogen	2.3	1.0	0.7	0.4
Mineral	2.7	1.3	12.0	7.2

Dry Weight Values For Amendments

Amendment ID	Total Carbon %	C:N Ratio	Moisture %	pH
Dakota Reed-Sedge	90.1	23	41.6	6.6
Canadian Sphagnum	96.7	65	31.3	4.3
Rice Hull Compost	78.5	74	41	5.9
Fir Bark	86.7	142	42.8	3.2

The USGA system consists of a gravel drainage field with a one-foot layer of a sand-based rootzone on top. In the early years, the rootzone consisted of sand, loamy soil, and an organic amendment such as peat. The use of soil in the rootzone has declined due to the compaction and restricted drainage that have been associated with the silt and clay in the soil.

The rootzone specifications used most often today include sand and an organic component. The sand contributes to the physical support of the surface and, more importantly, to the drainage characteristics of the rootzone. However, it has very little to offer the turfgrass system, especially during establishment. The interaction of the organic amendment with the sand contributes to the utilization and retention of fertilizer and water.

The main advantages of sand-based systems are the ability to move water through the rootzone profile to keep the surface dry during high rainfall and to allow adequate movement of air into the rootzone. The ultimate success of the turf surface in a sand-based rootzone depends on vigorous rooting. Deep-rooted turf will provide a more stable and durable surface. Good aeration and drainage are necessary to maintain a deep root system.

A valuable reference on specifications for selecting materials is the USGA publication *Turf Management for Golf Courses* by Dr. James B. Beard. The criteria for selecting sand and gravel components are fairly cut and dried. However, those for the or-

continued on page 30

Organic Amendments
continued from page 29

ganic amendment are not. They should receive more attention.

Most organic amendments used today are commercially available peat mosses or composts of various materials. The main criterion that has been utilized to evaluate organics is the total carbon or ash content.

The ash content represents the amount of minerals and silt/clay particles in the sample. The remaining portion of the sample is the carbon content. The recommended total ash content should be 15 percent or less. The carbon content should be 85 percent or greater. The purpose of the low ash requirement is to keep the introduction of silt and clay to a minimum.

Other requirements for the organic amendment pertain to its texture and state of decomposition. The amendment should be finely ground to achieve maximum surface area and coverage of the sand grains. The texture and complexity of the organic component also affect the microbial population of the soil, an important factor in decomposition. Complex organics contain chemical compounds that are resistant to degradation by soil microbes.

The state of decomposition of the amendment is very important. Soil microbes require oxygen and nutrients to break down undecomposed organic amendments. Plants also require oxygen and nutrients to grow. An undecomposed organic amendment can place a demand on the available oxygen and nutrients in the rootzone that can slow the establishment of the turf system or cause it to fail altogether.

Nutrient Reactivity

Organic Amendment	Humic Acid %	Fulvic Acid %	CEC meq/100 grams
Dakota Reed-Sedge	21.1	12.0	118.0
Canadian Sphagnum	8.3	8.6	74.8
Rice Hull Compost	5.8	6.9	16.5
Fir Bark	3.1	5.8	18.3

There are several ways to assess the state of decomposition. The easiest and most direct is the carbon-to-nitrogen ratio. Laboratories calculate this ratio by first determining values for total carbon and total nitrogen (dry weight basis). The percentage of carbon in the sample is then divided by the percentage of nitrogen.

Carbon to nitrogen (C:N) ratios greater than 30:1 are believed to promote the immobilization (tie-up) of nitrogen. Ratios higher than this may result in an insufficient amount of available nitrogen in the rootzone. Ratios less than 20:1 promote the mineralization (release) of nitrogen. Low C:N ratios may lead to salt burn or to leaching of nitrogen before the turfgrass plant can utilize it.

The amount of nitrogen tied up is roughly equal to the amount released when the C:N ratio is between 30:1 and 20:1. Ideally, the ratio for rootzones should fall within the 15:1 to 30:1 range.

Although competition between the establishing turf and the microbial population for nitrogen can stunt turf, so can competition for oxygen. Many chemical and

continued on page 32

Organic Amendments
continued from page 30

biological reactions occurring in the rootzone require oxygen. When oxygen is depleted faster than it can enter and diffuse into the rootzone mix, these reactions change. When this occurs, obstructions to water and air movement can develop within the mix, and toxic gases are produced. Both can lead to a poor turf stand and higher maintenance costs.

Humus is a desirable component of any soil system. The more humus present, the better the nutrient retention and cation exchange capacity of the mix. Nutrients such as ammonium, calcium, sodium, and magnesium bind to humus instead of leaching through the rootzone. The carbon to nitrogen ratio of humus is also a favorable 15:1. The humus content of the organic component is an important indication of its value in the mix.

The moisture content of organic amendments is another consideration. Dry organic materials may not rewet to their original moisture content. In general, the moisture content of an amendment should not drop below 30 percent. This level should also be consistent within the material prior to mixing with the sand. Steps should be taken to maintain moisture content prior to mixing with sand.

For the purpose of comparing various organic amendments for sand-based turf systems, four commonly used products were evaluated for their suitability. They are a reed-sedge peat from North Dakota, a Canadian sphagnum peat, a rice-hull compost, and a fir bark product from California. All four are frequently submitted to soil labs for evaluation.

The two tests usually performed for this purpose are total carbon and pH. In this case, tests were also performed for C:N ratio and humic acid content.

The moisture content of all four amendments was adequate, ranging between 31 percent for Canadian sphagnum to 43 percent for the fir bark.

The nitrogen content of the reed-sedge peat was more than twice that of Canadian sphagnum and three times that of rice hull compost. The mineral content of the rice hull compost and the fir bark is high but only a small amount is nitrogen.

The two main components supplied by organic amendments are carbon and water. The nitrogen and mineral content are indicators of the organic material's nutrient value. The nitrogen content, when compared to the carbon content, also shows how well decomposed the organic fraction is.

Reed sedge peat had the only carbon-to-nitrogen ratio (23:1, dry weight basis) that would not tie up nitrogen. It was the most decomposed, and also had the highest cation exchange capacity and humic acid content. Canadian sphagnum ranked second in these areas.

Based on the test data, the Dakota reed sedge peat has several attributes that make it appealing as an amendment for high-performance rootzones.

The most significant test is for the characteristics of sand mixes containing these amendments. The infiltration rate of the sand, supplied by P.W. Gillibrand Co., is very high without an amendment, while the water-holding capacity is very low.

Physical Data For The Amendments In a Mix

Organic Amendment Mix	Infiltration Rate in/hr	40 cm Water Holding %	Bulk Density g/cc
Gillibrand Sand 100%	108.9	4.3	1.6
90% Sand:10% Redge-Sedge	19.9	17.1	1.5
80% Sand:20% Sphagnum	65.1	13.1	1.3
80% Sand:20% Rice Hulls	101.0	14.9	1.4
80% Sand:20% Fir Bark	71.9	12.2	1.4

The interaction of an organic amendment with the sand component will vary slightly from one sand to another. All amendments enhanced the mix physically to some degree. All the mixes met the USGA criteria for water holding and decreased bulk density. Based on the C:N ratio and total carbon content, the rice hull compost does not fit USGA criteria. The fir bark product contains a better total carbon content but has a high C:N ratio.

The lowest infiltration rate, still almost 20 inches per hour, was for ten percent reed sedge peat and 90 percent sand. It is interesting to note that this mix had a better infiltration rate and water holding capacity at a ten percent volume than the other amendments at a 20 percent volume.

There have been some problems associated with mixes that have high infiltration rates and are made of materials with wide C:N ratios. The combination of nitrogen/air competition, low nutrient retention, and high infiltration rates can make the turf grow-in period a prolonged and difficult process. Even though the grow-in may appear to be going well, the cost of nitrogen and fungicide inputs is usually high. Some of the rice hull mixes observed in the field never achieved full grow-in, even with high nitrogen rates.

Based on the data collected on the four organic amendments, the Dakota reed sedge peat meets all the technical criteria necessary for construction of a high-sand rootzone. The Canadian sphagnum would be the next best amendment.

There are significant differences among organic amendments mixed with sand in high-performance turf systems. By testing amendments prior to construction and following specifications such as the USGA's, a turf system will establish quickly and perform well for years under reasonable maintenance levels.

Editor's Note: Charles Dixon directs the Turf Services Division of K. W. Brown & Associates, Inc., College Station, TX.