Organic Amendments – Soil Elixir or More Snake Oil?

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The maintenance of high quality sports turf under intensive use and management is an on-going challenge. The exploitation of various designs of sand or amended sand root zones was initiated primarily to address issues related to drainage and compaction, particularly in regions with high rainfall and periods of significant winter play. Nevertheless, the sand-based root zone brings its own challenges – effective water and nutrient management is essential for any turf, but can be particularly critical on the sand base. It is not an uncommon experience to see the investment of significant capital resources in new field construction provide inadequate performance and poor returns on investment as a consequence of insufficient provision for subsequent maintenance resources.

In addition to their more conventional uses, modern recreational sports turf is often subjected to a diversity of other activities, including festivals and concerts. The impact of stage construction, vehicle traffic, 25,000 rambunctious fans and ancillary requirements for concessions and portable toilets can result in excessive wear. Communication of the consequences of severe traffic and wear to user groups is often a significant challenge. We have found the following conversion of wear from conventional soccer play into a per metre expression of foot traffic to be an effective means of communicating the potential for damage to the turf.

On a soccer field, 70% of the play occurs on 30% of the field. Each player travels approximately 10 km/game – that produces 250,000 foot imprints per game (excluding the referee and goalies). At 42 foot imprints per square metre per game, a 100 game season results in 4,200 foot imprints per square metre! Given the additional impact of the referee, linesmen, goal tending pressures and other sideline activity, the real surprise is the ability to maintain any turf under this kind of traffic.

Holistic Management

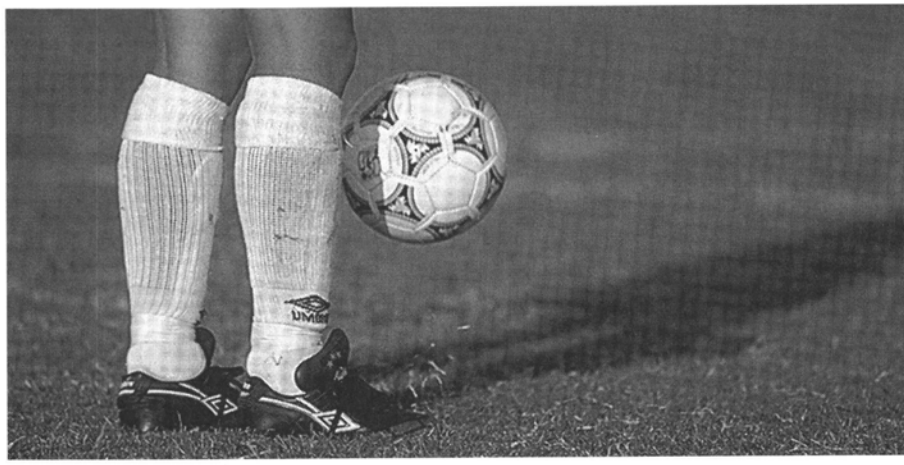
In assessing management options to improve the performance of sports turf, there has been considerable interest in organic amendment and supplementation of sand-based turf in particular. In addition to the range of materials that are available for new construction, there are many additional products available for fertilization, topdressing and supplementation. Organic amendment use should be part of a more holistic approach to turfgrass management reflected in the concept of Integrated Cultural Management (ICM) – "the process of managing sports turf by considering and analyzing all environmental factors, pests, maintenance processes and player-applied stresses which affect the health of the turfgrass culture" (Puhalla, Krans and Goatley. *Sports Fields; A Manual for Design, Construction and Maintenance.* Sleeping Bear Press 1999).

In this article, I will review briefly some of the underlying principles of organic amendment use and factors to consider in assessing the selection and application of a particular amendment type.

Much of the interest in organic amendments is derived from:

- Increased construction and use of sand-based turf systems and increased use (and degradation) of soil-based fields.
- Greater societal emphasis on "organic" approaches to turfgrass management in the context of "going green."
- The production of organic materials through a variety of recycling pathways and waste streams and regulatory and commercial pressure that perceives turfgrass as a desirable route for the re-introduction of these materials into the ecosystem.
- Increased understanding of the role and natural benefits of soil organic matter.
- Literature that attributes multiple benefits to organic amendments in the turf ecosystem, including provision of nutrients, improved soil structure, enhanced plant growth, higher stress tolerance, improved ability to recover from disease or insect damage, enhanced beneficial soil microbial populations and disease suppression.

The key to any good sports turf begins with a suitable growing medium and good turf management. A "typical" native soil includes solid components (mineral and organic matter) and pore space (air and water). Levels of approximately 3% are commonly quoted for the organic matter (OM) content of such "typical" soils. The physical properties of a good root zone include total porosity of 35-55% distributed between air-filled and capillary porosity, with a saturated hydraulic conductivity of 15-30 cm/hr and moisture retention of ≥2.5 cm/30 cm depth (Sheard, R.W. *Understanding Turf Management*, Sports Turf Association of Ontario 2000). These basic characteristics reflect the importance of physical composition and performance characteristics of the soil profile. Based on the figures above, it might be presumed that organic matter (OM) is a relatively insignificant component of the root zone mix. In fact, organic matter makes a disproportionate contribution to the soil-plant relationship. The significance of naturally occurring OM in water relations and in stabilizing soil aggregates and nutrient cycling has led to considerable interest in the use of organic soil amendments, especially for sand-based turf.



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Assessing Organics

What are some of the issues that need to be considered in relation to an assessment of organic materials and their appropriate use in turfgrass management?

The keys to this assessment include evaluation of:

- C/N ratios of the starting material
- Soil O_2 levels and gas exchange
- Soil microbial populations
- Physical and chemical nature of the material, including formulation
- Continuity and quality control of supply
- Independent substantiation of product claims

Organic amendments include peat, soil, peanut shells, sawdust, composted urban waste, composted sewage sludge (biosolids), organic fertilizers derived from a variety of sources (including composts), humates and biostimulants of various types. These diverse materials are composed of various amounts of sugars and starches, amino acids and proteins, cellulose, hemicellulose, lignins, fats and waxes. It is not surprising, therefore, that organic sources differ markedly in physical and chemical composition, rates of decomposition and contribution to the plant-soil ecosystem.

Organic matter decomposition involves reaction with microbes in an aerobic environment to produce humus, carbon dioxide and microbial biomass. Decomposition rates are influenced by C/N ratios, the physical and chemical formulation of the material and the soil conditions – particularly water and oxygen (good gas exchange is an essential feature of effective organic matter turnover). For material with the same surface area (particle size), the higher the C/N ratio of the organic material, the slower the decomposition process will occur. High C/N materials may also result in temporary immobilization of soil N, making it unavailable for plant growth in the absence of adjustments to the fertility program. Compacted or waterlogged soils will also have significantly poorer OM decomposition, and are more prone to developing microbial communities that include deleterious bacterial species.

Composition

Major interest in organic amendments has been focused on the increasing availability of compost and compost-based fertilizer products in the market place. In a native soil, good quality compost should increase particle aggregation, improve permeability, reduce surface compaction and contribute to nutrient re-cycling. The material should be highly organic and decomposed (or manufactured from such materials). Material high in recognizable wood chips may have higher C/N ratios and slower decomposition rates. Moisture contents of 30-50% are generally desirable. At levels above 60% the material is hard to handle and clumps; below 25% it may be excessively dusty. Moisture levels can be critical to effective spreading and/or ease of incorporation.

The reaction (pH) of the material should be between 6 and 8. In soil, pH is unlikely to be a significant issue; however, on a sand base, incorporation of compost may influence the overall pH and could affect nutrient availability. Because of the highly variable input sources that can be used for composting, it is also essential to obtain a measure of the salt content – some products are sufficiently high in salts to create additional soil problems. Composts, as with most organic materials, provide slow release, low analysis fertilizer inputs to the turfgrass system. In particular, the release of some materials may be particularly low in the first year. At higher application rates, this may lead to nitrogen immobilization. This uncertainty can be a particular challenge for the "unprocessed" composts that tend to be more variable in composition and less defined in terms of release rates than fertilizers that have been manufactured from composted sources.

Other organic amendments include materials such as humates and a range of biostimulants products such as kelp extracts, microbial inoculants and other biologically derived materials. Humic substances are "naturally-occurring, highly decomposed organic substances with very complex structures." They normally include humic acid, fulvic acid and humins, which are distinguished on the basis of their solubility characteristics. Many of the characteristics attributed to natural soil OM have also been associated with humic substances – they are not fertilizers, but have been correlated with increased mineral nutrient absorption, enhanced soil microbial populations, reduced aluminum toxicity, increased plant hormone activity, etc. The challenge with humic substances is that because they are defined on the basis of solubility, materials with similar solubility may be from very different sources, have different chemical structure and properties, and have a very different effect on plant growth. With such materials, it is clearly critical to have specific and dependable evidence for the performance claims of the specific source material.

That category of materials known as biostimulants is probably the most challenging group of products to assess. They are diverse in origin and offer a similar range of benefits to other organics – nutrient uptake enhancement, beneficial microbial activity, soil structural benefits, stress tolerance, etc. Our experience with some of these kinds of products is that they are generally more likely to be efficacious under stress conditions – when growing conditions are near optimal, often little benefit is observed. As with any other group of products, independent evidence to substantiate claims is an important part of the assessment. As James Baird of the USGA pointed out at the recent Ontario Turfgrass Symposium, red flags should be raised when product claims are preceded by the statement "*this product is so good, it didn't need any research.*" It is also essential that there be a clear rationale for the inclusion of these organic materials into the management program. Biostimulants, or any other organic amendment, are not substitutes for good turfgrass management.

Putting Organics to Use

In a sand-based sports field, and for soils in which OM deficits are clearly problematic, a strong argument can be made for the use of organic amendments in the initial design/ construction phase, and/or as part of the long-term maintenance strategy. As product availability increases, the ability to make an informed choice becomes more challenging. Particular attention should be paid to the basic rationale for including an organic amendment, to the properties of the material relative to the intended use, to appropriate incorporation of the material into the overall management strategy, and particularly to the scientific evidence used to substantiate the claims made for the product. If organic amendments have been incorporated into your management program, don't assume that is the end of the process. Continue to monitor the turf and its response to inclusion of any new organic amendment and to review the outcome in the context of your overall cultural management. Organic amendments may not be the elixir of life for your turf, but careful selection of materials with demonstrated potential can form an important part of an integrated cultural management program. ■