Understanding Turf Management

The sixth in a series by

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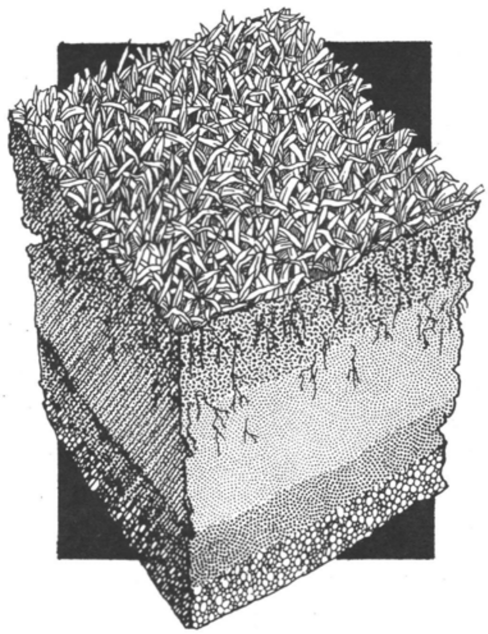
SOIL ORGANIC MATTER

The previous articles in this series dealt with the mineral fraction of the soil and the relationships between the soil minerals, air and water. Mention was made that the total volume of a soil may also contain up to 2.5% by volume of organic matter. While only a minor fraction of the total soil volume, the organic fraction has an influence on the chemical and physical properties to an extent far out of proportion to the small amount present.

Organic matter is the primary factor in increasing the formation and stability of soil aggregates, which in turn improve soil porosity and hence the movement of air and water. As improvement of aggregate stability can be expected from higher levels of organic matter the problems of soil compaction are reduced. The positive influence of organic matter on soil porosity may also increase the amount of plant available water retained in the soil.

It must be remembered, however, that the influence of organic matter on soil aggregate stability only applies to natural soils. Sports fields constructed with a sand rooting zone will see little benefit in moisture relationships from organic matter because sands do not form aggregates.

Organic matter also influences the chemical properties of a soil. It has a very significant effect on the ability of a soil to supply plant nutrients. The significance is partly due to an increased absorption of potassium, calcium, magnesium and other cations and partly because it becomes a source of all elements required for plant



growth as it decomposes. In the latter role organic matter can supply a major portion of the nitrogen and sulphur and 1/3 of the phosphorus required for turf grass production. Organic matter also increases the availability of the micronutrients required for plant growth.

Table 1: The elemental composition of organic matter.

Element	% on dry wt. basis
Hydrogen	3 - 4
Carbon	52 - 60
Oxygen	32 - 38
Nitrogen	4 - 5
Phosphorus	0.4 - 0.6
Sulphur	0.4 - 0.6

Composition

All decomposing remains of animal and vegetable life contribute to the formation of organic matter in soils. They may be insects, bacteria, fungi, plant tops and roots or organic materials such as peat moss added by the turf manager to the system. Since the origin of organic matter is animal and plant life, the elemental composition of the organic matter is similar to the original living organism (Table 1). Of particular importance in the growth of grass is the nitrogen, sulphur and phosphorus contained in the organic matter which may be released for uptake by plants at a later time. Some elements, such as potassium and micronutrients, may increase in surface soils due to the elements being absorbed from lower depths to be deposited at the surface as plant material decomposes.

The elements, carbon, hydrogen, oxygen, nitrogen, sulphur and phosphorus, combine to form organic compounds. Thus the organic compounds found in plant and animal tissue can also be found in soils. The type of compound which is found in the organic material will influence the rate at which it will decompose.

The organic compounds which have been identified in soil organic matter fall in the following groups:

- Sugars and Starches
- Amino Acids and Proteins
- Hemicelluloses
- Cellulose
- Lignin, Fats and Waxes

As one progresses from the first to the last compound in this list the harder it becomes for decomposition to take place. Thus simple sugar added to a soil will be broken down in a day or two, whereas cellulose, lignin and waxes may require months, if not years.

Thatch has been found to contain a relatively high proportion of cellulose and lignin, hence it does not decompose as readily as grass clippings and tends to accumulate at the soil surface. Likewise the addition of peat moss to a sand rooting zone can be expected to resist decomposition for one or more years because it also contains a high proportion of cellulose and lignin. Nevertheless decomposition of these resistant products eventually takes place to form the highly resistant end product of decomposition known as humus.

Humus

Humus is the end product of organic matter decomposition. It has a very complex and variable chemistry, in fact, the true composition has not been identified by soil chemists. It has an ability to absorb elements on its surface, such as potassium and calcium, required for plant growth, thus retaining them from leaching.

Humus has the ability to make some micronutrients such as copper and zinc more available for uptake by plants through a process known as chelation. Many fertilizers contain chelated micro-nutrients in an attempt to mimic the role of humus in the soil.

When extracted from the soil humus is dark brown to black in colour, a feature which generally makes high organic matter soils dark coloured.

Decomposition

The breakdown or decomposition of organic matter is primarily a microbiological process conducted by the wide diversity of microbial life in the soil and on the surface of the dead plant and animal life. Without this vital, ongoing process the surface of the earth would become covered in a depth of dead organic material and the carbon dioxide, along with other elements, would become tied up and unavailable for further growth of plants.

The environmental factors which control the rate of decomposition of organic matter are the same as those which control the rate of plant growth. Thus if some environmental factor such as a rise in spring temperature increases the rate of grass growth it also increases the rate of organic matter decomposition. In many situations it may increase the release of nitrogen from the organic matter which is required for the greater grass growth. This fact is the basis for the promotion of some organic fertilizers.

Normal organic matter decomposition requires oxygen as it is essentially a burning process the same as a fire but at a much slower rate.

Organic Matter + Microbes + Oxygen = Carbon Dioxide + Water + Microbe Tissue

Removal of oxygen from the system through poor drainage - there are microbes that can live without oxygen - results in incomplete decomposition and the formation of gases other than carbon dioxide, e.g., marsh gas. The formation of peat is a decomposition process where oxygen is excluded by imersion of the dead plant litter in water. Organic matter in poorly drained soils tends to be higher than in well drained soils, in part because decomposition is retarded due to a lack of oxygen. The release of nitrogen and sulphur during the decomposition of organic matter under conditions of low oxygen will be in a form where they are unavailable to plants and where they will be lost from the system.

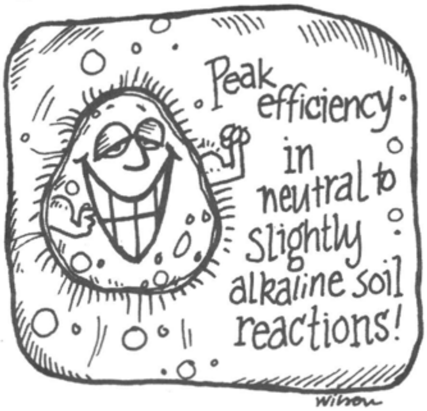
Since microbes, a living system, are an essential part of the process, temperature is an important factor. The optimum temperature for microbial activity in soil ranges from 30C (86F) to 40C (104F). Most soils under turf will be at the lower end of this range on a sunny summer day. In a cool spring decomposition of organic matter or organic fertilizers may not be rapid enough to equal the nutient demands of a grass plant.

Table 2: The Approximate C\N Ratio and Relative Decomposition Rate of Several Organic Materials.

MATERIAL	C\N RATIO	DECOMPOSITION RATE
Sphagnum Peat	100\1	Very Slow
Thatch	70\1	Slow
Grass Clippings	20\1	Rapid
Humus	10\1	Stable

Soil Organic Matter *Continued from page 5*

Microbial activity is influenced by the pH of the soil. Most microbes function best at neutral to slightly alkaline soil reactions.



The Carbon\Nitrogen Ratio (C\N Ratio)

When organic matter is decomposed under aerobic conditions (adequate oxygen) there is a loss of carbon as carbon dioxide - a gas - from the system and the retention of the nitrogen in the tissue of the microbes or as mineral nitrogen, for example nitrate nitrogen. This process continues until the ratio of carbon to nitrogen remaining in the system reaches a value similar to that of microbial protein which is approximately 10 parts of carbon to 1 part of nitrogen - a C\N ratio of 10. At this point decomposition ceases or becomes very slow because the microbes are now essentially recycling their own tissue. The stable material which remains is known as **humus.**

The C\N ratio and relative decomposition rate of several materials of interest to turf managers are listed in Table 2. With the exception of humus the higher the ratio the slower the rate of decomposition due to a shortage of nitrogen relative to carbon.

Induced Nitrogen Deficiency

The addition of a large amount of an organic material having a wide C\N ratio, for example, a heavy application of peat moss during the reseeding of a compacted goal mouth area, may result in a temporary nitrogen deficiency in the establishing grass. The deficiency occurs because the nitrogen in the soil is being preferentially used in growing new tissue by the microbes as their population explodes due to the large supply of carbon provided by the peat moss. The condition can be easily corrected by the application of soluble nitrogen fertilizer.

Similar conditions can exist during the establishment of turf on sand root zone systems. Thus it is recommended that no more than 10% of the volume of the upper 15 cm of the rooting zone be peat. It must be remembered that in addition to a potential to induce nitrogen deficiency, the peat will eventually decompose and the space occupied by the peat will be occupied by sand or grass roots. It is unlikely the volume of grass roots which may replace the peat will reach 10%.

GREEN CARE RESPONSE

In 1991, a lobby group called "The Urban Pesticides Caucus" was formed with the objective to persuade all municipalities to ban the use of chemicals for so called cosmetic appearances. They circulated a brief entitled 'Regulating the Urban Cosmetic Use of Synthetic Pesticides' to every municipality, and to MLA's, in Ontario.

In response to this group, Green Care commissioned a consulting firm, Ecological Services for Planning, to prepare an evaluation of the statements made in the brief. Their evaluation "A Scientific Response to the Urban Anti-Pesticide Lobby" is now available for the price of **$5.00** payable to:

Green Care Horticultural Association
26 Old Oak Road
ISLINGTON, ON.
M9A 2V8

Your Association considers this rebuttal of the Urban Pesticide Lobby brief a 'must reading' for every turf manager facing restrictions in the use of some of his management tools by misinformed public and legislators. **Be sure to get your copy.**

OTRF Supports Turf Research

In 1992 the Ontario Turfgrass Research Foundation supported research at the Guelph Turfgrass Institute to the amount of $30,000.00. These funds are primarily generated through membership in the Foundation, in which many STA members hold a membership, and through various fund raising efforts of the Foundation. Indirectly each STA member who registers for the 1993 Turfgrass Symposium will also make a small contribution to the Foundation through a profit sharing arrangement between the sponsoring bodies. In 1992 this contribution amounted to $6.65 per STA registrant.

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