Turf Questions
. . . and answers

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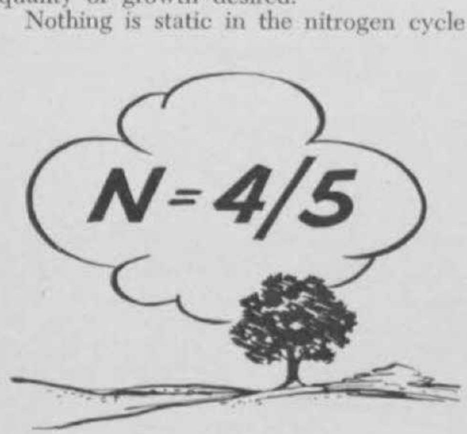
How Nitrogen Works

Nitrogen makes grass green! What a simple, beautiful statement! What a complexity of physical, chemical and biological processes there are that make such a statement possible!

The development of color, density and other features of quality turf is more dependent upon nitrogen than upon any other mineral element supplied by the soil. Nitrogen is needed in larger quantities than any other element. It must be available constantly in continuously adequate supply for the amount and quality of growth desired.

Nothing is static in the nitrogen cycle



in nature. In this dynamic system, everything is in a state of constant change and conversion from one form to another. This is growth and life and death. Nothing is lost. As a cell dies its constituents are reworked to provide new life for other organisms.

Growing points of grass (leaf tips, new shoots) are richest in nitrogen which exists mainly as protein (large complex nitrogen substances). When the supply of nitrogen is low, the plant transfers nitrogen from older leaves to the growing points. Evidence of this is the yellowing and, sometimes, death of older leaves. Carried too far, turf becomes thin, unthrifty, weedy.

Where does nitrogen come from? Most of it is in the air. About 4/5 of the atmosphere is elemental nitrogen (N), a colorless, odorless, tasteless inert gas. The 1957 Year Book of Agriculture states: "There are about 34,500 tons of nitrogen over every acre of the land area. This supply is constant." As rapidly as N is removed from the atmosphere, it is replaced from many sources by many processes. We tend to think of nitrogen for turf in terms of using a few pounds to 1,000 sq. ft. for the season — from 6 to 16, give or take a few pounds. The total supply in the atmosphere amounts to about 1,550 pounds of N for each 1,000 sq. ft. of land. There is no danger of running out of nitrogen!

Must Be "Fixed"

Grass cannot use nitrogen directly from the atmosphere. First it must be "fixed" in forms that then can be converted for use by turf. Nature fixes small amounts of nitrogen with electrical discharges (lightning). These oxides of nitrogen ars dissolved in rain water and thus enter the soil. Some soil microbes can fix annually up to 200 pounds of nitrogen per acre. For turf, the source of nitrogen is principally manufactured or processed materials derived from organic residues, from by-product chemical processes, or from the atmosphere by a series of chemical transformations.

No one fully understands the chemical nature of soil nitrogen. As soon as a nitrogen material enters the soil it begins to decompose, affected by nearly every factor that affects life itself. Virtually every organism present in soils has the ability, in its own fashion, to convert nitrogen-bearing compounds into ammonia, the first step in converting complex, unusable forms into simple usable forms. Much of the nitrogen in soils is present as proteins associated with lignin and clay. Some soil minerals can absorb and hold ammonia.

Release Agents

Microorganisms cause the release of soil nitrogen for grass growth through the activities of two great groups:

1. Ammonifiers (produce ammonia,) which embrace most bacteria and fungi, in fact, nearly every type of organism;
2. Nitrifiers (produce nitrites and nitrates), usually the Nitrosomonas which oxidizes ammonia to nitrite; and Nitrobacter which further oxidizes nitrites to nitrates.

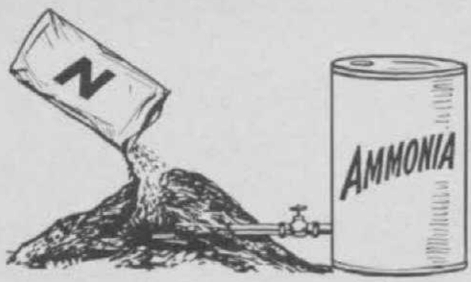
Nitrates react with calcium, magnesium, potash and sodium to form soluble nitrate salts which root hairs can absorb.

Grass can use ammonia as well as nitrates. Rarely can either form be detected in soils on which grass actively is growing. Most grass effectively can use much more nitrogen than it gets. Losses of nitrogen can be measured through crop removal, erosion, leaching and as gases. Good soil aeration not only favors conversion of nitrogen into useful forms but also reduces losses.

Soil Organisms

Soil nitrogen can be understood only to the extent that soil microbes are understood. Bacteria are the smallest and the most numerous. It takes about 25,000 of them end to end to measure one inch. An acre of rich soil may hold 1,000 pounds of bacteria. One teaspoon of soil may contain billions of living organisms.

Some bacteria derive both carbon for energy and nitrogen for food from organic substances. Others draw carbon from the air and obtain energy from oxidation of simple chemical materials. Most



bacteria need nitrogen that first has been combined into mineral forms or into organic forms.

Intensive microbial populations may be found on the surface of roots and root hairs to the extent of 50 times greater concentration than in the soil away from the roots.

Use of Enzymes

Soil organisms do a great deal of their work of decomposing organic materials by means of enzymes, organic catalysts which bring about or speed up chemical reactions. (A catalyst assists in a chemical change but is not affected by the reaction.)

Fungi are numerous and varied in soils. They are important in the decay of organic materials, producing cell substances, carbon dioxide and water. Some fungi form close harmonious and beneficial associations with plant roots. Actinomyetes resemble bacteria but have branched filaments like fungi. They contribute to the "earthy" odor of freshly plowed sods and are important in organic matter decay.

Algae are relatively insignificant except when conditions favor harmful surface scum formation.

Essential for Decay

Taken together, bacteria, the actinomyetes, and fungi are essential for the decay of organic materials, and for the mineralization (nutrification) of plant and animal residues. They constantly recycle important chemical elements. Over every acre there are about 20 tons of carbon dioxide, the amount returned in a year to the atmosphere by the activities of these organisms. When organic materials are decomposed, not only carbon and nitrogen, but many other minerals also are released. Phosphorus, iron, manganese and sulfur are made more available by microbial processes.

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Soil microbes help to produce water-stable soil aggregates (crumb structure) which improve aeration and drainage. The cells and filaments, plus the gums and the decay products produced, all serve to bind soil particles together. The aggregating effect readily will be reversed if supplies of organic materials (food and energy) are not kept adequate and continuous. Under conditions of flooding or excessive irrigation it is possible for microorganisms to clog the pores of fine textured soils.

(The second part of this article will appear in July Golfdom.)

Thatch Elimination

Q: I have just taken over a Club through an entirely new change in management. I am in charge of the course as well as golf, so I would appreciate your opinions and comments on the following.

We have under the greens, one of the heaviest cases of matting that I have ever seen. The thatch will, I am sure, measure between 1½ to 1¾ inches. This is on every one of the nine greens. My plan is as follows: Aerate a minimum of three times this season, with a very extensive triple aerating in the fall. Topdress after each aerating, using three parts sharp sand mixed with one good soil, plus fertilizer. On some of the greens that have had snowmold, use the same methods, but seed amply those spots.

Due to the close knit of Astoria bent, some of the staff are reluctant to topdress, feeling that any amount of topdressing will choke out the grass now on the greens. Due to the lack of previous topdressing, these greens are very bumpy, and of course the ball does not have a chance to roll true, despite the fact that ample 8-6-4 is used, along with a high liquid nitrogen application. It is my opinion that we will not be able to have smooth greens unless we smooth them up with a reasonable amount of topdressing.

Feeling that the greens are well built for drainage, some want to strip the greens this fall, cut the sod from the greens barely below the thatch line, recondition the soil underneath the greens and replace the sod.

I feel that continued aerating, plus my plan outlined above, will eventually bring the thatch under control. Please advise what you believe is the best method to use in this case. (New York.)

A: The aerating - topdressing - fertilizing plan is the most sensible, everything considered. Your greatest need now is to provide the best greens possible for your players. You may be sure that light topdressings of the 3-1 mix will not choke the grass. Heavy applications could cause