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Slow-Release Fertilizers:

Natural Organic Nitrogen Sources

These products provide a good source of plant nutrition, although questions about secondary benefits are still being investigated.

Michael L. Agnew, Ph.D.
Iowa State University

Natural organic nitrogen sources have been a staple in golf course management for years. They are valued for their low burn potential and long-lasting effects on Turfgrass. But today, synthetic fertilizers are produced in mass quantities at significantly lower costs than their organic counterparts. The benefits once obtained only from natural organic products can now be found in less expensive synthetic nitrogen fertilizers.

What benefits do natural organic nitrogen sources have over the synthetic versions? Benefits claimed by manufactures of organic fertilizer include reduced disease activity, reduced thatch buildup, thatch reduction, reduced soil compaction and reduced nitrate movement. However, investigation of these claims first requires an understanding of just what can be called a "natural organic nitrogen fertilizer."

According to the Association of American Plant Fertilizer Control Officials (AAPFCO), natural organic nitrogen sources are "materials derived from either plant of animal products containing one or more elements (other than carbon, hydrogen and oxygen) that are essential for plant growth. These materials may be subjected to biological degradation processes under normal conditions of aging, rainfall, sun-curing, air drying, composting, rotting enzymatic, anaerobic or aerobic bacterial action, or any combination of these. These materials shall not be mixed with synthetic materials or changed in any physical or chemical matter from the initial state except by physical manipulations such as drying, cooking, grinding, shredding, or pelleting."

Characteristics of Natural Organic Nitrogen Sources

The nitrogen concentration of a natural organic fertilizer averages between 1 percent and 13 percent. High protein content results in higher nitrogen content.

Organic nitrogen is found in proteins and other complex molecules. The nitrogen is tightly held to the organic matter and partial decomposition must take place before nitrogen release can occur. Most of the nitrogen is present in amine groups ($-NH_2$) and must be converted to ammonium (NH_4+) before it can be absorbed by the plant.

The process of releasing ammonium ions from decomposing organic matter is called "ammonification." This process begins with microbial action on the organic matter. AS the organic matter is decomposed, amine groups are converted to ammonium ions.

Initially, ammonium ions are available for microbe and plant uptake, and the majority of the ammonium ions will be adsorbed onto cation exchange sites. These adsorbed cations are held tightly until they are used by the plant and microbes or oxidized to other forms.

Since the rate of ammonification is directly related to the rate of microbial decomposition, microbial activity is greatest in warm, moist, acidic soils that have an adequate supply of nitrogen and organic matter, and is slower in dry soils or when temperatures drop near the freezing point.

Ammonium ions also can be converted to nitrates. "Nitrification" is the process that converts ammonium ions that are produced during ammonification to nitrates. The ammonium ion is first oxidized to nitrite (NO_2) and then the nitrate is oxidized to nitrate (NO_3). The nitrates are then available for both microbe and plant uptake.

The same weather conditions that favor ammonification also favor nitrification. In addition, the nitrification process is curtailed when the soil is too cold, too dry or lacks oxygen.

Natural Organic Nitrogen Sources

Natural organic nitrogen sources are best grouped according to their origin: animal or plant by-product. It is common for a commercially available source to have a combination of both types. Common natural organic nitrogen sources include composted chicken or turkey manure, bone meal, corn or soybean meal and activated sewage sludge.

Activated sewage sludge is probably the best-known natural organic nitrogen source. It is also a product that receives special attention because it is generated from municipal sewagetreatment plants. According to the AAPFCO, activated sewage products are:

"… Those products made from sewage freed from grit or coarse solids, and aerated after being inoculated with microorganisms. The resulting flocculated organic matter is with drawn from the tanks, filtered (with or without the aid of coagulants), dried, ground and screened."

Issues concerning environmental protection and sustainable agriculture have renewed interest in natural organic nitrogen products. In 1989, studies were initiated at Iowa State University to investigate the effects of several commercially available natural organic nitrogen sources on plant growth, soil physical properties and thatch development. In addition, two locally obtained products called ISUexpa and ISUexb were studied.

These investigations are still being concluded so any results discussed should be viewed as preliminary.

Initial trials investigated the value of natural organic fertilizers as a nitrogen source for plant growth. The seven products were compared to urea and a non-fertilized control. Applications were made at a rate of 1lb. N/1,000 sq. ft. in May, June, August and September on Kentucky bluegrass.

Most of the natural organic products that were applied provided good, uniform quality, while the urea treated plots were best just after fertilizer application. Over-all, the natural organic products produced less clippings than urea treated plants.

Natural organic fertilizers generally were a good choice as a nitrogen source for plant growth. However, one must be careful to select the right fertilizer. If the source is primarily from manure, be sure that the product is well composted. For example, the ISUexpb 5-3-5 fertilizer applied on research plots was not composted properly. As a result, growth and quality dropped shortly after the second fertilizer application.

The release rate of natural organic nitrogen sources will vary. Sustane, Ringers and ISUexpa products will release nitrogen very quickly because the products either contain some soluble ammonia or proteins. On the other hand the activated sewage sludges have a slower initial release rate because of the greater amounts of more complex organic molecules. Therefore the plant quality and clipping production is generally less until levels are built up in the soil.

Product Claims

There is growing evidence that some natural organic nitrogen sources reduce disease activity on golf course greens. Early research reported decreased dollar spot activity on Bentgrass treated with activated sewage sludge. Recently, Eric Nelson of Cornell University (*Agronomy Abstarcts,* 1991) reported that "well-aged or mature composts" successfully suppress a number of turfgrass diseases. He attributed the disease suppression to "the intense microbial activity associated with these composts." Though these diseases are suppressed, they are not always eliminated, so fungicide applications may still be necessary.

Natural organic nitrogen sources also have been promoted to reduce thatch buildup and thatch reduction. It has been suggested that applications of natural organic products would increase the microbial activity within the thatch layer. This, in turn, would enhance thatch decomposition.

After comparing natural organic nitrogen sources to synthetic slow-release nitrogen sources at Iowa State, no effects of fertilizer source in thatch reduction or buildup of Kentucky bluegrass have been found.

The claim that natural organic nitrogen sources reduce soil compaction has been studied by several researchers. We studied the effects of fertilizer source and core cultivation on soil physical properties and growth of Kentucky bluegrass when it was subjected to either compacted and non-compacted soil conditions.

Fertilizers were applied at a rate of 2 lbs. N/1,000 sq. ft. in May and August. Core cultivation treatments were made just prior to fertilizer application.

After three years, no effects of natural organic fertilizers were found. However, the expected alleviation of compaction by aeration was evident.

… applications of nitrogen fertilizers during times when the grass is not actively growing may increase nitrate movement in heavy soils.

Natural organic fertilizers will add organic matter to the soil. The level is small initially, but if organic fertilizers are used over a period of time, the effect may become significant.

Reduced nitrate movement is another positive benefit of most natural organic nitrogen sources. However, these same benefits can be expected from synthetic slow-release nitrogen sources. Relying solely on nitrogen sources to prevent nitrate movement is not the definitive answer.

The degree to which nitrate leaching is a potential problem also is related to soil type, nitrogen application rate and season of nitrogen application. Leaching problems are greatest on coarse-textured soils when water soluble quick-release nitrogen sources were applied at high rates followed by heavy irrigation or rainfall.

It has been suggested that applications of natural organic products would increase the microbial activity within the thatch layer.

In addition, application of nitrogen fertilizers during times when the grass is not actively growing may increase nitrate movement in heavy soils. Even natural organic nitrogen sources can leach nitrates if they are applied at excessively high rates because the plant and soil can only store so much nitrogen. If the ammonification and nitrification process exceeds uptake, leaching is possible.

Remember that natural organic nitrogen sources are first and foremost fertilizers. They provide nutrients for the growth and development of plants. Any other benefits are secondary.

Natural Organic Fertilizers Used In Iowa State Studies

Product	**Nitrogen Source**
Milorganite 6-2-0	Activated sewage sludge.
Ringers Greens Restore 6-1-3	Hydrolyzed poultry feather meal, wheat germ, soybean meal and corn fermented solubles.
Ringers Turf Restore 10-2-6	Hydrolyzed poultry feather meal, bloodmeal, wheat germ and bone meal.
Sustane 5-2-4	Aerobically composted turkey litter (Fine and medium grade).
ISUexpa 10-10-0	Corn gluten meal, local source.
ISUespb 5-3-5	Composted chicken litter, local source.