NITROGEN FERTILIZER

by
Eliot C. Roberts
Professor of Agronomy and Horticulture
Iowa State University
Ames, Iowa

The comment is made often that in using nitrogen fertilizers it is best to base rate and frequency of application on experience with the specific grass involved and not strictly on manufacturers directions. Because of the wide variation in plant response that can result from the use of nitrogen fertilizer it is important to know what to expect when various materials are used.

Facts of Life About Nitrogen

There are several key facts about nitrogen that must be understood before it can be effectively used in turfgrass fertilization.

First, nitrogen is the most important element in turfgrass production. Turf responds more to the presence or absence of nitrogen than to any other element. Too much nitrogen can be as detrimental to the turf as too little. Also, the nitrogen level within the plant often determines what effect other climatic factors will have on turf production.

Second, there are three different types of nitrogen fertilizers; i.e., inorganic, natural organic, and synthetic organic, but only two categories as far as use is concerned; i.e., fast acting soluble materials and slow acting insoluble materials. In general the fast acting soluble inorganics and certain synthetic organics must be applied in small amounts at frequent intervals. The slow acting insoluble natural organics and certain synthetic organics may be applied in large amounts at less frequent intervals.

Third, in soil, nitrogen is changed from the form in which it was applied to the nitrate form. Turfgrass may absorb some nitrogen in other forms, however, for the most part nitrogen nutrition involves nitrate nitrogen.

Fourth, turfgrass gets only the nitrogen that is left over after soil microorganisms get theirs. Usually a soil which is not microbiologically active does not produce high quality turf. It is important to recognize the value of soil born organisms and to realize that they utilize minerals from the soil and to this extent compete with the grass for some plant food.

Fifth, nitrogen response of turf is controlled by the type of nitrogen used and by how it is used. There are 17 different turfgrass growth responses that have been studied in research projects at Iowa State University during the past five years. Results of these investigations provide a rather complete picture of nitrogen effects on turf. They should help to make clear what can be expected from the use of a nitrogen fertilizer.

Nitrogen and Chemical Injuries

Fast acting soluble nitrogen fertilizers whether applied as liquids or as solids may severely burn foliage of turf if applied at rates in excess of 1 pound of nitrogen per 1000 sq. ft. These materials should be applied to dry foliage and watered in following treatment. Care should be taken to obtain even distribution of fertilizer. Avoid overlaps and adjust spreaders so that material is deflected and scattered before it hits the ground. The whirlwind type spreader scatters the fertilizer so that it is uniformly distributed.

Use of this type spreader eliminates the possibility of streams of material running out in rows on the turf and permits the safe application of fast acting nitrogen sources which are otherwise difficult to spread. It is often desirable to drag fertilized areas which cannot be watered so that materials lodged between leaves and on the foliage will be brushed to the soil surface. Where particles remain on foliage overnight they may dissolve in a heavy dew and cause foliar burn.

Nitrogen and Growth Stimulation

When temperatures are cool, light intensity is adequate, and moisture is readily available, nitrogen stimulates foliar production. Some minor differences in response are noted from time to time between varying nitrogen sources. For the most part these differences are due to the fast or slow acting properties of the fertilizer.

Nitrogen and Wilt

Nitrogen has a pronounced effect on both the rate of foliar growth and on total production of leaf tissue. Where grass receives excess nitrogen and where soil moisture and temperature are favorable for plant growth, the foliage that develops may become soft and succulent (filled with too much water for the amount of dry matter produced). Such foliage is susceptible to wilt any time the rate of water loss from the leaves is greater than water uptake from the roots. Soft succulent foliage wilts quickly and injury to the turf can be severe. Poa annua is particularly susceptible to wilt under these conditions. In order to avoid an increase in wilt from use of nitrogen fertilizers keep track of the total nitrogen being applied to greens throughout the season and avoid the accumulation of large amounts of slowly available synthetic nitrogen sources during warm weather. These nitrogen sources have been noted to breakdown and release nitrogen faster than desired during periods of hot humid weather. In general less nitrogen should be applied during the summer months than during spring and fall.

Nitrogen and Thatch

Grasses vary in their tendencies to form thatch. Those that are most likely to become thatched are especially vigorous growers and usually are very responsive to nitrogen fertilization. To keep thatch from developing at a faster rate than it can be removed fertilization must be carefully regulated. Growth rates should be stimulated by nitrogen only to the point where the turf has sufficient vigor to heal in quickly following injury and sufficient capacity to produce new foliage for proper play. Other elements such as

iron can be used to provide improved color if this is all that's lacking.

Once thatch has formed nitrogen is required by the microorganisms to decompose it. Topdressing thatched greens with soil to which fast acting nitrogen has been added should help to decompose these organic thatch deposits. Turf should be opened up by use of a verticle mower so that the topdressing can filter down into the thatch.

Nitrogen and High Temperature Effects

It has been noted that when temperatures are cool (65 to 80° F) nitrogen fertilizer stimulates growth of foliage; however, when it is hot (80 to 95° F), nitrogen reduces growth of foliage and weakens turfgrass stands. During hot weather high phosphorus added to high nitrogen further reduces the vigor of fine turf, but high levels of potassium help to harden off the tissue and thus increase turf vigor. Because of these relationships between nitrogen and high temperature, it is important not to use too much nitrogen during warm weather.

Nitrogen and Nutrient Balance in Turfgrass

Nitrogen is absorbed by grasses in larger amounts than any of the other mineral nutrients. Once nitrogen is absorbed and is inside the grass plant it must be assimilated or used in order to have a beneficial effect on plant growth. The use of nitrogen within the grass plant depends on the presence of other nutrients in the proper proportion one to the other and on several other physiological or growth factors.

When nitrogen is deficient for a period of time while other nutrients are readily available, the plant becomes unbalanced with respect to its mineral nutrition. It absorbs more of some nutrients than can be used because of the lack of others. If adequate nitrogen is applied to a turf which has become unbalanced because of lack of nitrogen, the grass will quickly absorb the added nitrogen. This nitrogen accumulates in the tissue and is slow to be used because the unbalanced nutrient condition is slow to adjust. Our studies at Iowa State University have shown that bluegrass turf can be produced with 4.5 to 5% nitrogen in the foliage and with other essential elements applied in adequate quantities to prevent the formation of deficiency symptoms, but not applied in proper balance. The result has been the development of yellow chlorotic foliage because although ample nitrogen was available to the plant, it could not be utilized. Nutrient unbalance prevented this nitrogen utilization.

Nitrogen Effects on Root Development

Turfggrass which is clipped high; i.e., above 1½

inches produces increased root systems under low nitrogen. In this instance the lower nitrogen level reduces the rate of foliar growth so that organic energy sources within the plant can be diverted to increased root development. As the clipping height is lowered and leaf surfaces available for photosynthetic processes are reduced, the amount of organic energy sources becomes less. Nitrogen is needed under these conditions to stimulate foliar growth so that the amount af these energy sources may be increased for root growth. In general, any time nitrogen increases foliar growth past the point needed to supply a base level of organic energy sources for foliar and root growth, the turf will produce excess foliage at the expense of the root system.

Nitrogen and Moisture Stress Effects on Foliage

Turfgrass grown under conditions of moisture deficiency is generally susceptible to extremes of other growth factors in the environment. For example, growth of turfgrass foliage is reduced by lack of available moisture when grown under medium levels of nitrogen; however, growth is further reduced when nitrogen levels are either low or high. Since fairways and trees may often suffer from a lack of moisture it is important to keep these turf areas well fertilized, but not over fertilized. Since greens are more likely to be over watered than under watered this growth response is not believed to be important in these areas.

Nitrogen and Moisture Stress Effects on Roots

Nitrogen fertilization also effects root growth under moisture stress. Where medium to high rates of nitrogen are used root growth remain unchanged as moisture becomes less available. Where nitrogen is kept low root growth increases as moisture levels become lower. Apparently a lack of available moisture in some way stimulates root development as long as nitrogen is not readily available to stimulate foliar growth processes. In the fall foliar growth rates are relatively slow and under these conditions the level of nitrogen appears to be less critical.

Nitrogen and Winter Desication

Cold dry winds blowing over the surface of a green that is not protected by a cover of snow often cause severe drying out or desication of the turf. Use of nitrogen fertilizer in the fall helps to produce deeper grass roots that can draw water from a larger volume of soil. Where greens are fertilized with slow acting nitrogen sources growth continues as long as soils remain warm enough for microbiological breakdown of the nitrogen carrier. Since days are shorter at this time of year than in the spring and since light intensity is usually less the turf has a better chance to utilize the added plant food in root production rather than in foliar growth. The development of a sturdy root system not only helps protect against winter desication, but also permits the grass to make a faster start in the spring.

Nitrogen and Rust Disease on Merion Bluegrass

Rust caused by the fungus Puccinia spp. can be serious on Merion bluegrass. Field studies have shown that when Merion bluegrass is watered well and fertilized with plenty of nitrogen, rust infection is substantially reduced. It has been theorized that the increased growth rate resulting from use of adequate water and nitrogen permits the turf to replace diseased tissue faster than the disease can spread. Close observation of Merion bluegrass turf has shown that some plant parts do not make rapid growth

even though the turf is watered and fertilized. These parts do not become as heavily infected with rust as similar plant parts on under watered and fertilized turf. This suggests that the level of moisture and nitrogen effect internal growth processes which help to render the turf more resistant to disease.

Nitrogen and Leaf Spot Disease on Bluegrass

Leaf spot caused by the fungus Helminthosporium spp. is the most damaging disease which attacks bluegrass. Both field and greenhouse studies have shown that where moisture levels are high and where nitrogen supply is plentiful bluegrass is more susceptible to leaf spot. Under these conditions not only are there more lesions per leaf, but the average size of the lesions is greater. During the period in late spring and early summer when climatic conditions are favorable for the development of this disease, nitrogen levels should be reduced and water applications made with care.

Nitrogen and Disease Complexes on Bluegrass

Often the disease causing fungi attack turfgrass as a group. Resulting disease complexes are usually quite lethal. Helminthosporium, Curvularia, and Alternaria have been noted to infect bluegrass turf during periods of hot humid weather in late summer. The disease develops in saucer shaped patches that result in near 100% kill of the grass. Nitrogen fertilizer studies have been conducted in areas where this disease complex has been common. Results indicate that under high nitrogen treatments diseased patches were reduced by 80% in comparison with low nitrogen treatments. In addition the diseased grass found under high nitrogen treatments was not completely killed and recovered quickly during favorable fall growth conditions. Diseased grass in the low nitrogen treated plots was completely killed and spots were slow to fill in. All disease complexes do not respond to nitrogen fertilization in this way; however, this response is typical of the pronounced effect that nitrogen has on resistance of turfgrass to infection by disease complexes.

Nitrogen and Dollar Spot Disease on Bentgrass

Dollar spot disease is caused by the fungus Scolerotinia homoeocarpa. This disease is much more pronounced under low levels of nitrogen than under high nitrogen fertilization. Differences in nitrogen source have also been noted. Where 10 lbs. of nitrogen was applied per 1000 sq. ft. per season all nitrogen sources resulted in three or more dollar spot scars per square foot except the natural organic fertilizer Milorganite which had only one scar per square foot. At a 5 lb. rate of nitrogen per 100 sq. ft. the number of scars varied from about 5 to 11 per square foot. Where turf was not fertilized with nitrogen 17 cars were noted per square foot. More research information is needed to determine why these differences occur. It is asumed at this point that the nitrogen level within the plant in some way affects the infective nature of the fungus.

Nitrogen Brown Patch Disease on Bentgrass

Brown patch disease on putting greens is caused by fungus Rhizoctonia solani. This disease is often more serious where greens are heavily fertilized than where they receive only moderate levels of nitrogen. In this instance the nitrogen disease relationship is not clear cut. Our studies at Iowa State University have not shown disease incidence to be increased under high nitrogen treatments.

(Conclusion and Summary next month)