NITROGEN, PHOSPHORUS, SULFUR, AND PESTS

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The nutritional status of the turfgrass plant is important not only for beauty and serviceability, but also for resistance to attack from pests, particularly plant pathogens. In general, plants with good vigor are less susceptible to pest damage than are weakened, undernourished plants. Proper nourishment is difficult to define, but in the strict sense, relates to the fact that all nutrients and growth factors are available to the turf plant in the proper ratio for normal growth and development. What may be considered to be the accepted level of nutrition for one geographic area may prove to be unacceptable in another, due to the presence or absence of certain plant pathogens.

Although there are 17 elements considered to be essential for plant growth, only three (nitrogen, phosphorus, and potassium) of those that can be supplied from fertilizer sources are classed as major nutrients. The remainder are classed as secondary or micro-nutrients. Investigations in recent years have shown interesting interrelationships between nutrient supply and turfgrass diseases and some will be discussed in this paper.

Nitrogen:

When all other nutrients are available in adequate supply, turfgrasses usually produce growth and color in proportion to nitrogen applications. Although growth and quality are not synonymous, growth is one measure of the vigor of the grass plant. Growth can help a plant escape from certain disease attacks by growing faster than symptoms may develop. Leaf rust symptoms may not become too apparent if the plants are stimulated by adequate levels of nitrogen and leaves are frequently clipped.

Fusarium patch disease, caused by the fungus Fusarium nivale, increased in severity when nitrogen was increased by increments from 6 lbs. to 20 lbs. per 1000 ft.^{2} per season in tests at Washington State University, without regard to P and K (2). Ophiobolus patch disease, caused by the fungus Ophiobolus graminis var. avenae severely attacks bentgrass turf in some regions. Nitrogen levels in excess of 12 lbs. per 1000 ft.^{2} per year helped to reduce disease severity in young plantings (3). High levels of N stimulated development of new root and crown tissue affected by this fungus. Red thread disease, caused by the fungus Corticium fuciforme, was more severe on bentgrass and fescue turf with decreasing N levels from 8 lbs. to 4 lbs. per 1000 ft.^{2} per year (4). The senior writer has observed heavy turfgrass damage from stripe smut and Helminthosporium spp. in the Midwest and Northeastern U.S. from nitrogen applications in excess of 4 lbs. per 1000 ft.^{2} per year.

Phosphorus:

This element is essential for normal growth and development of turf, but in smaller quantities than N and K. Phosphorus was shown to interact with potassium and helped reduce Fusarium patch disease severity when nitrogen rates were maintained at 12 lbs. per 1000 ft.^{2} or lower. No effect of P was observed with N rates

over 12 lbs. per 1000 ft.^{2} (2). P signficantly reduced the occurrence of Ophiobolus patch disease on bentgrass turf (3); however, some of this reduction was probably caused by a small level of sulfur as an impurity in treble superphosphate. P likewise caused a reduction in Corticium red thread infection in tests at W.S.U. (4).

Potassium:

It is only fair, at this point, to briefly assess the value of K in turfgrass disease control. Adequate levels of available K helped reduce infections of Fusarium patch, Ophiobolus patch, and Corticium red thread diseases (2) (3) (4). McNew (5) stated that, "More plant diseases have been retarded by the use of potassium fertilizers than any other substance, perhaps because K is so essential for catalyzing cell activity." These are ample reasons for guarding against K deficiencies.

Sulfur:

Sulfur is rapidly assuming a more important role in turfgrass fertility programs. It is necessary for many cell activities including the formation of certain amino acids which are building blocks for protein. Sulfur alone is an old timer in the list of effective fungicides for specific plant diseases. In well nourished turf, leaf tissue levels of S are 0.18 to 0.20% which is nearly equal to that of phosphorus. This element is certainly not a micro or secondary element for turfgrasses and should be classed along with N, P, and K as a macro or major plant food element.

The following brief discussion will point out the importance of sulfur in nutritional programs at Washington State University. Experiments have been conducted on a natural sandy loam soil with original high levels of P, K, and Ca. Bentgrass putting green turf was grown continuously for 15 years with all clippings removed. Nutritional treatments included 6#, 12#, and 20# N; 0 and 4# P_2O_5; and uniform 8# K_2O per 1000 ft^2/season in all combinations. Sulfur was applied to various plots at 0, 1.15#, and 3.45#/1000 ft^2 per season. S applications were split into equal applications for the year totals.

1. Effects of S on color, density, and vigor - Sulfur increased the yield of clippings in all plots regardless of N, P, and K. Color and density were significantly better and likewise the texture of the turf was improved in all S treated plots. Plots receiving only N were off-color and thin.
2. Effects of S on disease - Sulfur eliminated all Ophiobolus patch disease regardless of N and P treatments (1). Fusarium patch disease was significantly reduced, although variable according to N level.
3. Effects of S on black algae - No algae was observed on any plot receiving sulfur. This agrees with reports and personal observations that continued use of the fungicide Fore will decrease or eliminate algae. Fore has 37.8% S.
4. Effect of S on earthworms - Only limited activity of worms was observed in plots receiving 1.15# S/1000 ft.^{2}, none in the 3.45#/1000 ft.^{2} treated area, while check plots had high activity.
5. Effects of S on Poa annua - Perhaps this is the most significant result:
   A. 1.15# S increased the vigor of all turf including Poa annua at all N, P, and K levels while 3.45# S significantly reduced Poa annua at all N, P, and K levels.

B. Additions of P with all N and K levels and 3.45# S increased Poa annua significantly over those not receiving P. Plots receiving 6# N, 8# K_2O, and 3.45# S were 99% free of Poa annua. The same treatment which also received 4# P_2O_5 was approximately 15% Poa annua.

It is obvious that S exerts the most influence in Poa annua control with P and N rating second and third respectively.

In conclusion, we must stress that balanced nutritional programs are important in helping to control diseases and weeds in turfgrasses. Previous W.S.U. research indicated an N, P and K ratio of 3-1-2 was an optimum ratio for putting green and general turfgrass needs where clippings are removed. Recent research indicates that P can be reduced still further (to perhaps 3-0.5-2) and produce good turf with fewer problems. Sulfur should receive as much attention as P, particularly on specialized areas such as sand putting greens and athletic fields.

Literature Cited

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