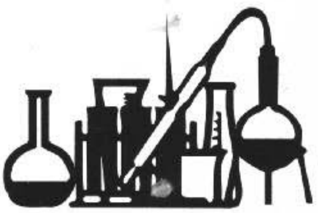

Manipulating Creeping Bentgrass Nutrition

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Disease occurrance, severity and subsequent recovery in creeping bentgrass have long been linked to the nutrient status of the grass. Statements such as "Low N favors dollar spot" or "High N favors pythium" are common. But what is "low" N or "high " N? Are other nutrients involved in the nutrition-disease connection? What are the mechanisms involved? How can we effectively manipulate the nutrient status of creeping bentgrass ? These are some of the questions that Dr. Julie Meyer and I hope to answer in a cooperative research project being funded by the Wisconsin Turfgrass Association.

Knowing the mechanisms involved in nutrition-disease relationships can be the key to manipulating turfgrass nutrition for disease control purposes. A classic example involves take-all disease. It has been known for some time that lowering soil pH reduces the severity of the disease and increases the effectiveness of chemical control. Only recently have we come to understand that what is involved here is manganese (Mn). The take-all fungus immobilizes Mn in the root zone through oxidation of the nutrient. This reduces plant uptake of Mn and, in the process, weakens the physiologic barrier to root penetration by the fungus. Lowering soil pH favors the reduction and plant uptake of the Mn.

This is but one example of how manipulation of turfgrass nutrition through cultural practices can aid in disease control and increase the efficacy of chemical control agents. Assuming other examples will be disclosed in our research, my task is to determine how turfgrass nutrition can most effectively be manipulated.

Manipulation of turfgrass nutrition is not as simple as just applying the nutrient of interest. As an example, consider Mn. Soil application of the nutrient when soil pH is around 7.0 is often ineffective because the Mn quickly undergoes oxidation and is rendered unavailable to turfgrass. Foliar application of the nutrient is not the answer either because the Mn does not readily translocate to the roots to change the resistance to take-all fungus penetration.

Another reality one has to deal with in attempting to manipulate turfgrass nutrition is the plant itself. Turfgrass, like all other plants, does not indiscriminately accumulate nutrients. Plants exercise considerable control over the amounts of nutrients taken up. To further complicate matters, the degree of control exercised varies from one nutrient to another. Manipulation of turfgrass nutrition requires knowledge of the limits turfgrass itself places on nutrient absorption.

Our study is being conducted at the O.J. Noer Turfgrass Research and Education Facility. Last season a stand of 'Penncross' creeping bentgrass was established on silt loam soil and is being maintained under fairway conditions. The soil pH averages 5.8, contains 2.9% organic matter, and has soil tests of 61 ppm P and 180 ppm K. These P and K levels are considered to be high to very high for turfgrass. The fertilizer treatments consist of three N rates, two rates each of P and K, various NPK combinations and annual applications of lime and elemental sulfur.

Analyses of a set of clippings collected last October have already begun to shed considerable light on how the nutrition of creeping bentgrass can be manipulated. By going from 2.0 to 8.0 lb N/M/season, there was a substantial increase in shoot growth. This, in turn, altered the nutrient demand of the turfgrass and clipping concentrations of several nutrients changed accordingly. Without this change in nutrient demand, uptake of nutrients such as P and K remained unchanged even when the nutrients were applied. For example, the clipping concentration of P remained at 0.44% whether P was applied or not and applying K increased tissue K a mere 0.02%, from 2.54 to 2.56%. How many more times do I have to say that applying nutrients to turfgrass growing on soil already well supplied with the nutrients is a waste of time and money?

Examination of the relationships of clipping N (an index of nutrient demand) to other nutrients revealed how and the extent to which alteration of nutrient demand can be used to manipulate bentgrass nutrition. The types of relationships found, the strength of the relationships and the percent changes in clipping nutrient content are shown below.

Nutrient	Relationship	Strength	Nutrien change percent
P	Positive	0.998	19.0
K	Positive	0.982	22.5
Ca	Negative	0.046	4.5
Mg	Positive	0.941	7.7
S	Positive	0.904	21.1
Zn	Positive	0.972	16.5
B	Negative	0.707	18.1
Mn	Positive	0.204	3.1
Fe	Negative	0.242	12.2
Cu	Positive	0.790	10.7

Positive relationships mean that clipping nutrient concentration increased as clipping N and nutrient demand increased. The strength of the relationships between clipping N and the other nutrients can vary from 0 to 1.0. The indication is, the closer this value is to 1.0, the more strongly that bentgrass uptake of that nutrient depended on clipping N concentration; i.e., on nutrient demand.

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The above information is good evidence that bentgrass clipping concentrations of P, K, Mg, S and Zn can be manipulated by increasing plant nutrient demand through an increase in the rate of N application. Clipping Cu was also dependent on nutrient demand, but the strength of the relationship indicates other factors were involved as well. Changing nutrient demand does not appear to be a means for increasing clipping concentrations of Ca, B, Mn or Fe. Applying lime did not alter clipping Ca concentrations either.

The fact that clipping B levels decreased substantially with increasing nutrient demand likely reflects a case in which plant influence over uptake of the nutrient is minimal and increases in clipping production simply caused a dilution of the B taken up. This suggests that B is an example of a nutrient where soil application can be effective in manipulating its clipping concentration.

Iron and Mn clipping concentrations displayed little or no dependency on turfgrass nutrient demand. This becomes understandable in light of the fact that both nutrients must undergo reduction in soil before they can be absorbed by plant roots. Thus, efforts to manipulate turfgrass Fe and Mn concentrations have to focus on the creation of conditions that favor or decrease reduction of the two nutrients in soil. Reduction in soil of Fe and Mn is favored by low soil pH. Liming favors oxidation and a decrease in plant availability of the two nutrients. Our observations bear this out.

Soil treatment	Clipping concentrations Fe	Mn
	ppm	
None	178	146
+ Lime	154	116
+ Sulfur	188	229

The indications from these data are that raising soil pH reduces plant availability of Fe and Mn while reducing soil pH with S has the opposite effect. The Mn concentrations were affected most. This reflects the fact that in-soil reduction of Mn is more sensitive to pH than is Fe.

One final observation here on how turfgrass cultural practices sometimes have unanticipated effects on turfgrass nutrition. In one series of treatments, lime application is in conjunction with use of three different N carriers: polymer+S coated urea; urea; and ammonium sulfate. Clipping N concentrations in October from these three treatments were as follows.

N Carrier	Clipping N
	%
Ammonium sulfate	4.27
Poly-S	4.15
Urea	3.40

What we see here is the effect of liming on volatilization loss of fertilizer N. Even though the bulk soil pH is only 5.8, liming obviously raised the soil surface pH high enough to promote volatilization of urea-N.

These initial research results provide strong indications that if we find bentgrass nutrition to be an important aspect of disease incidence and control, there are means to manipulate nutrient status. These means do, however, vary with the nutrient in question. Changing plant nutrient demand affords some control over clipping nutrient contents even when soil is well supplied with these nutrients. The nutrients subject to manipulation by way of nutrient demand are P, K, Mg, S, Zn, and, to a lesser extent, Cu. Boron uptake appears not to be under plant control and can be altered through fertilization. Iron and Mn can be regulated via soil pH adjustment.