Jump-Starting Microbe Activity in Sand-Peat Root Zone Mixes

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A trend that seems to have invaded the golf turf world in recent times is the application of large amounts of nitrogen to speed bentgrass establishment on sand putting greens. From discussions I've had, application of 30 lb N/M in the grow-in year, which is about double that recommended by USGA Green Section agronomists, is fairly common. Considering that in subsequent years the annual N rate generally settles in at about 3 to 5 lb/M/season, application of 30 lb N in the establishment year raises some interesting questions. Why do superintendents see the need for so much N? What do these N rates do for root development? Can these N rates set the stage for putting green failure? What are the environmental implications?

An untested response to the first question is that the problem is one of an initially low level of microbe activity in sand-peat mixes. The presumption behind this response is that when microbe activity is very low, the level of biocycling of N is equally low. Hence, fertilizer N needs are correspondingly high. Unfortunately, there is very little research that supports this presumption.

Research has demonstrated that by the time sand-peat greens are into their second year after establishment, microbe populations are very similar to those found in turf several years after establishment on native soil. In this circumstance, soluble fertilizer N virtually disappears within 48 hours after introduction into the root zone. Up to 75% of the soluble N is absorbed by the turfgrass. The remaining 25 to 40% is consumed by soil microorganisms. Much of this "immobilized" fertilizer N is thought to eventually become available to the turfgrass as a result of constant turnover of the microbe population. Thus, some 25 to 40% of the soluble fertilizer N applied takes on the character of slow-release nitrogen.

The scenario that has evolved from these types of observations is that new putting greens require so much N for grow-in because of severely restricted biocycling of fertilizer N. An added factor may be a consequence of the fact that root zone mixes initially contain only organic material with a high carbon:nitrogen ratio. Such material cannot sustain, let alone allow for the buildup of a high microbe population. A substantial amount of fertilizer N applied during turfgrass establishment may actually be used by microbes to offset the lack of N in the root zone organic fraction. At present, both explanations for the abnormally high N requirements of putting greens during grow-in are highly speculative. I'm anticipating the the new round of research recently funded by the USGA Green Section will include careful examination of the microbe dynamics of new putting greens and the consequences as far as N requirements are concerned. Meanwhile, there is great interest in the notion that considerable benefit can be derived from incorporating into root zone mixes organic materials that have the potential for greatly accelerating the buildup of microbe populations. Organic materials with low C:N ratios and substantial amounts of sugars, carbohydrates, amino acids and proteins are logical choices. Additional benefit may be realized if the materials themselves contain microorganisms commonly found in soil.

Thanks to the interest and financial support from the Milorganite Division of the MMSD, I have underway a greenhouse experiment that should provide some insights into the virtues of amending sand-peat root zone mix with different kinds and amounts of organic materials. My purpose here is to share with you some of my general observations and the lessons learned so far. I feel it is important to do so before any of you get involved in putting green construction.

One of the things being observed in simulated putting greens is the overall level of microbe activity at two depths in the root zones. I do have evidence that sand-peat mixes initially have very low levels of microbe activity and that this activity can be jump-started with high energy, low C:N ratio organic materials. BUT, in the three treatments exhibiting the highest level of microbial activity two weeks after seeding, disaster struck. Two weeks into the study these greens had dense, uniform, dark green stands of bentgrass approaching 1/2-inch in height. Over a 3 day period the grass suddenly turned brown and died. This observation leads to lesson #1: Being overly zealous in our efforts to stimulate microbe activity in root zone mixes can lead to unemployment!

In another series of treatments, greens with unamended root zone mix are being fertilized with feed-grade urea at rates of 0.2, 0.4, or 0.8 lb N/M/week. Over a 24-week season, these N rates lead to annual totals of 4.8, 9.6, and 19.2 lb N/M. The greens are now into their third month of establishment. Stand density, uniformity, growth rate and color are near ideal in the greens receiving 0.2 or 0.4 lb N/M/week and there is no visual difference between them. At the 0.8 lb N rate, several problems were encountered. The first was what appeared to be potassium deficiency. This was surprising in view of the fact that K was incorporated into the top 3 inches of the root zone mix expressedly to ensure an adequate K supply. Application of K restored some color to the bentgrass, but recovery was not complete. Adding a micronutrient mix gave some further improvement, but in the meantime the greens had thinned out and still have not filled in. Within the past week a new problem has cropped up at the 0.8 lb N rate. This time it appears to be an as yet unidentified disease. These observations lead to lessons #2 and #3. Lesson #2 is that for the environmental conditions under which the experiment is being conducted, application of more than 0.4 lb N/week is not advisable. Lesson #3 is that if you do choose to push the grow-in process by applying in excess of more than about 10 lb N/M/season, be prepared to deal with secondary problems such as multiple nutrient deficiencies and heavy disease pressures. In one treatment I'm attempting grow-in with 0.5 lb SRN/month. I've found it necessary to supplement the SRN with periodic applications of soluble N. Thus, lesson #4 seems to be that rapid grow-in cannot be accomplished with SRN alone.

In certain treatments where the root zone mix has been amended with organic materials, it has been possible to achieve satisfactory bentgrass establishment without application of soluble N. One such treatment has, however, begun to show the same symptoms as experienced when the root zone mix was not amended and the soluble N rate was 0.8 lb/M/week. This leads to lesson #5: Pushing the bentgrass along too fast with some organic materials selected to promote microbe activity can, like the 0.8 lb N/week, create secondary problems that will have to be dealt with.

Summing these five lessons, I think it is obvious that extreme caution must be exercised when taking actions designed to jump-start the microorganism population in sand-peat root zone mixes. This is a case where solid research needs to precede action. Acting on the basis of theory, speculation or hype could prove detrimental to your health!