Root Zone Amendment Effects on the Quality and Nutritional Status of Creeping Bentgrass Putting Greens

By Christopher L. Kerkman and Dr. Wayne R. Kussow
Department of Soil Science, University of Wisconsin-Madison

The putting green used in this study was constructed in 1993 according to USGA standards at the O. J. Noer Turfgrass Research and Education Facility. The green was constructed with 10 different root zone mixes blended from 3 different sands, 6 organic amendments and one inorganic amendment. The objectives of the project were to assess the effects of the amendments on putting green quality and on the nutritional status of the greens. Some of the more important and useful observations resulting from the study are the subject of this report.

All indications from the first 3 years of the study are that the USGA recommendation that the root zone amendment contain >85% organic matter is too stringent for Wisconsin conditions. The putting green with the highest quality ratings has consistently been that whose root zone amendment is peat humus containing only 64% organic matter. There seems to be several reasons for this. One is better moisture retention than one gets with a highly organic root zone amendment. Associated with this increased moisture retention has been the absence of localized dry spot. The key figure here seems to be retention of an average moisture retention capacity of more than 12% water volume in the root zone.

The increased moisture retention by the peat humus green is not due to the ability of the peat humus itself to hold more water than, say, a Canadian sphagnum peat. Rather, what seems to be at issue is the amount of organic matter in the root zone mix. All mixes were 80/20 volume blends. Because the peat humus had a bulk density more than double that of the highly organic peats and blending was on a volume basis, the peat humus root zone mix ended up with nearly one percent more organic matter on a weight basis.

Across the 6 organic amendments there were significant relationships between root zone mix organic matter content and moisture retention and between amendment fiber content and root zone organic matter content. The higher the organic matter content of the mix, the greater the amount of water retained in the top 3 inches of the root zone. The higher the fiber content of the amendment (and the lower its bulk density), the lower the organic matter content of the mix and the lower the amount of water retained in the top few inches of the root zone.

The significance of these relationships lies in the fact that throughout this study there has been a strong relationship between the moisture retention properties of the greens and their quality. This began with the rate of bentgrass establishment and has continued through the first two years after grow-in. Thus, our conclusion is that in the selection of organic amendments for root zone mixes, attention needs to focus more on the moisture retention capacity of the mix than saturated flow or infiltration rate.

An interesting observation involved the development of localized dry spot on one replicate of a treatment that has generally not had the problem. This occurred during a two-week period in which irrigation was the only source of water and daily water inputs on each plot were being monitored. Due to persistent drying winds over a period of three days, this particular plot received only 1/3 the intended amount of irrigation. That's all it took for development of prominent localized dry spots. One year later, the dry spots still persist. While an isolated observation, the implications seem to be that drying down greens for tournament play or deliberately keeping greens on the dry side runs the risk of creating localized dry spot, particularly when the root zone mix has been compounded from a highly organic amendment at a volume ratio that results in less than 12% moisture retention in the root zone.

Choice of root zone mix amendment was found to have some effect on the nutritional status of putting greens that, at a level subservient to moisture retention, can influence

putting green quality. Fertilizer nitrogen found in the clippings for one month after application of 15N labeled ammonium sulfate was significantly different among the different root zone mixes. The reasons were differences in the moisture retention capacities of the different root zone mixes and non-uniformity in irrigation water application. Leaching of fertilizer N beyond the 8-inch depth of the root zone resulted in less uptake by the bentgrass. The amount of leaching increased significantly for those plots constructed with root zone mixes with low moisture retention capacity and situated in those areas of the green that consistently received more than average amounts of irrigation water.

Laboratory studies showed that all of the root zone mixes required approximately the same amount of fertilizer P to raise soil test P by one unit. This ratio turned out to be 0.029 lb P_2O_5/1 ppm soil test P per yd^3. While this ratio was quite constant across the various mixes, there were major differences regarding the optimum soil test P level for turfgrass. We found that this ranged from 5 ppm P in the straight sand root zone to 32 ppm P in the root zone mix blended with peat humus.

Type of root zone amendment also affected the potassium relationships in the root zone mixes. When the mixes contained peats with more than 85% organic matter, soil solution K^+ concentrations were 3 or more times higher than in the mixes containing amendments with mineral contents in excess of 17%. This difference in solution K concentrations readily explains why USGA greens typically have excessive K^+ leaching rates.

From this research, we feel that the USGA recommendation that the organic amendment in root zone mixes contain at least 85% organic matter should be modified, at least for putting greens in northern regions of the country. Allowing for higher mineral content in the amendment will lead to higher moisture retention in the root zones. In our experience, this will result in more rapid and uniform bentgrass emergence, better putting green quality, and less susceptibility to formation of localized dry spot. Of secondary importance may be reductions in the amounts of fertilizer N and K required. While we've experimented with only one peat humus amendment, indications are that use of the material in root zone mixes will not result in unacceptably low water infiltration rates. Measures taken in 1995 revealed an infiltration rate of 13.1 inches/hour in the peat humus treatment, which was not significantly different from the Canadian sphagnum peat and Dakota reed sedge root zone mixes.

This report is based on the M.S. thesis of Chris Kerkman. Chris received his M.S. degree in June, 1996 and is employed by Egypt Farms, Baltimore, MD.