

indicating that the acid was being moved downward somewhat in the very sandy soil by leaching. In contrast, the pH effects from the ground sulfur applications were not as marked nor was there any injury apparent on the turf, even at the 20 lb application rate. Thus, it is very important to consider the type of sulfur being applied when determining the rate of application.

One should always use caution in applying the powdered form of sulfur. A maximum annual rate of 4 to 5 lbs per 1000 square feet is suggested when this is used. pH change on finer-textured soils or soils which have considerable amounts of free calcium carbonate and have pH as well above 7 would be much slower than observed here, of course. More sulfur would be needed to bring about a similar pH change so the treatment period would need to be extended over a period of years. As is clear, the ground sulfur which has larger particles gives much slower pH change but the effect would last longer. There are some products on the market which are granular in nature but when they are put in water, they break down to fine particles and give relatively quick pH change again. Let me stress the importance of using sulfur very carefully to reduce soil pH.

Studies on the effect of using core cultivation on soils have proven very interesting. Marty Petrovic completed his Ph.D. on this study in the past year and now is the turf specialist at Cornell University in New York. He utilized the Computerized Axial Tomography scanner (CAT Scanner) in the Medical School here at Michigan State University to evaluate the density of soil over very small distances. With this piece of equipment, he was able to determine that core cultivation does, in fact, cause zones of compaction both parallel to the sides of the tines and in the soil right at the bottom of the coring hole. Based on greenhouse studies, we feel that the compaction on the sides of the coring holes is minimal and with time these walls tend to sluff into the opening and in fact provide improvement in aeration and associated responses such as rooting. The bottom of the coring hole, however, presents a different problem. After several months of growing the cores in the greenhouse, the soil at the bottom of the coring hole still exhibited a marked increase in compaction as a result of the core cultivation. It is apparent that with continued use over a period of years coring to the same depths can cause a type of coring pan, or compaction zone below the surface.

How serious is this problem? We really do not know the long-term detriment of this effect. Perhaps with freezing and thawing we may get improvement of the compaction layer such that it will not be noticeable. Should one consider not using core cultivation in the future? Definitely, we would say that core cultivation should be practiced where needed. If the surface compaction problem is such that core cultivation is necessary, this is an essential practice. But it might be well to consider coring to different depths to be sure there is not one depth that is reached with your coring tine every time this is practiced. Naturally, the coring depth will vary as there are changes in soil moisture content, the amount of sand in a particular green, how compacted the soil is for particular greens, and the length of the tines at the time the coring is done. It may be well to not always follow the same routine when starting with new tines. That is, do not core number 18 first and proceed in a set pattern. By varying the depth of coring, one then can vary the depth to which this compaction might occur.

The basic conclusion from these studies is not that we should cease coring operations, but that we should evaluate carefully the objectives for such practices and then determine that they are, in fact, giving us the improvement in turf conditions which is desired. If we just stop to think about it, anything that creates a hole where there was not one will have to cause compaction due to the downward motion. For example, spiking surely causes some compaction in the surface inch or so of soil under a green. Is spiking giving use the improvement in maintenance conditions desired? There are some clear advantages of spiking,

but the potential for increased compaction in the surface cannot be overlooked.

Appreciation is expressed to the companies which donated products and to the superintendents and their associated golf courses on which we conducted the research studies: Ed Karcheski, Traverse City Country Club; Kurt Thuemmel, Walnut Hills Country Club; and Red Bell, Country Club of Lansing.