Mercury Levels in a Golf Green

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The levels of mercury in the environment and its effect on biological activity are of concern to both ecologists and agriculturists. One source of environmental mercury is fungicides used for turf disease control.

Our objectives in this study were to determine, under field conditions, the degree of mercury accumulation in soil after repeated organomercurial fungicide applications over a 15-year-span, the vertical and horizontal movement of mercury in a soil and the uptake of mercury by turf plants growing in a mercury treated soil.

Soil samples were obtained from a green and adjacent fairway area of a commercial golf course in southeastern New Hampshire. The green had received an annual application of approximately 0.69 ounces of metallic mercury per 1,000 square feet derived from organomercurial fungicides, principally phenylmercuric acetate, mercuric acetate, and mercuric chloride, over a period of 15 years. The time of sampling was August, 1971, and an arbitrary maximum sampling depth of 12 inches was established. A photograph of the major sample area is shown in Figure 1 while the specific sample sites and depth profile are shown in Figure 2. On the same date, an off-site soil and turf sample was obtained from the fairway approximately 1,000 feet from the primary sample area. Since the fairway was involved, the turf species was Merion Kentucky bluegrass.

The golf green section of the sample area planted to velvet bentgrass has a slope of approximately three-to-four degrees. The fairway portion that collected drainage water from the green had a slope of about 10 degrees (Figure 1). During peak rainfall periods considerable drainage occurred across the area sampled (Figure 1 dotted line). The total rainfall for the site was 40 inches annually with approximately 10 inches of water applied via irrigation. In commercial practice, the fungicide applications would be made during June-September for the control of turfgrass diseases such as brown patch (*Rhizoctonia solani*) and dollar spot (*Sclerotinia homoecarpa*).

The green which was sampled in this investigation was developed on a prepared soil, a usual practice in golf green construction. The soil was a loam with a pH of 6.4 and an organic matter content of 3.6 per cent. The cation exchange capacity of the soil was 12.1 megs/100 g soil.

The results depicted in Figure 2 show an accumulation of mercury at the soil surface, a diminished Hg concentration with increasing soil depth, and little, if any, movement of mercury downslope from the site of application. Specific cultural practices used in turf management such as aerification and irrigation

Figure 1.

would enhance downward migration rate of fertilizers, lime, or fungicides. The prepared topsoil, enriched in organic matter, retained significant amounts of mercury. In this regard, other research has also shown soil organic matter content to be highly correlated with the soil's adsorptive capacity for mercury. Furthermore, sorption of mercury compounds from water is effectively performed by polyphenolic materials (e.g., tannins) and proteins, both of which are common constituents of soil organic matter. Mercury is a member of the zine subgroup of the Periodic Table of Elements. Thus, the partial immobilization of mercury in topsoil may be similar to that noted with zinc following surface applications of zinc sulfate.

Sample site D received no intentional application of fungicide although this area represents the path of the sprayer to and from the green and the edge of the green may have occasionally been inadvertently sprayed over the 14-year-period. Clippings were also frequently deposited there following mowing operations. No explanation is readily available for the low Hg value at the 10-12 inch depth at sample site A other than a difference due to inhomogeneity in soil characteristics or topsoil depth which may have altered downward movement of mercury at this location.

The mercury content of a soil sample taken to a 6-inch depth at the fairway site was 0.24 ppm and the turf sample (Merion Kentucky bluegrass) collected at this site showed a mercury level of 0.10 ppm. The turf sample (Velvet bentgrass) composited to represent the entire green showed a Hg level of 1.68 ppm. The heavy metals zinc, iron, copper, and manganese occurred in the turf tissue from the green at levels of 75 ppm 326 ppm, 15 ppm, and 250 ppm, respectively. Levels of these same elements in turf tissue from the fairway site were 50 ppm, 190 ppm, 13 ppm, and 170 ppm, respectively.

Fundamental differences in soil characteristics, turf species, fertilization and management practices between a golf green and a fairway area prevent definite conclusions regarding the specific impact of mercury on plant performance at this time. The above levels of essential elements are within limits commonly observed in turf specimens grown under New Hampshire conditions. While additional research is warranted in this area, visual observation showed no adverse effects from the rather substantial soil Hg levels. Thus, the soil complex or the action of higher plants may inactivate the toxic influence of mercury.

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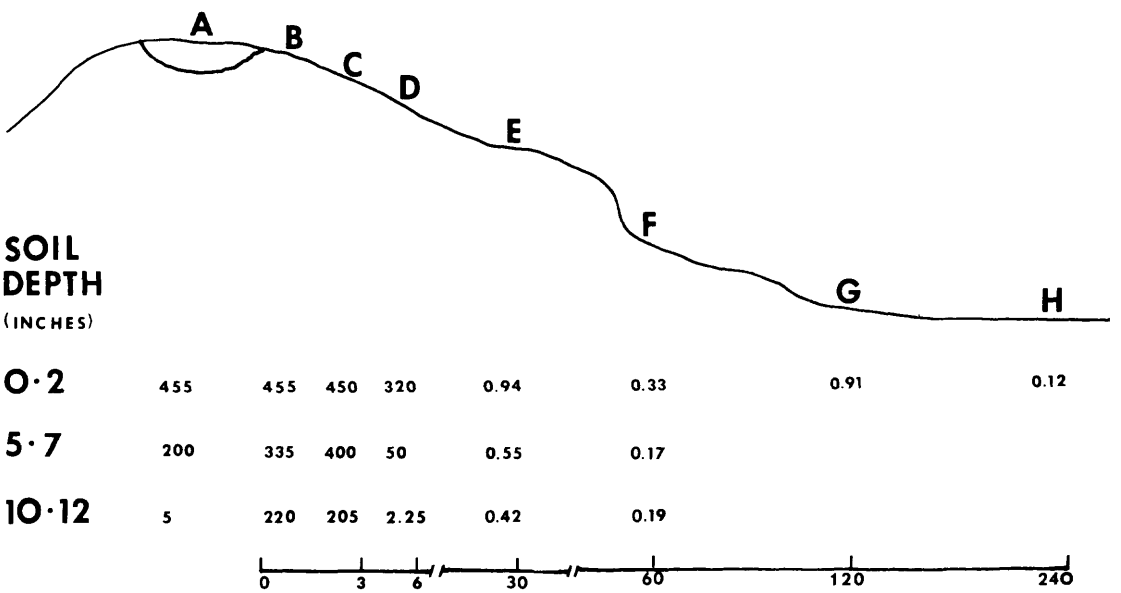
William E. Knoop has been the Extension Turf Specialist at the University of New Hampshire since 1969. He has a wide educational background, receiving his Bachelor of Science from Iowa State and his Masters at the University of Florida.

Figure 2.



A TURF TIP FROM *JOHN:*

John Dunlop, golf course superintendent at the Oakwood Club, Cleveland, Ohio, suggests using an air blow-out fitting installed adjacent to the irrigation water pumps for easy winter drainage of the irrigation lines. In northern climates, the irrigation lines must be thoroughly drained for winter protection. The old gravity drains are usually hard to find each fall and costly to install. But with a rotary screw-type air compressor of 160 CFM capacity, the entire system can be blown out from the fitting at the pump. An automatic system is particularly easy since you can program the clocks to run through two or three cycles and each head and valve is completely blown out. It is suggested on the last cycle, a visual inspection be made as each head operates, to make sure all water has been flushed out. If not, any head which shuts off still spouting water can be manually operated to clear it. The entire operation takes just six hours for an 18-hole course and is a highly recommended procedure for retiring your system in the winter.

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