Effect of Turf Management on Ground Water Quality

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The scientific community began to emphasize the study of nitrates in ground water as a result of agricultural fertilization in the mid to late 1970's. The emphasis on the study and regulation of agricultural pesticides in ground water began late in that decade. By the mid 1980's, ten of thousands of wells were found to contain elevated nitrate concentrations and detectable concentrations of pesticides (USGS, 1985; U.S. EPA, 1988; Cohen, 1988). However, most of the studies in these reports focused on agrichemicals, rather than turf chemicals.

The first public concerns expressed about impacts of turf management on ground water quality, to this author's knowledge, were in 1978 and 1983. Texas investigators observed potentially toxic concentrations of arsenic below the root zone of a Kentucky bluegrass/red fescue (90/10) lysimeter plot (Duble et al., 1978). In late 1983, The Board of Health of the Town of Brewster (Cape Cod) requested EPA's assessment about potential impacts of a proposed golf course on ground water quality. The proposed golf course was to be located over a "sole-source aquifer" with vulnerable hydrogeology. EPA's conclusion (to its own surprise) was that most turf chemicals could be used safely on the golf course.

This issue has been raised more frequently and often with greater public focus in recent years.

Hydrogeology 101 Summarized

Ground water is water found in the saturated zone. The saturated zone is an area beneath the ground surface where all pore spaces and cracks are filled with water. An aquifer is a geologic formation containing ground water that is capable of yielding water to a well. It is better to think of ground water as seeping rather than flowing. Typical ground water velocities are 1/2 inch to 1 foot per day. It can be as shallow as 3 feet below the surface in parts of Florida or 800 feet deep in parts of Hawaii.

One half of the total U.S. population and 95% of the U.S. rural population rely on ground water as its main source of drinking water. There are approximately 10.5 million drinking water wells in the U.S.

Results of the Recent National Pesticides Survey(NPS)

EPA recently completed a $12 million national survey for pesticides and nitrates in drinking water wells (EPA, 1990). The NPS had a highly sophisticated statistical design. EPA estimates that 10% of the community wells and 4% of the private wells contain

detectable concentrations of pesticides. Surprisingly a turf chemical -- the diacid metabolite of DCPA (Dacthal) -- was the most frequently detected organic, with atrazine second. Fortunately, however, no community wells and only 0.2% of the private wells were found to exceed the Health Advisory Level for all pesticides/pesticide metabolites. Nitrate contamination seems to be a greater problem.

Turf Results

In addition to the national results summarized above, the results of the first-ever intensive ground water study of golf courses were recently published (Cohen et al., 1990; Cohen 1990). The Barnstable County government (Cape Cod), EPA, and four superintendents collaborated on a study of four golf courses in hydrogeologically vulnerable environments. Nineteen monitoring wells were installed and sampled approximately quarterly for pesticides and monthly for nitrates for 1 1/2 years. Samples were analyzed for 17 organics plus nitrates.

No currently registered pesticides were found at toxicologically significant concentrations. The only currently registered pesticides or pesticide metabolites detected were DCPA diacid, chlorothalonil, dicamba, isofenphos, chlorpyrifos, 2,4-D, and 2,3,6-TCPyr (a chlorpyrifos breakdown product). Most detections were under greens and tees. Most nitrate results were below the 10 ppm MCL. However elevated nitrate concentrations were reduced during the course of the study by changing N-management (more to less; water soluble to slow release).

These results, in the context of work done at universities and in other areas, leads us to the following conclusions:

- Those who say turf chemicals will never leach to ground water are wrong.

- Those who say that chemicals applied to turf in vulnerable environments will almost certainly "zip right down" to ground water are equally wrong. (This was stated by a University of Michigan professor in a hearing before an MDNR judge in September, 1990!)

- The limited data are, however, very encouraging for the golf industry. But they do point to the need for preliminary risk screening for pesticide persistence, mobility, and toxicity, to limit or eliminate potentially risky situations.

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