TURFGRASS TRENDS

ENVIRONMENTAL ISSUES

Glyphosate Runoff on Fairways Falls Below EPA Limits

By Steven K. Starrett and Jamie Klein

This USGA-funded study focused on observing the fate of glyphosate following Roundup applications in a turfgrass ecosystem. Kansas State University, in cooperation with Jim Colbert, the Professional Golf Association, the Golf Course Superintendents Association of America and various alumni, built a championship course (Colbert Hills Golf Course) in Manhattan, Kansas.

The course, opened in 2000, provided the study area for the research presented here. Water and soil samples were taken from the study watershed for three years (2001-2003) during the early operation period of Colbert Hills.

The objectives of the study were:

- To measure glyphosate runoff from zoysiagrass fairways on a course following the application of Roundup herbicide.
- To analyze glyphosate runoff concentrations and determine the resulting effect on the environment.
- To provide up-to-date data of research findings on pesticide fate and transport when applied to turfgrass.

With the introduction of glyphosate to the environment, a number of environmental considerations arise, probably the most important being the health implications to those who may come in contact with the chemical. The EPA RED (1993) facts sheet reported that glyphosate ranks high among pesticides causing illness or injury to workers who report numerous incidents of eye and skin irritation from splashes during mixing and loading.

Glyphosate toxicity to wildlife is also an important issue to consider. Glyphosate has been found to be practically nontoxic to birds, honeybees, fish and aquatic invertebrates. The fate of glyphosate is influenced by its numerous interactions with the surrounding environment. The most notable interactions take place with water, soil, air and the treated vegetation. The fate of glyphosate through these different modes is highly dependent on its physical properties.

A total of 617 runoff samples were mostly taken by ISCO 3700-automated water samplers at the inlet and outlet of the sub-watershed detention pond and from three separate fairway drains on hole No. 9 (Figure 1).

Twenty-three water samples most likely to contain glyphosate were tested by the U.S. Geological Survey (USGS) lab for glyphosate, AMPA (amino methyl phosphonic acid) and glufosinate. Thirteen of the samples contained non-detectable concentrations of glyphosate. The limit of detection for the testing process used was 0.10 µg/L (micrograms per liter).

The majority of samples with detectable concentrations of glyphosate were taken from one of the three fairway drains. Those samples contained significantly greater concentrations than the inlet, outlet and pond samples. Nine of the 13 samples taken from the fairway drains

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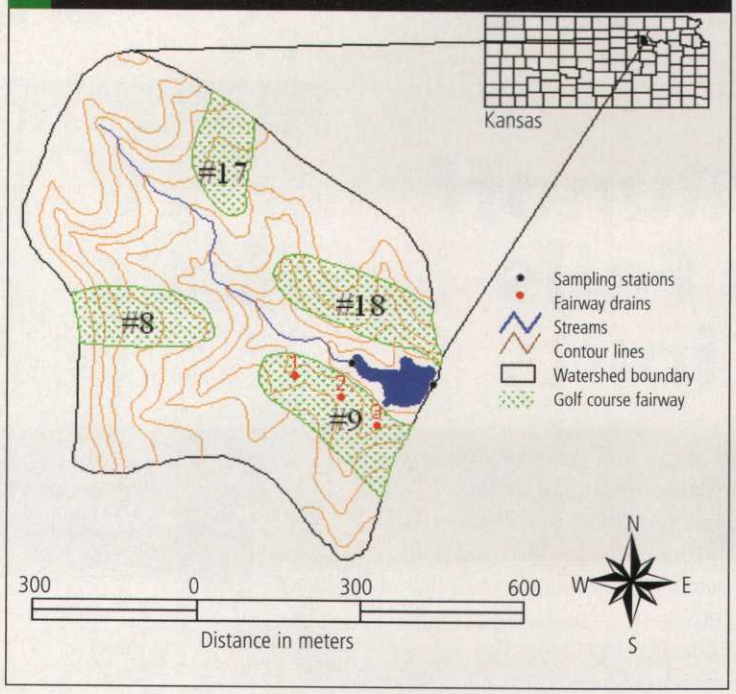
FIGURE 1



Location of fairway drains on No. 9 at Colbert Hills GC. They eventually connect and empty into the detention and irrigation pond.

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during the years of 2002 and 2003 (when Roundup was applied) contained glyphosate at a concentration greater than 0.10 µg/L, while 10 of the 13 samples contained AMPA at a concentration greater than 0.10 µg/L.

The sample with the highest concentration observed throughout the study period was taken from the No. 2 fairway drain 62 days after Roundup application. The glyphosate concentration of this sample was 5.18 µg/L, which is significantly lower than the 700 µg/L limit for the EPA-established maximum contaminant level (MCL).

Five samples taken from the inlet into the pond were tested by the USGS lab. The one sample that contained glyphosate at a concentration above the detection limit of 0.10 µg/L was taken on April 29, 2002. This was earlier in the year than any of the fairway drain samples, which might explain why a detectable concentration was present in this sample.

The main reason the inlet samples contained undetectable concentrations of glyphosate was dilution. The drainage area for the inlet sampling location was 115 acres, with approximately 6 percent of that being zoysiagrass fairways that had been treated with Roundup.

Four samples that were taken directly from the detention and irrigation pond were tested for glyphosate. Two of the samples were taken in April 2003 and the other two were taken in August 2003. None of the four samples contained glyphosate at a concentration greater than 0.10 µg/L.

There were two primary reasons why low concentrations should be expected within the pond. First, significant dilution occurred when runoff from the watershed mixed with the water present in the 3-acre pond. Further dilution also occurred because of the addition of purchased water that was pumped into the pond for irrigation purposes. Second, the reduced runoff velocity paired with readily available suspended solids promoted glyphosate adsorption to soil particles and settling.

One sample taken from the outlet of the detention pond was tested for glyphosate. While the concentration of glyphosate was below the detectable limit of 0.10 µg/L, an AMPA concentration of 0.26 µg/L was present. Low concentrations of glyphosate were expected from the outlet for the same reasons mentioned above for the pond samples. Because water from the pond is used for irrigation, it was not favorable for water to be lost through the outlet. Therefore outlet discharge events would likely occur only after significant or frequent precipitation events.

This was the case with the tested sample, which was taken 12 days after a 1.4-inch precipitation event. In these cases, it was likely that, due to the pond being full, the amount of water entering approximately equaled the amount exiting, which left less time for dilution, adsorption and settling of glyphosate.

Glyphosate concentrations in runoff samples from the 115-acre study watershed following annual applications of Roundup were much lower than associated health standards. The factors present during the study period effectively maintained glyphosate concentrations to acceptable levels at fairway drains and to undetectable levels within the detention pond. ■

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