Agriculture and Bacterial Ground-Water Quality in Central Appalachian Karst

Douglas G. Boyer[1]

The impact on water quality by agricultural activity in karst terrain is an important consideration for resource management within the Appalachian Region. Karst areas comprise about 18 percent of the Region's land area. An estimated one-third of the Region's farms, cattle, and agricultural market value are on karst terrain. An eight-year study (1991-98) was conducted in a karst region in southeastern West Virginia to determine the impact of agriculture on ground-water quality. The primary agriculture was grass-fed beef with some animal feeding operations, which were primarily dairy.

Fecal-coliform densities were measured weekly in the resurgences of three karst basins possessing different degrees of agricultural intensity (79, 51, and 16% land use in agriculture). Fecal coliforms also were measured in a creek at sites upstream and downstream from the known resurgences from the most agriculturally intensive (79%) basin.

The fecal-coliform densities in the resurgences followed a pattern of peak densities in the summer and a dramatic decline in the fall, with a recovery in late winter prior to the introduction of new cattle. The timing of the recovery indicated that significant storage of fecal material had taken place, which was transported to the ground water when soil-water conditions permitted. For most of each year, soil-water effects appeared to have a greater bearing on the fecal-coliform densities than did the presence or absence of cattle. The data did not generally support a strong relation with percent land use in agriculture, which was attributed to the high variability in the data and to low soil moisture during periods of recession that inhibited the transport of fecal material to the ground water. The karst resurgence springs of the most intensively agricultural basin were contaminated with fecal bacteria. Fecal-bacteria concentrations were observed to significantly increase, in the receiving surface stream, from a point upstream of the resurgence springs to a point downstream of the resurgence springs**.**

Fecal-bacteria densities also were measured in cave streams draining two primary agricultural land-management areas. The first area was pasture serving a beef cow-calf operation. The second area was a dairy. Neither area had best-management practices in place for controlling animal wastes. Median fecal-coliform and fecal-streptococcus densities were highest in cave streams draining the dairy. Median fecal coliform densities in the dairy-impacted stream were greater than 4,000 colony forming units per 100 milliliters (CFU/100 ml) and the median fecal-coliform densities in the pasture-impacted streams were less than 10 CFU/100 ml. Median fecal-streptococcus densities in the same streams were greater than 2,000 CFU/100 ml and 32 CFU/100 ml, respectively. A second dairy, with best-management practices for control of animal and milkhouse waste, did not appear to be contributing significant amounts of fecal bacteria to the karst aquifer. It was concluded that agriculture was affecting bacterial densities in the karst aquifer. New management practices specifically designed to protect karst ground-water resources may be one way to protect the resource.

---

[1]U.S. Department of Agriculture, Agricultural Research Service, 1224 Airport Road, Beaver, WV 25813-9423 (dboyer@afsrc.ars.usda.gov)