Pesticide National Synthesis Project

Pesticides in Surface Waters

U.S Geological Survey Fact Sheet FS-039-97

Significance to Water Quality

Under provisions of the Safe Drinking Water Act, the U.S Environmental Protection Agency (EPA) has established maximum contaminant levels (MCLs) for concentrations of certain chemicals in drinking water. Of the currently used pesticides, only nine have established MCLs. Compliance with the Safe Drinking Water Act is determined by the annual average concentration of a specific contaminant in drinking water, based on quarterly sampling. While the MCLs do not directly pertain to concentrations of pesticides in untreated surface waters, they provide benchmark values for comparisons, and they provide perspectives on the significance of the levels observed in surface waters.

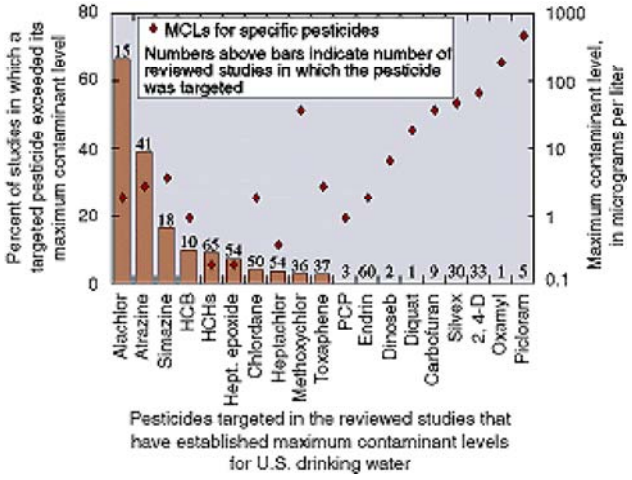

Figure 5. Percentage of reviewed studies in which a pesticide concentration exceeded a maximum contaminant level (MCL).

The percentage of reviewed studies in which a pesticide exceeded an MCL is shown in Figure 5. Seven of these compounds are organochlorine pesticides or their degradation products, detected primarily in the 1960's and 1970's. In recent years, the herbicides alachlor, atrazine, and simazine have frequently exceeded their MCLs in individual samples. A number of studies have

shown that procedures commonly used at most water treatment plants have little effect on concentrations of these herbicides in water. Thus, drinking water derived from some surface water sources in the central United States likely contains concentrations of one or more of these compounds above the MCL for part of the year because of the seasonal pattern described earlier. Annual mean concentrations however, rarely exceed the MCL. A series of exposure assessments done for atrazine, the most commonly detected pesticide, indicate that the majority of people whose drinking water is obtained from surface water sources in the central United States are exposed to annual average concentrations below the MCL (Ciba- Geigy, 1993). The typical situation for a small stream is illustrated in Figure 6, which shows results from eight years of monitoring of alachlor concentrations in Honey Creek, Ohio. Average monthly concentrations of alachlor routinely exceeded the MCL of 2 micrograms per liter during spring and early summer, but the annual average concentration remained below the MCL throughout the 9-year period. In larger rivers, concentrations of herbicides rarely exceeded MCLs. In the Mississippi River, for example, the annual average concentration of atrazine remained below the MCL of 3 micrograms per liter during 15 consecutive years of monitoring at Vicksburg, Mississippi (Ciba-Geigy, 1992).

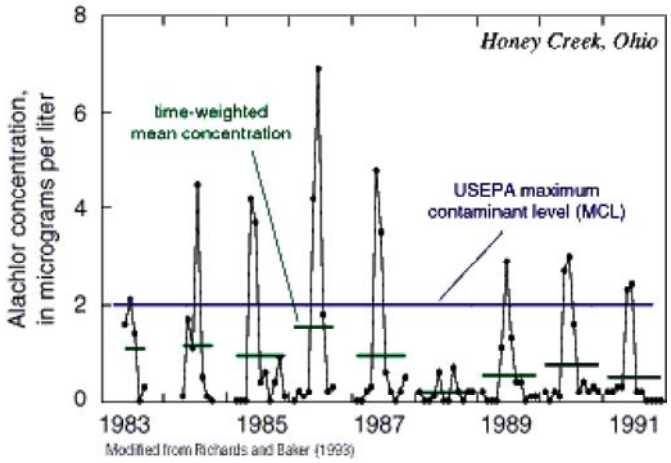

Figure 6. Comparison of the long-term record of time-weighted mean and average monthly concentrations of alachlor in a small Midwestern stream with maximum contaminant level established for alachlor in drinking water (modified from Richards and Baker, 1993).

The EPA has established water-quality criteria for the protection of aquatic organisms for short-term (acute) and long-term (chronic) exposures. These guidelines have been established for only 20 of the 118 compounds targeted in the studies reviewed. The National Academies of Sciences and Engineering (NAS/NAE) have recommended criteria concentrations for another 23 of the compounds. All of the organochlorine insecticides targeted in the reviewed studies have exceeded an aquatic-life criterion, if one has been established. Diazinon, an organophosphorus insecticide, has frequently exceeded its NAS/NAE chronic criterion of 0.009 micrograms per liter. No EPA aquatic-life criteria have been established for herbicides, and only 12 have NAS/ NAE criteria. Atrazine concentrations often exceed the NAS/NAE criterion of 1 microgram per liter established for protection of marine organisms. NAS/NAE criteria for other herbicides were rarely exceeded. Aquatic-life criteria have not been established for any of the high-use agricultural fungicides.

Our ability to assess the significance of pesticides in surface waters is limited by several factors. First, water-quality criteria have not been established for most pesticides and pesticide transformation products, and existing criteria may be revised as more is learned about the toxicity of these compounds. Second, criteria are based on tests with individual pesticides and do not account for possible cumulative effects if several different pesticides are present. Finally, many pesticides and most transformation products have not been widely monitored in surface waters. These factors, and the lack of data on long-term trends, show significant gaps in our understanding of the extent and significance of pesticide contamination on surface waters. The

results of this analysis indicate a need for long-term monitoring studies in which a consistent study design is used and more of the currently used pesticides and their transformation products are targeted.

Additional Reading:

This Fact Sheet is based on the book by S.J. Larson, P.D. Capel, and M.S. Majewski, Pesticides in the Hydrologic System, Vol. 3: Pesticides in Surface Waters, Ann Arbor Press, Inc., Chelsea, Michigan; for more information call 1-800-858-5299.

References:

Ciba-Geigy, 1992, A review of historical surface water monitoring for atrazine in the Mississippi, Missouri, and Ohio Rivers: Ciba-Geigy Corporation, Environmental and Public Affairs Department, Technical Report 6-92, 69 p.

Ciba-Geigy, 1993, Atrazine and drinking water sources: an exposure assessment for populations using the greater Mississippi River system: Ciba-Geigy Corporation, Environmental and Public Affairs Department, Technical Report 2-93, 20 p.

Coupe, R.H., Goolsby, D.A., Iverson, J.L., Markovchick, D.J., and Zaugg, S.D., 1995, Pesticide, nutrient, water-discharge and physical-property data for the Mississippi River and some of its tributaries, April 1991-September 1992: U.S. Geological Survey Open-File Report 93-657, 116 p.

Fallon, J.D. and Thurman, E.M., 1996, Determining the relative age, transport, and three-dimensional distribution of atrazine in a reservoir using immunoassay, in Morganwalp, D.W., and Aronson, D.A, eds., U.S. Geological Survey Toxic Substances Hydrology Program--Proceedings of the Technical Meeting, Colorado Springs, Colorado, September 20-24, 1993: U.S. Geological Survey Water-Resources Investigations Report 94-4015, v. 1, p. 499-504.

Goolsby, D.A., Battaglin, W.A., Fallon, J.D., Aga, D.S., Kolpin, D.W., and Thurman, E.M., 1993, Persistence of herbicides in selected reservoirs in the midwestern United States: some preliminary results: U.S. Geological Survey, Open-File Report 93-418, p. 51-63.

MacCoy, D., Crepeau, K.L., and Kuivila, K.M., 1995, Dissolved pesticide data for the San Joaquin River at Vernalis and the Sacramento River at Sacramento, California, 1991-94: U.S. Geological Survey Open-File Report 95-110, 27 p.

Majewski, M.S., and Capel, P.D., 1995, Pesticides in the atmosphere: Distribution, trends, and governing factors, Ann Arbor Press, Inc., Chelsea, Mich., 228 p.

Kuivila, K.M. and Foe, C.G., 1995, Concentrations, transport, and biological effects of dormant spray pesticides in the San Francisco Estuary, California: Journal of Environmental Toxicology and Chemistry, v. 14, no. 7, p. 1141-1150.

Richards, R.P., and Baker, D.B., 1993, Pesticide concentration patterns in agricultural drainage networks in the Lake Erie Basin: Journal of Environmental Toxicology and Chemistry, v. 12, no. 1, p. 13-26.

For more information:

Information on technical reports and hydrologic data related to National Water Quality Assessment (NAWQA) pesticide studies can be obtained from:

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Additional information on NAWQA and other U.S. Geological Survey programs can be found by accessing the NAWQA home page on the World Wide Web at:
"http://wwwrvares.er.usgs.gov/nawqa/."

U.S Geological Survey Fact Sheet FS-039-97

Index

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