Introduction

Contamination of surface and ground water from nonpoint sources is a national issue. Examples of nonpoint-source contaminants from agricultural activities are pesticides, which include fungicides, herbicides, and insecticides; sediment; nutrients (nitrogen and phosphorus); and fecal bacteria. Of these contaminants, pesticides receive the most attention because of the potential toxicity to aquatic life and to humans. Most farmers use pesticides to increase crop yields and values. Herbicides prevent or inhibit the growth of weeds that compete for nutrients and moisture needed by the crops. Herbicides are applied before, during, or following planting. In addition to agricultural use, herbicides are used in urban areas, often in larger rates of application, for weed control, such as along rights-of-way. Alachlor, atrazine, cyanazine, and metolachlor, which are referred to as organonitrogen herbicides, were the four most commonly applied herbicides (1991) in the Central Nebraska Basins (CNB), the area shown on the map. These herbicides are used for corn, sorghum, and soybean production. Atrazine was the most extensively applied pesticide (1991) in central Nebraska. Insecticides are used to protect the crop seeds in storage prior to planting and also to protect the plants from destruction once the seeds have germinated. Like herbicides, insecticides are also used in urban areas to protect lawns, trees, and ornamentals.

Many of the 46 pesticides shown in the table have either a Maximum Contaminant Level (MCL) or Health Advisory Level (HAL) established by the U.S. Environmental Protection Agency (USEPA) for public water supplies. The purposes of this Fact Sheet are (1) to provide water-utility managers, water-resource planners and managers, and State regulators an improved understanding of the distributions of concentrations of pesticides in streams and their relation to respective drinking-water regulations or criteria, and (2) to describe concentrations of pesticides in streams draining a selected small agricultural basin and a large agricultural area. This Fact Sheet is based on pesticide data collected from May 1992 through March 1994 at the Platte River at Louisville and Maple Creek near Nickerson sites (see map). Samples were collected monthly, with additional samples collected over a wide range of hydrologic conditions.

Study Area

The CNB lies entirely within Nebraska and includes the Platte River drainage between the confluence of the North and South Platte Rivers near North Platte in western Nebraska to its confluence with the Missouri River at the eastern boundary of Nebraska (see map). The two major tributaries to the Platte River are the Loup and Elkhorn Rivers. The Platte River at Louisville sampling site represents the outflow of the CNB, which encompasses approximately 30,000 square miles (mi²) and is one of 60 study areas being assessed as part of the U.S. Geological Survey’s (USGS) National Water-Quality Assessment (NAWQA) Program. The sampling site at Louisville on the Platte River is downstream from the confluence of the Platte and Elkhorn Rivers (see map), and the quality of water at this site is considered representative of the water that the cities of Lincoln and Omaha withdraw from the adjacent.
Mean daily streamflow of the Platte River is about 2,500 cubic feet per second (ft³/s) at the western (upstream) boundary of the study area near North Platte and 6,735 ft³/s at the eastern boundary at Louisville. Maple Creek drains 388 mi² and is a tributary to the Elkhorn River. The sampling site at Nickerson on Maple Creek is considered representative of surface-water quality in the eastern part of the study area. Mean daily streamflow of Maple Creek near Nickerson is 72.1 ft³/s.

Land use in the study area is predominately agricultural. Rangeland and pastureland account for about 54 percent of the land use, and cropland accounts for about 37 percent. Rangeland characterizes most of the northern and western parts of the area, whereas cropland dominates the southern and eastern parts. Major crops are corn, soybeans, sorghum, and wheat. Most of the corn is produced in the eastern part of the study area and along the Platte Valley (see map) and is commonly irrigated. Urban areas occupy a small percentage of the land area (about 1 percent), with Lincoln being the largest city. Land use within the Maple Creek drainage basin is composed of about 45 percent corn, 20 percent soybeans, 2 percent pastureland, and less than 1 percent sorghum (Douglas Garrison, U.S. Soil Conservation Service, oral commun., 1994).

Lincoln, Omaha (outside the study area), and smaller cities along the Platte River withdraw water for public supplies from the alluvium. The alluvium adjacent to the Platte River has a direct hydraulic connection to the river and thus is affected appreciably by the quantity and quality of water in the river.

**Results**

Differences in the distributions of concentrations of pesticides at the Maple Creek and Platte River sites partly reflect differences in land use and land-management practices.
Creek Basin (about 66 percent) than in proportionately more cropland in Maple management practices. There is Creek and Platte River sites partly reflect differences in land use and land-use concentrations of pesticides at the Maple Differences in the distributions of cyanazine in water concentrations of herbicides in the Platte River at Louisville.<br><br>When the river stage is high, water may differ from the concentrations measured in the Platte River, depending on streamflow rates, distance traveled in the alluvium, amount of organic and clay materials in the alluvium, and hydraulic characteristics of the alluvium. Of 46 pesticides analyzed, it appears that alachlor, atrazine, and cyanazine pose potential problems to public water supplies. Of the 70 samples collected at the Platte River at Louisville and analyzed for alachlor, 11 (about 16 percent) exceeded the MCL value of 2.0 µg/L. Of the 70 samples analyzed for atrazine, 23 (about 33 percent) exceeded the MCL value of 3.0 µg/L, and of the 68 samples analyzed for cyanazine, 18 (about 26 percent) exceeded the HAL value of the 1.0 µg/L. Presently, the USEPA has only established a HAL for cyanazine and not a MCL; a HAL is a
Herbicides, such as atrazine, can be washed from the land surface into the river and then move into the river's alluvium to the treatment plant.

criterion and a MCL is enforceable. Thus, based on current MCL's, atrazine is the herbicide most likely to exceed its MCL at the Platte River at Louisville. It is important to recognize that a MCL or HAL for a pesticide is based on an annual average and that one or more exceedances of the specified value does not necessarily indicate noncompliance. It is also important to recognize that the current MCL or HAL for a pesticide applies only to the parent compound and not to any of its degradation products.

Studies have shown that conventional water treatment is ineffective in removing organonitrogen herbicides such as alachlor, atrazine, cyanazine, and metolachlor from finished drinking water. These herbicides remain in solution, in contrast to many other contaminants that are more easily removed by conventional treatment processes such as coagulation, sand filtration, and chlorination.

—John K. Stamer and Michael E. Wieczorek

Selected References


For information and selected readings about the Central Nebraska Basins study, write to:

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100 Centennial Mall North
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Additional information on NAWQA and other USGS programs can be found by accessing “http://wwwrvares.er.usgs.gov/nawqa/nawqa_home.html” on the World Wide Web.