Looking for pollution under the earth

Scientists are drilling 400 holes in California to check on pollution of underground water supplies by agricultural fertilizers

by Louise A. Purrett

California scientists are poking holes in their state to find out if it's polluted. As part of a six-year study involving 20 scientists from the University of California, a team led by John M. Rible of the Riverside campus is drilling some 400 holes throughout the state's major agricultural areas. What the scientists hope to learn is whether fertilizers used by California farmers are polluting underground water supplies.

Rible and his colleagues will drill holes 50 to 100 feet deep at selected sites in Orange and Ventura Counties and in the San Joachin and Salinas valleys. Ideally, Rible told SCIENCE NEWS, they would like to be able to sample aquifers, rock formations bearing enough water to supply a well or spring. But aquifers are often buried too deep to be reached by the team's drilling rig. So they will at least try to penetrate to the underground water table, the upper level of underground water. As they drill downward, they will take soil samples every three feet.

The soil samples will be analyzed for soluble salts, but what the researchers are especially concerned with is nitrate. When nitrates get into the water supply they have very undesirable effects. Sufficient levels of nitrate in drinking water cause a tie-up of oxygen in infants: Their hemoglobin loses the capacity to carry oxygen. The result is the so-called "blue baby."

A major source of these nitrates may be fertilizers. Any nitrogen fertilizer, even nitrogen in manure used as fertilizer, could be oxidized under the right conditions to form nitrates, says Rible. "Up to a few years ago we liked nitrate in soil, but now public health departments are beginning to crack down." The question the California scientists hope to answer is how much of the nitrogen applied to crops converts to nitrate and eventually reaches water supplies. In California and other Western states the question has particular urgency because of the widespread use of irrigation. California alone has some 8 million acres of irrigated land. "Not only California is involved, but also 17 Western states with more than 43 million irrigated acres, producing about a fourth of the value of all U.S. farm crops." Irrigation could aggravate the nitrate pollution problem by washing nitrates down to the water table.

In the actual drilling, Rible and his colleagues are using a conventional bucket drilling rig of a type usually used to dig foundations and septic tanks. Four holes will be drilled at each site and the results will then be averaged out.

The scientists are also developing a computer model to predict how much pollution might result from a given application of nitrogen fertilizer. The results from analyses of the soil samples will eventually be combined with laboratory and field data collected by soil and water scientists at other California campuses and plugged into the computer model.

Developing such a computer model will be difficult. Many factors influence how much nitrate may eventually reach the water table. Some of the variables the computer model will have to take into account are the amount of nitrogen initially going onto the soil, the amount of water (from both irrigation and precipitation) applied, and the permeability of the soil. The type of crop will also make a difference; some crops remove more nitrogen from the soil than others. Certain types of organic matter in the soil also chemically reduce the nitrates in a process known as denitrification. The aeration of the soil influences denitrification: The process is anaerobic and is promoted where the oxygen content of the soil is low.

The researchers began drilling in mid-October and so far about 100 holes have been drilled in Orange County. Samples from only four of the sites have been analyzed so far, too few to draw conclusions.

Rible estimates that the drilling phase of the project will take another year and a half. Then will come the soil analysis, refinement and testing of the computer model. The last phase of the study will be to return to basins sampled earlier for more detailed study. With the computer model and data on the condition of soils, he says, "we will be able to project what an underground water situation will be in 20 years. This will make it unnecessary to drill year by year in the same locations."

UC at Riverside

Rible (right) and colleague Ken Holtzclaw examine subsurface soil samples.

The benefits of fertilizer use must be balanced against the hazards of soil and water pollution, he notes. "We hope to come up with guidelines that will show farmers how to continue increasing food production without polluting water supplies."

Rible predicts that more and more studies like the California project will be done in the future. "We just happen to be the first." □