Best Management Practices– A Practical Way to Protect the Environment

By Angela Woida

"Best Management Practices" (BMPs) aren't as glamorous a rallying cry as "Save the Whales," but BMPs work to protect the environment just the same. These guidelines are effective, not only reducing pollution, but also producing the highest crop yields at the lowest cost.

It makes sense. Ecological sense and economic sense.

The federal Clean Water Act in the early 70s led the way to state monitoring of nitrogen and other contaminants. In early 1977, the Arizona Environmental Quality Act was passed, and in 1986, the state put environmental legislation under the umbrella of the Department of Environmental Quality. One of DEQ's jobs was to develop a draft assessment of the state's environmental health.

Guidelines for water and fertilizer consumption are still being developed and refined as a joint venture, among individual growers, the University of Arizona College of Agriculture, the state Department of Agriculture and the Environmental Protection Agency.

Arizona farmers are using modern technology through BMPs designed to improve economic performance and minimize pollution, especially water pollution. Guidelines specify techniques which help growers select the best rate, timing and placement of water and fertilizer for the crops they grow.

Cotton is the state's largest single crop, with some half a million acres grown. So BMPs applied to cotton should have a large environmental impact, says Tom Doerge, the University of Arizona Cooperative Extension soil specialist who helped develop the guidelines for fertilizer applications. Other shallow-rooted crops are often very heavily fertilized and watered. They may contribute more to nitrate-leaching losses than cotton, acre for acre.

The amount of water that such plants as cotton need can be measured with reasonable accuracy. The total amount of water needed (consumptive use) equals the sum of the water actually used by the plants (the water plants transpire through their leaves) plus the amount that evaporates from the soil surface. Also, some water may be needed for stand establishment and leaching.

Jeff Silvertooth, extension agronomist working with cotton, says that cotton's consumptive use equals 36 to 60 acre-inches of water, per season. An acre-inch is the amount of water it would take to cover an acre field to a depth of one inch. The cotton growing season when water is needed runs from April through September or early October. The crop requires less water at higher elevations, and more in lower areas. Cotton grown near Buckeye and Gila Bend, both in low-elevation deserts, probably uses the most irrigation water in the state.

"Farmers tend to use a little too much rather than risk the economic loss..."

Although toxic chemicals, such as pesticides, leaching into the soil and ground water have received a lot of publicity, fertilizers actually are more widely used.

"Pesticides are applied mainly to the foliage of the plants, and many break down with exposure to sunlight, so

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OVERVIEW

Air and Water Quality

By Suzanne McCormick


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Thomas A. Doerge

As Arizona grows as an urbanized state, so does the amount of potentially toxic by-products found in its environment. Created from sources such as industry and automobiles, the impact of these by-products on water and air quality is generating concern at the state and national level.

- The Arizona 1991 Legislature considered an unprecedented number of environmental bills, and passed new laws controlling hazardous waste, household garbage and air pollution.
- Phoenix, Arizona's capital, has been cited by the Environmental Protection Agency for violating standards on urban air pollution.
- In a 1991 newspaper survey of Tucson residents, air pollution ranked as Arizona's most severe environmental problem, with water issues close behind.

In fact, the air quality division of the Arizona Department of Environmental Quality (DEQ) states the number one issue is urban air pollution. Phoenix has been violating standards on carbon monoxide, ozone and particulates such as dust, and Tucson has had problems complying with carbon monoxide standards. In addition, Tucson and Yuma at times have been close to exceeding ozone standards.

The 1991 environmental legislation earns mixed reviews on its effectiveness. For example, a College of Agriculture scientist suggests that lawmakers and politicians have looked for quick technological fixes rather than preventive, long-term measures to curb pollution.

"Solving environmental problems can be an extremely expensive proposition," says Thomas A. Doerge, an extension soils specialist in the Department of Soil & Water Science. But, no politician wants to raise taxes or curtail personal life-style choices. For instance, Arizona has adopted an oxygen-

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relatively small amounts penetrate the soil," Doerge says. "Fertilizers, on the other hand, are applied directly to the soil." Farmers typically use large quantities of fertilizers during the growing season of many crops. The reasons are simple — economics and the risk involved.

Not all fertilizer will pollute the water supply.

Fertilizer costs much less per season than irrigation water. Water costs average $190 per acre, per season, but the average fertilizer cost per acre might be only $25. The relatively low cost encourages growers to use fertilizer generously.

"Farmers tend to use a little too much rather than risk the economic loss caused by a deficiency of nitrogen fertilizer," says Doerge. Unfortunately, using more fertilizer than plants can absorb means that the remainder is available to percolate into deeper soil layers, possibly down to the water table. Actual movement down that far could take many years.

Not all fertilizer will pollute the water supply. Two or three plant nutrients in fertilizers are essential to high crop yields: zinc, phosphorous and nitrogen. For cotton, only 10-20 percent of Arizona fields probably need additional phosphorous, and excesses don't threaten ground water supplies. Zinc doesn't result in pollution problems

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ated fuel program to help reduce the level of pollutants from automobile emissions. Doerge believes such programs represent a choice of "band-aid technology" rather than more costly regional transportation or mass transit plans to get more vehicles off the road.

Vehicle emissions are also a source of toxic air pollution, which is most serious in Phoenix, reports DEQ. The department has detected critical amounts of such toxic materials as carcinogens in the Phoenix area, and they've discovered formaldehyde in the Tucson air and ethylene oxide in Flagstaff.

Visibility — or the lack of it — is another concern in sensitive areas, such as the Grand Canyon or Saguaro National Monument in Tucson. Increasing numbers of particulates in the air create blankets of haze hovering over some Arizona cities and their recreation areas.

And finally, the air quality division of DEQ reports that Arizona's international border is contributing to the state's air pollution. Doerge is not optimistic that border conditions will improve soon.

"Too many poor people are burning anything for fuel to keep warm," he explains. The lack of environmental controls also contributes to the problem.

The lack of water in Arizona aggravates the problems of water pollution, because less water means less dilution of pollutants, Doerge explains. One proposal to increase instream flow requirements calls for using effluent or treated water. However, cost estimates of an upgrade of a major sewage treatment plant in Phoenix to produce a higher caliber of treated water could total $4 to $5 billion.

Again, Doerge asks, "Who's going to pay for it?"

Jurisdictional restraints also hamper the state's efforts to comply with some water quality standards, the department says. Nogales and Naco, as well as Indian reservations, cannot be consistently monitored and adequately supervised. Ground water contamination in urban areas also leads the pollution list. As urbanization increases, solvents and industrialized pollutants such as gasoline and TCE threaten Arizona's ground water supply, according to DEQ. On a positive note, they report that pesticide contamination in groundwater is small compared to other pollutants.

The largest source of water contamination is sediment, which is not toxic. But, Doerge says sediment or soil can disrupt and clog a stream or disrupt reservoir functioning. Produced by construction, grazing, forestry and the lack of vegetative cover to protect the soil — this combination of water runoff and soil erosion is difficult to control.

Contact Doerge at the Department of Soil and Water Science, 424 Shantz, University of Arizona, Tucson, AZ 85721, or call (602) 621-1138.

even when it's over-used. On the other hand, unused nitrogen fertilizer can leach down into the soil and possibly into the water table. Large amounts of nitrates in drinking water can pose a health threat, because they interfere with the body's ability to carry oxygen, especially for infants younger than 6 months old.

Soil testing for nitrogen levels starts before the crop season even begins. Once seedlings are developed, growers initiate a season-long plant tissue-sampling program, using stems, or petioles, to determine the plant's nitrogen supply. Growers can add nitrogen fertilizer when it is needed, even before the plants show any visual symptoms of nitrogen deficiency.

Fertilizers are not the only source of nitrates in the water, says Larry Stevens, of the Department of Environmental Quality in Phoenix. In some cases, the nitrates come from mineral rock — some wells are going to have high nitrogen content just because of the geologic strata they're in. So nitrogen exists naturally in the water, although most wells and surface flows have very low amounts.

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Arizona cotton harvest.

Nitrogen is also a part of soil organic matter. It includes plant residues, such as cotton stalks that were shredded and plowed under from the previous harvest. Sources of more typically high nitrogen levels include wastewater effluent, crop residues, green ground covers or legumes, septic tanks and compost.

"The general strategy we like to follow is to use up any soil nitrogen that is present," Doerge says. "As the crop uses up the residual nitrogen in the soil, we recommend applying fertilizer."

When growers use nitrogen fertilizers based on plant needs, they reduce the likelihood that excess nitrate will find its way into drinking water. They also save money.

"When they're managing effectively environmentally, they're managing economically as well", says Doerge.

Through their adoption of BMPs, farmers can actively working to protect the environment, while maintaining their place among the world's most productive farmers.

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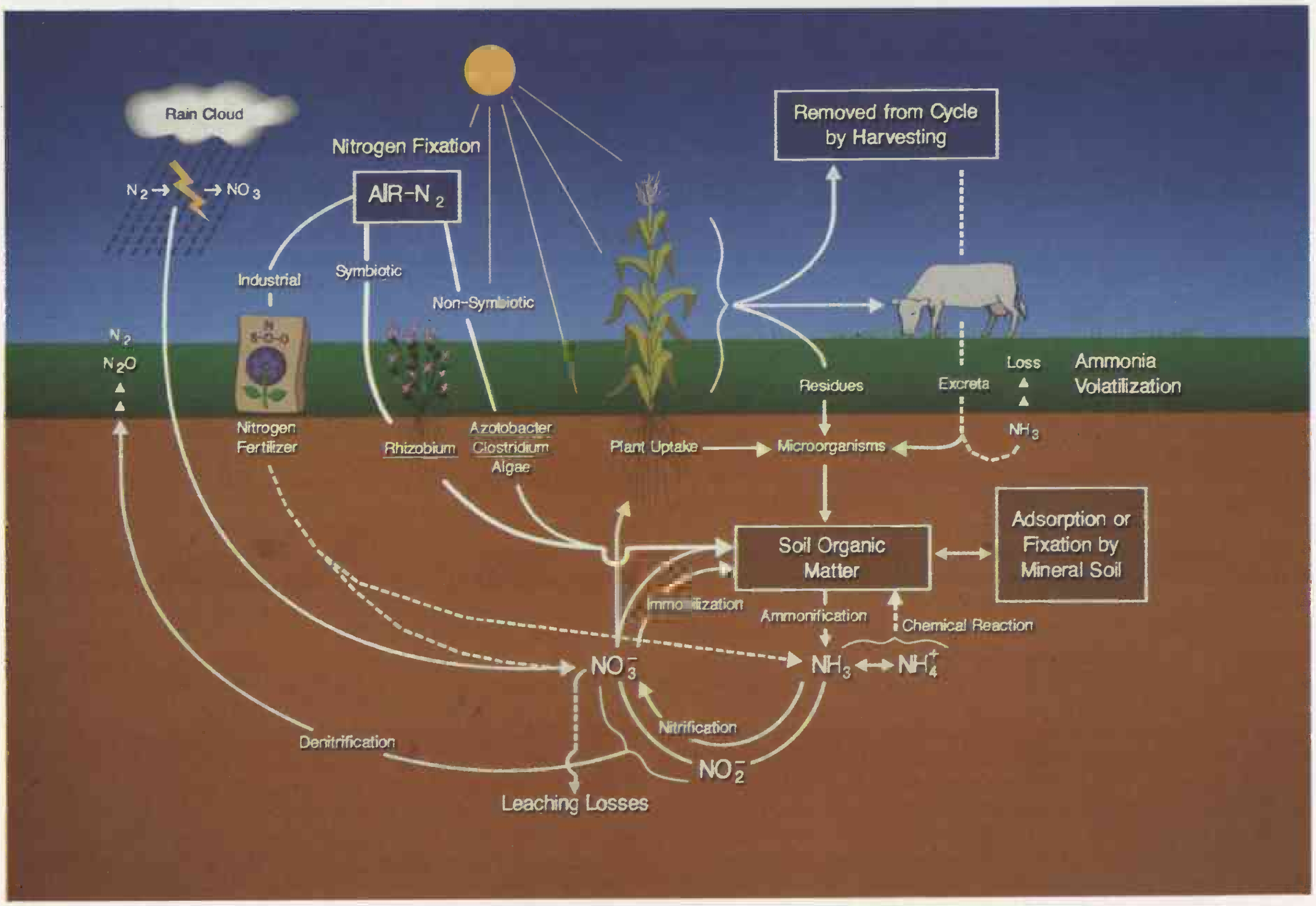

The nitrogen cycle in soils. (Illustration from *Nitrogen Fertilizer Management in Arizona*, by Doerge, Robert L. Roth and Bryant R. Gardner, published by the College of Agriculture, University of Arizona, May 1991) For ordering information, contact Agricultural Communications/Computer Support at (602) 621-7176.