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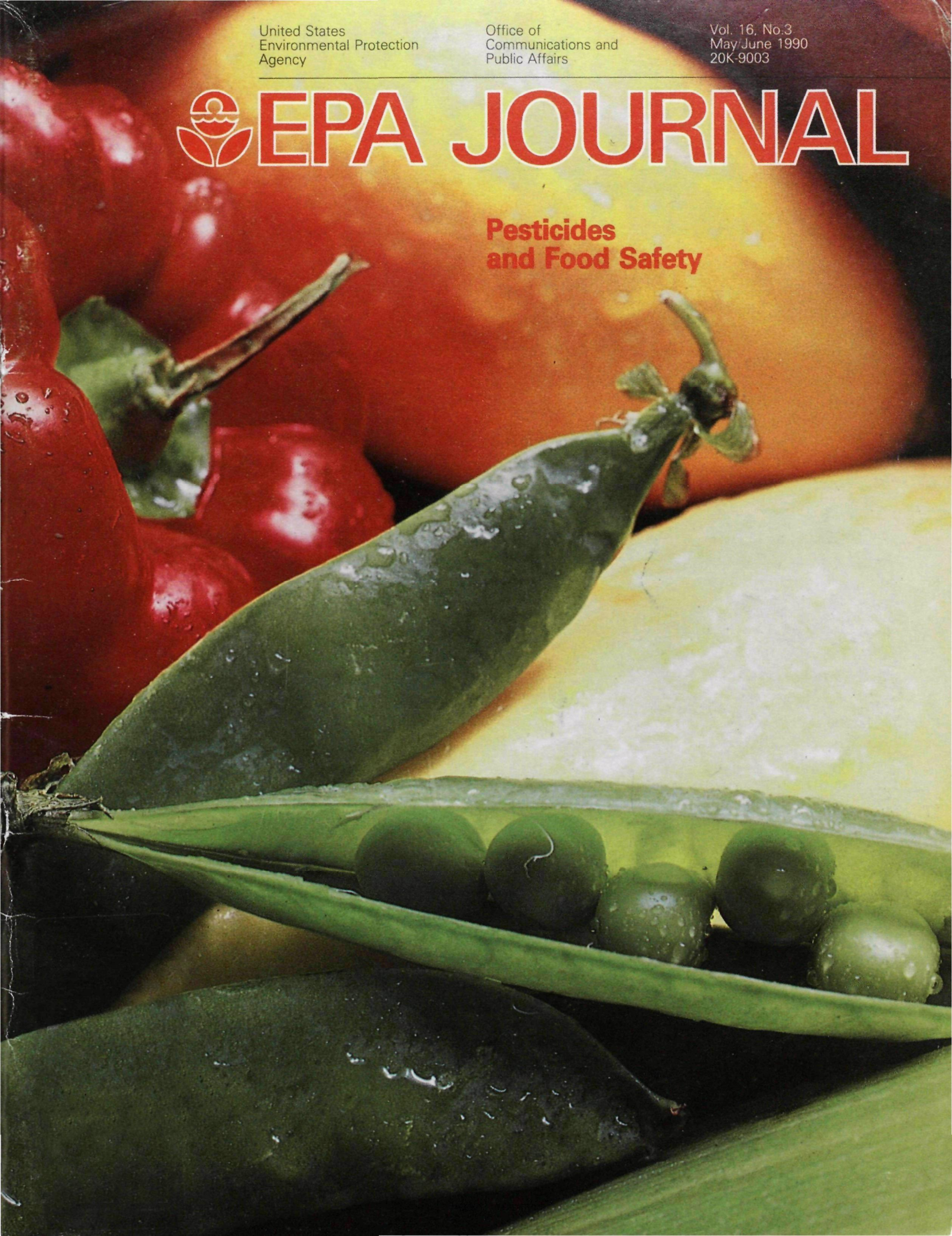
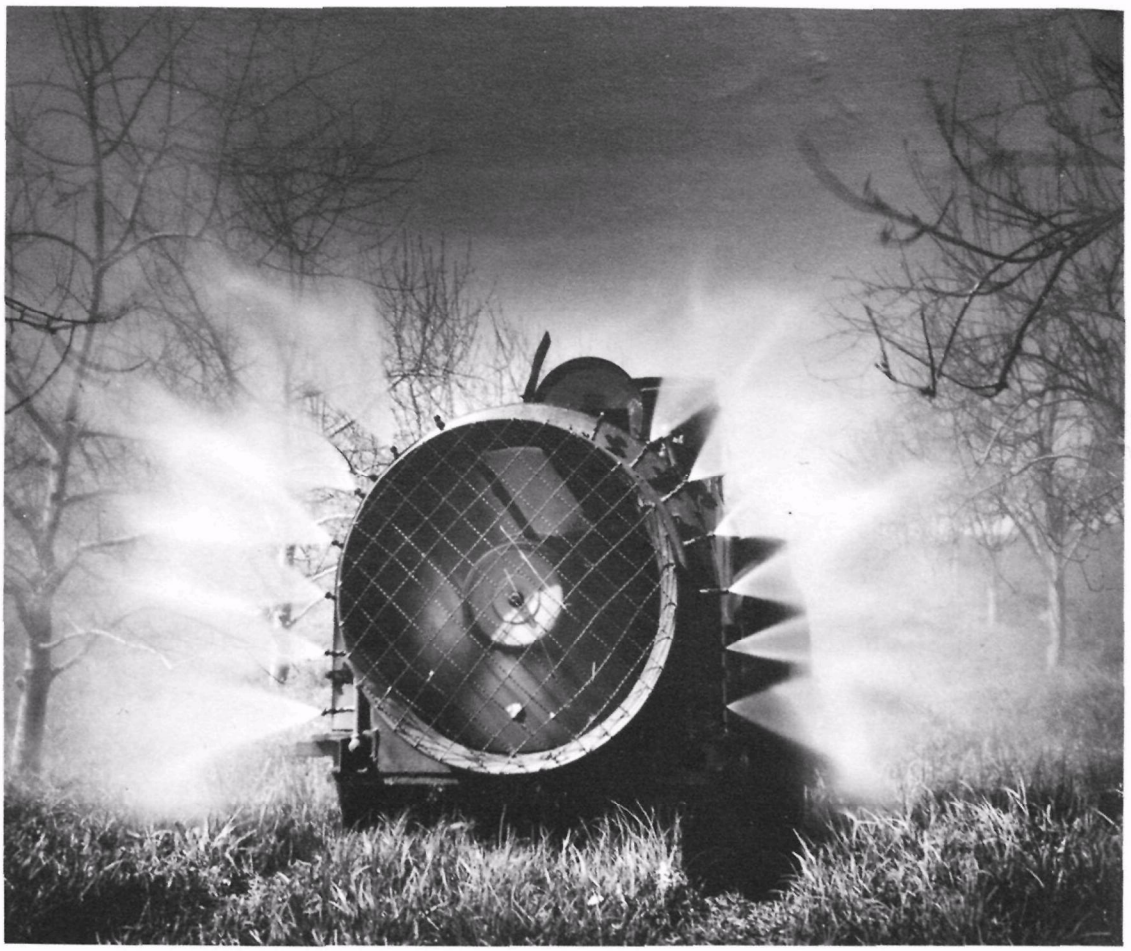
EPA JOURNAL

Pesticides and Food Safety



Pesticides and Food Safety



Spraying apple trees with insecticide. Grant Heilman Photography photo

Pesticides and food safety—a widely publicized topic of concern and the subject of this issue of *EPA Journal*.

The magazine begins with a perspective piece by journalist Cristine Russell, reprinted from *The Washington Post*. The article, which portrays the food-safety issue in terms of a crisis in public confidence, looks back on the recent history of the issue and highlights major points of controversy.

Next EPA Administrator William K. Reilly takes a broad approach to the subject, placing food-safety concerns in the context of a strategic framework for making environmental decisions that the public can understand and trust. The acting Commissioner of the Food and Drug Administration (FDA), James S. Benson, addresses pesticides and food safety from another vantage point of federal responsibility. And the Deputy Secretary of the U.S. Department of Agriculture (USDA), Jack Parnell, discusses the subject on behalf of the third federal agency that, together with EPA and FDA, plays a major role in the regulation of pesticides used in food production.

Then EPA's top pesticides official, Linda J. Fisher, answers specific questions the public is asking about pesticides and food safety. Fisher, who was interviewed by *Journal* staff, is Assistant Administrator for Pesticides and Toxic Substances.

A section follows on "the basics" concerning pesticide residues and the pesticide regulatory program at EPA. First is an article on how the Agency assesses dietary risk from pesticides and how it acts to reduce these risks as necessary. The second article follows a common fruit—the tomato—through its life history from farm to dinner plate, showing how pesticide residues are reduced at the various steps along the way.

Recognizing the many controversial aspects of the food-safety issue, the magazine includes three features that profile outside opinion. First is a forum in which five observers present their views on the question whether children are at greater risk than adults from pesticide residues in foods. Second is an article presenting differing viewpoints on whether the consumer would be willing to buy pesticide-free foods even if they might be less attractive and more expensive. Third is a piece summarizing comments from a diversity of farmers on whether they are changing their pesticide use patterns as a result of food-safety concerns.

Then, in related articles, two farmers report their experiences in reducing their reliance on pesticides through Integrated Pest Management practices. One of the farmers is a New England fruit grower. The other represents a large agricultural company in the West that is using a giant vacuum cleaner, the "Salad Vac," as one alternative to pesticides for insect control.

The *Journal* also asked an official with a large food-processing firm, Del Monte, to discuss how this industry and its growers are reacting to food-safety concerns and what the impacts might be for consumers.

The magazine then turns to the "Big Green" debate in California, with articles from the two opposing viewpoints. One side has proposed sharply tightened restrictions on pesticide use in that state, while the other side has proposed a less stringent control effort. California voters will be asked to choose between these initiatives in November.

Next is a six-page feature designed specifically for young children, printed in large type. It is intended to explain basic material concerning pesticides and food safety in terms children can understand. In addition to the main feature, there is an educational maze and games.

A regular feature—Appointments—concludes this issue of the magazine. □

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EPA JOURNAL

EPA is charged by Congress to protect the nation's land, air, and water systems. Under a mandate of national environmental laws, the agency strives to formulate and implement actions which lead to a compatible balance between human activities and the ability of natural systems to support and nurture life.

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Front Cover: *Food safety—an issue that touches everyone. Photo by Peter Garfield for Folio, Inc.*

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Correction: In the March/April issue of EPA Journal, Representative Claudine Schneider's article (page 11) should have read: "When fully used, these products will ... prevent the annual generation of hundreds of millions of tons of carbon dioxide (CO_2) in addition to substantial reductions of sulfur dioxide (SO_2) and nitrogen oxide (NOx) pollutants."

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A Crisis in Public Confidence

by Cristine Russell

"Guess what we're doing?" says Meryl Streep, wearing a striped apron as she stands at the kitchen sink, up to her elbows in soapsuds. "The broccoli," answers a young child at her side.

Meryl Streep scrubbing broccoli?

"Why? What's on the food? And why are children particularly at risk?" asks the Academy Award-winning actress and mother of three in a commercial for the environmental group project, "Mothers and Others for Pesticide Limits."

Next comes another familiar face—actress and model Brooke Shields on behalf of a California food producer, the Nunes Company. She appears on East Coast television and in magazine and billboard ads promoting the "Foxy" brand of lettuce and cauliflower as "the natural beauty food."

It is all part of a continuing media battle between competing camps seeking to influence public perception, as well as public policy, on the safety of the American food supply. In the controversy over pesticides and other agricultural chemicals, image has become as important as law and science in framing the way politicians and the public view fresh fruits, vegetables, and other food products.

The long-simmering debate erupted in the public eye over a year ago, on Feb. 26, 1989, when a "60 Minutes" television expose indelibly linked that all-American symbol of health, the apple, with questions of cancer and children. The television show highlighted a report by an environmental group, the Natural Resources Defense Council (NRDC), charging that children were at particular risk from exposure to residues of suspected cancer-causing agents like Alar, a growth-regulating chemical used to keep apples from falling off the tree.

Now, over a year later, Alar is off the market but the resulting furor still has not died down.

"The Alar controversy served as a sparkplug for public concern," says Janet Hathaway, senior project attorney for NRDC in Washington. "Now, there is activity under way to translate that concern into lasting pesticide reform. Alar was symptomatic of the problems that permeate the whole regulatory process."

"Alar was a watershed," agrees Frank Young, deputy assistant secretary for health at the Department of Health and Human Services and former head of the Food and Drug Administration (FDA).

Yet he and other government health officials maintain that the public's concern about pesticides is exaggerated. "There is no serious human health risk for the general public associated with pesticides," he says.

Image has become as important as law and science in framing the way politicians and the public view fresh fruits, vegetables, and other food products.

But in the environmental politics of the "post-Alar era," as Young calls it, food safety and the use of agricultural chemicals are key issues for both the public and federal regulators. As Linda Fisher, assistant administrator at the Environmental Protection Agency (EPA), says: "I think the controversy overshot its mark in terms of creating anxiety about the food supply and apples in particular. But it brought to public attention that we ought to change our laws."

It also put food growers on alert. "Food safety, to be honest, took a lot of people by surprise," says Matt Seeley, head of marketing for the Nunes Company.

Politics of Broccoli Power

Surveys show that about eight out of 10 Americans see pesticide residues on food as a serious threat to health. There is also general agreement that the pesticide regulatory system needs fixing.

The 30-year-old provision known as the Delaney Clause, which prohibits any synthetic carcinogens in processed foods, is under serious challenge. President Bush recently proposed a food safety plan, while a number of Democrats and Republicans on Capitol Hill have their own bills.

The "farm bill"—up for renewal this year—is another likely target. Earlier this month, a coalition of environmental, consumer and "alternative" agricultural groups announced proposals to encourage less use of pesticides.

The three federal agencies that oversee the use of pesticides—the EPA, FDA, and Department of Agriculture (USDA)—have stepped up efforts to work more effectively together, particularly in communicating with the public.

Grass-roots activism is also on the rise. A new California environmental initiative, dubbed "Big Green," sets a time-table for banning cancer-causing pesticides. It will be on the state ballot next November. In addition, "Mothers and Others for Pesticide Limits," sponsored by NRDC, has attracted 7,000 supporters.

Growers, large and small, are looking at ways to reduce pesticide use, as well as at alternatives to pesticides. An "Alternative Agriculture" report released last fall by the National Research Council gave added impetus to the movement.

Chemical manufacturers are also taking a more active role in regulating themselves. After the Alar controversy, a second wave of public concern about a widely used group of potentially carcinogenic herbicides called EBDCs (ethylene bis-di-thiocarbamates) was headed off, in part, by industry moves to restrict voluntarily their use on many major crops.

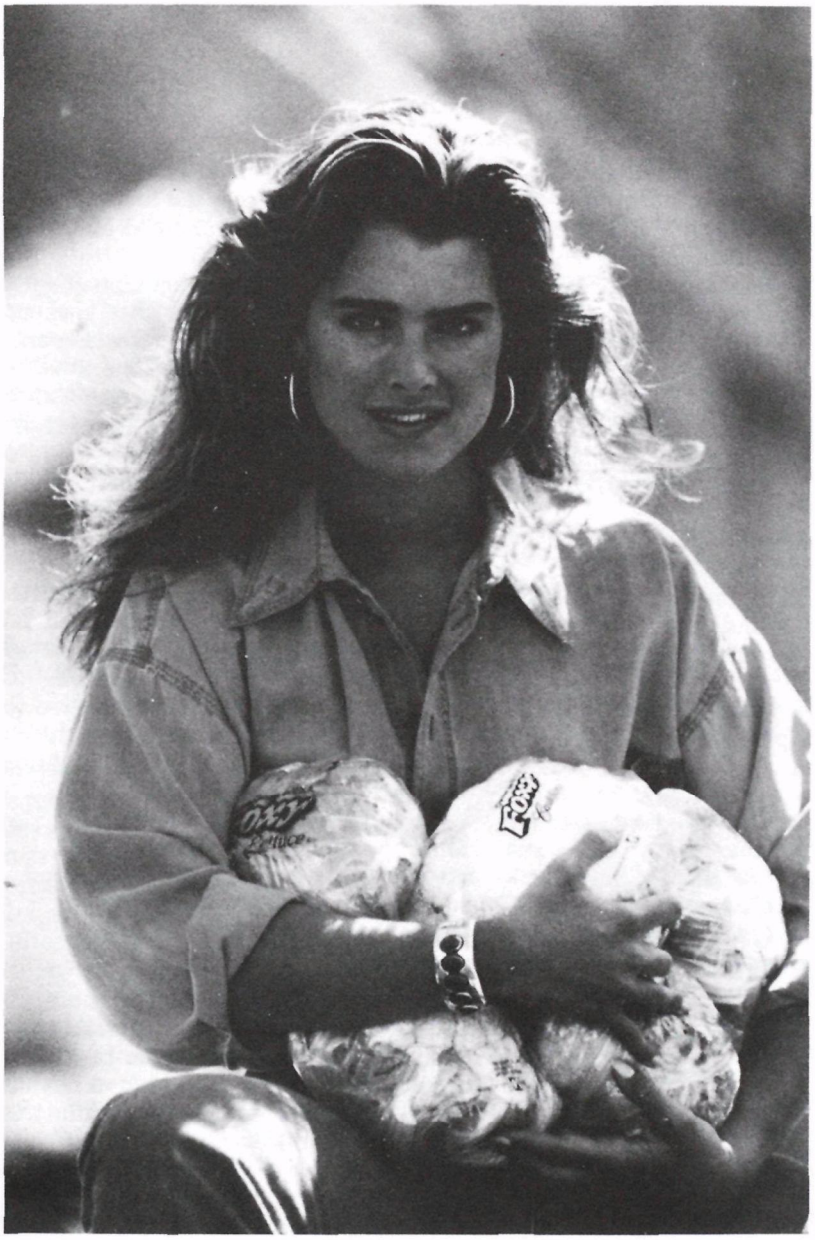
What's more, a number of grocery chains and food producers now hire private laboratories to monitor fruits and vegetables to make sure pesticide residues fall far below federal limits.

As for Alar, or daminozide, its manufacturer, Uniroyal Chemical Co., announced last June that it was voluntarily halting sales and recalling supplies because of the "fear" campaign. It notified the EPA in October that it was cancelling all food uses. The EPA, meanwhile, proposed in September to phase out all allowable residue levels by June 1991. According to an agency spokesman, a final order has been issued.

Risk: Rhetoric vs. Reality

"The U.S. food supply is the safest in the world," said Fred Shank, director of FDA's Center for Food Safety and Applied Nutrition, in a recent speech to the American Chemical Society food safety conference in Point Clear, Ala.

(Russell is a Washington Post special health correspondent. This article originally appeared in the newspaper's Health Section, February 27, 1990.)



Nunes photo.

The Nunes Company, which began its own pesticide residue monitoring program in 1988, emphasizes food safety in marketing its vegetables. Actress Brooke Shields was hired to promote the company's "Foxy" lettuce and cauliflower.

It could be much safer, respond environmental critics.

The debate about pesticides depends on whether you worry more about what scientists do know about the risks of pesticides—or what they don't know.

Until now, most public concern has focused on the risk of cancer. Second only to heart disease, cancer is estimated to kill about 500,000 Americans this year. About one in four Americans will develop cancer during their lifetime.

Yet, based on what is known, most scientific experts do not believe that environmental pollution from manufactured chemicals, particularly pesticide residues, is a major cause of cancer in this country.

A frequently cited 1981 analysis by British researchers Richard Doll and Richard Peto estimated that about one third of cancer deaths were tobacco-related and another one third were linked to dietary factors such as high-fat, low-fiber consumption. Doll and Peto estimated that "pollution" accounted for only about 2 percent of current cancer deaths and that pesticide contamination of food was relatively "unimportant" as a cause of current cancer mortality.

More recently, in a study called "Unfinished Business," the EPA ranked pesticides as one of the top environmental hazards but estimated that in the "worst case," pesticides in food might contribute to about 6,000 cancer cases each year.

Michael Gough of Resources for the Future, a nonprofit Washington think tank that studies environmental and economic issues, looked at both the Doll and Peto work and the EPA report and concluded that they were in remarkably close agreement.

But when he reviewed a number of other estimates of the cancer risk from pesticides in food, he found that the worst-case scenarios varied enormously, ranging from 400 to more than 21,000 pesticide-related cancers annually. He also noted that at the lower end, the actual risk estimate would be close to zero.

Meanwhile, there is a growing consensus that pesticides pose much less of a safety hazard than other food problems. At a meeting last week of the American Association for the Advancement of Science in New Orleans, FDA officials stressed that the agency's primary food safety concern is disease-carrying microorganisms, such as food-poisoning bacteria that cause everything from diarrhea to deadly botulism. "Bioligical hazards pose the real risk in the food supply and are at the top of the list as to where we direct our priorities," said the FDA's Douglas Archer.

FDA's Robert Scheuplein also emphasized that cancer-causing compounds that occur naturally in the food supply—mold toxins, for example—are a greater threat than are synthetic carcinogens, echoing the concerns of University of California scientist Bruce Ames. "The effort to reduce the last bits of Alar virtually has no effect on total risk. Pesticides are a very small risk," Scheuplein said.

But all these views are based on what is known. What is not known, say environmental critics, continues to raise questions about the safety of pesticides and other chemicals. Much is unknown, for example, about the long-term effects of being exposed to low levels of a cancer-causing chemical or the cumulative effects of being exposed to different chemicals not only in foods but in ground water. Because cancer does not develop for two decades or so after exposure to a carcinogen, it is difficult to pick up individual causes of cancer in the environment.

The evidence from occupational studies is mixed. Recent National Cancer Institute research has suggested that farmers as a whole do not appear to have greatly increased risks for cancer. At the same time, farmers who work with certain pesticides have been found at higher risk for some cancers. Kansas

farmworkers who used herbicides, for example, had a higher risk for developing non-Hodgkin's lymphomas.

For the general population, the risk to an individual from scant amounts of pesticide residues is probably exceedingly small. But on a societal basis—since virtually all Americans eat commercially produced food—a tiny individual risk multiplied by a large population could mean thousands of potential pesticide-related cancers spread across the country.

In addition, certain groups, such as children, may be at somewhat greater risk than the general public, in part because they consume larger amounts of fruits and vegetables. Another National Academy of Sciences report, looking at the risks of pesticides in the diets of infants and children, requested by Congress before the NRDC Alar report, is expected to be completed later this year.

Cancer is not the only concern. Medical researchers are increasingly worried about the effects of pesticide chemicals on the nervous system. They also fear that in pregnant women, certain chemicals may cause potential damage to the fetus.

Environmental advocates argue that the prudent course is to reduce potential exposure to chemicals, including pesticides, that can contaminate not only food but water.

"This is a significant public health problem," said Lawrie Mott, senior scientist for NRDC in San Francisco. "First, every single consumer gets pesticides in [his or her] food supply. Second, these are unavoidable risks to the public, unlike smoking, alcohol, or dietary fat."

Concluded Mott: "People should continue to eat a well-balanced diet of fruits and vegetables and at the same time get involved in making the food supply safer, expressing a desire for foods with less pesticides."

Coping With Alar Anxiety

To a large degree, the food safety crisis has been a crisis in public confidence.

Following the widespread coverage of the EDB—ethylene dibromide—contamination of cereal products in the early 1980s, annual national surveys by the Food Marketing Institute (FMI), a trade association representing food retailers and wholesalers, found that about three-fourths of consumers have serious concerns about pesticide residues in the food they buy.

In its January 1989 survey, the FMI found the proportion who saw pesticide residues as a "serious hazard" had risen to 82 percent, a level that far outranked consumer concerns about drugs and hormones in meat, nitrites in foods, irradiated foods, additives, or artificial colors.

A more in-depth look by the institute documented the degree to which public confidence was further shaken by the Alar controversy. In January 1989, 81 percent of shoppers surveyed said they were "mostly" (58 percent) or "completely confident" (23 percent) that the food in their supermarket was safe. But after Alar and the Chilean tampering scare involving cyanide poisoning of what turned out to be two grapes, the confidence level dropped to 67 percent in mid-April. It then rebounded temporarily to 73 percent at the end of April, but in June and August, confidence in the food supply had again dropped back to 65 and 67 percent.

"These data indicate that consumer confidence in food safety, once shaken, is slow to rebuild," said an FMI report.

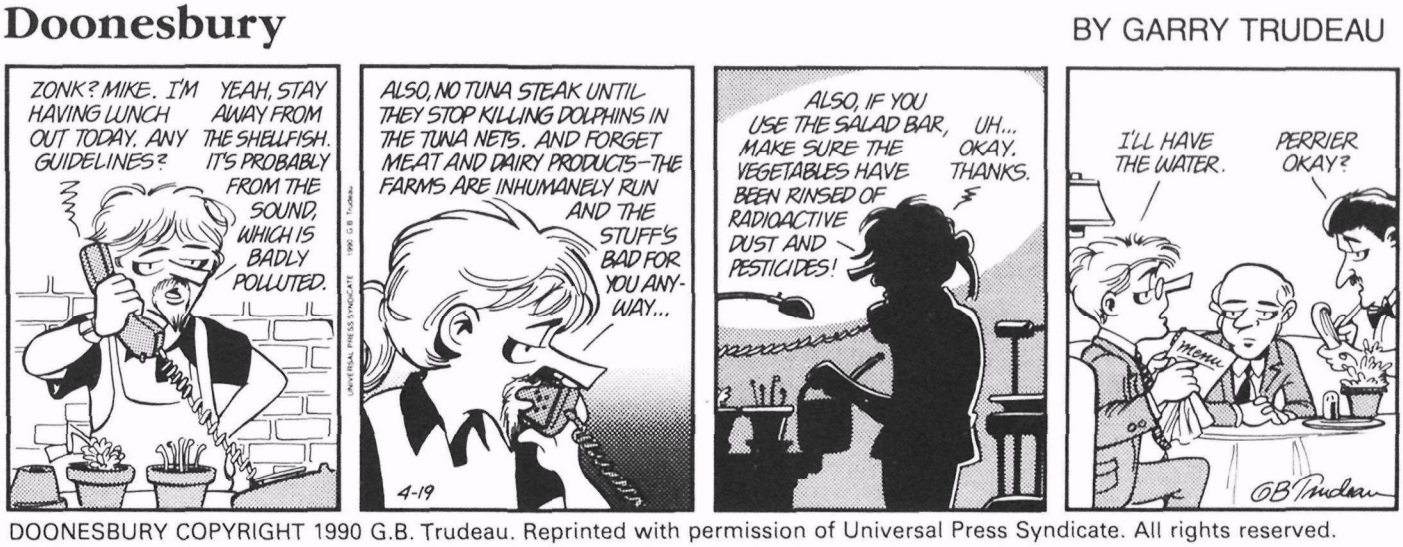
A survey late last year by the Missouri-based Maritz Marketing Research Inc., found that 78 percent of those surveyed were either concerned or very concerned about pesticide use, with women somewhat more concerned than men. Just over half of those surveyed felt that there had not been any improvement over the past year in the safety of the fruits and vegetables; 17 percent thought safety had declined.

Most believed that greater federal government involvement was needed to guarantee a safe food supply. Nearly two-thirds said the government is doing "too little" to ensure food safety.

Three federal agencies—the FDA, EPA, and USDA—share the responsibility of making sure the food supply is safe, and almost everyone agrees that the existing regulatory system has problems:

- The laws governing pesticides are outdated. There is still considerable debate about what is a cancer-causing agent that poses a risk to human health, but the EPA has identified more than 60 pesticide chemicals as possible carcinogens. Under existing law, the anti-cancer provision of the Delaney Clause applies an absolute zero-risk standard to processed food, saying that no chemical additive known to cause cancer in animals or man is allowed.

In contrast, for fresh produce, another section of the law allows residues of cancer-causing pesticides as long as the



benefits of the use of these pesticides are deemed to outweigh the potential risks.

In addition, a 1987 National Research Council report noted that the EPA has applied the Delaney Clause to pesticides registered after 1978 but not to earlier pesticides. As a result, it concluded, some older pesticides that present a potentially greater risk remain on the market, while newer ones that pose far smaller risks have been kept off.

The Council report on the Delaney Clause recommended that health officials set a standard of a "negligible" lifetime dietary cancer risk of not more than one case of cancer for every one million people exposed to the chemical. This standard would eliminate almost all of the dietary cancer risks posed by pesticide residues, the report concluded.

- The system is too slow. The law requires "old pesticides" to be reevaluated or "reregistered" according to modern scientific safety standards. But the safety review was dragging on so long that the General Accounting Office estimated that the EPA would not finish until the year 2024. To speed things up, Congress in 1988 passed amendments to set a timetable for finishing the review by 1997. Even when a chemical is targeted for removal, it can take four to eight years to remove hazardous pesticides from the market.

The standard FDA monitoring test only detects about half of the major pesticides now in use. There is also little data on where pesticides are used and by whom. As a result, there were widely varying reports during the Alar crisis about how much of the apple crop had been treated with the chemical.

In addition, the system is slow to respond to a crisis, in part because the three regulatory agencies sometimes have conflicting views.

Most states, meanwhile, have long had their own approaches to regulating pesticides, and some have gotten ahead of the federal government. A new California law, for example, now requires much more extensive gathering of information on pesticide use and stepped-up monitoring.

In Washington, changing the laws on pesticides has become an urgent political issue. "Alar heightened the activity in Congress that maybe there are things we need to fix in the law," says John McCarthy of the National Agricultural Chemicals Association.

"The issue had been simmering. But nearly all of the political pressure was generated by Alar," says Skip Stiles, staff director for the House Agriculture subcommittee responsible for the FIFRA [Federal Insecticide, Fungicide, and Rodenticide Act] pesticide law.

An array of proposals has come forth—more than ever before, say environmentalists. Initial deliberations on a proposal to change the food and drug and law, sponsored by Rep. Henry Waxman (D-Calif.) and Sen. Edward Kennedy (D-Mass.) with support from some environmentalists, are expected to begin soon. A proposal to change the

In Washington, changing the laws on pesticides has become an urgent political issue.

EPA's regulatory process has come from House Agriculture subcommittee chairman Rep. George Brown Jr. (D-Calif.). An alternative supported by many members of the House Agriculture Committee, as well as many agricultural industry groups, would amend both acts at once.

President Bush unveiled a food safety proposal last October, which the White House described as a "sensible approach to complex and contentious issues." But the administration has been slow in sending details to Capitol Hill. As outlined, the administration plan would give EPA more flexibility to remove potentially hazardous pesticides from the market, mandate ongoing review of safety data, increase enforcement penalties, replace the Delaney Clause with a negligible-risk standard [see box on page 16], and increase coordination between the federal agencies.

Two issues are likely to surface in the upcoming debate on Capitol Hill: What is an acceptable risk, and should states have the right to set more-stringent pesticide safety standards?

Industry is pushing for national uniformity, and the Bush administration plan backs it, saying that inconsistent state-by-state requirements create "the potential for considerable consumer confusion and substantial disruption of the interstate commerce in food products."

Environmentalists are adamantly opposed to the administration plan, and Democrats such as Waxman have pledged to fight federal preemption of state laws. Whether Congress has time to actually act on pesticides in an election year with a calendar already crowded by the farm bill and Clean Air Act revisions remains unclear.

Big Green From California

A key prod for federal action in Washington may be what is brewing in California. Frustrated by inaction at the federal level, environmentalists are using the state's unusual initiative process to put the pesticide issue directly on the ballot.

The Environmental Protection Act of 1990 is a sweeping proposal known as "Big Green" that deals not only with pesticides but also coastal protection, global warming, and enforcement. It would phase out use of certain cancer-causing pesticides; phase out chemicals that destroy the ozone layer; establish a reforestation plan and protect the redwoods as well; impose strict controls on discharge of toxic wastes into state waters, ban additional offshore oil drilling along the California coast, establish an oil-spill prevention and cleanup program, and create a statewide elected environmental advocate.

The pesticide provision would target any pesticide determined by the state or the EPA to cause cancer or reproductive harm to be phased out over five years. The sale of food containing residues of these products is to be prohibited as well. New standards would be required for all pesticides to protect children, and a new agricultural worker protection program would be established.

NRDC estimates that about 19 pesticides would be affected immediately.

The agricultural industry has already struck back with its own "wholesome food" ballot initiative. Industry calls the environmentalists' proposal "irresponsible," while environmentalists have derided the industry proposal as "big Brown."

But the rhetoric is just beginning. The California food fight is sure to attract both big money and visible faces in what promises to be yet another political media extravaganza in which perception will again be as important as reality.

Which movie stars will play a starring role in reaching the hearts as well as minds of California voters? Stay tuned for the next round of commercials. □

Facing a Tough Issue:

An EPA View

by William K. Reilly

Few environmental issues generate as much heat and as little light as controversies over food safety.

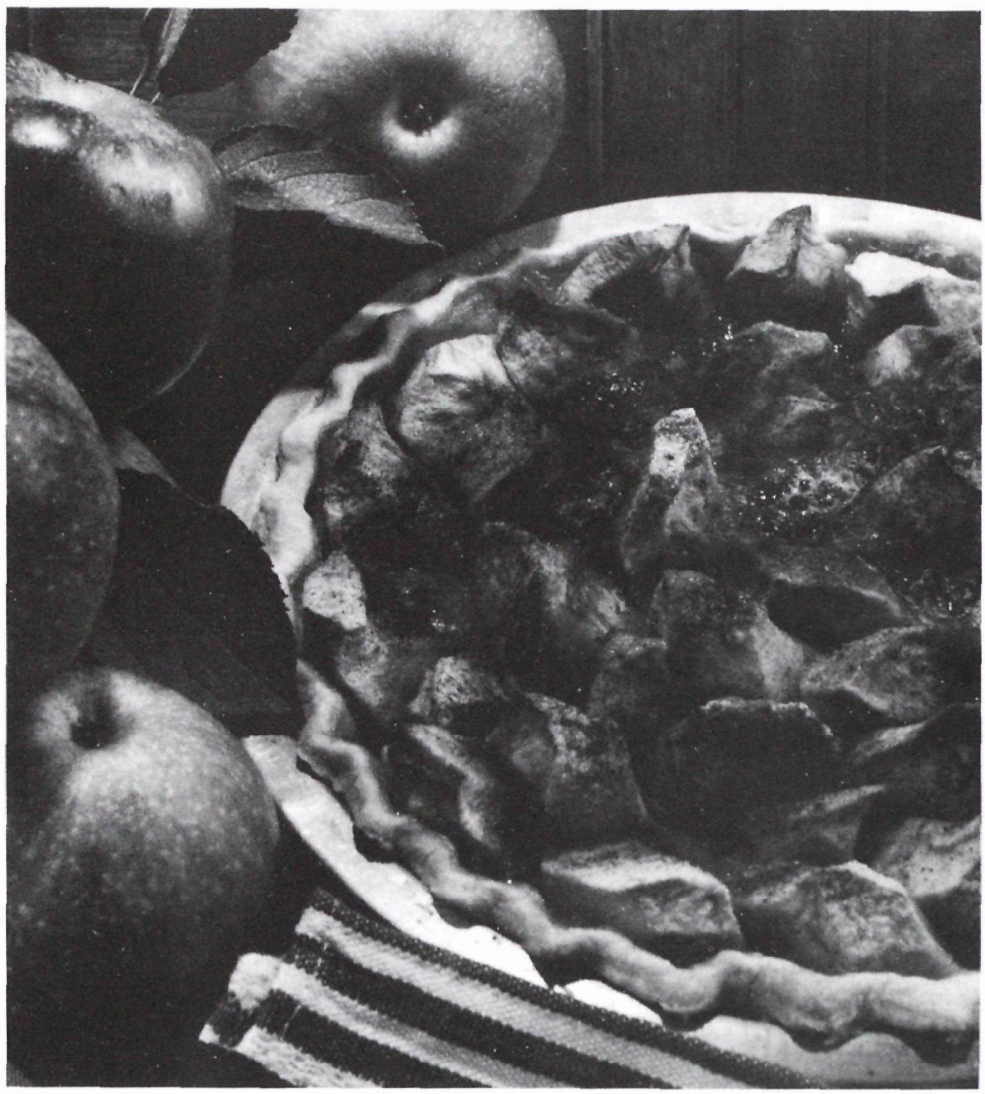
It is ironic that the United States, which has one of the safest and most closely regulated food supplies in the world, should face a credibility problem on this issue. But clearly we do. In last year's Roper poll on environmental issues, half of those responding said they regarded pesticide residues on the food they eat as a "very serious" problem. The recurring pesticide scares of the last few years—EDB in grain and drinking water, Temik in watermelons, heptachlor in milk—undoubtedly are responsible for much of that public anxiety.

My own introduction to the subject of food safety was characteristically intense: Scarcely three weeks into my tenure as EPA Administrator, the Natural Resources Defense Council (NRDC) released its now-famous pesticides report and communication campaign on Alar—unleashing yet another firestorm of news media attention and public debate over health risks from chemical residues in apples and other food.

Thousands of Americans, concerned about news reports suggesting a link between eating apples and cancer, turned to the government and the scientific community for answers. For the most part, it appears, they were disappointed. It wasn't that the scientists had no answers; rather they had too many. The government experts said one thing, the food industry experts said another, and NRDC's scientists said something else. The public was left dangling in confusion.

Besides underscoring the difficulty of trying to explain the fine points of risk assessment in the middle of a public firestorm, the Alar controversy brought home another important lesson about food safety: The public neither understood nor accepted a situation in which it could take years to remove a problem pesticide from the market. It was clear that EPA must be able to gather available information on both the effects of and exposures to pesticides more quickly and, as necessary, to act quickly when faced with new evidence of unacceptable risk.

With this lesson in mind, the Bush Administration has taken aggressive steps to improve the government's ability to respond to concerns about food safety. Shortly after the Alar scare, the President directed EPA, the U.S.



Last year's public controversy over Alar and food safety tainted the traditionally wholesome image of apples and apple pie.

Barry L. Runk photo. Grant Heilman Photography.

(Reilly is Administrator of EPA.)

Department of Agriculture (USDA), and the Food and Drug Administration (FDA), the agencies which share responsibility for regulating the nation's food supply, to develop a new Administration initiative on food safety and pesticide reform.

The President's food safety plan includes legislative proposals, such as recommended amendments to the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and the Federal Food, Drug, and Cosmetic Act. It includes budgetary initiatives: the Agriculture Department has asked for funds in its 1991 budget to expand its monitoring of pesticide use and residues. And the plan calls for improved coordination among our institutions.

Without the streamlining changes the President has proposed, the nation's pesticide laws are seriously flawed, and EPA's ability to cancel a problem pesticide is inexcusably burdened by procedural requirements that can entail years of fruitless delay. The President's food safety plan, along with the 1988 amendments to FIFRA and the Administration's proposed 1990 Farm Bill, will put in place mechanisms to improve the government's ability to assure the safety of the nation's food supply in the years to come.

Along with emphasizing the need for food-safety reforms, the Alar crisis also raised a deeper, more persistent issue which still needs to be addressed: how the American people perceive and react to environmental risk generally, whether from the food they eat, the air they breathe, the water they drink, or the land on which they live.

To be fully effective, the federal agencies charged with protecting public health and safety must be able to communicate constructively to an informed public—a public that trusts the processes and the people involved in making risk-related decisions. In the past, however, we have had only limited success in communicating these decisions to the public.

Look at what happens, almost invariably, when EPA announces a regulatory decision. Some scientists, environmentalists, and citizens who understand risk point to the very real uncertainties inherent in our risk-based decision-making and charge that our approach is not sufficiently protective, or that it underestimates the environmental and health problems that will result from not taking stronger action. At the same time, others in academia or the business or farm communities assert that the assumptions used in our risk models, which are purposely designed to err on the side of safety in order to ensure public health protection, are *too* protective; that our decisions undervalue the economic and other benefits of pesticides and other chemicals.

This problem arises because any decision about environmental risk is complex and requires a great deal of information: information about the health and ecological effects of pollutants, about their presence and persistence in the environment, and about the extent to which human beings and natural systems are exposed to them. Given this complexity, government regulators, who must live in the interval between the discovery of a problem and its solution—typically before the science is adequately established—simply have to get used to the fact that disputes and disagreements go with the territory.

One key to building and maintaining public trust is to improve public understanding of how we make regulatory decisions. While we must listen carefully and respond to the public's concerns, the public needs to understand that EPA must and will continue to rely on a rational, science-based process for determining when to take risk-management actions. Our regulatory decisions must and will continue to be based on the best available science. At times we won't have all the scientific data we would like to have, but we will not be able to wait for it to come in before we take action. Based on what we *do* know, we must and will take a cautious, protective approach until we get better data and until we learn more about the effects of toxic substances on human cells and ecosystems and the mechanisms by which diseases are caused.

This doesn't mean going to ridiculous extremes in overstating risk or making decisions using risk estimates without scientific grounding. We are constantly updating our risk-assessment guidelines as scientific knowledge advances; we are insisting that these assessments be subjected to rigorous internal and external peer review; and we are looking for ways to achieve greater consistency in our use of risk assessments across the range of EPA decision-making. The very nature of the science of risk assessment, however, will continue to force us to make many decisions on public health in the face of uncertainty, based on less than complete information.

Given these realities, how can we foster public trust in science-based regulation while continuing to serve the public's interest? Here are four steps we can take that can, I think, help us resolve this dilemma:

- First, there must be *aggressive enforcement of our laws.* The public must believe that violators will be caught and prosecuted. With respect to food safety, this means beefing up the enforcement and penalty provisions for pesticide misuse under FIFRA, another key point in the President's food safety plan. As it now stands, FIFRA is one of the weakest environmental laws on the books from an enforcement standpoint; its penalties should be brought more

Mike Lockhart photo U.S. Fish and Wildlife Service.

An American symbol, the bald eagle, was pushed to the brink of extinction by widespread use of DDT; the bird made a comeback after the pesticide was banned. In Administrator Reilly's view, foreseeing and preventing health and environmental problems must take on a high priority in policy-making.

into line with other comparable environmental statutes.

- Second, we must redouble our efforts to *educate, inform, and involve the public* in our regulatory process. While our environmental decisions must never become popularity contests, it is entirely appropriate, even necessary, to bring the public into the debates on which our decisions turn. We must do a better job of explaining the legal mandates under which we operate, how the process works, and how we factor risk-benefit tradeoffs and other considerations into our decisions.

- Third, *instead of seeing the environment in pieces, we need to see it whole*—as, in fact, it really is. Much misunderstanding results from the fact that the public tends to lump problems together, while government, with its patchwork of media- and pollutant-specific legislation and regulatory programs, tends to separate them into discreet packets. While EPA tries, for example, to determine what level of a particular chemical in food, in the air, or in drinking water might pose unreasonable health risks, citizens look at the entire spectrum of chemicals to which they are exposed in daily life—in the home, on the job, and in between—and worry about cumulative effects as well as effects from multiple sources of exposure.

I think the public has the right idea. Our risk-management process must take a broader, more integrated view of the full costs and benefits of environmental action or non-action. We must find ways to compare environmental risks across programs and to concentrate on those areas where we can realize the greatest benefits for human health and the integrity of natural systems. And we must broaden the factors we explicitly consider in making risk-management decisions to reflect legitimate cultural and ethical values and concerns, as well as the inherent uncertainties of risk assessment.

- *Finally, we need to make risk reduction and pollution prevention the watchwords of our environmental-protection policies.* It is unrealistic to expect that we can ever achieve consensus on what constitutes an "acceptable" level of risk. There are too many unknowns, too many competing social values and policy agendas, too many trade-offs between various kinds of costs and benefits. The search for the Holy Grail of risk management—the so-called "bright line" that would let policy-makers determine, under any and all circumstances, whether a particular level of risk is "acceptable" or not—seems doomed to failure. Probably the best we can do on this score is to adopt and enforce general guidelines, such as the "negligible risk" standard for cancer in the President's food safety plan.

I believe the most effective approach to risk is for us to identify the most significant, most troublesome kinds of risk and then focus our resources and efforts on *reducing* those risks.

How do we do this? One important way is to emphasize pollution prevention: to look at risk-management options that eliminate the *source* of the risk. Not only is this approach more effective than traditional end-of-pipe treatment and control, but it avoids arguments about the levels of risk involved in managing, treating, or shunting wastes off to other environmental media.

For example, in the case of two especially troublesome substances—lead and dioxin—EPA has set up multi-program task forces that are looking for ways to reduce overall exposures to these substances from all sources. Recently we announced an action plan to require reductions in the amount of dioxin discharged into streams, spread on land in sludge, and incorporated into paper products—even though we are still a long way from scientific agreement on the degree of risk posed by the presence of trace levels of dioxin in water and food. The focus of the plan is on reducing the *formation* of dioxin, not on removing it after the fact. We plan to announce a similar plan for lead soon.

We know from experience that pollution prevention works, it can save money, and it can save lives. It means setting in place laws and policies, such as the creative market incentives in the President's proposed amendments to the Clean Air Act, that unleash American ingenuity to solve problems in new ways.

I noted earlier that our decisions must be based on sound science. Ultimately, if we are to gain public trust, the pollution-prevention approach must take its place in our regulatory pantheon alongside the science of risk assessment. We must continue to improve our ability to assess and characterize risk. But the surest path to protecting human health and the environment, and to gaining the public's trust, lies in our ability to point to a steadily decreasing volume of and exposure to hazardous substances in the environment.

This approach will require us to change some fundamental precepts; it will ask that we think more carefully about the consequences of our actions on future generations; it will demand creativity and commitment from all of us; and it will require those of us in the federal sector to work together as never before.

But it will pay off in the public trust that is the foundation of our democratic government—trust not only in our food supply, but in *all* of our activities devoted to protecting public health and the environment. □

Food Safety: Whose Job Is It?

Three federal agencies share responsibility for regulating pesticides used in food production: EPA, the Food and Drug Administration (FDA), and the U.S. Department of Agriculture (USDA). Their combined efforts are intended to ensure that pesticides are rigorously tested, properly used according to approved label directions, and kept within legal residue limits in or on food and animal feed commodities. In addition, state governments also play an active role in regulating agricultural pesticides.

EPA regulates the sale and use of pesticides in the United States under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), which mandates the "registration" (licensing) of all pesticide products. EPA is responsible for reviewing scientific data on pesticides and their health and environmental effects. Based on these data reviews, EPA registers those pesticides that, when used according to label directions, will not pose significant risks to human health or the environment. Once a pesticide product is registered by EPA, the label is the law: It is illegal to use any pesticide except as prescribed on the label.

Under the Federal Food, Drug, and Cosmetic Act (FFDCA), EPA also sets "tolerances" or limits for the amount of pesticide residues that lawfully may remain in or on foods marketed in the United States. EPA-established tolerances apply not only to foods produced in this country but also to all food commodities imported from abroad.

If scientific data show that any pesticide poses unreasonable risks, EPA has authority under FIFRA to cancel permanently its registered uses. If the pesticide is deemed to present an imminent hazard if it remains in use during cancellation proceedings, EPA can temporarily suspend its uses while deciding whether or not to cancel them permanently.

FDA enforces the pesticide tolerances established by EPA. FDA monitors all domestically produced and imported foods travelling in interstate commerce, except meat, poultry, and some egg products, which are monitored by USDA. FDA can seize and destroy food shipments that are found to contain pesticide residues in violation of the tolerances set by EPA.

FDA's *Enforcement Monitoring Program* enforces the tolerances set by EPA and provides information on the incidence and level of pesticide residues remaining in foods.

FDA's Total Diet Study, or "Market Basket Study," measures the American consumer's daily intake of pesticide residues from foods prepared and ready to serve. (See article on page 10 regarding recent results of FDA's monitoring and Total Diet Study programs.)

USDA's Food Safety and Inspection Service (FSIS) monitors domestic and imported meat and poultry products for bacterial contamination and for residues of pesticides, drugs, and other chemicals. Through its National Residue Program, FSIS ensures that pesticide residues in meat and poultry do not exceed the tolerances set by EPA.

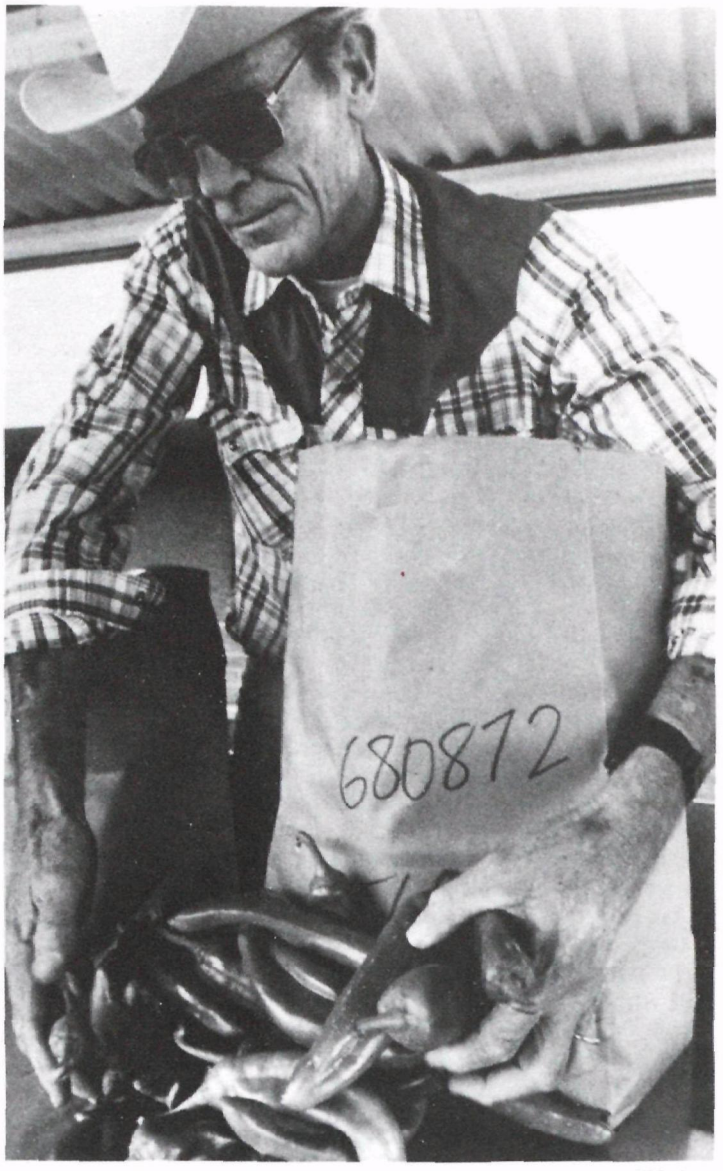
More than 7,500 USDA meat and poultry inspectors and other food safety technologists work in about 7,000 plants across the country. These specialists inspect meat and poultry samples and spot check for residues of pesticides, drugs, and other chemicals. Each year, FSIS conducts 10,000 to 20,000 pesticide residue analyses. Currently, fewer than 1 percent of these tests show illegal residues, and the violation rate has been declining steadily over the last two decades.

The 50 **states** also play an important role in ensuring the safety of the food supply. State regulatory agencies work in concert with their federal counterparts in the administration of federal regulatory standards. In addition, the states have their own programs to regulate pesticides and monitor the safety of foods produced and sold within their own boundaries. Some state pesticide regulatory programs are more stringent and aggressive than federal programs.

Facing A Tough Issue:

An FDA View

by James S. Benson



FDA photo.

An FDA inspector selects a sample of imported produce to be analyzed for pesticide residues. At U.S. border crossings, seaports, and airports, FDA spot checks food shipments imported from other countries for compliance with U.S. residue limits. This is the "circle of poison" issue—the fear that pesticide use overseas may result in risky levels in imported foods.

Although the Food and Drug Administration (FDA) touches the lives of Americans each day in many ways, no program brings us closer to the average American family than does the Total Diet Study. Four to five times each year, FDA investigators walk the aisles of supermarkets and grocery stores in 12 cities from coast to coast (and in Hawaii and Puerto Rico) and fill their carts with 234 carefully selected food items.

Working from a uniform shopping list, these employees pick infant formulas and baby food, meat and vegetables, fruit and candy bars, and beer and soda pop just as if they were shopping for their own family or for a neighbor. By the time all items on the list have been checked off, each of the dozen "market baskets" costs up to $1,200 and contains just about everything that goes into the diet of eight population groups including infants and toddlers, teenagers, adults, and senior citizens.

This prodigious shopping is the first step in one of the three programs by which the FDA protects the American public from harmful levels of pesticides and other chemical contaminants in the nation's food supply. Unlike the Agency's sampling of food shipments in interstate commerce or its cooperative schemes with various states, the Total Diet Study monitors the food prepared the way it's actually eaten. As soon as each investigator finishes shopping, the perishable groceries are packed in ice and rushed to the FDA laboratory in Kansas City, Missouri. There, 20 chemists and technicians probe each ready-to-eat item with an array of sophisticated equipment capable of detecting residues at one part per billion, a level 5 to 10 times lower than that normally used to monitor the food supply. The rest of the ingredients are analyzed in the same meticulous way after being cooked into stews, roasts, and other dishes, as would be done at home.

The 29-year-old Total Diet Study has proved to be the most accurate—and reassuring—gauge of pesticide residues that actually reach the American table. Although each market basket may contain traces of up to 70 or 80 pesticides and other industrial chemicals, the levels of contaminants are invariably far below the Acceptable Daily Intake (ADI) levels established by the United Nations' Food and Agriculture Organization and the World Health Organization.

On rare occasions, the FDA chemists in Kansas City run into a puzzle, such as the appearance in breakfast cereals many years ago of polychlorinated biphenyls or PCBs—a toxic industrial chemical which can cause liver damage. The FDA lab found that the chemicals—which fortunately were not present at dangerous levels—had migrated into the breakfast food from cereal boxes made from recycled paper containing carbonless carbon paper. In response, FDA issued a regulation that has kept excessive levels of PCBs out of paper for food packaging.

In general, however, the findings of the Total Diet Study provide heartening evidence of the continued, decade-long decline of chemical residues in our food. For instance, DDT, a highly persistent pesticide once widely used but now banned in the United States, appeared in the most recent surveys at very low levels in 20 percent of the Total Diet Study samples—one-half the rate of positive findings six years ago. Levels of other banned chlorinated

(Benson is Acting Commissioner of Food and Drugs.)

FDA photo.

FDA employees go shopping for FDA's Total Diet Study at local supermarkets and grocery stores around the country. Each regional "market basket" includes 234 items chosen to represent the diet of the U.S. population; table-ready foods are then analyzed for chemical residues.

pesticides, such as dieldrin and heptachlor, are also rapidly diminishing. Some of these residues are unavoidable because of their persistence in the environment. But in our most recent reports, dietary levels of most pesticides were less than one percent of the ADI.

The Total Diet Study is an offshoot of the food-safety testing program that has been a growing FDA responsibility since its founding in 1906. Early on, the few pesticides in use were mainly naturally occurring poisons, such as arsenic, lead, and nicotine. After World War II, however, synthetic pesticides entered the market in a big way.

Today, the food industry uses many thousands of pesticides derived from a little over 300 different active ingredients. At the same time, interstate shipments of foods, which the FDA monitors for safety, have mushroomed. The resulting potential workload has reached staggering proportions. By one calculation, the job of sampling each of the 27,000 domestic and foreign annual shipments of apples for pesticides would alone cost about $900 million—almost twice the FDA's annual budget.

To deal with this dilemma, FDA has carefully targeted our checking of raw produce and processed foods which are most likely to contain illegal residues. Sometimes other agencies help us by flagging certain crops or food shipments in particular geographic areas that should be sampled. And in particular cases, EPA has asked FDA to look for residues of certain "problem" pesticides on particular crops, either during our routine monitoring activities or by conducting special surveys. For example, in recent years, EPA has asked us to look for aldicarb, the EBDC fungicides, Alar, and EDB in the U.S. food supply, as concerns about the health effects of these pesticides were being addressed.

Imported foods also receive special attention in our monitoring program. In 1988, FDA inspectors at border crossings, airports, and seaports checked 10,475 imported items—more than 57 percent of the year's total 18,114 samples—ranging from Mexican watermelons to Guatemalan papayas, Chinese mushrooms, and Canadian cucumbers. In 1987, when the total sample was about a quarter smaller than in 1988, foreign products made up 55 percent of the inspected items. The samples were tested for residues of one or more of the 256 most widely used pesticides, from acephate to zineb.

The results again confirmed that our food rarely contains pesticide residues at levels that exceed EPA-established tolerances. In 1987, no residues of pesticides were detected in 57 percent of the domestically produced and imported samples tested (most of which were fresh vegetables, fruits and dairy products). The comparable figure for 1988 was 61 percent. In both years, the remaining samples showed traces of about 120 pesticides, but only four percent of all samples violated existing regulations. Usually, the violation consisted of illegal use of a registered pesticide on a particular commodity for which the chemical was not approved.

Above-tolerance residues in both years were found in less than one percent of the import samples. And yet in 1988, the number of imported products on the FDA automatic detention list more than doubled. This was the result of a new, tougher FDA policy: After a single shipment from a given source is found to violate U.S. tolerance regulations, all shipments from the same source are subject to automatic detention. In the past 18 months, for instance, FDA investigators in the port of Philadelphia have refused to allow the entry of 55 Chilean and Spanish shipments of pears, lemons, and clementines. Imports from suspect sources are resumed only after the shipper or importer has produced certified analyses showing that pesticide residues are within EPA tolerances.

In addition to our own initiatives, FDA is increasingly tapping the information resources of various state pesticide programs. About half of the states supply their residue sampling data to the FDA regional offices. Some states exchange their findings with FDA at regular intervals. Ten states contribute their monitoring results to "Foodcontam," a database operated by Mississippi State University under contract with FDA.

The campaign against the hazards of pesticides has chalked up impressive results over the years. Unfortunately, the public health agencies are compelled by law to fight a costly and unwinnable battle against minute violations of the Delaney Clause of the Federal Food, Drug, and Cosmetic Act, which seeks the virtually unattainable goal of banning all traces of carcinogenic food additives. President Bush's food-safety program announced last fall addressed this contradiction by proposing to replace Delaney's unreachable "zero risk" formula with the more realistic yardstick of "negligible risk" in the range of one in a million over a lifespan of consumption.

As an agency which has been regulating food contaminants for 84 years, FDA heartily supports the proposal. In our experience, science provides a much sounder base for problem-solving than fear. □

Facing a Tough Issue:

A USDA View

by Jack Parnell

As I travel the country, I find that consumers are confused about the safety of our food supply. At the same time, farmers are concerned that the facts are being distorted regarding the wholesomeness and safety of the food they produce. Why are there such conflicting perceptions? Let's take a look at some of the issues.

Most farmers in the United States use chemicals to help them grow food and fiber. American farmers are the most productive in the world. During the past 10 years, U.S. farm productivity has increased by more than a fourth, over twice the increase achieved in the non-farm sector. Every U.S. farmer now feeds and clothes 120 people here and abroad. This is a tremendous accomplishment.

Most people don't fully realize that modern production technology, including agricultural chemicals, is the main reason why U.S. farmers are the most productive in the world. Because U.S. farmers are so productive, Americans today spend only 11.8 percent of their disposable income for food—less than in any other country in the world.

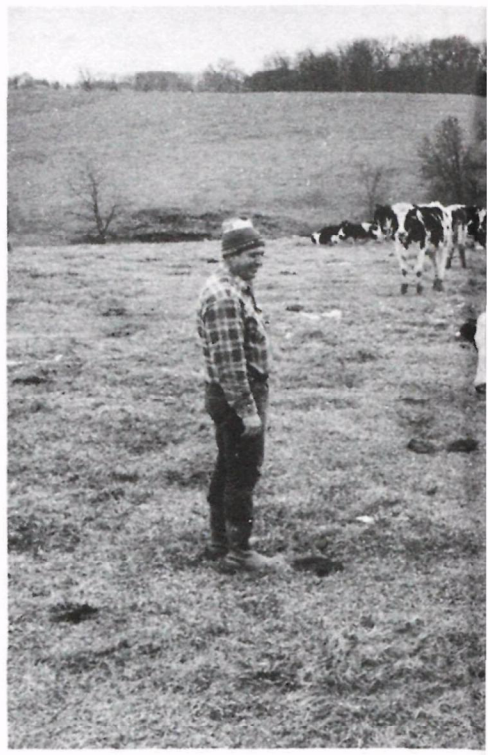
It is important to note, however, that farmers generally use pesticides and other agricultural chemicals very judiciously. Chemicals are one of the most expensive "inputs" that a farmer uses. Farmers tend to use them very sparingly because they cost a great deal of money and take away from bottom-line profits. In addition, farmers, like everyone else, are concerned about the health of their families. If the use of a pesticide poses a threat to health, then it is the farmer and his family who are threatened first because they live on the land where pesticides are applied.

Where alternatives to chemical use are available and profitable, farmers are often quick to adopt them. For example, tremendous strides have been made in recent years in such areas as integrated pest management and low-input farming techniques. These new developments have allowed farmers to reduce chemical usage while maintaining productivity and efficiency. There are many promising technologies on the horizon as well, such as biotechnology. The quest for new technologies must continue so that productivity can be maintained while agricultural practices continue to become more sensitive to the environment.

Many experts believe that pesticides pose less risk to health than do certain microbes and natural toxins in food. In other words, the chemicals applied to agricultural commodities can in fact safeguard the public from naturally occurring health threats. Thus, natural does not always mean better, and chemicals do not always mean bad. Marry these two concepts with the facts that people in the United States are living longer and that cancer is on the decline. So why are consumers confused about the safety of the nation's food?

Scientific advances that allow pesticide residues to be detected at very low levels in food have surpassed our society's wisdom to determine how significant those findings are. As a result, perceptions of problems—not the problems themselves—have tended to drive public policy on this issue. These concerns must be put in proper perspective so that science can speak and be heard, instead of the weather vane of uninformed public opinion.

In that regard, the federal government has a great deal of work ahead, and I am happy to report that government has responded in part. Just last fall, the President announced a food-safety initiative that, if adopted by Congress, would go a long way to streamline and improve the food-safety regulatory network. Briefly, the President's proposal would simplify and make more workable the regulation of pesticides; assure that pesticides found unsafe are not used; revise the Delaney Clause to bring it in line with current science (see box on p. 16); and provide for national uniformity on allowable levels of residues in foods once chemicals have been scrutinized by modern science.



The U.S. Department of Agriculture (USDA) is doing several things in the food safety arena. To begin with, food-safety issues have been designated a higher priority than at any other time in USDA's history. Secretary Yeutter has

(Parnell is Deputy Secretary of the U.S. Department of Agriculture.)

A bountiful corn crop in the making.

USDA photo.

American farmers are the world's most productive.

Mike Brisson photo.

given me direct responsibility for overseeing the implementation of new legislation, initiatives, and programs in this area. In addition, we are building stronger working relationships with EPA and the Food and Drug Administration in order to better coordinate our work on food-safety issues.

USDA has also proposed new funds in the President's FY 1991 budget for a federal/state food-safety data initiative which calls for:

- A pesticide-residue monitoring program that involves cost-sharing contracts to the states for conducting pesticide-residue tests on fresh fruits and vegetables within market distribution channels
- A pesticide information base that will involve conducting pesticide-usage surveys and economic analyses to determine the types and amounts of chemicals used on specific crops in each state
- A residue-exposure assessment system that will be used to estimate the pesticide-exposure levels for specified sub-populations that may have sensitivities to certain chemicals.

This three-part initiative will increase substantially the quantity and quality of data available to the federal government—and to consumers and farmers as well. The additional data will be extremely beneficial in making food-safety decisions and in educating producers and consumers concerning pesticides and other chemicals used in food production. USDA, EPA, and FDA are currently working in concert to develop uniform protocols for this program. This is very much a coordinated effort.

Our work is cut out for us. Federal regulators, working with farmers, consumers, and food and chemical companies, will continue to make improvements to further assure the safety of the food supply. Food safety is one of the top priorities at USDA. U.S. farmers are striving to provide a safe, wholesome, abundant, and affordable supply of food to consumers. Likewise, USDA is pursuing rational, practical policies to ensure that farmers have the tools they need to grow food and fiber to feed and clothe the world while protecting the environment and the safety of the food supply. □

Providing Some Answers: An Interview with Linda J. Fisher

Last year's public controversy over Alar and food safety is a recurring theme in this issue of EPA Journal. *While the controversy has subsided to some extent, many people still have basic questions about pesticides and our food supply. To obtain answers to some of these questions, the* Journal interviewed Linda J. Fisher, the Agency's Assistant Administrator for Pesticides and Toxic Substances. The text of the interview follows:

Q Early in 1989, the Alar case set off a virtual public panic about pesticides and food safety. Should the public be concerned about pesticides in foods, or was Alar just a false alarm?

A The public's response to Alar was definitely an overreaction. I do not think there was any reason for people to throw out their apple products. Parents did not have to be afraid of feeding their children apple juice or apple sauce.

However, the Alar case did call everyone's attention to the need to strengthen our pesticide regulatory program. It underscored the fact that we need to do a better and quicker job of regulating pesticides. It called attention to some fundamental weaknesses in EPA's statutory authority for regulating pesticides under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and the Federal Food, Drug, and Cosmetic Act (FFDCA). In that sense, the controversy rightly sent a signal to Congress and the Administration on the need to improve our laws.

Q Generally speaking, are children at greater risk than adults from exposure to pesticide residues on food? (The *Journal* has posed this same question to participants in a forum that appears later in the magazine.)

A In making food safety evaluations on pesticides, EPA does take into account the eating patterns of children: the *amount* of food they eat relative to their body weight and the *kinds* of foods they eat. The special dietary patterns of children are factored into our evaluations because they can make a difference in children's exposure to pesticide residues through their food intake.

Your question raises a legitimate issue that EPA is trying to deal with. It's an issue that entails a number of questions, including whether children might be more sensitive than adults to the effects of pesticides. We do not have firm scientific answers to all of the relevant questions. For this reason, EPA has asked the National Academy of Sciences to study the effects of pesticides in the diet of childr and provide a report on their findings. We have also asked the Academy to make recommendations as to whether and how the Agency might do things differently to better account for childhood differences in pesticide exposure and risk.

Q Last fall, the Bush Administration announced a set of proposals called the food safety plan. What does this mean for consumers?

A Basically, the President's initiative would strengthen EPA's ability under FIFRA to take action against troublesome pesticides. The existing law authorizes EPA to cancel a pesticide's registration—its license for use—if test data show that continued use would pose unreasonable risks to health or the environment. Also, if an imminent hazard would result from continued use of a pesticide during the time required to complete cancellation proceedings, EPA has authority to issue a suspension order to halt use.

The President's initiative would streamline the existing cancellation process. It would also make the suspension process a little more flexible, so that EPA could use it more easily than under the current law. The plan also bolsters EPA's enforcement authority to ensure that our regulations are in fact being followed and not abused.

In addition, the plan would eliminate the current inconsistency in federal law governing pesticide residues in foods. [See box on p. 16.] It would enable us uniformly to apply a negligible-risk standard in making decisions on pesticide residue tolerances for both raw and processed foods.

Q You just used the term "negligible risk," which is often used in discussions about pesticides and food safety. What does the term really mean, and how does the government decide whether a risk is negligible or not?

A The concept of negligible risk refers not just to pesticides, but also to other areas of food safety when additives are introduced into food. We are trying to set a standard below which the cancer risk is so small that from a regulatory or public health point of view, there would be no need to worry.

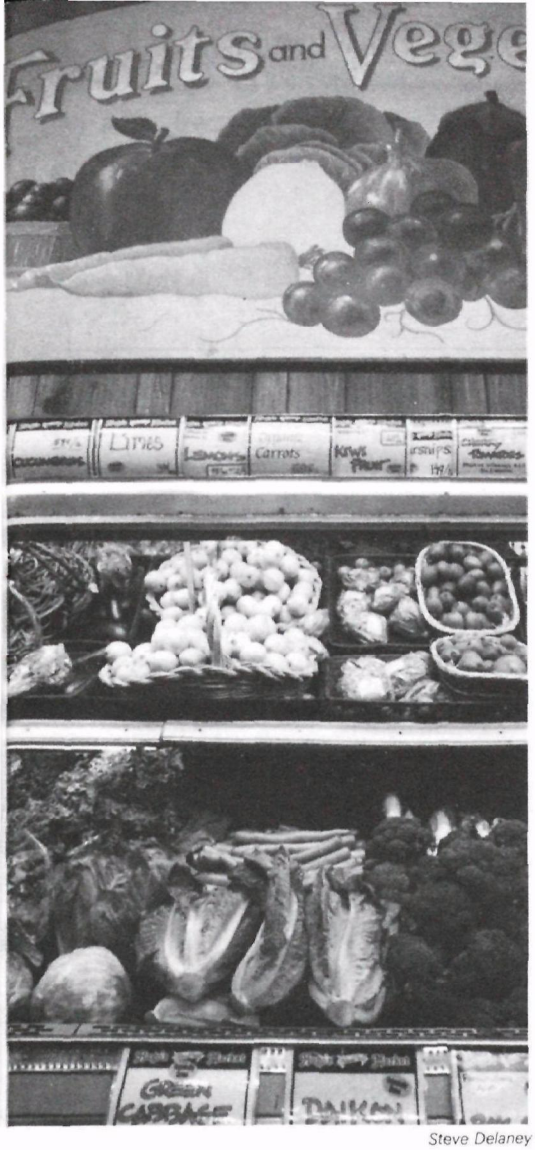
In the pesticide program, when a pesticide is identified as potentially carcinogenic (cancer-causing) through laboratory testing, our current policy is that negligible risk is in the range of one in a million (10^{-6}). In other words, our working definition of negligible risk is one additional cancer case per million people as an "upper limit" of risk. EPA scientists make these calculated estimates of human cancer risk by extrapolating from laboratory animal test results.

The negligible risk concept applies when cancer is the health risk being evaluated. We use a different approach when assessing other possible health effects—such as whether a pesticide could cause thyroid damage or reproductive effects, for example. In these cases, laboratory studies are used to define an exposure level at which no ill effects occur in test animals. Once we find a "no observed effect level" in animals, we add an additional safety factor when we calculate acceptable risk to humans. In most cases, the safety factor is 100.

Q Some critics say that the notion of negligible risk is just an excuse for allowing cancer-causing pesticides to be used on food. How do you answer that?

A I do not think that is an appropriate reaction. As I said, we have tried to define negligible risk so that it is low enough that people do not need to be concerned.

Moreover, as a matter of perspective, cancer is not the only potential health effect worth worrying about. We need to be sure that our pesticides are reasonably safe, not only from the standpoint of cancer risk, but other



Steve Delaney

Some consumers opt for "organic" produce though it may cost more than other fruits and vegetables. Hugo's Natural Foods Market, Washington, DC, has been a successful business for 12 years.

possible health effects as well. We also need to pay attention to environmental effects, such as whether a pesticide is likely to contaminate ground water. We need to look across the board at all health and environmental effects. The point is to make sure that our pesticides do not pose unreasonable risks, looking at the broad spectrum of health and environmental concerns.

Q What is the status of the food safety plan?

A The Administration announced its proposal last October. EPA has provided Congress with guidance on statutory language that we believe should be included in the legislation. And we have been working with the Congressional committees which are considering the legislation, in both the House and the Senate. The plan seems to be moving forward in Congress.

Q The next few questions concern the science of pesticide decision-making. What sort of evidence does EPA have to back up its pesticide decisions that relate to public health?

A We require a very broad array of tests on each pesticide chemical to ensure that it meets safety standards. Before a new pesticide can go on the market, its manufacturer must satisfy EPA's extensive testing requirements. Required testing for health effects covers everything from acute toxic poisoning to delayed or chronic health effects such as nerve damage or birth defects. Still other tests are required on the potential effects of a pesticide on ecology and the natural environment.

EPA also has a "reregistration" program for older pesticides. Reregistration requirements affect approximately 600 chemicals that were licensed for use before modern health and safety standards were established under FIFRA. As we go back and reassess these older pesticides, they are required to meet the same rigorous health and safety testing requirements that apply to brand new pesticides.

Q If you are working with data on rats and mice or other laboratory animals, how confident are you when you make pesticide decisions that affect public health?

A EPA issues guidelines on how to conduct health and environmental safety studies, and we involve the larger scientific community in the development of our testing requirements and protocols. We try to get the best scientific opinion on what the tests should be, how they should be conducted, and how their results should be extrapolated to humans. For instance, our cancer guidelines, which we are currently revising, have benefited from a lot of public participation and review in the scientific community.

I think our risk assessments are state-of-the-art by modern scientific standards; we try to keep up with the science as it evolves. Even so, the underlying question is, How sure can you be? Clearly, there is some uncertainty because in most cases we do not have actual human data on health effects resulting from pesticides. We are projecting human risk based on laboratory animal data; we are extrapolating from one species to another and from high to low exposure levels, and that process, by its very nature, involves uncertainties.

Q The public gets very confused when scientists inside and outside the government disagree about pesticide risks, as has happened with Alar and some other cases. Why does this happen?

A There will always be some scientists who disagree with others on a given issue, just as there will always be attorneys who can read the same sentence in two different ways. I don't think this is something for people to be afraid of. Science does not always provide clear, unqualified answers. And when scientific study results do indicate clear answers, people will differ in their opinions as to how much weight should be given to those answers.

When we make pesticide decisions at EPA, we try to ensure that we have a basic scientific consensus on what we do. Striving for a unanimous opinion—on almost any issue, whether it involves science, law, or policy—is probably an unrealistic goal. I think that it is very important for the Agency's decisions to be based on sound science. That means, if not unanimous agreement, at least a basic consensus.

Q When EPA takes a "problem pesticide" off the market, is there any assurance that the substitute is not as bad or worse?

A As part of the decision-making process under FIFRA, we take into account where we believe the user community will go for substitutes if an existing pesticide is cancelled. Our recent decision on the group of fungicides called the EBDCs (ethylene-bis-dithiocarbamates) is an example. We tried to take into account the question, What are farmers likely to turn to? Would they turn to captan or chlorothalonil, which are alternative fungicides? What would be the risk from increased use of those pesticides in lieu of the EBDCs?

We need to do that kind of broad analysis more often. Hopefully, as we proceed with reregistration reviews on older pesticides, we will have the information necessary to answer these kinds of questions.

The substitute-chemical issue is a legitimate one: The Agency ought to be

looking at what is really going to happen in the marketplace. We do try to take comparative risks into account.

Q Let's back up and ask the question, Why do pesticides have to be used at all? After all, some farmers grow produce without pesticides, and some stores advertise pesticide-free food.

A I think that agricultural chemicals are very valuable in maintaining an affordable and diverse food supply. This country has been blessed with a large farm economy; we feed not only ourselves but many parts of the world. And we do so at a price that people can afford. Chemicals have played a role in that. I am not sure that, without pesticides, we could produce the kind of quality, quantity, and abundance we have now.

Organic farming—or true pesticide-free farming—can be expensive. That is not to say that consumers should not have the option of choosing organic produce. But could we truly afford to feed everyone, using only organic farm practices? It's doubtful. As I see it, the better question is: Can we maintain a strong agricultural economy, which I believe is essential, by using chemicals less, and using them wisely? Here I'd say yes, I think there is room for improvement.

Q Is it feasible, then, for farmers to cut back the amount of pesticides they use? Consumer sentiment appears to be moving in this direction.

A Both consumer and farm sentiment are moving in this direction, I think. Consumers, of course, can vote with their pocketbooks. And many farmers, responding to consumer concerns, have taken a step back to see how they might use chemicals less intensively and more wisely, often in an integrated pest management (IPM) system of some kind.

I think the answer to your question is yes, and I believe the farm community wants to be part of the process that will lead to less reliance on chemicals. Farmers also have obvious economic motivations for spending less on chemicals.

Q Are there any specific government policies to encourage less use of pesticides? Any education or research efforts?

A There is a variety of initiatives. First of all, the Administration is seeking changes to some of the existing Farm Bill commodity programs, which tend to encourage the use of pesticides. The idea is to promote reduced use of chemicals by changing the structure of our commodity programs.

Both within the Administration and on the Hill, there is interest in alternatives to conventional pesticide use, such as IPM and, for example, the LISA program, or "Low-Input Sustainable Agricultural Program."

At EPA, pollution prevention is being stressed as a priority, and this includes pesticides. Projects are being funded to develop new techniques and information to help farmers rely less on farm chemicals. Earlier I mentioned EPA's efforts to consider substitute chemicals when we are deciding whether the risks of an existing pesticide outweigh the benefits of keeping it on the market. In addition, we are looking to build into the review process for existing pesticides an increased emphasis on non-chemical alternatives to problem pesticide uses; our analysis will include non-chemical alternatives, where available, as well as chemical substitutes.

The U.S. Department of Agriculture also has a variety of initiatives to

The "Delaney Paradox"

EPA regulates pesticides under two laws: the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), which governs pesticide registration (licensing) decisions, and the Federal Food, Drug, and Cosmetic Act (FFDCA), which governs tolerances (residue limits) for pesticides in foods. Section 409 of FFDCA, which sets standards for processed foods, contains the so-called "Delaney clause," which prohibits a tolerance for any food additive (including a pesticide) that has been found to cause tumors in humans or animals.

The inconsistency in pesticide law is this: On the one hand, FIFRA and most relevant provisions of FFDCA set an overall *risk/benefit* standard for pesticide decisions; under FIFRA, EPA is required to balance the risks of a pesticide against its agricultural or other benefits when making regulatory decisions. On the other hand, the Delaney clause, interpreted literally, implies a "*zero-risk*" standard for certain uses of any pesticide found to induce tumors in test animals at any dose level—no matter how borderline the response may be in test animals or how marginal the risk may be to consumers.

The Delaney clause affects only selected uses of a pesticide: It applies only to residues in processed foods, not raw agricultural commodities, and only to those processed foods in which pesticide residues are concentrated to higher levels than in the original raw commodity.

The "Delaney paradox," according to a 1987 National Academy of Sciences report, is that a literal, mechanistic application of the Delaney clause in EPA's pesticide decision-making process is not the best way to minimize dietary cancer risk from pesticides. One reason for this is that the Delaney clause, literally applied, could interfere with EPA's ability to discriminate, through the regulatory process, between relatively significant versus insignificant risks to consumers; it would discourage a policy of targeting comparatively high-risk pesticide/crop uses as regulatory priorities. In light of the Academy's findings and recommendations, EPA favors a "negligible-risk" standard applied consistently to all uses of both new and existing pesticides, for both raw and processed foods.

develop new methods and transfer those technologies to the farming community. Both in government and in the farm community, there is growing interest in successful alternatives to conventional chemical pest control.

Q Some people say that pesticides are really a much smaller food safety risk than other problems, such as natural toxins and bacteria. Is this a minority opinion? What is your view?

A Many people have raised this issue: Should we be more or less afraid of pesticides than a number of possible kinds of food contamination. Some recent articles have suggested that natural toxins may pose perhaps a bigger health risk than pesticides.

Two thoughts: One is that it is important to keep the risks from pesticides in perspective compared to other things, such as improper handling of food, improper cooking techniques, or natural toxins. It is true that pesticides are not the only substances that can pose risks in our food supply.

Second, keeping pesticide risks in perspective does not mean downplaying the need for pesticide regulation. On the contrary, I believe we definitely need a strong regulatory program that requires pesticides to meet modern health and safety standards. One reason why pesticides may be said to present comparatively low risks in our food supply is that they are generally well-regulated under FIFRA and FFDCA.

Q Another question on perspective: A couple of months ago, a *Washington Post* article entitled "A Year After Alar," described Alar and its legacy in terms of "a crisis in public confidence." Would you agree? disagree?

A It's true that when EPA talked about Alar, the public did not respond accordingly. We told people that it was safe to continue eating apples, but for several months people threw their apple products out. Clearly, there was a breakdown in trust and in confidence as to whether EPA was doing the right thing. What's more, the questions being asked went beyond Alar. There were questions about our ability to regulate pesticides: Was EPA aggressive enough? Did EPA have sufficient resources and wherewithal to make the necessary decisions on other troublesome pesticides?

There were factors outside EPA, clearly, that played into the public panic. But when the American public throws away a commodity like apples in response to a campaign about a pesticide, there is obviously a credibility problem. And without public confidence, it is difficult for EPA to carry out an effective pesticide regulatory program.

Q In the wake of this kind of crisis of confidence, is it possible for EPA as a government agency to regain public trust? Could EPA perhaps do a better job of communicating with the public about pesticides?

A I think there is a lot we can do to restore public confidence. This includes, among other things, strengthening our pesticide laws, assessing whether in fact the Agency has adequate resources to deal with all of the pesticide issues that face us, doing a better job of explaining pesticide issues to people, and encouraging more participation in our decision-making process by outside parties.

We have asked Congress to strengthen our legal authorities, and I think that will be a cornerstone to restoring public confidence. The resource issue is also important for the timely registration of new and safer pesticides and for expeditious action to get older, questionable ones off the market.

Historically, EPA's regulatory process on pesticides has been something of a "black box" to the public. We need to demystify that process as much as possible. And we need to tell people what we are doing. A great deal of activity is under way at EPA on pesticide issues, on a number of fronts, but people don't know because we haven't publicized the work that's going on.

More outside participation in our pesticide decision-making process will be very important. But to make that happen, we are going to have to work hard to improve two-way communication between EPA and the public, between EPA and outside groups such as farmer and public interest groups, and between EPA and Congress.

Q Many consumers are concerned about an apparent circle of poison in which foods grown abroad are treated with pesticides that are banned by the United States, then exported to this country. Is the circle of poison a myth or a fact of life?

A I do not consider "circle of poison" fears to be justified. Imported fruits and vegetables are monitored by the Food and Drug Administration (FDA) for compliance with pesticide tolerance regulations, just as domestic produce is sampled and analyzed. EPA works closely with FDA on food import issues and surveillance priorities, and we are not seeing cause for alarm. (See article by FDA Commissioner Benson on page 10.)

I might add that EPA is working with several Third-World countries on pesticide issues. We are pursuing a number of international information-sharing initiatives, including outreach efforts to keep other countries abreast of U.S. pesticide tolerance regulations. And recently EPA proposed a new policy that would improve notifications to other countries concerning U.S. pesticide exports allowed under FIFRA. □

A Look at the Basics:

Reducing Dietary Risk

by Doug Campt

Most people know that pesticides are used in growing some food crops, but they may not realize how much the use of chemical technology to combat a wide variety of pests has become an integral part of farming. Since the late 1940s, over 300 chemicals have been registered for use in protecting food and animal feed crops from insects, weeds, and fungal diseases, as well as from lesser pests such as rodents, birds and even the bacteria that help frost to form. In recent years the use of these chemicals in American agriculture has leveled out at roughly 845 million pounds per year.

The availability of agricultural pesticides and other technological advances allows consumers to enjoy a wide variety of good-quality fresh fruits and vegetables all year around, at reasonable cost. However, with this abundance have arisen questions about the safety of pesticides, especially as people may be exposed to them through their diets.

Most pesticides are applied while plants are still growing, sometimes even before they emerge from the ground. Nevertheless, minute traces or residues of pesticides may persist on the surfaces of fruits and vegetables, and sometimes within the food itself. Improvements in science now enable us to detect residues, by chemical analysis, in or on food at very low levels. Residues from agricultural uses of pesticide may occur in crops after they are harvested, and sometimes even in food commodities after they have been processed or cooked. Residues may also be found in the meat and milk of animals fed pesticide-treated commodities. One of EPA's main responsibilities in relation to food safety is to ensure that the low-level pesticide residues remaining in our food supply do not pose unreasonable risks to the public.

Nearly all pesticides, by their very nature as pest-killing or pest-repelling agents, are inherently toxic, and too much exposure to them can be harmful. Therefore, before approving a pesticide for use on a food crop, the Agency requires that it be tested for both short- and long-term health effects. The Agency also requires that studies be performed to determine what residues of the pesticide may remain on the food. Short-term effects include skin and eye irritation, some nervous-system effects, and acute poisoning. Testing for intermediate and long-term effects evaluates the potential for such health hazards as cancer, birth defects and other reproductive disorders, and adverse effects on the nervous system or other organs.

In addition, EPA requires data on the potential harmful effects of the pesticide on non-target species, such as birds, and on what happens to the pesticide in the environment after it is used—for example, whether it contaminates ground water. As many as 100 separate tests could be required on a food-use pesticide, costing the company performing the tests $10 million or more.

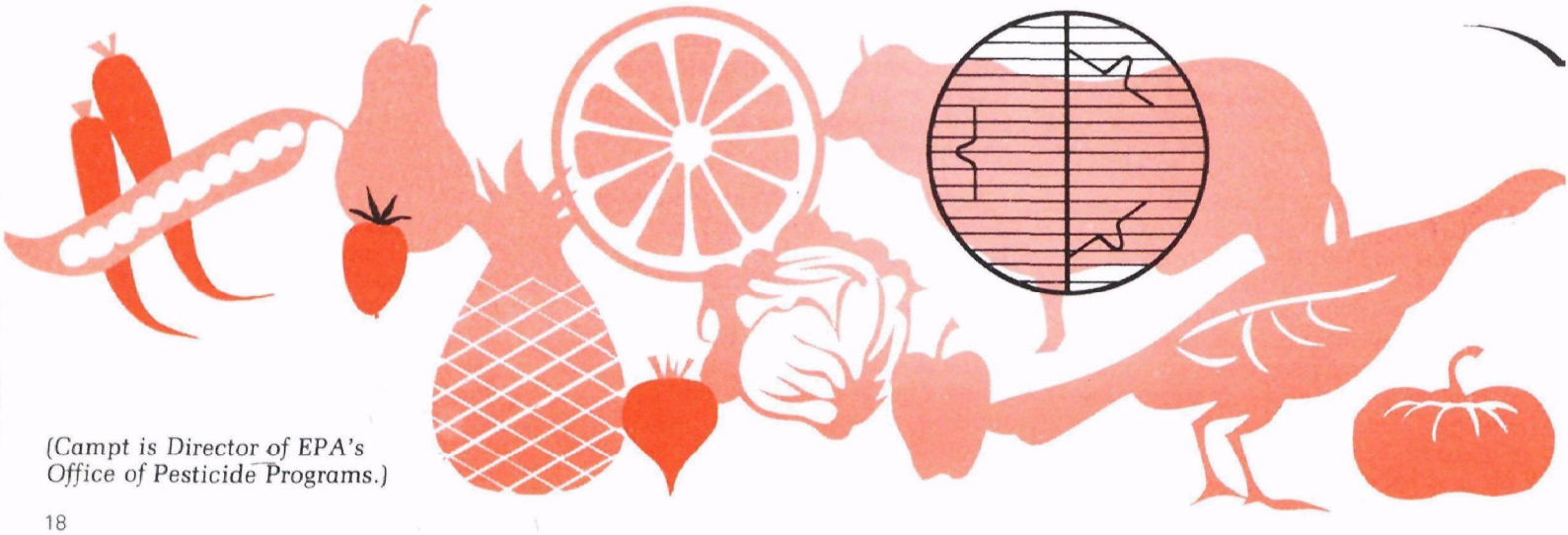
EPA considers two characteristics in evaluating the safety of pesticides used in producing food: toxicity—the harmful effects that the pesticide is capable of causing; and dietary exposure—how much of the pesticide people will be exposed to through the food they eat. This holds true whether EPA is considering the registration of a new pesticide or reassessing the safety of an "old" agricultural pesticide. (See box.)

Toxicity

A pesticide's potential for causing adverse health effects is identified through a battery of short-term or "acute" and long-term or "chronic" toxicity testing. In several series of tests, laboratory animals are exposed to different doses of a pesticide to determine the lowest dose that will cause harm. EPA scientists then evaluate the tests to find the highest level of exposure which did not cause any effect in any of the tests available: In scientific parlance, this is called the "No Observed Effect Level," or NOEL.

When evaluating pesticides for potential effects other than cancer, the Agency divides that level by an uncertainty factor, usually 100 or more, to determine what is called the Reference Dose (RfD), also known as the Acceptable Daily Intake (ADI). At or below this level, it is assumed that daily exposure over a lifetime will not pose significant risks to a person's health.

In addition, the Agency routinely requires multi-year feeding studies in two species of laboratory animals to screen pesticides for cancer effects. When any evidence of cancer arises in these animal studies, no matter what the dose, it is assumed that *some* risk may occur from exposure to *any* amount of the pesticide. The size of the risk



(Campt is Director of EPA's Office of Pesticide Programs.)

Reassessing "Old" Pesticides

In an ideal world, all pesticides sold today would be as fully tested and evaluated as if they were brand-new products just entering the marketplace. However, that is not the case because many existing pesticides were originally licensed for use before current standards were established under U.S. pesticide law.

To address the "old chemicals problem," Congress has enacted, beginning in 1972, a series of amendments to the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) setting requirements for the review and "reregistration" of all existing pesticides—some 600 chemicals contained in 25,000 registered products. Most recently, the 1988 FIFRA amendments established an accelerated reregistration program and authorized the collection of fees to support pesticide reregistration.

EPA is deep in the process of revisiting all of these previously registered pesticides, applying the same scientific and regulatory standards used in the Agency's pre-market reviews of new pesticides. Intensive scientific reviews have been done on the approximately 200 pesticides that account for most pesticide use in the United States, including 90 percent of agricultural pesticide use.

Under FIFRA, pesticide manufacturers are responsible for developing and submitting all test data required by EPA for reregistration. For virtually all pesticides, manufacturers have now satisfied or will soon have satisfied all of EPA's requirements for long-term health effects studies. However, for nearly all of these older pesticides, some additional testing is necessary before the decision process can be concluded.

For all existing agricultural chemicals, EPA is not only reviewing their registration status but reassessing established tolerances (residue limits) to make sure they meet current food safety standards. In a manner of speaking, this means "walking backward" through the dietary risk assessment and tolerance decision process. If dietary risk concerns or other problems are discovered during a routine review, EPA starts an intensive Special Review of the pesticide's risks and benefits to determine what regulatory action may be warranted.

depends on the amount of exposure.

Since people get only minute amounts of pesticide residue in their food, scientists believe that the risks are generally very small. EPA applies a "negligible-risk" standard to pesticides that may be cancer-causing. In other words, the standard EPA strives to achieve for any food-use pesticide is a theoretical cancer risk no greater than a risk in the range of one in a million over the average person's 70-year lifetime.

(See box on p. 20, "Understanding Cancer Risk Estimates.")

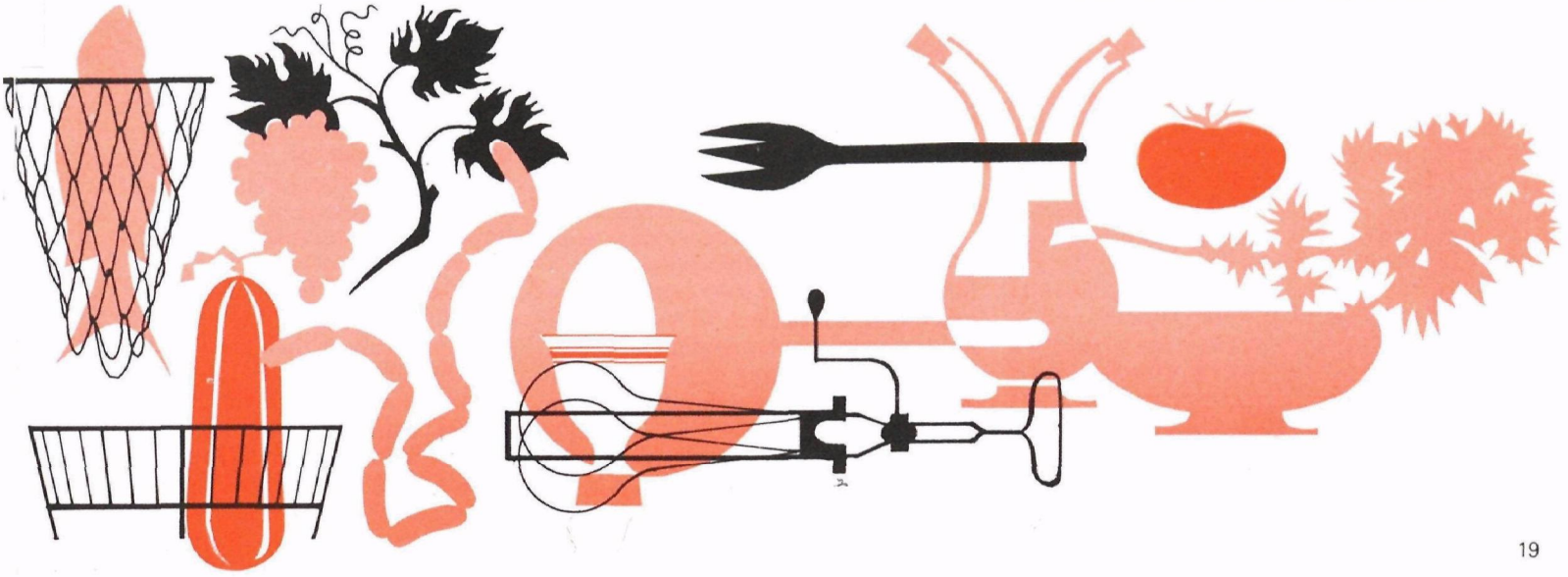
Dietary Exposure

The amount of a pesticide that people are exposed to through their diet depends on two factors: the amount of the pesticide remaining on various foods when they eat them, and the quantity of these foods that they eat. To estimate amounts of residue in particular foods, EPA uses data from residue samples from crops in the field, harvested crops, foods in warehouses or trucking transfer stations, and foods in retail stores. The quantity of foods that people typically eat is determined through surveys periodically conducted by the U.S. Department of Agriculture (USDA).

Field Residue Data. EPA uses data from field tests in setting tolerances for pesticide food uses. The tests are conducted on growing food crops using the highest application rates allowed by the pesticide product label. Crops are harvested and tested to determine the amount of residues present at harvest.

EPA also needs to know what happens to residues of the pesticide as foods are processed and cooked. Do the residues decline, or do they concentrate? Do they break down into harmless by-products or into other, harmful forms? If residues are found to build up or concentrate during cooking or processing, special "food additive" tolerances may be set, but only if the more highly concentrated residues are judged to be safe.

The large majority of pesticide tolerances (maximum residue limits) set by EPA are based on residue levels found on crops as they are harvested—in other words, at the "farm gate." However, experience shows that the pesticide residues in most food commodities when they are eaten are well below the tolerance. This is partly because the tolerance is based on the maximum application rate allowed, which often is not used by growers. Also, residues of most pesticides

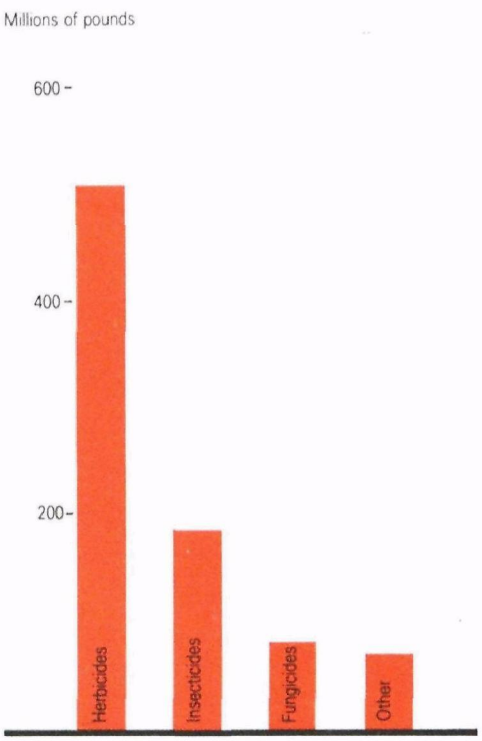


decline over time as the food moves through the chain of commerce from farm to grocery store; washing, processing, and cooking foods further reduces most residues.

Thus, while tolerances define the residue level that is appropriate for enforcement by the Food and Drug Administration (FDA) and USDA, they are not a realistic indication of the amount of pesticide residue actually remaining on ready-to-eat foods. When EPA needs a more realistic estimate of actual dietary exposure—for example, to re-evaluate the safety of an existing pesticide—the Agency turns to other types of information, usually monitoring data.

Residue Monitoring Data. Data showing the levels of pesticide residues actually occurring in foods as they are harvested, processed, marketed, and prepared to be served are vital to EPA in ensuring that existing pesticides are being properly used, and in re-evaluating the safety of these existing pesticides. Monitoring data provide a realistic estimate of the levels of pesticides on food when it is sold to consumers; monitoring results are also used to estimate the actual levels that occur in food when it is prepared and ready to be eaten.

U.S. Agricultural Pesticide Usage, 1988



Monitoring of pesticide residues in the food supply is conducted at various points: from samples taken at the farm gate immediately after harvest, to surveys of food in the grocery store, to samples of prepared food. Grocery store surveys are called "total diet studies" or "market basket surveys."

EPA sometimes requires pesticide manufacturers to perform monitoring studies. Monitoring data are also sometimes available from FDA, USDA, and state agencies. These agencies conduct inspections and analyze samples of both domestically produced and imported shipments of foods to ensure that EPA-approved tolerances are not being violated.

Estimating Food Consumption

The second part of the Agency's calculation of dietary exposure to pesticides involves estimating the amount of food people eat. EPA starts with the Nationwide Survey of Individual Food Consumption conducted by USDA, which reveals the types and amounts of food people consume over the course of several days. Participants include people from all age groups, different parts of the country, and different ethnic groups. Thus, the survey takes a "snapshot" of the eating habits not only of the general population, but also of 22 different subgroups such as children, Hispanics,

Understanding Cancer Risk Estimates

Government statements about cancer risks are often alarming and difficult to understand. However, while they may *sound* like mumbo-jumbo, these statements have been carefully framed to describe the outcome of a complex process without oversimplifying the facts. For example, have you ever read a statement like the following—and wondered what it meant?

> *"EPA considers chemical X to be a possible human carcinogen and estimates the upper-bound lifetime dietary risk of cancer to be one in a million."*

EPA uses this kind of statement to describe the cancer risk of pesticide residues on food. The statement has three elements:

- *The quality* of the cancer risk evidence: "X is a *possible* human carcinogen"
- The *type* of risk assessment being presented: "*upper-bound, lifetime, dietary* risk of cancer"
- The *size* of the risk: "*one in a million.*"

Try thinking about cancer risk projections as something like long-range weather forecasts. The analogy is not perfect, of course, but both endeavors use limited information in trying to predict what may happen some time in the future.

Qualitative Evaluations of Carcinogenicity. Predicting whether a chemical will cause cancer is a little like predicting whether Washington, DC, will have snow five years from now. Based on past history, a weather forecaster might call January, February, and December "probable snow months"; and March, April, October, and November "possible snow months." May through September would probably be considered "unlikely snow months." Any of these predictions involves uncertainty: It *might* snow in September; it might *not* snow in February.

In a similar way, EPA assesses scientific information to predict the cancer risk of a pesticide in terms of one of five qualitative categories: Group A: Human Carcinogen; Group B: Probable Human Carcinogen; Group C: Possible Human Carcinogen; Group D: Not Classifiable (insufficient information); Group E: Evidence of Non-Carcinogenicity for Humans.

Before assigning a pesticide to one of these groups, EPA first looks for any direct evidence that the pesticide causes cancer in humans. For example, a study showing that workers who manufacture the pesticide have a significantly higher rate of a particular cancer than the average population would constitute such direct evidence. However, these studies, called epidemiology studies, seldom are available because they are difficult to

pregnant or nursing women, people in the Southwest United States, and so on.

The USDA data confirm what many parents observe each day—that infants and children consistently eat more food in proportion to their size and body weight, and more of certain types of food, than the rest of the population. Therefore, the daily exposure of infants and children to pesticide residues will generally be higher than that of adults, at least for the foods most often consumed by children. This higher-level exposure is maintained only for a relatively short time—less than two years as opposed to an entire lifetime; however, when performing dietary exposure calculations, EPA still looks specifically at how the eating habits of children can affect their exposure to pesticides.

The food consumption information available from USDA describes foods as they are eaten, for example, fried chicken, pizza, chocolate cake, etc. To make use of this information, however, EPA must translate the data on food as eaten into information on the separate ingredients (or individual raw agricultural commodities) in the prepared foods; for example, how much wheat flour, egg, sugar, and so on is in chocolate cake. To do this, EPA uses its "recipe files," which contain standard recipes for hundreds of different kinds of foods. Our pizza recipe, for instance,

perform. Epidemiology data are nearly always necessary to assign a chemical to Group A.

Assignments to Groups B and C are based primarily on the results of animal tests—usually studies in which rats and mice are fed the pesticide for two years beginning shortly after they are weaned from their mothers. Tissues from each animal are examined under a microscope for the presence of cancerous cells. Then the results for the groups exposed to the pesticide are compared to results for animals which were not fed the pesticide. If there is a significant difference in tumor incidence, scientists must make the difficult judgment whether humans will respond like rats or mice.

If the animal and other evidence is strong—such as tumors in both rats and mice—the pesticide is assigned to Group B—probable human carcinogen. Less compelling evidence leads to an assignment to Group C—possible human carcinogen. Group D is comprised of chemicals on which there is too little information to make a judgment. When there is no apparent link between a pesticide and cancer, EPA assigns it to Group E.

Types of Risk Estimates. Weather forecasters make a variety of predictions—forecasts for the next day and the next week, long-range forecasts for an entire season Some predictions are quite precise: a "high of 59." Others are more qualitative: "a 30-percent chance of rain" or "wetter than normal."

Like weather forecasters, EPA scientists develop different types of risk estimates, depending on the route and duration of human exposure that could occur. Dietary intake of pesticide residues in foods is one route of exposure; another route might be applicator exposure during mixing, loading, or application of the pesticide. EPA also considers the duration of each potential route of exposure: Is it for a lifetime or for a short period?

Always in predicting cancer risk, EPA makes "upper-bound" estimates. In other words, the estimated cancer risk is virtually the highest level of risk that EPA expects might occur. In all likelihood, the actual risk may be less; it could even be zero.

In terms of our extended analogy, an upper-bound estimate of lifetime cancer risk is something like an estimate of the amount of snow that will fall on January 17 five years from now. No sensible forecaster would give a precise estimate; more likely the forecast would describe a range: possible snow anywhere from two feet down to no snow at all. Two feet of snow represents a realistic upper bound of the "snow risk." Likewise, EPA presents an upper bound on cancer risk. But remember—just as there may be no snow, there may be no cancer at all.

Quantitative Estimates. Like weather forecasts, EPA's quantitative estimates of cancer risk are presented as probabilities: "There is a 50-percent chance of rain," or "the upper-bound lifetime cancer risk is one in a million." A 50-percent chance of rain predicted for tomorrow does not mean that rain will fall for half the day. Rather, it means that there is an equal possibility that it *will* rain at some time during the day or that it *won't* rain at all. Similarly, a dietary cancer risk of "one in a million" means that, at most, one out of every million people exposed to a pesticide over a lifetime could get cancer as a result.

Unlike weather forecasters, EPA almost never gets to see if its predictions about cancer risks hold true. Time frame is an issue here, since EPA's risk predictions cover the entire lifetime of the average person, estimated at 70 years—but not the only issue. Besides pesticides, other man-made chemicals and naturally occurring substances to which everyone is exposed during a lifetime may contribute to an individual's overall chances of developing cancer. And even when the disease occurs, pinpointing an exact cause is usually impossible.

Despite uncertainties, EPA's method of estimating cancer risk is useful because it enables the relative risks of different pesticides and other substances to be ranked so that the riskiest ones can be controlled.

reveals how much wheat flour, tomato, cheese, sugar, oregano, and so on, are in two slices of pizza. The exercise of "unbaking the pizza" is necessary because the pesticide residues in the pizza are the sum total of residues in the ingredients used to make the food.

Having thus reduced each food to its component ingredients, EPA then adds up a person's daily exposure to each basic ingredient. For example, EPA calculates from the survey how much flour a person consumes if, on one day, he or she eats a doughnut for breakfast, a sandwich for lunch, and a slice of cake at dinner. The Agency makes similar calculations for each of the hundreds of other basic food ingredients.

Estimating Dietary Exposure

The last step in EPA's analysis of people's dietary exposure to a pesticide is to combine the estimates of food consumption with information on residues of the pesticide in foods. For example, if a pesticide is used on both broccoli and carrots, EPA would calculate how much residue an average person gets from eating broccoli and how much from carrots. The two calculations would then be added to produce a dietary exposure estimate for the pesticide.

Evaluating Safety

As stated earlier, EPA's goal is to assure that the total amount of pesticide residue in the diet is at a level considered to be safe. This judgment is made by comparing the dietary exposure estimate for each pesticide with its Reference Dose (RfD) or Acceptable Daily Intake (ADI), or with the level associated with an estimated lifetime cancer risk in the range of one in a million.

If the dietary intake is less than the RfD or ADI, or poses a negligible lifetime cancer risk, the pesticide usually is considered safe for food use. If the dietary exposure exceeds the RfD/ADI, or poses a lifetime cancer risk that is greater than approximately one in a million, EPA generally attempts to reduce exposure to acceptable levels. If a new food use is under consideration, it will likely be denied unless the amount of pesticide to be applied can be reduced, thus lowering the residue levels remaining on foods. Similarly, for an existing food use, EPA will ask the pesticide manufacturer to find ways to reduce overall dietary exposure by modifying the pesticide's use patterns or dropping some uses from the product label. If sufficient exposure- and risk-reduction measures cannot be identified, EPA will likely cancel the food uses of the problem pesticide.

In view of this regulatory protection, consumers should not be reluctant to eat fresh fruits and vegetables, regardless of the latest "pesticide scare." A report issued by the National Academy of Sciences (NAS) in 1989 on diet and cancer concluded that there is no evidence that pesticides or natural toxicants in food contribute significantly to cancer risk in the U.S. In fact, the NAS recommended that people eat more fresh fruits and vegetables to avoid risks of cancer and other chronic diseases. Even though these foods may contain low levels of pesticide residues, NAS noted, any potential, small increased health risks would be greatly outweighed by the benefits to good health from greater consumption of fruits and vegetables. □

Food Safety Tips

Thanks to natural processes and the simple passage of time, residues of pesticides and their metabolites tend gradually but surely to decrease from "farm-gate" levels. This is generally true not only for surface residues, but also "systemic" residues of pesticides that work by being absorbed through the roots of growing plants and distributed to all parts including fruits and vegetables. In addition, pesticide residues are further reduced in the processes involved in preparing raw and processed foods for the market.

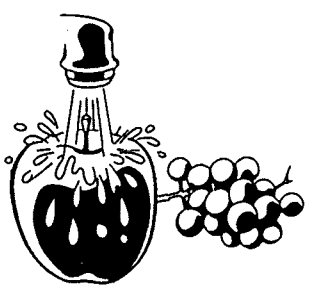
Nevertheless, there are steps consumers can take in preparing foods at home that will further reduce pesticide residue levels.

Surface residues of pesticides on fresh produce may be totally or partially removed by washing, peeling, or trimming the fruit or vegetable. Cooking can also help remove surface residues. Often, fresh produce has already been rinsed and trimmed to some extent by the time it is offered for sale to consumers. However, the home cook may still prefer to thoroughly wash produce with water and scrub pieces of fruit and individual vegetables with a brush.

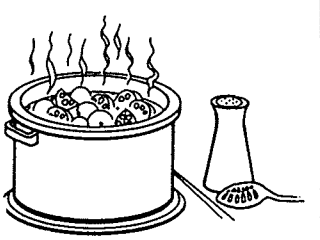
If produce can be peeled, this will also do a great deal to remove surface residues. The home cook may also want to throw away the outer leaves of leafy vegetables such as lettuce and cabbage, unless such trimming has already been done by the grocer.

Systemic pesticide residues inside fruits and vegetables can almost always be substantially reduced by cooking. As the high temperatures used in cooking transform the texture and flavor of raw food, they also accelerate the breakdown of any pesticide residues within it.

In short, three simple steps commonly involved in preparing fruits and vegetables—washing, peeling and trimming, and cooking—are not only basic culinary procedures but also contribute to the breakdown of pesticide residues.


Wash


Peel


Cook

The Life Story of a Tomato

by Joel Garbus, Susan Hummel, and Stephanie Willett

A pyramid of red tomatoes in the supermarket produce department; a basket of freshly picked, ripe tomatoes at a roadside stand: It's easy to picture a delectable salad or a tangy pasta sauce for dinner tonight. But what about chemical residues? Recently, a lot of attention has been focused on pesticide residues in foods, and these days nearly everyone is concerned about food safety.

In fact, the nature and amount of chemical residues that may remain in or on a ready-to-eat tomato or tomato product depend on a number of factors. Among other things, these include the particular chemicals applied, when and how often applications are made, the conditions under which the tomato plant is grown, and whether the tomato is fresh or processed. Tomatoes grown under "minimum tillage" practices, tomatoes grown in greenhouses, field-grown tomatoes from different regions of the country, "organically" grown tomatoes, canned tomatoes, tomatoes in pasta sauce: All may have different levels of different chemical residues, and some may have no detectable residues at all by the time they reach the dinner table.

The best way to gain perspective on what pesticide residues may remain in a tomato is to follow this commodity through its "life cycle." This article will do just that: trace the tomato in its path from seed to salad—or, alternatively, from seed to processing plant to spaghetti sauce or ketchup bottle or . . . .

Like other living things, tomato plants require specific conditions for optimum growth. Proper climate and soil, an adequate supply of required nutrients, and freedom from disease and predators are among these conditions. Why are agricultural chemicals (fertilizers and pesticides) widely used in tomato production? The answer is, in short, they are used to help ensure optimum conditions for growth in order to obtain a high yield of ripe, disease-free, and insect-free tomatoes as an end result.

The use of agricultural chemicals in crop production is really not so different from the dietary supplements many of us use to ensure that we have all the essential chemical ingredients we need to thrive: amino acids, carbohydrates, lipids, vitamins, and minerals, etc. Like tomatoes, we humans need different types and amounts of nutrients at different stages of our lives. Moreover, we may take chemicals (drugs) to help prevent diseases or cure them if we become ill. By the same token, it is important to note that, as with human health, there are advocates

(This is the second of two articles explaining "the basics" on pesticide residues and regulation. The authors are chemists in the Dietary Exposure Branch of EPA's Office of Pesticide Programs.)

Tomato seedlings are typically grown in soil that has been treated to render it free from tomato diseases.

of ways to grow crops without the use of synthetic chemicals. (For example, see box on page 33 describing standards for organic produce).

Cultivation practices differ by region, but the life history of a tomato typically begins with preparation of the soil in which tomatoes will be planted. Following the previous harvest, the land may have been cleared and allowed to remain dormant for two to three months. Common practice is then to enrich the soil with a fertilizer providing nitrogen, phosphorus, and potassium. Anywhere from 500 to 10,000 pounds of fertilizer per acre may be applied, depending upon local conditions. The chemical elements in this fertilizer are essential components of the tomato plant itself and are thus absorbed into all plant parts. During the growing season, additional nitrogen may be added.

In some regions, the soil may be contaminated with small organisms such as the golden nematode or eelworm or the seeds of undesirable plants. To control the weeds and the worms, the soil may be treated by injecting pesticides (weed- and worm-killers) into the soil before the new crop is planted. This kind of pre-planting soil treatment is something like sterilizing instruments before a surgical operation: The objective is to rid the immediate environment of detrimental living organisms.

Because the chemicals used as soil fumigants are volatile and thus readily vaporized, they are dissipated by the time the tomatoes are harvested. There are exceptions, but most pesticides, by design, are chemically unstable and therefore dissipate or break down into simpler molecules as time passes. This process may be accelerated in the presence of sunlight, moisture, heat, oxygen, or enzymes in plants or soil.

Tomato plants are started either in the fields directly from seeds or transplanted as seedlings started earlier

Selected Tomato Pests and Diseases

Alternaria Rot, a fungal disease of injured or weakened fruit, causing a ring of decay around stems and on the skin

Anthracnose, a fungal disease causing dark spots and pustules on ripe tomatoes

Bacterial Canker, a bacterial disease that causes a brown spot surrounded by a characteristic white halo

Bacterial Spot, which causes brownish-black scab-like lesions

Bacterial Wilt, caused by a soil parasite, Pseudomonas solancearum, resulting in plants that wilt

Buckeye Rot, which causes an irregular, chocolate-brown rot in ripe fruit

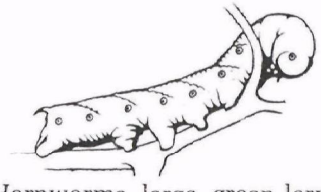
Catface, a disease of unknown causation resulting in irregular malformed fruit

Damping Off, caused by several fungi, causing the seedlings to shrivel and topple over

Early Blight, a fungal disease that affects stems, leaves, and fruit

Flea Beetles, small (1/16th-inch) jumping beetles that attack and severely damage young plants, especially transplants

Fusarium Wilt, a fungal disease that causes the yellowing and dying of tomato leaves



Hornworms, large, green larvae that are voracious feeders and quickly damage tomato plants

Late Blight Rot, which causes rust-tan pebbly blotches

Leaf Miners, small larvae that tunnel through leaves

During the growing season, tomato plants may be treated with pesticides as often as every five days.

Rhizopus Rot, a fungus that causes the total loss of the tomato

Root Knot, caused by nematodes

Stalk Borers, insects that bore tunnels in the stem of the plant

Stink Bugs, insects that suck the sap from the plant

Tomato Fruit Worms (also known as the cotton boll worm and the corn ear worm), which bore into and destroy the interior of the fruit

Tomato Russet Mites, invisible to the eye, which cause a progressive bronzing of the color of the plant and fruit

Verticillium Wilt, a fungal disease that causes yellowing and wilting of foliage

Viral Diseases, including Tobacco Mosaic, Cucumber Mosaic, Single Virus Streak, Double Virus Streak, Spotted Wilt, and Curly Top.

in greenhouses or outdoors. The seeds themselves may carry destructive tomato diseases, so seeds are sometimes treated with chemicals before they are sown. Studies have shown that chemicals used as seed treatments generally do not result in detectable residues in mature tomatoes.

Tomato seedlings are typically grown in soil that has been treated to render it free from tomato diseases. In addition, the seedlings themselves may be treated with chemicals such as the antibiotic streptomycin. Six to eight weeks are generally required to produce plants large enough for transplanting.

To lessen the shock to the seedlings when they are moved from a heated greenhouse environment to outdoor fields, the seedlings are conditioned ("hardened") before transplanting. This means lowering their surrounding temperature and giving them less water and more ventilation for a period of three to 10 days.

At planting, nutrients and herbicides may be added to the soil along with the seeds or seedlings. The nutrients provide additional sustenance for the young plants, while the herbicides inhibit the growth of weeds that could deprive the tomato plant of these same nutrients. Tomatoes grown for the fresh market are typically staked to help preserve their shape and overall cosmetic appearance. Tomatoes grown for processing are often allowed to grow on the ground.

Tomato plants thrive best under clear, dry conditions, in a temperature range of 65 to 85 °Fahrenheit. In high temperatures and high humidity, tomatoes become increasingly vulnerable to diseases of the foliage. Tomatoes are in fact subject to many viral, bacterial, and fungal diseases; they also host a considerable number of invertebrate pests. (For a partial list of these, see adjacent box.)

In U.S. agriculture, the tomato is very important among fruit and vegetable crops—second only to potatoes in dollar terms. Given the many diseases and pests that this valuable crop is heir to, it is not surprising that many pesticides have been developed to protect tomatoes from diseases and other pests. Moreover, like the organisms that cause human diseases, weeds and pest organisms may become resistant to toxic agents. In medicine, new therapeutic agents are developed to compensate for this problem. For use in agriculture, additional pesticides are developed to combat resistant pests. To help circumvent pesticide resistance problems, agricultural researchers are also working to develop additional pest-resistant crop strains.

Currently, about 80 chemicals are registered for use on tomatoes. These include chemicals for pre-planting, pre-harvest, or post-harvest use as herbicides, nematicides, acaracides, insecticides, or fungicides. In general, herbicides are used to control weeds and other noxious plants; acaracides control mites; nematicides are used to combat nematodes, small worms that inhabit the soil and cause serious damage to the root systems of plants; fungicides prevent or inhibit the growth of the fungi that are responsible for the fungal diseases that afflict plants and animals; and insecticides control detrimental insects that attack and damage plants and animals.

During the growing season, tomato plants may be treated with pesticides as often as every five days. The nature, amount, and timing of the pesticides applied depend on many considerations: the particular diseases or pests to be controlled, the stage in the tomato's growing cycle, the effectiveness of the pesticide under local conditions, and the economic tradeoff between the

cost of the pesticide and the potential increase in yield to be derived from using it. Even though roughly 80 chemicals are approved for use on tomatoes, in reality only four or five chemicals are normally used in the production of a given tomato crop. As in other areas of agriculture, many tomato growers use Integrated Pest Management strategies to avoid unnecessary use of pesticides.

Three to four months after planting, tomatoes are ready for harvesting. Tomatoes harvested for the fresh market are picked by hand when they are mature but still firm. Picking, packing, and handling must be done with care to minimize physical damage. Bruised, torn, or cracked skin not only makes tomatoes aesthetically unappealing but renders them more vulnerable to fungal and bacterial infections.

From the fields, fresh-market tomatoes go to packing sheds where they are added to a vat of water. Water and conveyor belts carry the tomatoes through the packing shed, where they are weighed, inspected, graded, and sorted. After the tomatoes are washed, fungicides and waxes are applied to prevent decay and shriveling of the fresh fruit. Fungicides are used during packing procedures to protect the tomatoes from fungal disease during shipping, ripening, and storage.

Chemical residues from these post-harvest fungicide applications are regulated by EPA tolerances (maximum legal limits) in the same way that EPA regulates residues from pre-harvest pesticide applications. The tomatoes are cooled promptly and kept under controlled temperatures during shipment and distribution, at 55 to 65 ^{0}F.

Tomatoes grown for the processing market follow a somewhat different itinerary. Unlike fresh-market tomatoes, process-market tomatoes are mechanically harvested when they are fully vine-ripened. They are then transported to processing plants, where they are graded, sorted, and dumped into a running stream of water in a trough. This washing removes most surface residues from the tomatoes as they are conveyed through the plant.

About 50 percent of processed tomatoes are peeled and canned. To facilitate peeling, tomatoes are typically exposed to steam or a hot lye solution that loosens the skin so that it is easily rubbed off. This procedure has the effect of further reducing surface residues of pesticide. The peeled tomatoes are then canned and sterilized, again reducing remaining chemical residues.

Another 40 percent of processed tomatoes are converted into tomato juice. The remaining 10 percent are converted into tomato pulp that is used to make tomato puree, tomato paste, tomato-based sauces, and ketchup.

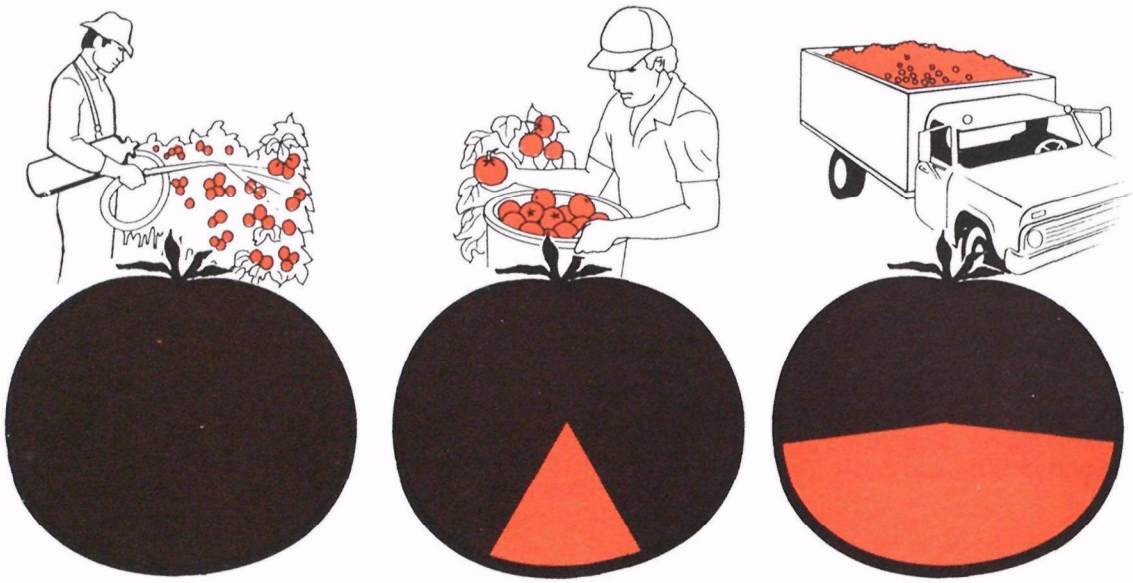
Tomatoes which are rejected as unsuitable for either the fresh or processing markets may be used as animal feed, together with the skin, pulp, and seeds that are waste products of tomato processing. In this way, pesticide residues contained in harvested tomatoes may be consumed by animals that produce meat and milk. Therefore, EPA routinely sets tolerances for pesticide residues that may occur

Fungicide Residues in Toma

Fungicide X, a hypothetical pesticide, is one of approximately 80 chemicals registered for use on tomatoes. The legal tolerance for residues of this fungicide in or on tomatoes is 5 parts per million (ppm).

Recent residue data on Fungicide X in tomatoes come from four studies—two conducted in California, and two in Florida—designed to measure actual residues of the fungicide in fresh tomatoes as they leave the field, and as they are eaten. During the growing season, growers applied Fungicide X at their discretion in accordance with label directions for weather conditions, rates of application, harvesting schedules, etc. The last application was made 24 hours prior to harvest, which is the minimum "pre-harvest interval" allowed by the label.

To trace changes in residue levels between the farm gate and consumption, residues were measured in the treated tomatoes at three stages: immediately after harvest, as the tomatoes left the packing house, and as they were marketed in stores or restaurants. At the packing house, following standard procedures, the tomatoes



Following the last pesticide application before harvest, residues are at their maximum, up to tolerance levels set by EPA. As tomatoes and other produce move through stages from the farm gate to the dinner plate, residues tend to be reduced considerably. This process is aided by the passage of time and exposure to light—as well as washing, cooking, and other food-preparation procedures.

oes: A Case Study

were washed, dried, sorted, graded, waxed, and packaged. The tomatoes were subsequently shipped to grocery stores or restaurants.

The chart shows the effect of each of these steps on residue levels. All post-harvest "farm gate" residues in tomatoes in these studies were well below the tolerance level of 5 ppm. There was little or no detectable residue of Fungicide X in tomatoes by the time the commodity reached the consumer. In fact, over 99 percent of residues were removed during washing at the packing house.

Tolerance Versus Actual Residues Measured on Fresh Tomatoes

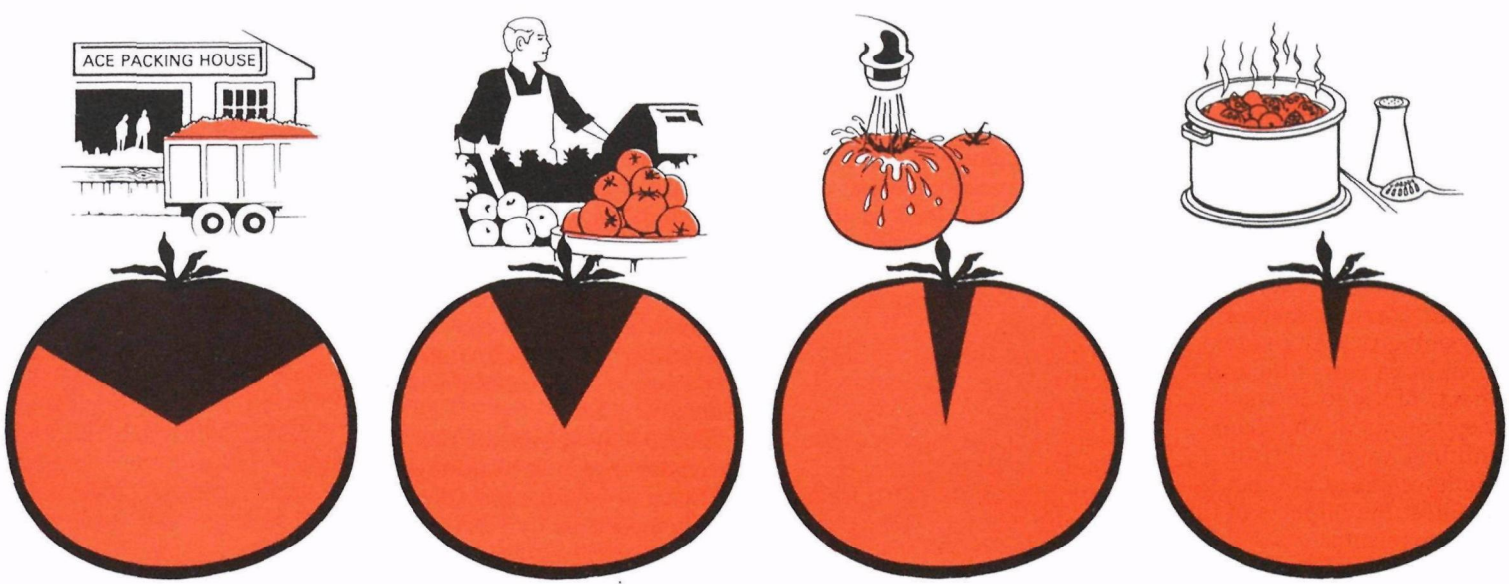
Established Tolerance	5.00 parts per million (ppm)
Average Residue (All Test Samples)	2 ppm
Actual Residues in Field	>1 ppm
—At Packing House	0.01 ppm
—In Grocery Store or Restaurant	not detectable

not only in fresh tomatoes and processed tomato products, but also in tomato-derived animal feed and in the meat and milk from animals fed this feed.

For tomatoes and tomato products, as for other food and animal-feed commodities, tolerances are set at levels no higher than necessary to account for pesticide applications according to EPA-approved label directions. EPA's tolerances are based on a very conservative set of assumptions including: that each pesticide is applied at the maximum *rate* allowed by the label, the maximum allowable *number* of applications are made, and only the *minimum permissible interval is* allotted between applications. EPA applies these basic assumptions in setting tolerances whether the pesticide is intended for pre-planting, pre-harvest, or post-harvest application.

As discussed elsewhere in this issue of *EPA Journal*, tolerances are intended to apply to treated agricultural commodities when they first enter into commerce, starting "at the farm gate" (see feature on p. 18). By definition, tolerances represent residue levels that are protective of public health. As our tomato story suggests, however, pesticide residues are generally reduced at each step between the farm gate and the dinner table so that they are often well below tolerance before the commodity reaches the consumer. And in a majority of cases, washing, peeling, and home cooking of foodstuffs also serve to reduce any remaining residues in consumer foods.

As a practical matter, tolerances thus represent "upper limits" of pesticide residues that rarely occur in ready-to-eat food commodities. □



A Forum:

Are Children at Greater Risk?

Are children at greater risk than adults from dietary exposure to pesticide residues? EPA Journal posed this question to several observers who have different vantage points on the issue. Their responses follow:

Grant Heilman Photography.

Robin Whyatt

No one can responsibly deny that pesticides in food pose a greater risk to children than to adults. Children's exposure is greater because they consume more food, and thus more pesticide, relative to their weight. Their immature physiologies may render them more susceptible to the effects of the toxic chemicals they consume. Moreover, children have their full lifetimes ahead of them to manifest the impacts of this early exposure.

Pound for pound, children eat more than adults do. This is no news to parents. Children are growing, and they have a high rate of metabolism. Using data from a recent federal survey of actual food intake, the Natural Resources Defense Council (NRDC) has calculated that, relative to their weight, young children out-consume adult women two to six times for all major food groups. Fruit is a particular favorite. Relative to weight, preschoolers eat six times as much fruit as adult women, including seven times as many grapes and apples and 18 times as much apple juice.

Unfortunately, the more food kids eat, the more pesticide they also take in. Monitoring programs of the Food and Drug Administration (FDA) found in 1987 that 23 percent to 50 percent of samples in the six food groups tested contained detectable levels of pesticides, with fruit showing the highest contamination rate.

EPA has recognized that "estimated (pesticide) exposures are invariably highest in the infant and child subgroups" and has found that dietary exposure of infants can exceed that of adults by up to 17 times. In evaluating 23 pesticides last year, NRDC estimated that the rate of exposure for preschoolers to the majority of these pesticides was on average four or more times greater than the rate for adult women. For some of the pesticides, the preschooler exposure was 10 to 18 times the adult rate.

These exposure estimates are more than just troubling. Looking at average residue levels measured by FDA monitoring of fruits and vegetables, NRDC has estimated that at least 17 percent of one- to five-year olds or roughly three million preschoolers are being chronically exposed to organo phosphate insecticides at levels above those EPA considers acceptable. Both NRDC and EPA have estimated that preschooler exposure to carcinogenic (cancer-causing) pesticides (including daminozide) presents unacceptably high health risks. EPA has initiated regulatory action to eliminate daminozide use.

And there is more to the problem than greater exposure. Because of their physiological immaturity, the young may be more susceptible than adults to the toxic effects of pesticides. This is particularly true for carcinogens that damage DNA and initiate the carcinogenic process: Cancer is initiated more readily during periods of rapid cell division such as occur in infancy and early childhood.

Furthermore—and this is especially important due to cancer's long latency period—the young have many years of life expectancy during which cancer initiated in childhood can become manifest. Based on the high rate and early timing of exposure in children, NRDC has estimated that 50 percent or more of a person's lifetime cancer risk from consumption of certain carcinogenic pesticides in fruit occurs during the first five years of life.

The real question is not whether children's risk is greater than adults, but only why it has been tolerated so long. □

(Whyatt, who is a principal author of Intolerable Risk: Pesticides In Our Children's Food, *is a scientist for the Natural Resources Defense Council.)*

Wayne Smalligan

Infants and young children are a special point of concern regarding the effects of pesticides; therefore, it is important to focus on the facts available so as to calm the emotional response.

There are reasons for this concern. The infant's diet begins with a single food (breast milk or formula) and gradually expands to include a limited number of specific foods—primarily cereals, fruits, and vegetables. During this time, caloric intake per body weight and resulting growth are greater than at any other time in life. The early years are also formative in the development of certain body tissues.

On the other hand, there are some reassuring facts. No food is more carefully prepared and regulated than that which is processed for infants and young children. As an example, Gerber agricultural specialists work closely with contract growers to minimize pesticide application and forbid the use of certain chemicals. Monitoring data on the produce at the farm gate show that detectable pesticide residues are only a small percentage of levels allowed by EPA tolerances.

Moreover, the preparation of ingredients (cleaning, hulling, washing, peeling, blanching, etc.) by the food processor further reduces, and often eliminates, any remaining pesticide residue. Using the latest analytical techniques, baby-food processors have gathered extensive monitoring data on their own products. These data show that, most of the time, residues are not detectable in the final product. In addition, the National Food Processors' Association and the Infant Formula Council have compiled an extensive industry-wide data bank which shows that pesticide residues are usually undetectable in processed foods including baby food.

Other reassuring data come from the California Department of Food and Agriculture, which recently reported that 90 percent of samples of produce earmarked for processing had no residue detected. In addition, the Food and Drug Administration's Total Diet Study for 1988 reported that pesticide exposures for infants seldom exceeded one percent of Acceptable Daily Intake levels established by the World Health Organization, which include a 100-fold safety factor.

Even though the current data indicate minimal exposure, the food industry, the agricultural chemical industry, government agencies, and universities continue research on Integrated Pest Management and Low-Input Sustainable Agriculture in efforts to further reduce the amount of pesticides used. Meanwhile the baby-food industry continues to be very strict in dealing with pesticides. Our goal is a baby food and formula supply with no detectable pesticide residue. □

(Smalligan is Director of Scientific Services for Gerber Products Company.)

Bruce N. Ames

There is no convincing evidence that children are more at risk from pesticides than adults. This holds true even though children's intake of pesticides per kilogram of their body weight is about double that of adults.

Synthetic pesticide residues do not present a significant risk to either children or adults. In general, fear of pesticides is based on a misinterpretation of animal cancer test results. Consider the following:

- Animal cancer studies are conducted with enormous doses of the test chemical: the maximally tolerated dose *that does not kill the animals* outright. New evidence suggests that effects triggered by these very high doses—chronic cell killing and cell division—are risk factors for cancer. In other words, it is the high dose itself that causes cancer.

  Thus, a high percentage of all chemicals might be expected to be carcinogenic at maximally tolerated doses. This is exactly what is found. About half of all chemicals tested in chronic studies at these massive doses are rodent carcinogens.

- Of the chemicals that have been subject to testing for carcinogenicity in rats and mice, 82 percent are synthetic—despite the fact that almost all chemicals in the human diet are natural. Therefore, it is important to determine whether a high percentage of natural chemicals is also cancer-causing at high doses.

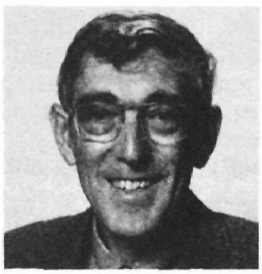
  My colleagues and I have analyzed pesticides in detail, and we calculate that 99.99 percent (by weight) of the pesticides in the human diet are naturally occurring chemicals that plants produce to defend themselves. Only 50 natural pesticides have been subject to cancer testing, and again about half (27) are rodent carcinogens; these natural pesticides are present in most common foods.

  Adults eat about 1,500 milligrams of thousands of these chemicals per day; this compares to 0.09 milligram of about 100 synthetic pesticide residues. Of the natural mold toxins that have been tested for carcinogenicity, 11 out of 16 are carcinogens, including aflatoxin.

  In addition, from cooking our food, we eat thousands of chemicals that add up to about 2,000 milligrams per day. For example, only 12 chemicals in roasted coffee have been tested; nine are carcinogens, totalling 9 milligrams per cup.

  Our tiny exposures to pesticide residues should be compared to an enormous background of natural substances. My colleagues and I conclude that natural and synthetic chemicals are equally likely to be positive in high-dose animal cancer tests and are similar in their toxicology. We also conclude that at the low doses of most human exposure, where cell-killing does not occur, the hazards may be much lower than is commonly assumed and will often be zero. Evidence from both epidemiology and toxicology suggests that synthetic pesticide residues are not likely to be a significant cause of cancer.

- The important consideration is that synthetic pesticides have markedly lowered the cost of plant foods, thus increasing consumption. Eating more fruits and vegetables is known to prevent cancer. The vitamins, antioxidants, and fiber that come from plants are anticarcinogenic. □



(Professor Ames is Director of the Environmental Health Sciences Center at the University of California at Berkeley and a member of the National Academy of Sciences.)

Lynn Goldman

Children are the most vulnerable members of society. They face many health threats in the environment that they can do nothing to avoid. Among other things, these include second-hand tobacco smoke, lead poisoning, car accidents, and occupational hazards at their part-time jobs.

Parents can minimize some risks by taking personal action, such as buying car seats and not smoking near their children. But some threats to children's health can be reduced only through government action. One such hazard is pesticide contamination in food, which is unnecessary and preventable.

Members of the Committee on Environmental Hazards of the American Academy of Pediatrics believe that no child should be at risk from the chemicals used as pesticides on the food he or she eats. Children are more vulnerable to pesticide contamination than adults. Because children are growing, they eat more food in proportion to their body weight than do adults—including more of the fruits and vegetables which contain the highest levels of pesticides.

In addition, a much higher percentage of the food children eat consists of fruits and fruit juices because most parents insist that their kids eat more of these foods than is typical of the adult diet. Consequently, children receive a much heavier dose of pesticides in proportion to their body weight than do adults.

Members of the Committee on Environmental Hazards think that allowable levels of pesticides in food should be set so that all children, even those who consume particularly large amounts of fruits and vegetables (such as children on a vegetarian diet) do not receive unhealthy amounts of the chemicals. In other words, a vegetarian child should safely be able to eat whatever diet suits her or him. When the legally allowable amounts of pesticides—the pesticide food tolerances—are added up for all the foods a child might eat on a given day, the total should be less than the Acceptable Daily Intake established for that chemical.

Pesticide producers argue that there is no need for concern because pesticide residues in food are far less than are legally allowed. For three reasons, this just isn't true.

First and foremost, current methods of testing foods for pesticides are not accurate. They measure pesticide levels in samples drawn from a small fraction of all the farms growing fruits and vegetables. This is like using a microscope to view a landscape. As a result, the actual levels of pesticide found in each food item are uncertain. It was recently discovered, for example, that aldicarb, an extremely toxic insecticide, was present in individual potatoes at levels that could easily make a child very ill.

Second, as more is learned about the capacity of pesticides to cause cancer, birth defects, damage to the nervous system, and other health problems, it is clear that many existing pesticide limits are not strict enough. In some cases, as with daminozide (Alar), which was used on apples loved by children, the product simply should not be used in food production.

Finally, the purpose of the pesticide regulatory system is to assure the public that the food supply is safe. There is no point in setting limits for these substances if, when the amounts of allowable pesticide are added up, the result is sometimes hundreds of times above the level that EPA's own scientists have declared unsafe. This has happened with many of the fungicides; examples include the EBDCs and captan.

The message from children and their pediatricians is this: The legal limits of food chemicals must be set at a level low enough that every citizen, young or old, vegetarian or not, can consume the diet he or she chooses and still not receive an unsafe dose of pesticides. □

(Dr. Goldman is a pediatrician and a member of the Committee on Environmental Hazards, American Academy of Pediatrics.)

John A. Krol

At Du Pont we ask ourselves tough questions like this one as we continually evaluate the margin of safety of each of our products. This particular question must be answered on a case-by-case basis.

Based on toxicology assessments, we have found that with some substances, children and infants could be at greater risk than adults unless appropriate safeguards are set. For other substances, children could be at lesser risk.

Du Pont shares the public's concern for food safety. We are concerned about minimizing any possible risk associated with the use of pesticides, and we are committed to the ethical management of this potential risk for all people—including infants and children.

We believe the current EPA regulatory process provides safeguards to minimize risk in the diets of infants and children. We are committed to meeting these standards. We try to exceed these standards by minimizing risk further than the standards currently require. The Agency's health and safety requirements take into account that children and infants may eat comparatively more of certain foods than adults. By using margins of safety, pesticide-use restrictions are defined so that possible residues on food do not approach a level where there could be a health concern to any segment of the population.

Du Pont is promoting a better understanding of risk assessment through scientific forums and appropriate research: We are conducting in-depth studies to determine more accurately the levels of dietary residues throughout the food chain and developing improved tools for monitoring pesticide residues.

We share the public's value for affordable, plentiful, and nutritious food. Crop-protection products allow Americans to safely enjoy the health benefits of a year-round supply of produce.

The agricultural community continually looks for crop-protection products with higher margins of safety and ways to more effectively assess their safety. We continually evaluate our products using the latest technologies and taking responsible actions to ensure appropriate margins of safety are maintained.

Du Pont firmly believes that, through evolving technology, we can attain the twin goals of supplying affordable and abundant foods while safeguarding public health and protecting the environment. □

(Krol is Group Vice-President, Du Pont Agricultural Products.)

A Future for Pesticide-Free Foods?

by Roy Popkin

Do Americans' concerns about food safety mean that consumers are willing to pay higher prices for organically grown, pesticide-free food products? EPA Journal put this question to a number of people with first-hand knowledge in the marketing of "organics." Here is what they said.

Raymond Lane, Food Editor, *Times-Journal Newspapers*, Springfield, Virginia, has published several articles on organic foods. Based on reader calls, he believes those who are willing to pay more for organically grown foods are "those who are more knowledgeable about nutritional and environmental matters. The others are not really interested in the subject.

"What we really need is more promotion and education. Neither our paper nor the *Washington Post* devotes a lot of space to the subject, and food pages don't get the attention that other sections of a paper might receive because in many parts of the country they are little more than recipe sources. The lack of knowledge is not surprising because there hasn't been much sign of national leadership interest in the subject. If President Bush said he would eat broccoli if it were organically grown, there'd be a run on the stuff."

The United Fresh Fruit and Vegetable Association's scientific director, **Dr. Jill Snowdon** says, "At this time, people are not willing to pay more than they are already paying for fresh produce." The association represents primarily commercial growers and distributors but would also like members of the organic farming community to join the association.

"Right now," she continues, "we see the demand for organic produce as a specialty, or 'niche' market. But if the public really wants organic produce, the industry is willing to provide it if possible. I say *if*, because organic farming is extremely labor-intensive; any major expansion of that market will require a large supply of skilled farm labor, which is currently in short supply.

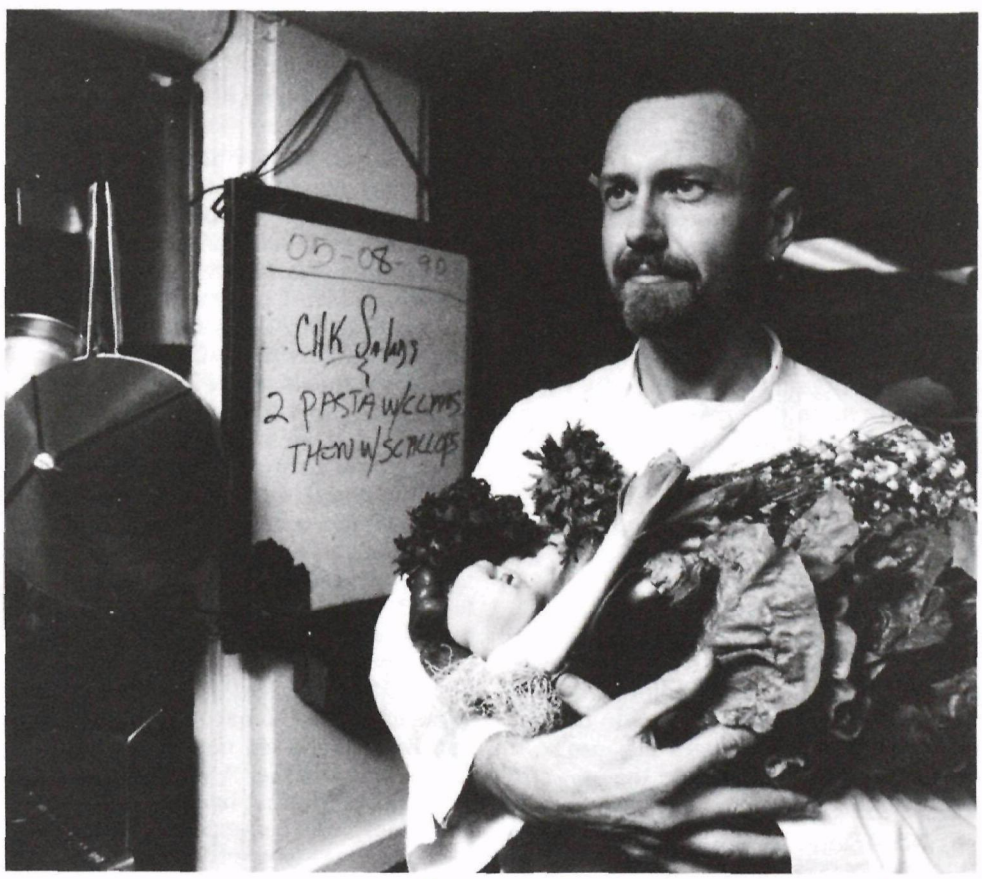
"We have no quarrel with organic produce so long as the produce is labeled fairly. However, labeling issues are complicated right now because few states have specific organic standards, and there are no national standards."

Snowdon is generally optimistic: "In the long run, if the consumer is in control, the health-consciousness trend could make labeling of produce only a matter of time because consumers will press for a national standard."

Chris Kilhelm is vice-president for marketing at Bread and Circus, a chain with five markets in the Boston area and one in Providence, Rhode Island, that sells $8 million in organic foods annually.

"Our experience over 15 years is that people who understand what organics are all about will pay more. In fact, we did a study for EPA two years ago that indicated consumers are willing to pay up to 20 percent more," he said. "Part of our own success is that this is an area with a lot of educated people who understand the difference between organic and non-organic food and are willing to pay for that difference."

"Organic food sales have been



Steve Delaney photo.

Some restaurant operators guarantee the food they serve is pesticide-free by growing it on their own farms.

(Popkin is a Writer/Editor with the EPA Office of Communications and Public Affairs.)

hampered by the cosmetic appearance of some organically grown produce. In our experience, such problems usually result not from the way organic foods are grown, but from the way they are handled, cooled, stored, and shipped. That's where the blemishes come from. Most of our suppliers are relatively small farming operations that don't have the storage and packinghouse resources of big commercial farms, but by working with them and teaching them how to handle their crops once they are picked, we get produce that looks as good as any in the supermarkets. One of our suppliers now sends us cauliflower that is county-fair-blue-ribbon quality in appearance."

In contrast is another local market that "doesn't pay attention to how the organic produce is handled before it reaches the store displays wilted, unattractive stuff. It gives organics a bad name."

After last year's Alar publicity affected apple sales in its stores, Giant Foods, a large supermarket chain in the East, responded to public concern about chemicals in foods by creating special organic/natural food sections in several Washington metropolitan area stores. **Eileen Katz** is assistant director of consumer affairs for Giant, which is headquartered in Washington, DC.

"We went through a four-month test in seven of our larger stores. Natural and organically grown foods were displayed separately under large overhead signs calling them to shoppers' attention. Special pamphlets explained the difference between regular and organic foods and why the latter were more expensive," she reports. "And we made a special effort to bring food in from California, because it could be certified as organically grown under that state's agricultural laws."

The special organic sections didn't catch on. "It didn't seem to look any different than the regular produce in the store, so we don't know why sales never grew to reasonable levels before we ended the test. Carrots seemed to be the most popular item, perhaps because they were closest in price to the non-organic produce."

Stefan Bonner, of Berryville, Virginia, who operates Natural Beef Foods, raises and sells organic beef and also sells organically raised pork, chicken, and turkey raised by other farmers to about 1,500 customers annually. He says, "I don't think most people will pay premium prices for organically grown food—they're not beating down my doors.

"While our customers are growing in number, they are still a very small percentage of the population in the Washington metropolitan area," he comments. "Because of the higher costs of raising livestock and poultry organically—I pay $5 a bushel for organically grown feed-corn—our customers pay anywhere from 25 to 40 percent more than they'd pay in a regular supermarket. What they get by paying more is a guarantee that their meat and poultry have no antibiotics, sulfa drugs, or hormones, and no synthetic herbicides or pesticides were used to grow their feed.

"Because the percentage of people's income spent on food is much lower than it was years ago—now, it's about five percent—they are much more concerned about buying a new car than eating good food. They're just not aware of the health problems caused by pesticides. We need year-round education programs to promote healthy food."

The Inn at Little Washington located in Washington, Virginia, grows its own organic produce. Although his restaurant is usually crowded, the restuarant's proprietor, **Patrick O'Connell** feels "people by and large are not ready to pay premium prices for organically grown, pesticide-free restaurant meals and will not be ready to do so in my lifetime.

"Although we are widely known for growing our own vegetables and using organic foods, in the 13 years I have operated this restaurant not a single patron has asked about whether the food is pesticide-free. People want the food to be fresh and to taste good, regardless of what may be in it; they are much more concerned about fat or cholesterol or sugar," he reports. "Recently, they've begun ask how the fish was caught—in nets or on lines—and whether it was bruised in the process. It must be the publicity about dolphins being caught by tuna fishermen.

"Our menus do not specify organically grown but do emphasize freshness and locally grown produce. I don't want to raise the question of what on the menu is organic and what isn't—this would set up a positive/negative aspect to the dining experience."

Further, he believes most people think environmental problems other than chemicals in food are more severe so that "I don't know when and if the use of organic foods will become mainstream. And there is always the danger that once it does, it will be corrupted. Even now, a lot of things are being sold as natural this and natural that regardless of what may be in it."

Rod Leonard heads the Community Nutrition Institute, which acts on behalf of consumers in nutritional matters related to the quality of the nation's food and nutritional problems. He believes "the market for organic foods is growing quite rapidly, as shown by a number of recent public opinion surveys reflecting strong support for or demand for such products. Also, as concern about pesticides grows, surveys show people want the federal government to do a better job of protecting them from pesticides in food."

The physical appearance of some organic produce has affected peoples' willingness to pay for it, Leonard contends. "Grade labeling under the Food and Drug Administration and the Department of Agriculture hasn't helped, either, because it is based on size, weight, and blemishes rather than nutritional value. Since organic vegetables are often not the kind you'll see at a state fair, they are often graded lower than other produce, even though health-related quality is not involved. During the past 20 years, there has been much emphasis on appearance instead of quality."

The proprietor of the Wellsprings natural foods supermarkets in Durham and Chapel Hill, North Carolina, **Lex Springer**, agrees about the need for education. "People don't really want to pay more for food, and when our prices go up to more than 25 percent higher than elsewhere, we start to lose the customers," he says. "What is needed is the proper information exchange between the retailer and the customer on what organic is all about. Organic is an education-intensive subject.

"We try to get people to look at the organic farming process as a whole. I think many non-organic food prices are

What is 'Organic' Produce?

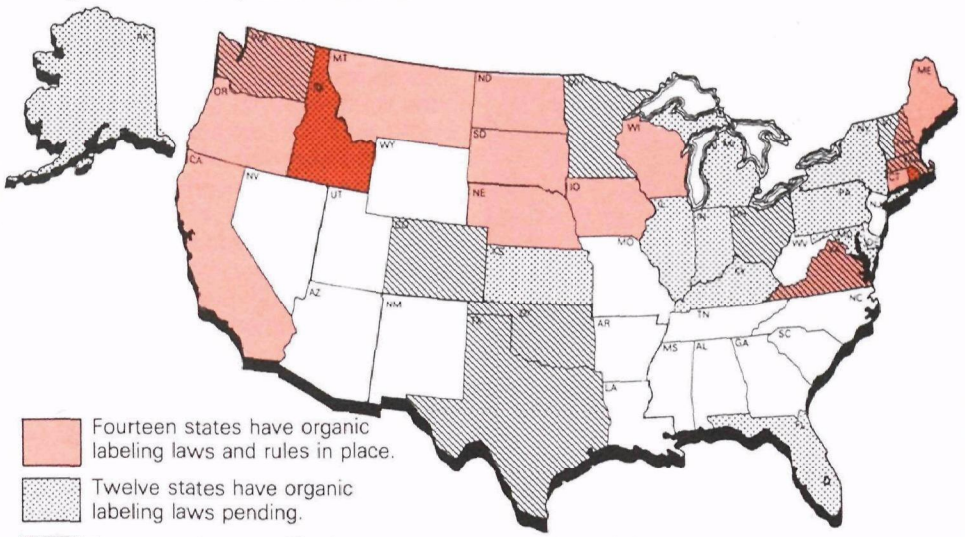
If you ask any 10 people to define the terms "organic" or "organically grown," chances are no two responses would be quite the same. The fact is, there is presently no single, nationally agreed-upon definition of organic produce. However, a number of states have enacted organic food legislation which sets standards for organic foods through labelling requirements and state-run or state-sanctioned certification programs.

In general, these organic certification programs define organic produce in terms of allowable "inputs" such as fertilizers and means of pest control. Although not identical, the programs' lists of "allowable materials" are fairly similar. Most organic certification programs have not one but three lists: generally allowable materials, restricted materials, and prohibited materials. Worth noting: Not all natural pesticides are automatically placed on the "allowable" list. For example, rotenone and sabadilla, two natural pesticides, are often on the "restricted" lists because of their toxicity to organisms other than target pests. Two other natural pesticides, arsenic and strychnine, are usually on the "prohibited" list due to their toxicity to nontarget organisms.

Do the existing certification programs have the same standards? Again, not exactly, but they tend to be similar. All certification organizations require farmers to wait at least a year after their last application of synthetic fertilizers and pesticides before they can successfully apply for organic certification; some programs require two- or three-year waits. Some certification programs do not allow any residues of synthetic pesticides on food certified as organic. Others allow up to 10 percent of tolerance levels because some pesticide residues may result from spray drift from aerial pesticide applications on neighboring farms. Low-level pesticide residues may also occur from crops' "uptake" of synthetic pesticide residues remaining in the soil from past applications.

Organic food standards and regulations are a comparatively recent phenomenon. Oregon passed the first organic food labeling law in 1973. Since then, thirteen other states have passed similar laws, and another dozen have such laws pending. (See map.) In addition, approximately 10 states either have their own organic certification programs or have sanctioned independent certification programs, and others are planning some kind of organic certification initiative.

In states that do not have organic labeling laws or state-sanctioned certification programs, independent certification organizations may certify foods to be organic; however, consumers do not have legal recourse if foods are falsely labelled or sold as organic.



Fourteen states have organic labeling laws and rules in place.

Twelve states have organic labeling laws pending.

Ten states have certification programs for organic foods in place (either state-run or state-sanctioned).

Two states are planning certification involvement.

Source: Office of Pesticide Programs, EPA.

artificially low because they don't include the cost to the environment which the customer later pays, indirectly. For example, a gallon of canola oil in a supermarket costs less than $2. But the commercial oil is extracted from the beans with hexane. The leftover chemical is dumped into the water supply and the leftover chemical-impregnated cake is fed to animals. That's an environmental cost which our customers aren't paying. In our store the oil costs over $3. Organic products are on a 'pay-as-you-go' basis."

"Whether people will pay more for pesticide-free foods is not the question," says **Jeff Smith**, the Public Broadcasting System's "Frugal Gourmet." "They'll have to, because sooner or later we're going to have to outlaw pesticides. It's really only a matter of time.

"As the demand for organic food grows, American business will see that there's money to be made with such foods," he maintains, "and farmers will have to move towards chemical-free agriculture to hold their customers. The question of how much the public will pay may be a problem today, but it won't be in the future."

On and off the air, the "Frugal Gourmet" is an advocate of using fresh, chemical-free foods. His viewers' letters and calls generally support his viewpoint, although he admits, "I get even more reaction if I do something like cook a rabbit on the show."

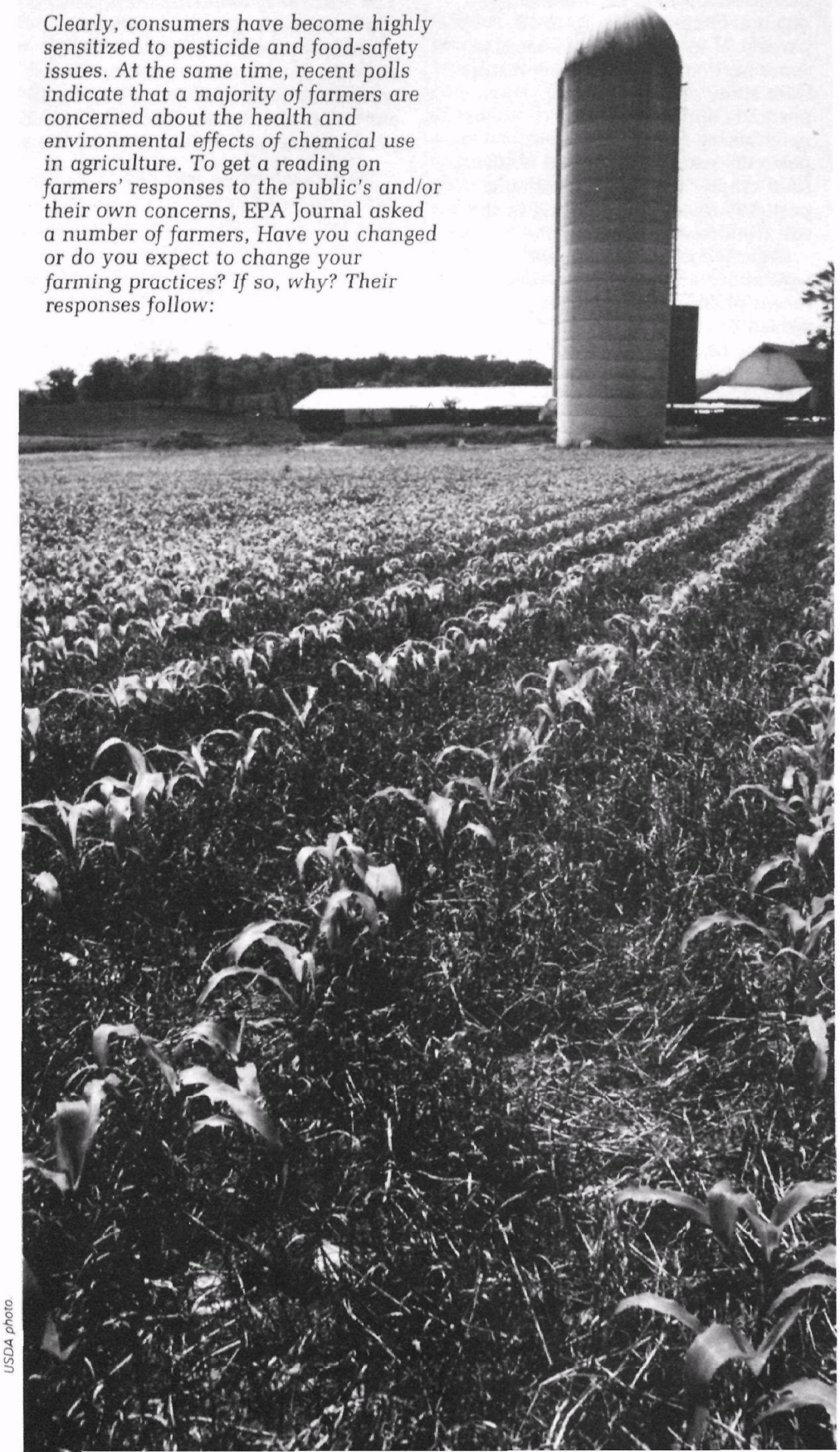
As to whether the appearance of organically grown food discouraged purchasers, Smith noted that when "we purchase organic produce for use on the program in markets near the Chicago North Side studios where it is taped, it often looks unappealing, but at the South Water Street wholesale market, it looks wonderful." Told that others had attributed the difference to the way the produce was stored and handled (in this case, between the wholesaler and the smaller markets) he said: "That's something people will have to talk to their supermarket produce managers about. Tell them you'll buy if it's handled right and looks good.

"I can't understand why people tell me they use canned or packaged food because they don't have time to cook from scratch. They've got their mathematics wrong. If they keep using convenience foods and packaged stuff, they'll take five years off their lives. They'd better find time for using fresh, untainted food." □

What Do Farmers Say?

by Gregg Sekscienski

Clearly, consumers have become highly sensitized to pesticide and food-safety issues. At the same time, recent polls indicate that a majority of farmers are concerned about the health and environmental effects of chemical use in agriculture. To get a reading on farmers' responses to the public's and/or their own concerns, EPA Journal asked a number of farmers, Have you changed or do you expect to change your farming practices? If so, why? Their responses follow:



USDA photo.

Jim Wiers
Willard, Ohio
Varied vegetables; 4,000 acres

"I wouldn't say we've changed because of the publicity; we've always been aware of food safety. We've always been strict about the label precautions for herbicides and pesticides we use.

"Over the last eight to 10 years—even 20 years ago—we've hired outside help to inspect for disease and pests. This was the beginning of an Integrated Pest Management (IPM) program. The theory of applying herbicides and other pesticides according to a schedule: we threw that out years ago.

"In the past five to six years we've also started extensive crop rotation. It helps cut back on the buildup of certain elements in the soils. This year we are going to try to raise squash in an organic-only setting. It's an experiment, but we'll see how it goes.

"The saddest part of the whole recent hype and hoopla created by the press and lack of information is that the consumer is still confused. What is safe? What is acceptable? The produce industry will now need to increase the public's knowledge about nutrition and what fresh fruits and vegetables contain. The industry needs to publicize more, be more aggressive. And this has started to happen. Groups have formed among growers and farmers to get the real facts out about produce."

(Sekscienski is an intern with EPA Journal and a graduating senior in journalism at the University of Maryland.)

Chuck Bird
Greeley, Colorado
Onions, potatoes; 1,700 acres

"Yes, we are moving even more towards Integrated Pest Management and some of the other methods to lessen the amount of pesticides and herbicides used. But over the last five years or so, we have been moving in that direction.

"Cost is a factor because IPM is certainly less expensive, but also we've learned that more is not always better. You reach a point of diminishing returns. But remember we're not the bad guys here. We [the farmers] eat the very same food the public does. I have children too and I care about what goes into what my family eats, just like everybody else. Believe me, farmers are well aware of what they put into what they grow."

Tom Lauffer
Dodgeville, Wisconsin
Dairy farm, feed crops; 2,000 acres

"I've given up using all herbicides and insecticides. We grow all our feed crops—corn, oats and peas, and alfalfa—with no pesticides. In our corn fields, for example, a lot of weeds grow with the corn plants because we don't spray. At first, when I would drive past my neighbors' farms and see how tidy they looked, I felt foolish that I let the weeds grow. But now I don't really care.

"It came down to, How long can we keep putting more chemicals into the ground. We have to start thinking about our kids, and our kids' kids, and on down the line. And the more we produce, the cheaper food gets. So we try to increase production, but actually get less money for what we produce. It's slowly killing us, both economically and physically.

"So far it's costing us a little more. But if all goes well, and so far things look good for this season, it may wind up being cheaper for us."

Steve Stierwalt
Sadorus, Illinois
Corn, soybean, and popcorn; 700 acres

"Yes, we have changed, but the trend toward more careful application has been going on for at least five years. The emphasis is now on applying crop-protection materials only when there is a known need to do so—as opposed to the shotgun application method where you apply chemicals in anticipation of what might show up.

"It's a finer approach now. We wait and identify problems, then apply only what is needed to combat that problem. The old shotgun approach is not the way to go; it costs more money."

Rick Roth
Belle Glade, Florida
Mixed vegetables; just over 4,000 acres

"I think the general public totally misunderstands the issue. They don't understand agriculture. Those involved in farming have become a small minority of the population. With the urbanization of the country, not everyone has a grandfather or uncle who was or is a farmer. This is one reason why there is misperception.

"Right now, we throw away 30 percent of our crops because they are blemished or bruised. The stuff has to be first class, 'A'-number one. The American housewife wants that—but now, no pesticides. It is the advent and use of pesticides that created the perfect fruit or vegetable they want.

"So, the consumer benefits from the judicious use of chemicals; it holds prices down and produces more from less inputs. But you can't get rid of it all. You can't get there by waving your hand and saying, 'No more chemical use.' We're moving in that direction, but it has to be done in a reasonable fashion."

Ed Sills
Pleasant Grove, California
Popcorn, yellow corn, rice, oats, almonds; 2,000 acres

"We're just about totally organic, now. Our crops can be sold at a premium price because they are organic. But five or 10 years down the road, we might not get higher prices. So a lot of that money goes into research and development—either on our own or with other farmers—to find less costly, organic alternatives. We're looking for ways to maintain the soil fertility and lower costs. But all farmers have to find out what is best and most logical for their farms. The answers are different in each state and county.

"The consumers are going to decide this issue for us. They have to make up their minds as to what they want. You can produce the juiciest, sweetest-tasting oranges in the world, but if the peel looks bad—if it's too blemished—people aren't going to buy it.

"In California, at least, there is a market for organic foods. And right now it is growing and should continue to expand. That's why it is important for us to get our costs down, to find ways to produce the products at lower costs.

"The independent farmer's future will depend on how fast the rules change. If the farmers have time to move to other products and methods—organic, well-researched methods—then they can stay in business. If laws or regulations demand change too fast you'll lose a lot of small-family farmers.

"But there's also the other side; you need some regulation to push people to change. If it involves higher costs, it's tough to get people to change unless everyone is forced to change. So that's where there has to be middle ground—an area between the two extremes."

Continued next page

Farmers are increasingly concerned about possible pollution of their well water by agricultural chemicals. Shown is a ground-water sample being tested by USDA's Agricultural Research Service on Maryland's Eastern Shore.

Tim McCabe photo, USDA

Daryl Peterson
Luddington, Michigan
Assorted fruits; 450 acres

"I started cutting back my chemical inputs about 10 years ago. The reduction in costs was a plus. And having to spray the insecticides or herbicides over 450 acres is a lot of labor. Now with IPM I can get away with one herbicide application per season, compared to two or three before.

"The distributors I deal with have been a great help on things like the proper handling of the chemicals, understanding the labeling, and worker protection. So the information is out there and well-used. What's dangerous, though, are the scare reports—like the Alar controversy last year. It was just improper use of information. You know the value of apples still has not come back to the pre-scare levels. Here in Michigan, we were cutting back [on Alar use] in 1984 and 1985. A lot of the processors wouldn't accept Alar-grown apples from the growers. Then in 1989, all this publicity hit the fan."

Gary Seipel
Eau Galle, Wisconsin
Dairy farm, feed crops; 500 acres

"My father farmed organically. He didn't use insecticides or herbicides. And I can remember some pretty lean years back then. When I started farming the land in 1972, I started using small amounts of herbicides and commercial fertilizers, but no insecticides. And that's how it's been ever since. I use about one-half the minimum listed for effective use on the labels of the herbicides.

"There is a push from the consumer side. But there is also a movement—and this is where it really counts—from the farmers and the co-ops and the agribusiness people. In the 1970s and early 1980s, the co-ops and agriculture people recommended much heavier use. Now, I think they are opening their eyes to sustainable agriculture.

"In the couple of smaller farms I've bought over the years, I've seen the damage that insecticides do to the soil. The soil on these farms—when I first turned it—was just flabby, sort of lifeless. Now without the insecticides, the soil is much stronger. The earthworms have come back. We also rotate our crops and that helps."

Ward Sinclair
Dott, Pennsylvania
Vegetables; 15 acres

"My partner, Cass Peterson, and I learned a lot as reporters covering environmental and agricultural issues, and when we started farming on a small scale in 1983, we felt we should use organic methods. I think the common perception that it is difficult to farm organically is somewhat overstated. But we also didn't have to switch. We started that way. We had no habits to break.

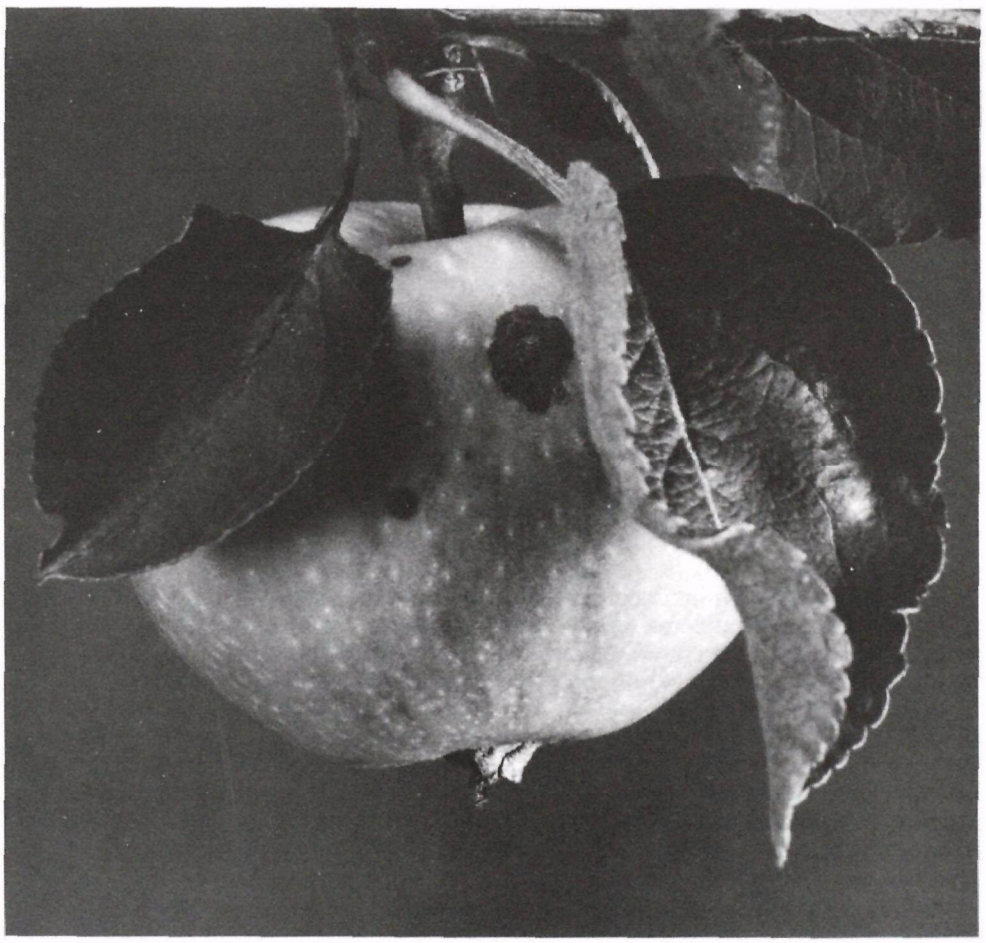
"The extension services and land grant agencies are of little use for us because there is still relatively little research, comparatively, going into alternative agriculture methods. So we wing it with the help of some publications—the best are horticulture, 'how-to' books from 100 years ago.

"Our stuff looks as good as anything I've seen in the supermarkets. About 98 percent of what we grow is marketable. As far as prices go, we're competitive with conventional growers and only sometimes do we get a higher price because ours is an organically grown vegetable. □

The Trials of a Fruit Grower

by Stephen Wood

Apple scab, a fungus disease, is considered the worst disease problem that plagues New England apple orchards.



Runk/Schoenberger photo. Grant Heilman Photography.

The recent public furor over food safety has strengthened and popularized a belief that agricultural pest-control methods must change radically to satisfy public-health and environmental concerns. This is an excellent impulse as far as it goes. However, it has greatly magnified the power of certain misconceptions which—if allowed to dominate policy-making—threaten to put food safety and good ecological sense further out of reach than they now appear.

In particular, three misconceptions deserve scrutiny:

- That it is or should be possible to grow food for this overpopulated planet by "natural" methods
- That in a world where artificial chemical inputs must be used, cutting down drastically on the number and variety of such chemicals will help ensure food safety
- That growers are stubbornly loyal to toxic "conventional" pest controls.

All three are based on a lack of knowledge and therefore misguided in ways that need to be addressed.

"Natural" Versus "Unnatural"

I grew up on an apple orchard in New Hampshire, and I have grown apples for most of my adult life. For years I have struggled to improve my pest-control methods, with the goal of increased environmental and economic soundness. My experience has convinced me that Integrated Pest Management (IPM) offers the best practical hope for reducing pesticide residues in food and the environment, without causing severe disruption of market prices or growers' ability to meet demand.

IPM involves a combination of techniques: careful monitoring of pest populations, exploitation of natural predators and processes, judicious use of selective pesticides, artificial disruption of pest populations, and mechanical methods of pest control to produce crops for a market that continues to insist on produce virtually free of insect damage or disease. By applying an understanding of a field's ecology, IPM growers limit pesticide use to the absolute minimum necessary to produce marketable crops.

Over the past decade or so, IPM apple growers in New England have drastically reduced the total amount of pesticides applied, without raising the consumer price of the fruit. We have promoted native populations of predator organisms that can control pests for us and avoided promoting immunities in the pest population—a chief long-term danger of excessive pesticide use. And in the end, we have saved money: money formerly spent on chemical applications. Most important to the

(Wood owns and operates Poverty Lane Orchards in West Lebanon, New Hampshire. He also serves as president of the New Hampshire Fruit Growers' Association and director of the New England Fruit Growers' Council on the Environment.)

The syrphid fly larva eats aphids and is therefore a "hero" insect. Protecting useful insects while destroying the "rogues" presents a challenge to farmers.

consumer, thanks to IPM, our harvest-time pesticide residue levels are a fraction of legally allowable levels.

These results have been achieved using means developed by dynamic applied research, primarily at land grant colleges and universities. This research is overwhelmingly practical, and it avoids setting up misleading distinctions between "natural" and "unnatural" methods of raising food. The notion that a poison, by virtue of occurring naturally, is somehow better, safer, or gentler to the environment is hardly logical.

If there is a crisis in American agriculture today, it is not a crisis of markets or of stubborn rural will, but a crisis of knowledge, for which vigorous applied research is the only remedy.

Let me give an example. Recently I had a painful conversation with an organic apple grower in New England who was vainly battling codling moth in his orchard. He was relying on rotenone, a naturally occurring poison, and one of the few botanic pesticides generally permitted for use by organic growers. Unfortunately, rotenone is only moderately toxic to codling moth, though it is considerably toxic to other creatures—some of them beneficial. Having noticed codling moth in late July, he applied rotenone repeatedly over the course of several weeks without success in controlling the moth.

Meanwhile, my own "unnatural" IPM strategy against codling moth had been to note the first male moth caught in a pheromone trap, estimate the likely time of egg hatch (when the larvae are easiest to kill, but have yet to damage the fruit), then apply an extremely low amount of an effective organophosphate insecticide. My "unnatural" strategy was 100-percent effective; my organic colleague's strategy left him with severely damaged fruit. My approach barely disrupted the ecology of my orchard, while his must have completely scrambled his orchard's ecology.

Moreover, my single, low-rate application of an unstable insecticide is extremely unlikely to have left detectable residues on my fruit at harvest: I shudder to think what my colleague's repeated, late-season applications must have left. My fruit was sold in the general wholesale market, for a normal price, without extraordinary claims about responsible and safe methods of production. My colleague's fruit was sold at an unnaturally high price with an orange "organic" sticker on the polyethylene overwrap—implying that it had been grown by the safest, most environmentally responsible methods available. What is wrong with this picture?

This example is admittedly dramatic, and I do not mean to suggest that all organic growers behave in such an obviously misguided way. Still, I do mean strongly to suggest that efforts to grow crops by adhering to rigid rules, based on specious distinctions, are bound to have grim, unintended consequences.

My example also suggests the more complex point that organic pest controls are appropriate only for certain crops in certain regions. Each agricultural region, indeed each patch of ground, sets certain ecological limits to what growers can produce there and how they produce it. It so happens that conditions in certain parts of this country, notably the West Coast, make it possible to use organic pest controls in large-scale commercial plantings of some crops; in other regions, these same crops cannot be produced economically for a non-specialty market without some use of synthetic pesticides. For instance, many apple pests do not occur in California, which suggests that "organically grown" apples may be produced there more feasibly than in the Northeast or other regions of the country.

Should we therefore encourage apple growing in California and discourage it elsewhere? Not if we are concerned with the ecological problems of heavy irrigation typical of West-Coast fruit production. And not if we are conscious of the environmental cost of long-distance shipping technology.

Things are more complicated than they seem, or than we might wish them to be. Organic farming is a positive influence, but it is not a complete solution. Everyone should recognize that modern farming itself, whether organic or otherwise, is a highly unnatural activity. Creating a field out of primeval forest stands Nature on its ear. Planting crops in that field further disrupts Nature, no matter how gently the crops are managed.

The point is, if we are serious about improving food safety and environmental quality, we need to work toward a national policy that encourages the development and use of environmentally and economically sound means of crop production, disregarding false distinctions between "natural" and "unnatural" methods.

Too Many Agricultural Chemicals?

Food safety advocates and environmentalists tend to argue that many agricultural chemicals now in use should be removed from the market. Many of these compounds are acutely toxic to humans. Many are suspected of being carcinogenic or capable of causing other chronic health effects. Many of them have the potential to wreak environmental havoc. In order to be absolutely safe from these chemicals, the argument runs, it is necessary to outlaw them, or at least the most potent of them.

However, this logic is disastrously wrong. The fact is, a greater variety of available pesticides offers a positive benefit to public and environmental health. As a practical matter, the more choices available to IPM growers for dealing with each pest, the more overall pesticide use can be reduced. Chronic use of any single chemical often promotes resistance and eventual immunity in pest populations. This can only lead to increased pesticide use in the future. IPM growers are careful to rotate among the different compounds available to control any one pest, in order to guard against increased resistance. Simply put: The more alternatives the better.

Runk/Schoenberger photo. Grant Heilman Photography.

In addition to the immunity issue, there are many other pest-control problems that can best be solved by exploiting the subtle differences between the effects of one compound and those of another. Two compounds that supposedly "control the same pest" virtually never have exactly the same range of results. And in many cases, a compound that appears, because of its toxicity, to pose more health or environmental risk than another may be the better choice. Why? Because its use in one situation will remove the pressure to use more of another chemical later.

Still another critical advantage of a large variety of available compounds is that such variety favors progress in research. New and very different uses of old compounds are being studied. For example, we are learning, in some situations, to apply pesticides to fields before bloom or after harvest, thus reducing the need to apply pesticides to the fruit itself. Of the pesticides now being overused on a large scale, many have valuable potential for specialized uses at much lower application rates. Such measures will serve us well during the years of waiting for a new era of inherently safer chemicals, more sophisticated knowledge, and pest-resistant crops.

In general, most theoretical health and environmental risks from pesticide use are associated with older compounds, registered before 1972. Under the present regulatory scheme, EPA attempts to identify older compounds that present a high theoretical risk; their continued use may be disallowed, while "less hazardous" alternatives are allowed to remain in use.

The problem is that this regulatory approach undercuts IPM options to achieve maximum pest control with minimum chemical intervention. IPM growers make pesticide application decisions that are highly specific to the exact conditions and exact combinations of diseases, pests, and predators in their fields at any given time. Without a wide variety of chemicals to choose from, such precision would be impossible.

An example of unintended consequences from the removal of a pesticide from the market is the current case of ethylene bisdithiocarbamate fungicides (EBDCs). The EBDCs are under Special Review at EPA for various possible chronic health risks associated with their use. Pending a final decision from EPA, the manufacturer has removed all but 10 food uses from the labels of EBDC products.

Here's the hitch: EBDCs are the only broad-spectrum fungicides registered for use on apples that are both reliably effective against the apple scab fungus and compatible with spray oil used in the biological control of plant-feeding mites. Apple scab is the severest disease that assaults New England apple crops and is the reason for the vast majority of our use of chemical fungicides. Biological control of destructive plant-feeding mites depends on one or two applications of oil, applied right in the middle of the primary scab season.

Without EBDCs, many growers will have to choose between tree damage resulting from spray applications of oil combined with an incompatible fungicide versus season-long chemical battles against apple scab and/or pest mites. In any case, the principles of IPM will be violated and the total volume of pesticide used will dramatically increase.

The true benefits of an individual compound lie largely in its value in reducing the use of other compounds, and in the overall ecological effect of such reductions in use. The true costs of eliminating individual compounds often show up as increases in overall chemical use and excessive environmental disruption. Growers have already lost a number of chemicals that, though no longer regularly used, were extremely valuable in occasional, highly specialized applications. As one New England IPM grower commented on the current state of pesticide use, "We no longer use bulldozers to swat flies." But if the trend toward fewer available tools continues, we may find ourselves resorting again to bulldozers.

IPM: From Radical to Mainstream

Once considered radical, rigorous IPM has become mainstream among New England apple growers. Over the past

decade or so, we have responded to two critically important inducements: a trustworthy agricultural research program and a vigorous Cooperative Extension Service, promoting the practical applications of that research.

Growers in our region have voluntarily adopted the new methods because we felt confident that IPM methods would reduce our chemical use and thus our costs. We began to appreciate the long-term benefits of improved ecological balance over the short-term benefits of heavy reliance in chemicals. And we began competing with one another to exploit the latest research and participate in new experiments.

University Extension agents in New Hampshire are no longer able to conduct their annual comparison between "conventionally managed" orchards and those following the newer IPM recommendations—because there are no longer enough "conventionally managed" orchards in the state.

Few, if any, of the growers in question would describe ourselves as "alternative" producers. Many are conservative second- and third-generation farmers who have the combination of ingenuity, expertise, and business sense required for survival in modern agriculture. In such people lies the best hope of a large-scale solution to our food-safety and environmental problems.

Perhaps a quick "before-and-after" sketch will be useful. In 1966, a typical recommendation (this one made to my father) by a senior university extension agent in New Hampshire ran as follows:

> I would suggest that you use 3/8 pound of Cyprex per 100 gallons of water until after blossom, putting this material on starting as soon as you have rain and applying it from then on either before or immediately after rain until the petals have fallen off the blossoms. Then start spraying with two pounds of Captan plus one pound of Guthion. Do this on a 10-day schedule, rain or shine, until the middle of August.

Runk/Schoenberger photo. Grant Heilman Photography.

Coddling moth larvae thrive on apples. This one has eaten all the way to the seeds. One IPM strategy is to monitor the species' mating behavior, then spray just as eggs hatch.

My father was thus advised to apply 9 dosage equivalents (full-strength sprays) of a broad-spectrum insecticide and approximately 14 dosage equivalents of a fungicide during the growing season, regardless of insect or disease pressure. Such methods were still common in the state in the late 1970s. Today, New Hampshire IPM growers are accustomed to growing crops with 3 to 6 dosage equivalents of insecticide, and 6 to 8 dosage equivalents of fungicide, depending on field conditions. For the most part, this change occurred in the space of 10 years, and progress continues.

The point here is not to advertise the cleverness of certain apple growers, but to insist that our progress so far is a mere hint of what might be accomplished throughout agriculture—if obstacles are reduced and inducements are strengthened.

What Lies Ahead?

If there is a crisis in American agriculture today, it is not a crisis of markets or of stubborn rural will, but a crisis of knowledge, for which vigorous applied research is the only remedy.

We must insist that Congress and the Department of Agriculture establish a tough-minded and rational policy toward reforming the excessive use of pesticides in American agriculture. Such a policy must place less emphasis on the theoretical risks posed by individual chemicals and more emphasis on overall reduction in agriculture's reliance on pesticides. Such reform can be accomplished only through strenuous support of applied agricultural research and the Cooperative Extension Service that enables farmers and growers to make use of that research.

Our entire society must learn to accept a broader concept of risk and benefit. We must consider the dismal unintended environmental consequences of our self-indulgent insistence on absolute certainty about our health and safety. In the furor over pesticides and food safety, America has shown little sensitivity to the many paradoxes of raising food for an overpopulated world.

It is one thing to work toward a day when growers can all park our sprayers behind our barns until the wheels rust off: I know of no New England apple grower who would not happily do so, if he could. It is quite another to pretend that we have already reached that day. By striving to eliminate the very tools that enable researchers and growers to evolve toward environmentally progressive crop production methods, sincere proponents of food safety are pushing for policies that are ultimately counterproductive to their own aims. Such unfortunate romanticism, if allowed to drive markets and control policy, will severely impede real progress toward a safer, sounder agriculture. □

Vacuuming Up the Bugs

by Steve Bassi

The nation's second largest lettuce grower is reducing pesticide use by sucking up bugs with a huge vacuum cleaner called the Salad Vac.

Vacuum cleaners? Sucking up bugs? Come on. But Tanimura and Antle, a Salinas, California-based company that farms 20,000 acres in California, Arizona, and Mexico, has developed what it calls the Salad Vac Integrated Pest Management (IPM) system: The system combines the machine with a range of IPM practices. With over $5 million invested in research and development, the Salad Vac system is a serious response to consumer concerns over pesticide use.

A fleet of 48 machines—each costing $80,000—vacuums approximately 25 percent of the company's lettuce acreage. A single Salad Vac machine stretches across eight rows of lettuce—nearly 30 feet—and sucks insect pests such as aphids, thrips, worms, lygus, leafminers, and whiteflies into its industrial-strength fans—fans that generate 70 mile-per-hour winds. The bugs are literally ripped from the plants and chopped into tiny pieces. When the machine encounters a swarm of bugs, you know right away: A cloud of dark material—insect bits and pieces—shoots out of the fan exhaust ports with a growl, like when a power lawn mower runs over a clump of dirt.

The level of pest control the Salad Vac provides varies according to the insect, stage of crop growth, and vacuum setting used. Worm, aphid, and thrips control is about 30 percent. compared to chemical insecticide control levels that run 90 to 95 percent. But its control of flying insects such as whitefly, leafminer, and lygus has been tremendous—around 85 percent. In Arizona, using the Salad Vac has proven more effective on the whitefly population than chemical insecticides. In addition, the vacuumed lettuce is higher quality and has a longer shelf life than chemically treated lettuce.

(Bassi is a production manager at Tanimura and Antle.)

The Salad Vac IPM program has been a "learn-as-you-go" endeavor. The program began in 1988. In order to accommodate the rather bulky Salad Vac machine in the fields, farm managers had to learn to change some of their accustomed farming practices. Irrigation techniques were changed so that alternate rows of lettuce are watered at a time, thereby leaving some rows dry to accommodate the machine's tires. This allows the Salad Vac access to the fields at all times. An entirely new system of watering had to be devised to insure that all parts of the field received the correct amount of water at the right time.

A fleet of 48 machines—each costing $80,000—vacuums approximately 25 percent of the company's lettuce acreage.

With the irrigation problems solved, the next hurdle was that insect control with the Salad Vac alone was not satisfactory for all insects. As a first step, biological and other natural products that are used by organic growers were added to the Salad Vac program. But many of these products were expensive and ineffective, and in some cases actually retarded the growth of the plant. For example, more than one application of the insecticidal soap suffocated lettuce and caused it to produce very small heads. To improve the effectiveness of these natural products, new application equipment had to be built. Ultra-light, low-volume, air-assisted application equipment was developed resulting in the near-total elimination of aerial spraying. Natural products that were once thought to be ineffective were now making the Salad Vac program much more productive.

During 40 weeks of the year, operations were successful in managing insect populations. However, there were periods when aphids and thrips could not be effectively controlled non-chemically at an acceptable level or at a reasonable cost. Controlling aphids and thrips is not purely for cosmetics. Aphid control is an absolute necessity because aphids are the vector for the spread of the devastating lettuce mosaic virus. The company quickly found that wholesale produce buyers would not accept less than perfect lettuce.

The Salad Vac IPM program centers around daily monitoring of fields by IPM specialists. When intervention is needed to control pest or disease problems, a combination of chemical pesticides, biological agents, and the Salad Vac is devised and applied. This produces lettuce that is free of detectable residues. Air application of pesticides has been virtually eliminated, and chemical pesticide use has been reduced by 50 percent.

The program is structured around the growing cycle. For the first 30 to 50 days of the cycle, chemical pesticides are used to control pests and disease. During this period no harvestable foliage is present. During the last 30 to 50 days of the growing cycle, biological agents and the Salad Vac are used to control disease and pests. At harvest, the outer wrapper leaves are removed and the lettuce is wrapped with film which identifies the product as having been grown with the aid of the Salad Vac.

The company is continuing research into adopting the Salad Vac for use on other vegetable crops such as celery, cauliflower, broccoli, and green onion. Meanwhile, the technology that created the Salad Vac system is continually evolving. As more effective natural products and other IPM technology become available, growers may find it easier to produce reasonably priced fresh produce for the American consumer that contains no detectable chemical pesticide residues. □

The View from a Food Processor

by Steven S. Balling

The business of growing food is on the brink of a fundamental revolution—one that could send reverberations through the entire food industry. The revolution will transform agriculture from a chemical-intensive to a knowledge-intensive management system.

The impetus for this change is the growing public concern over the health and environmental impacts of pesticides. The legislative and regulatory responses to this concern, however appropriate, are leading to a significant loss of pesticides that American farmers have come to rely upon to protect their crops from disease and insect damage. In the long run, the changes will be desirable, both for agriculture and the environment. But in the short run, they could significantly disrupt the abundance and quality of our food supply.

For many reasons, it's getting tougher for the American farmer to produce inexpensive, high-quality food:

- Several critically important pesticides that farmers have relied upon for decades are being cancelled by EPA because of health or environmental risks.
- The much-needed 1988 reauthorization of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) requires the complete reregistration of over 600 pesticides in nine years. Manufacturers, burdened by the tremendous costs of meeting new data requirements and by a severe time crunch, have already begun to eliminate any crop registrations that don't reap a sufficient profit.
- The Environmental Protection Act of 1990, a broad-sweeping public initiative just placed on California's November ballot, appears destined to pass, based on recent polls. If adopted, the Act will ban the use of any pesticide suspected to be a probable or a possible carcinogen, regardless of whether or not anyone is actually exposed to the compound. Over 50 pesticides are currently on EPA's list of suspected carcinogens, and the number is likely to grow as reregistration data come in. The California initiative would pull these from the farmers' repertoire within five years.

For many reasons, it's getting tougher for the American farmer to produce inexpensive, high-quality food....

The problems started 40 years ago, when agricultural pesticides arrived on the scene with the promise of complete eradication of crop pests. Pesticides were seen as a panacea for protecting crops from the vagaries of weeds, insects, and disease. Unfortunately, this treasure chest seems to have metamorphosed into a Pandora's box, full of unforeseen difficulties—real, perceived, and imagined.

Pest resistance, biomagnification, acute toxicity, ground-water contamination, food safety, ecological disruption: The list of possible impacts of pesticides has grown astonishingly over the years. Much to the public's confusion, the significance of these impacts has generated more scientific debate than consensus.

Meanwhile, farmers have come to rely on pesticides, seemingly succumbing to a kind of agricultural chemical dependency. Pesticides provide immediate, low-risk investment returns; they are an effective insurance policy. Because the farmer is caught between increasing competition in the marketplace and rising farming costs, the added 5- to 10-percent increase in yield and quality provided by agricultural chemicals can mean the difference between solvency and bankruptcy.

The benefits of agricultural pesticides are not limited to farmers. In 1940, before the introduction of synthetic pesticides, 23 percent of the U.S. population was involved in agriculture. Today, 2.5 percent are in agriculture. The other 20 percent—freed in large part by pesticides—now work in service, information, and high-tech industries.

Agricultural chemicals have also contributed to the year-round availability of many fruits and vegetables, allowing expansion of growing areas into tropical and subtropical climates where pest pressures are intense. The expanded availability of fruits and vegetables has coincided with, or maybe stimulated, a steady rise in U.S. fruit and vegetable consumption, until they now represent 20 percent of the American diet. And demand will likely increase. Last year's National Academy of Sciences report, *Diet and Health*, recommended that Americans double their intake of fruits and vegetables. Demands on pest-control effectiveness are likely to rise accordingly.

Meanwhile, the evidence continues to accumulate on the risks associated with the use of pesticides. Although many of the risks are based on speculation (the "yes, but what if . . ." argument), the prudent course is to look to less risky pest-control alternatives. Unfortunately, the search has been hastened by the intense media attention on pesticide residues in food. It is this attention that is provoking an agricultural revolution.

The problem is, revolution often does more damage than good, particularly

(Dr. Balling manages Del Monte Foods' Pest Management Programs. Del Monte is a founding member of the National Coalition on Integrated Pest Management.)

Pesticides were seen as a panacea for protecting crops from the vagaries of weeds, insects, and disease.

when radical changes are forced where there is no infrastructure to support it. In agriculture, the infrastructure necessary to support alternatives is exceedingly weak. Recognizing that current alternatives to pesticides are inadequate, it is important to seek evolution, not revolution.

There is a model in place for meeting the needs of both farmers and environmentalists. It's a system, or more properly a philosophy, of pest control called Integrated Pest Management (IPM). Simply put, IPM integrates non-chemical means, such as natural predators and parasites, disease- and insect-resistant plants, crop rotation, and insect-mating confusion, with the judicious use of chemicals based on pest-monitoring data.

When making a decision on control methodology, IPM practitioners consider more than just the traditional criteria of cost and efficacy. Environmental protection, worker health, and food-safety concerns are also factored into the decision. IPM, then, is an information-based system, and education is a critical prerequisite. Unfortunately, funding for IPM education has not anticipated demands. U.S. Department of Agriculture (USDA) Cooperative Extension funding for IPM has remained constant at $7.1 million annually for the past 13 years. During that same period, inflation has cut buying power by 50 percent.

While American farmers are increasingly interested in converting their crops to IPM systems, they lack the experience and technical support necessary to make the transition. Imagine someone climbing into the cockpit of a jet and, with no flight experience, being asked to pilot it. Then sympathize with the farmer who is being asked to pilot a pest-management program without even an owner's manual, and with the future of his farm and family resting on his success.

Outside pressures, then, are forcing the shift from pesticide-intensive to knowledge-intensive pest-management systems faster than the traditional agriculture support network (i.e., USDA and the Land Grant Colleges) can respond. The loss of the insurance that pesticides provide won't play out evenly. Some farmers, some regions will be disproportionately affected. Other farmers, blessed by geographical moderation (California versus Florida) or by forward-thinking commodity groups who have invested heavily into the search for pesticide alternatives, will do better. But even they will be faced by increasing competition from foreign countries not bound by the regulatory restraints imposed upon U.S. farmers.

The turmoil will also affect the processed food industry. Much like their growers, those processors located in prime growing areas will have relatively good success. Crops in prime areas suffer less from disease and insect problems and provide higher quality, more predictable raw product for the processor. Those processors located in marginal growing areas will incur high costs due to yield and quality losses. In a low-margin business like food

Kim Komerich photo, USDA.

The Mediterranean fruit fly is a pest problem for California citrus crops and the subject of a heated debate on pest-control options. This worker is putting up a cardboard trap, part of an effort to detect medflies early, before they multiply.

A Georgia peach orchard. Consumers have been confused as mixed signals concerning fresh fruits and vegetables have played out in the public arena. While some recent reports have stressed the health benefits of these foods, the public has become increasingly alarmed about the possible effects of chemical residues.

USDA photo.

processing, small increases in raw product costs can substantially affect survival.

The frustration for food processors is that the whole scenario seems so unnecessary. For decades, processors have maintained tough pesticide-control programs designed to guarantee maximum food safety. Most processors contract with independent growers before the growing season begins, assuring control of crop management from the outset. Typically, processors control pesticide use on contracted crops by:

- Including a pesticide clause in the contract warning against unapproved pesticide applications
- Distributing to each grower pesticide lists that contain prior-approved chemicals for each crop
- Maintaining a complete record of every pesticide applied to the crop
- Verifying that all applications are in compliance with federal, state, and processor limitations before the crop is received at the plant
- Analyzing pesticide residue levels in raw and final products.

The frustration for food processors is that the whole scenario seems so unnecessary.

Processors are acutely aware of which pesticides EPA considers to be potentially harmful. Oftentimes, food processors will initiate use restrictions or suspension of controversial chemicals long before EPA makes a decision, in an effort to minimize risk to consumers. These control programs have been remarkably successful. In 1988, the California Department of Food and Agriculture ran pesticide residue analyses on 997 samples from crops destined for processing. Only one sample contained a pesticide not labeled for use on that crop, no sample contained residues over the federally set tolerance, and over 90 percent of the samples contained no measurable residues of any pesticide tested.

Despite food processors' solid record of success in protecting the safety of their product, many are pursuing additional avenues to further guarantee that safety. Some of the areas being explored include grower-education programs on IPM, additional funding for research into pesticide alternatives, incentive programs to encourage grower adoption of IPM, and improved methods for sorting out pest-damaged produce so that grading standards may be met with less intensive use of pesticides. The success of these programs will directly affect the price of food in coming years. The more successful such programs are, the less market instability we can expect.

In the long run, however, the playing field will tend to even out. As alternative systems become more sophisticated and support becomes more widely available, the turmoil of revolution will give way to the relative calm of evolution.

The goals driving agricultural change are legitimate and, given sufficient time, they are achievable. But it must be remembered that the food supply is driven by basic principles of ecology. Any ecological system, even a monocultural system like agriculture, is connected by the webbing of its components. Pluck one string, and they will all vibrate. □

"Big Green" and Pesticides:

This November, California will hold a referendum on pesticides and food safety. Two initiatives will be on the ballot. The proposed Environmental Protection Act of 1990, dubbed "Big Green," not only calls for stringent new standards for agricultural pesticides but includes a number of other environmental provisions as well.

A second, somewhat less stringent initiative—the Consumer Pesticide Enforcement Act for Food, Water, and Worker Safety—has been proposed as an alternative to "Big Green" by a coalition of agricultural, food-processing, and grocers' organizations. The coalition and the initiative are known as CAREFUL, an acronym for "Californians for Responsible Food Laws."

The following two articles are authored by proponents of "Big Green" and CAREFUL, respectively.

Let's Get Tough!

by Al Meyerhoff, Lawrie Mott, and Tom Hayden

Each year, 2.7 billions of pounds of pesticides are added to the environment across the United States. The harmful consequences of these toxic chemicals are irrefutable.

Forty-six pesticides—some known to cause cancer or other harmful effects—have been found in ground water in 26 states as a result of normal agricultural use. In many instances, these pesticides have been detected in ground water at levels at or above their established or proposed health advisory levels. Thousands of agricultural workers are poisoned by pesticide products annually. Disturbing data are confirming significantly higher cancer rates among farmers who are routinely exposed to agricultural pesticides. And these substances continue to pollute our lakes and rivers and to threaten wildlife.

Pesticides are routinely found in the American food supply. However, the full extent of this contamination cannot be determined because the federal government's primary laboratory methods can detect only about half the chemicals registered for use on food. Of approximately 300 pesticides used on food, at least 63 have been classified by EPA as probable or possible human carcinogens. As the former head of EPA's pesticide program said regarding the imperative of making pesticides one of the Agency's highest priorities, "Pesticides dwarf the other environmental risks the Agency deals with. Toxic waste dumps may affect a few thousand people who live around them. But virtually everyone is exposed to pesticides."

The justification for such heavy reliance on toxic chemicals in agriculture is to increase yields of food and fiber. Yet, in 1985, Congress passed a Farm Bill that called for farmers to idle 61 million acres of farmland, an area equal to all of Ohio and Indiana plus half of Illinois. It also paid dairy farmers to kill 1.6 million cows. Through federal "marketing orders," a depression-era device used to control supply and demand, this same legislation compelled fruit growers to destroy three billion oranges, two billion lemons, and millions of pounds of raisins. The ostensible rationale for such counterproductive policies is to keep farmers in business. Yet the primary affliction of the American farmer is oversupply, and family farms are still failing at an alarming rate. These federal farm programs now cost about $20 billion a year in taxes and $10 billion a year in higher food prices.

American farm policy has not only failed to deal adequately with surplus crops and their adverse impact on family farmers, but it has also consistently ignored serious long-range environmental and health costs associated with continued heavy dependence on agricultural chemicals. Since 1950, according to the National Cancer Institute, the incidence of cancer in the United States has increased more than 22.6 percent, including sharp increases in cancer of the brain, colon, liver, bladder, and thyroid. If lung cancers are included, total cancer incidence has increased 36.6 percent. During the same time period, cancer among children under the age of 14 has increased 21.5 percent. Each year in the United States, more than a million Americans contract cancer, and 500,000 die from it. Cancer may cost the nation as much as $39 billion each year in lost production and income, medical expenses, and research resources.

How many cancers are caused by the continued reliance on pesticides? No one knows. Despite assertions by

(Mott is a Senior Scientist at the Natural Resources Defense Council (NRDC); NRDC attorney Meyerhoff and California Assemblyman Hayden are co-authors of the California Environmental Protection Initiative.)

Grant Heilman photography.

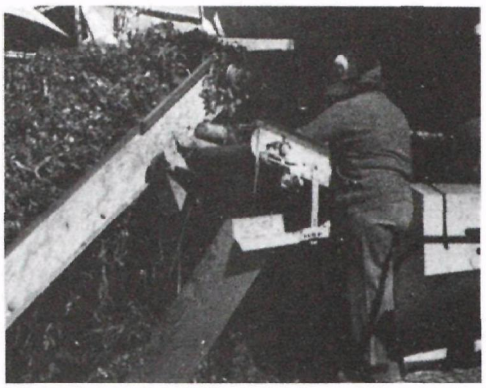
A helicopter sprays miticide on fruit-tree nursery stock. Californians will decide on proposed pesticide reforms in the state's November election.

chemical industry representatives and, too frequently, by government officials who should know better, the most that "science" can tell us is that many pesticides cause cancer and other health effects in animals and may do so in humans. For several decades, our public policy has been, therefore, to avoid exposure to cancer-causing substances and to acknowledge that there is no "safe" or threshold level for carcinogens.

Industry spokesmen and some government regulators are now offering so-called "risk management" as the solution to this problem. By using various computer formulas and plugging in data about toxicology and exposure, the federal government will decide how many and how much of these carcinogens will be permitted in the American diet. Not only is this approach at variance with more than 30 years of codified public policy on food safety dating back to enactment of the Delaney Clause of the Federal Food, Drug, and Cosmetic Act in 1948, it puts far too much reliance on the pseudoscience of risk assessment, notoriously replete with vagaries and uncertainty. Current techniques for estimating cancer risks are simply not up to this task, particularly when more than 250 million Americans are being exposed to these chemicals.

The proper objective of laws and regulations should instead be to prevent environmental exposure to carcinogens, particularly for those most at risk. Chemicals that are known to cause cancer should be eliminated from the food supply. We should not, and need not, accept the inevitability of carcinogens in food. As documented in a recent National Academy of Sciences (NAS) study, American agriculture *can* do business without creating health hazards for its own employees, farmers, and consumers. A timetable should be established for phasing out known carcinogens used on food while providing the means and the incentive to the pesticide industry and agricultural research establishment to develop safer alternative pest-control methods. The Environmental Protection initiative, or "Big Green," to be voted on in California next November does just that.

Under the initiative's pesticide provisions, any pesticide already determined by the EPA or California's governor to be a known carcinogen or reproductive toxin (e.g., classified as an EPA Group A or Group B carcinogen or listed under the Proposition 65) will be phased out of use in California after five years. (There are 19 food-use pesticides in this phase-out category, according to EPA). An extension of up to three years may be granted if no alternative exists and the phaseout will cause severe economic hardship.



USDA photo

Tomatoes being harvested. Modern agriculture has produced striking results, in part because of heavy reliance on pesticides. A question being raised now, in California's "Big Green" debate and elsewhere around the country, is whether satisfactory results can be achieved with less pesticide use.

In addition, under Big Green, food containing residues of these pesticides, whether grown in California or elsewhere, cannot be sold in the state. The phaseout would initially affect some 20 pesticides. Pesticides classified by EPA as "possible" human carcinogens (Group C) are subject to a separate track: Registrants will be required, within five years, to complete adequate testing and affirmatively demonstrate that they are not known carcinogens. Otherwise, these chemicals will be subject to the same five-year phaseout.

The initiative also establishes health-based standards for all pesticides in food, including requiring special protection of children. It transfers pesticide jurisdiction from California's Department of Food and Agriculture to its Department of Health Services and requires the development of a tough farm-worker protection program. Finally, the initiative appropriates $20 million from the state's general fund for research to develop safe alternatives to pesticides.

The phase-out approach embodied in the initiative represents, in some degree, a middle ground, since under the so-called Delaney Clause of the Federal Food, Drug, and Cosmetic Act, any pesticide that "induces cancer when ingested by man or animal" is to be immediately prohibited from leaving residues in *processed* foods. In the past, the EPA has not applied the Delaney Clause to "old" pesticides found to cause cancer long after their initial registration. But in a recent decision, the Agency has reversed that policy. The Agency also asserted that the Delaney Clause contains an exception if the risks are "*de minimis*" (left undefined by EPA), but that thinly reasoned claim will shortly be subject to judicial review.

The probability is that the California electorate will pass Big Green. Opinion surveys show 75 to 80 percent voter support for the phaseout of cancer-causing pesticides in food. Expecting defeat, the opposition has adopted a strategy of deception, putting an alternative "food safety" initiative on the same ballot. Buried in fine print is a provision that would preempt the pesticide language of Big Green in the event that both measures pass but the latter receives more votes. The voters will see through this electoral charade.

Whatever the electoral outcome, there is strong consensus for pesticide reform. The old ways of thinking about agriculture will have to give way. Alternative agriculture practices in lieu of pesticides are taking hold throughout the country; the California initiative would accelerate this trend by funding research for effective alternatives. In its recent report, *Alternative Agriculture*, the NAS found that farmers who adopt alternative agricultural techniques "generally derive significant sustained economic and environmental benefits." The report goes on to say that "wider adoption of alternative systems would result in even greater economic benefits to farmers and environmental gains for the nation."

The future is clear. Americans are convinced that they can be both healthy and prosper. Phasing out cancer-causing pesticides will not leave them with empty grocery shelves. They have the creativity to find alternatives to specific chemicals that have only been used for a decade or two. If officials don't embrace the message, the voters will do it for them. The enactment of the California's Environmental Protection Initiative will be the first major step on the road back to an environmentally sound agriculture policy. □

"Big Green" and Pesticides: Be Careful!

by Bob L. Vice

Recent consumer surveys have indicated that there is more concern about the potential health effects of pesticides in the nation's food supply than about other contemporary issues of food safety, including cholesterol, antibiotics, microbial contamination, food additives, or irradiation. This concern is fully justified. In recent years, consumers have been told repeatedly that the foods they eat are unsafe. Be it *salmonella* in chicken, mercury in fish, or pesticide residues on fruits and vegetables, they have heard it all several times over. Although the Alar incident is now old news, it is still fresh in the minds of many.

Consumers are confused as well as concerned. Even as the news media and some consumer groups are publicizing just how unsafe the national food supply is, health authorities are recommending that everyone eat the very same foods that headlines across the country have characterized as harmful.

This concern and confusion have led to a loss of confidence in the food supply, especially fresh fruits and vegetables. Recognizing this concern, the California Legislature passed the Food Safety Act of 1989. Sponsored by California's leading health organizations and several farm groups, including the California Farm Bureau Federation, the new law was designed to improve California's food-safety program by closing the few gaps that existed and by expanding the information base on which food-safety decisions are made. The Food Safety Act provided assurance that California's food supply is the safest in the world.

But for some, that wasn't enough. Less than two weeks after passage of the California Food Safety Act, several environmental groups—taking advantage of heightened consumer concerns—launched an effort to throw out California's existing pesticide regulatory program for all the wrong reasons. Their attack is embodied in the "California Environmental Protection Act of 1990," an omnibus initiative headed for the November ballot.

Dubbed "Big Green" by its sponsors, the initiative includes forest protection, oil-spill prevention, greenhouse-gas reduction and global-warming prevention, coastal resource protection, and pesticide regulation all in one package. One might say it has a little something for everyone. California voters will be asked, after wading through its 39 pages, either to embrace all of its provisions, or none at all. Although some may understand the thrust of the proposal, few will be aware of its significant, and potentially disastrous, finer points.

In its most basic terms, Big Green ignores most legislation that has been put in place in past years and concentrates instead on public perception. Among its most Draconian provisions is its treatment of pesticides. By addressing the perceptions rather than the facts regarding the safety of the food supply, it completely ignores modern medical science. Regarding pesticide residues on food, the initiative takes a zero-risk approach (in other words, no level of residue is acceptable). Such an approach not only contradicts the fundamental principle of toxicology—which states that risk from exposure to a substance depends upon the dose of the substance and not simply its presence—but also disregards what the experts are telling us.

More than 50 percent of pesticides used in California would fall prey to the initiative and be prohibited from use by 1995. These chemicals would be banned without benefit of dietary risk assessments and without regard for the public health and environmental trade-offs that may result. Many will be lost in just two years because of a little-understood provision in the

Looking forward to a bumper crop. Those who favor the CAREFUL initiative instead of "Big Green" are concerned that fewer pesticide options would mean decreased yields and higher food prices.

Tim McCabe photo. USDA.

(Vice is President of the California Farm Bureau Federation.)

initiative regulating the inert ingredients of pesticide formulations.

Still other pesticides would be treated in an unprecedented fashion by placing the burden of proof on registrants to prove that their chemical does not cause cancer. Depending on how this provision would be implemented and enforced, many more pesticides may be subject to the five-year ban.

If Big Green passes, it would lead to the almost immediate removal of a wide spectrum of essential crop-protection products. Fungicides will be the hardest hit, despite the fact that fungicides provide an important public-health protection by preventing deadly molds from contaminating commodities.

Big Green would also have a crippling effect on our most successful pesticide use-reduction program, Integrated Pest Management (IPM). Many of the pesticides that would be banned are integral components of IPM, which incorporates biological, cultural, and other innovative pest management methods with the judicious use of pesticides. IPM provides an effective approach to crop protection that is widely employed by farmers.

Quantity, quality, and availability of produce also would be affected. Conservative estimates by GRC Economics, a Washington, DC-based firm, show that production of fruits and vegetables and other commodities would be reduced by as much as 40 percent. The availability of many fruits and vegetables imported from other states or countries also would be dramatically reduced in California due to Big Green's provisions. Reduced yields, coupled with reduced availability and increased production costs, would push prices higher.

The bottom line will be fewer tools available to farmers, potentially greater overall pesticide use, decreased production, decreased quality, and higher farm and consumer prices. And for what? Upon close scrutiny, although the initiative poses significant risks for California's number-one industry and, for that matter, the economic stability of the entire state, it offers virtually no benefits to consumers. It will not result in a safer food supply and will provide no measurable improvement to the health of consumers.

Rather than go on the defensive, a coalition of agricultural, food processing, and grocers' organizations (Californians for Responsible Food Laws, or "CAREFUL") filed an initiative of its own entitled the "Consumer Pesticide Enforcement Act for Food, Water, and Worker Safety." The proposal is designed to offer an alternative to the food-safety provisions of Big Green and provide California voters a rational choice at the ballot box in November. Like the Food Safety Act, the CAREFUL initiative is founded on modern medical science and is designed to provide California with the most advanced and comprehensive pesticide regulatory program in the world. In so doing, CAREFUL will provide improved tools and methods to fully understand prospective regulatory actions on health, the environment, and food production instead of simply banning pesticides with no regard for the implications of that action.

Barry Fitzgerald photo USDA

Listening for telltale sounds of fruit-fly larvae chewing inside a grapefruit—so that pesticide use can be limited to known infestations. CAREFUL includes a provision for increased pest-control research.

First, CAREFUL is based on sound toxicology, using the acute and chronic health effects data required for new pesticide registrations as well as for re-evaluations of older pesticides. Both the California Department of Food and Agriculture and the Department of Health Services will play important roles in the re-evaluation of many older pesticides that did not undergo the same rigorous registration standards that are used today.

Second, CAREFUL, like the Food Safety Act, requires farmers to submit pesticide-use reports for *all* pesticides purchased and used. California's new "Total Use Reporting Program," the first in the nation, requires comprehensive information on pesticide use patterns.

Third, CAREFUL provides for an improved and expanded capability to detect pesticide residues in food, enhancing our ability to enforce established laws, and providing a more comprehensive survey of actual dietary exposures and corresponding risks.

Fourth, CAREFUL gives special consideration to the unique dietary and physiological characteristics of infants, children, and other sensitive subpopulations.

Fifth, CAREFUL would institute new programs to assure greater safety in the workplace for farm employees, including the establishment of a program for worker-hazard communication and for training all persons who handle, mix, or apply pesticides thought to pose a hazard.

Sixth, CAREFUL provides for enhanced water-quality protection, including the monitoring of state waters for pesticide and other chemical residues.

Finally, CAREFUL would fund ($5 million annually) a new program of research into alternatives to pesticides and innovative pest-management practices that would reduce pesticide usage and minimize residues remaining in foods.

Clearly, CAREFUL is designed to provide a better understanding of the use patterns, benefits, substitution possibilities, and public health and environmental ramifications of pesticide regulation. This understanding is essential to any balanced food-safety program designed, on the one hand, to minimize dietary exposure to potential cancer-causing pesticides and, on the other, to provide an abundant and wholesome food supply.

The CAREFUL approach is also consistent with health organizations' recommendations that consumption of fresh fruits and vegetables be increased. These recommendations are reinforced by a recent National Academy of Sciences (NAS) report which points out that the risk of cancer from ingesting residues on fruits and vegetables is greatly outweighed by the benefits (e.g., reduced risk of cancer and other chronic diseases) of regular consumption of these foods. A respected California toxicologist has estimated that the benefits outweigh the risks by roughly a factor of 1,750.

The NAS report also underscores the significance of adopting scientifically based pesticide policies as opposed to a high-emotion, low-science program such as that proposed in Big Green (which ultimately may do more harm than good). Only then can there be a balanced strategy designed to achieve the highest level of cancer prevention.

Let's hope that Big Green is one diet Californians will not choose to go on. □

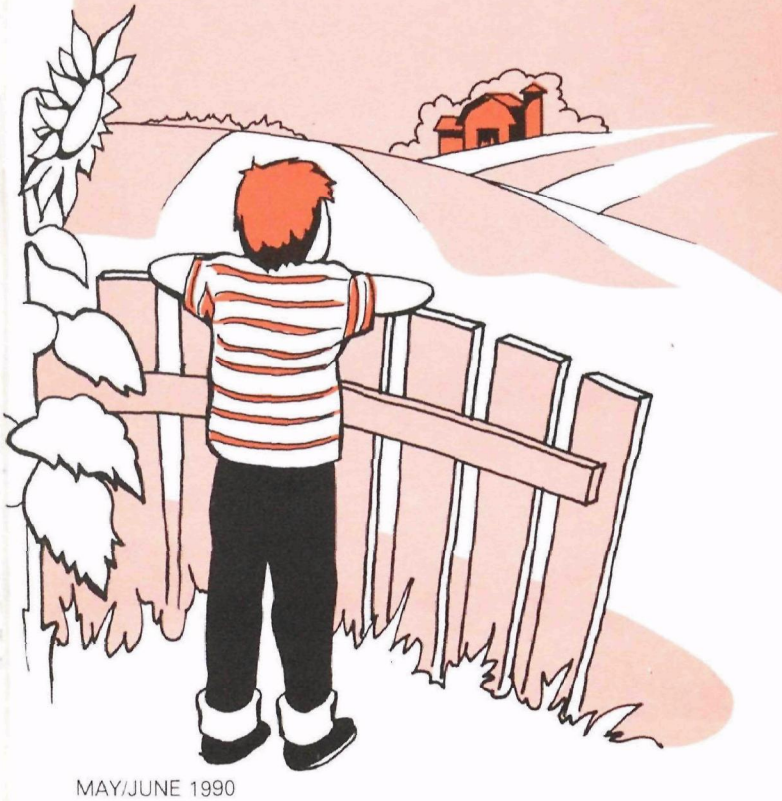
Pesticides and Food Safety:

A Feature for Young Readers

by Jennifer Zicht

"Would you like corn for dinner?" your mom asks. She husks and washes each ear of plump yellow kernels. Then, she drops the ears into a pot of boiling water. Imagine for a moment your great grandmother preparing the same meal. As she husked the corn, however, she probably discovered that some of the ears had caterpillars on them or were peppered with mushy brown kernels.

Why should the corn your mother and great grandmother prepared be so different? For one reason, farmers today use powerful chemicals called pesticides. Pesticides are poisons that kill problem insects, animals, microorganisms, weeds, and other pests. About 50 years ago, scientists discovered how to make pesticides. The scientists were amazed at how powerful and dangerous these new poisons proved to be; insects, rats, and mice died quickly after eating them.



Scientists used pesticides to attack insects and microorganisms that carry dreadful diseases. Millions of people's lives were saved. Farmers, too, were quick to use the new weapons. They began spraying orchards, fields, and storage areas. They no longer lost great quantities of vegetables, fruits, and grains to insects and rodents. By spraying herbicides, farmers could kill weeds that compete with food plants for water, sunlight, and soil nutrients. With pesticides, farmers could grow more and greater varieties of food cheaply. Pineapples, bananas, oranges, and other fruits overflowed supermarket shelves. Fifty years ago these fruits were hard to come by and very expensive because they were difficult to grow and transport.

For a time after pesticides were first developed, many people thought their pest problems were solved forever. Unfortunately, as people used more and more pesticides, they soon discovered there were disadvantages as well as benefits.

Farmers discovered that many pesticides lose their effectiveness over a period of time. Some pests become "superpests," able to resist even the strongest poisons. Each time farmers use different and better poisons on them, millions of the pests die, but a few of the strongest ones remain. These resisters mate and multiply. Scientists and technicians have to keep developing newer and more deadly pesticides to keep up with the problem.

Worse yet, people discovered that pesticides can be hazardous to good creatures as well as bad ones. If people who make and spray pesticides are exposed to too much of certain pesticides, they can get sick or develop diseases later on. Birds, beneficial insects, fish, and other wildlife may die along with the pests when they eat or breathe the poisons.

Soon, people realized that pesticides also can continue to be hazardous to good

creatures, long after the pests are dead. Often small amounts of pesticides called residues remain in the environment after they are applied. Although some pesticides break down when it rains or when the sun shines, others don't disappear. Instead, some residues remain in the soil, seep into drinking water, or float through the air. The residues often remain on or in our food. Little bits of pesticides are everywhere.

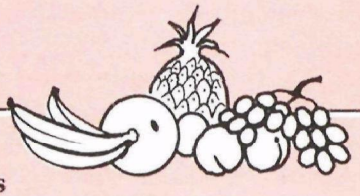
In 1970 our government created the U.S. Environmental Protection Agency, or EPA for short, to help protect our environment and our health. EPA studies data from thousands of laboratory tests made on different pesticides to see if the chemicals cause diseases like cancer and if the chemicals threaten the environment. If scientists believe a pesticide can cause diseases in people, even at the low, low levels that may remain in our food, it may be outlawed. For all pesticides, EPA sets up strict rules for where and how much can be used. When EPA learns new information about the risks of a pesticide, it can change the rules, or decide to outlaw the use of the pesticide altogether.

A piece of fruit, for example, may have microscopic amounts of residues on the peel or inside the fruit. EPA decides how much pesticide residue is safe for us to eat in that fruit.

To make sure the amounts of pesticide residues in our food remain small, other government agencies monitor farms, processing plants, warehouses, and markets to make sure the food is safe. Government officials check food for pesticide residues. If too much pesticide residue is on the food, the whole crop or shipment may be taken away and destroyed. EPA doesn't want foods with too many pesticides to be sold or eaten.

There are some people who believe that even the small amounts of pesticide residues that EPA allows in foods are hazardous. Other people believe that over a lifetime, small amounts of many different kinds of chemical residues may build up inside our bodies and eventually cause diseases like cancer. No one really knows if this is true; not enough tests have been conducted to find out for sure which chemicals cause which health problems.

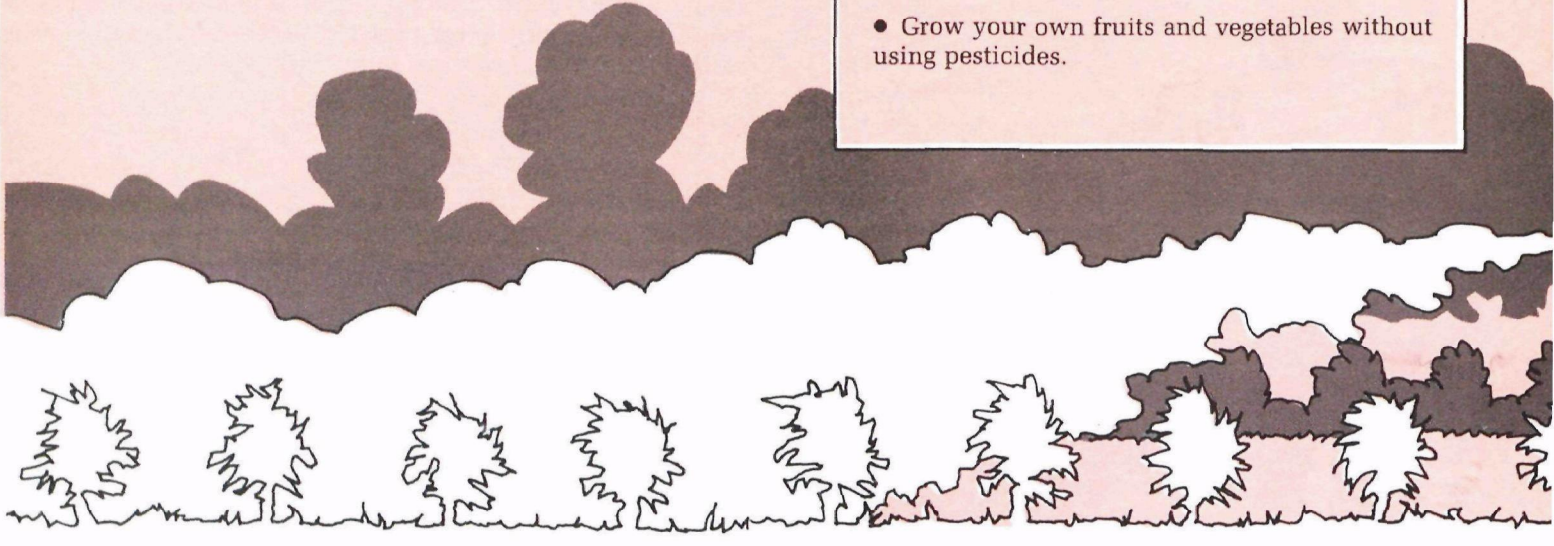
Meanwhile, just to be on the safe side, it is a good idea to know how to avoid or reduce



Food Safety Tips

To reduce the amount of pesticide residues in your diet, follow these simple tips:

- Wash and scrub all fresh fruits and vegetables thoroughly under running water.
- Peel fruits and vegetables when possible. Throw away the outer leaves of leafy vegetables such as lettuce and cabbage.
- Cooking and baking usually help to break down the pesticide residues in food.
- Trim the fat from meat, chicken, and fish. Some pesticides collect in animal fat.
- Don't pick and eat berries and other wild foods that grow on the edges of roads and fields where pesticides may have been sprayed.
- Grow your own fruits and vegetables without using pesticides.



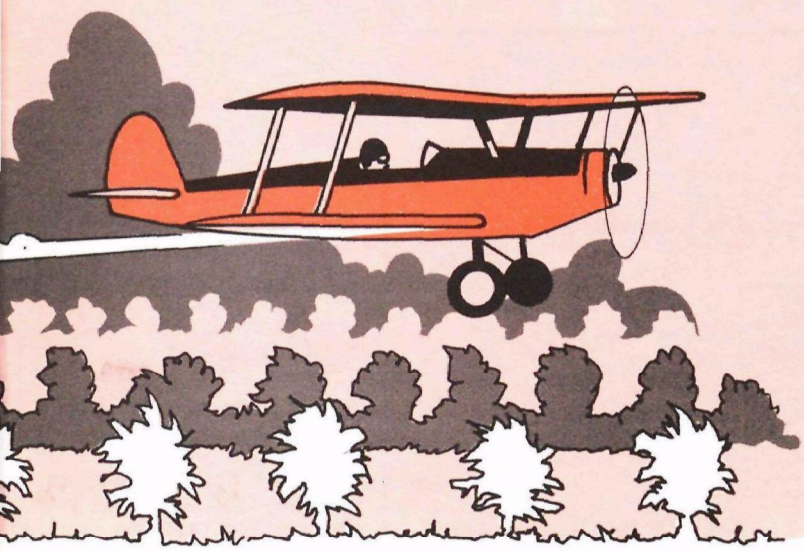
pesticide residues in foods. By doing some or all of the things listed in the box entitled "Food Safety Tips," you will eat less pesticide residues. In many cases, if you wash, peel, and cook fresh fruit and vegetables, you can remove much, if not all, of the residues.

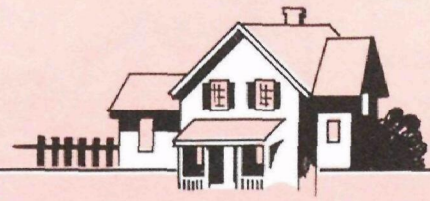
Scientists and farmers continue to improve farming methods. In labs, scientists develop safer chemicals which attack only specific, bad insects or weeds. They are also developing non-poisonous chemicals that change the life cycle of some pests. For example, if its life cycle is disturbed, an insect may not be able to feed on food crops or to reproduce. Other scientists are developing stronger types of food plants which can resist pests.

Since many pests resist all types of pesticides, farmers are trying to depend less on chemicals and more on different farming techniques to control pests. With one technique, the farmers try to trick insect pests by changing the types of crops they grow in their fields from year to year. A corn-eating insect gets a surprise and may go away when a farmer grows cucumbers where he had formerly grown corn. Farmers can also use beneficial insects to control insect pests. These beneficial insects are the pests' natural predators. Many farmers are beginning to use a combination of field techniques and pesticides or no pesticides at all.

The corn your children husk 20 years from now will probably be more perfect looking than it is today. It will probably be healthier as we find better ways to make our food supply even safer. □

(Zicht is a free-lance writer in the Washington, DC area.)





Home Report Card

You might not know it, but pesticides are used almost everywhere, not just on farmers' fields. If you have a bathroom, kitchen, laundry area, lawn, garden, pets, or pool, it's likely your family uses pesticides. People scrub toilets, bathtubs, and tiles with pesticides to kill harmful germs. Many people apply pesticides inside their homes to get rid of roaches and ants. Others spray grass to kill weeds, and roses to kill Japanese beetles. The flea collar on your dog or cat probably contains a pesticide. Even the chemicals poured into a swimming pool to kill tiny green plants are pesticides.

To see how well you keep away from pesticides and how safely your family uses and stores them, fill out the report card below. Write a letter after each question. Write either: "A" for always, "B" for most of the time, or "F" for never. If you don't get all "A's," you and your family should work harder to follow the safeguards; they will help you stay safer and healthier.

- Do you stay away from pesticides, and stay far away from people using them?
- Do you keep pesticides away from younger children?
- Do adults in your household read and follow pesticide label directions carefully?
- Does your family store all pesticides "out of children's reach," locked inside a cabinet in a basement, garage, or garden shed?
- Does your family keep pesticides used indoors, like bug sprays and disinfectants, away from the kitchen where food is prepared?
- Do you stay indoors and close the windows when someone outside is spraying pesticides on trees, lawns, or gardens?
- Do you stay off of lawns for several days after they have been sprayed by a lawn care company?
- Does your family dispose of unused or unwanted pesticides through household hazardous waste collection programs in your community?
- In case of an emergency, do you have the number of a poison control center written near or on each of your telephones?
- Can you think of other things you can do to avoid pesticides?
- Can you think of ways to prevent and get rid of pests around your home without using pesticides?

Children's games on the next three pages ➧

Ketchup Maze

Practically everyone dabs sticky red globs of ketchup onto French fries and hamburgers. If you've always wondered where ketchup comes from, other than out of a bottle, here's your chance to find out.

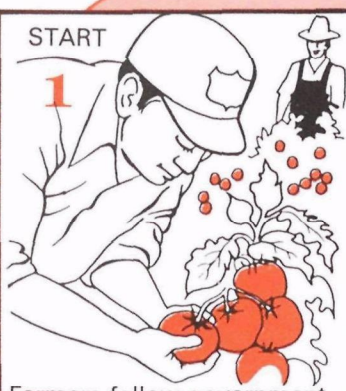
Ketchup has been around for hundreds of years. It may have first come from China where people mashed up herbs, spices, and fish brine to make a sauce. Travelers brought the recipe to Europe, where tomatoes eventually became the main ingredient.

Years ago you couldn't be too sure what fell into the pot as people were making a batch of ketchup. Today we use modern methods to prepare ketchup. Farmers, our government, and food companies work together to make sure we are getting healthy food.

In this maze, see if you can find the correct path from the tomatoes growing in the field to the ketchup bottle at the barbecue. Although it takes about a day for tomatoes to be processed into ketchup, let's hope it takes you only a few minutes to complete the job through this maze.

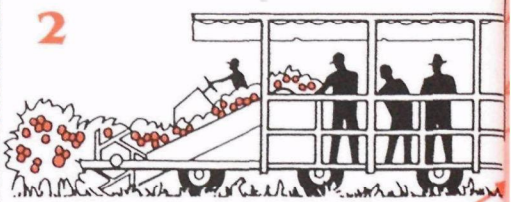
START

1



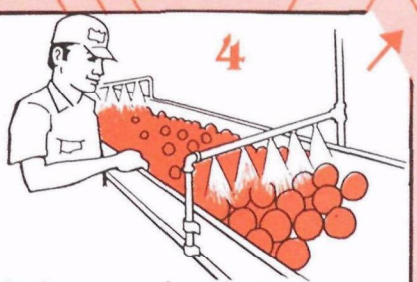
Farmers follow government rules about using pesticides properly when growing tomato crops. County agents help farmers use only as much pesticide as necessary.

2



A machine harvests the tomatoes. Then farmers check the harvest for quality before it is loaded into trucks.

4



At the processing plant, tomatoes go through a flume where water washes off dirt and chemical residues.

3

A food company buys the fresh tomatoes from the farmer and trucks them to an inspection station. The fruit is inspected for overall quality and for pests and pesticide residues.

6

A cook adds spices and other ingredients. Only substances OK'd by the government can be added. Ketchup samples are tested to make sure they are pure and meet government standards.

9

Shoppers buy the ketchup and take it home.

8

The food company carefully labels the contents of the bottles so consumers will know what they are eating.

5

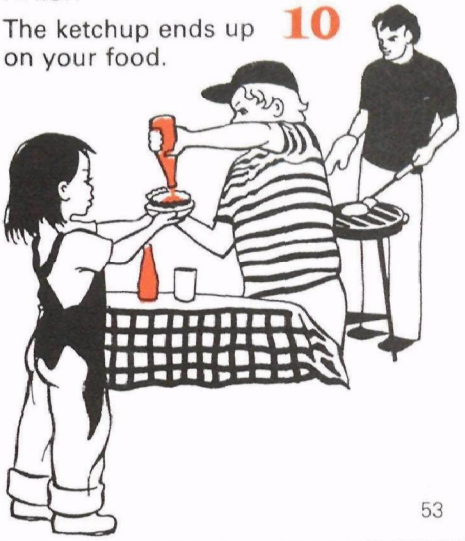
The tomatoes are chopped and crushed, then put through a pipe into a steam cooker where they are boiled. A technician checks the temperature.

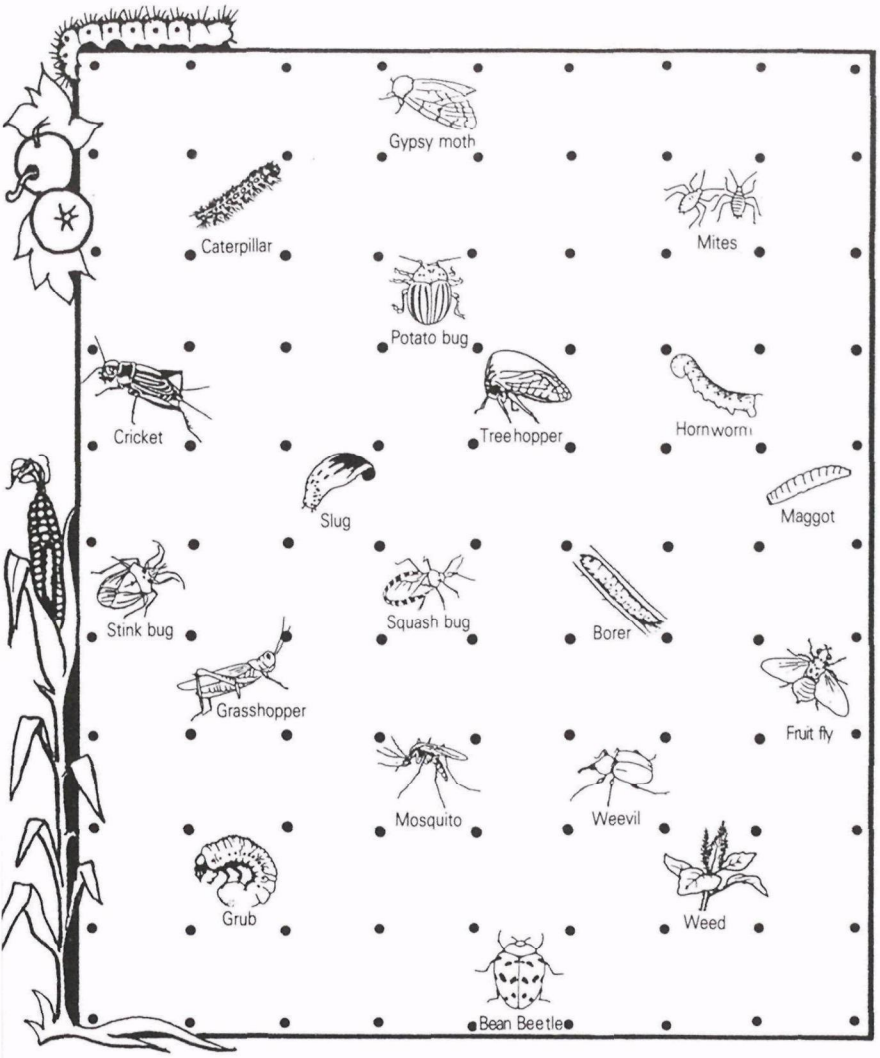
7

The filler shoots ketchup into clean glass bottles. Then the bottles will be capped and cooled automatically.

FINISH

The ketchup ends up on your food. **10**





Pesky Pest Trap Game (for two or more players)

Pests come in all shapes and sizes. See how many pests you can trap by drawing squares around them.

Take your turn by connecting two dots with a line going up, down, or across. When a line you draw *completes* a square—any square—write your initials inside that square and take another turn. The game ends when the last line is drawn.

Adding up your score: Each initialed square counts as 1 point, and each square that contains a pest is worth 3 points. The player with the most points wins.

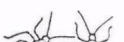
Word Scramble

In the box below, look up, down, forward, and diagonally to find words for things to eat.

G	F	O	T	A	V	Z	S	B	S	T	I	C	A
T	R	G	N	A	Z	E	B	C	H	C	H	U	T
N	O	R	A	P	L	E	A	N	N	U	Z	C	E
O	E	G	G	P	L	A	N	T	O	C	M	U	S
S	O	R	P	L	E	T	A	C	E	L	M	M	I
J	P	A	E	U	I	P	N	W	G	R	U	B	A
M	Z	P	A	M	O	R	A	N	G	E	S	E	W
P	D	E	O	S	M	I	S	F	O	W	H	R	W
R	E	S	P	T	H	L	F	P	E	A	R	S	O
A	R	A	D	S	A	E	M	N	A	Z	O	C	M
M	B	A	N	M	R	T	S	F	B	H	O	K	T
B	I	S	I	U	E	T	O	E	O	A	M	H	J
H	S	L	E	T	T	U	C	E	Z	K	S	U	I
L	P	Z	T	Q	N	S	O	L	S	R	I	J	R

Pesticide-Pest Match

Different kinds of pesticides are named after the kinds of pest they are made to control. See if you can match the following types of pesticides with their "target" pests.

NEMATICIDE	1. 
MITICIDE	2. 
INSECTICIDE	3. 
FUNGICIDE	4. 
HERBICIDE	5. 
RODENTICIDE	6.

Find the "Good Guys" Game

See if you can find the beneficial insects and natural enemies of certain pests hidden in the drawing. Hint: There are eight.

Answers

Good Guys Game: Drawing includes a spider, praying mantis, bee, ladybug, bird, lacewing, toad, and bat.
Pesticide Match: Nematicide—5, miticide—6, insecticide—1 (and 6), fungicide—2, herbicide—3, rodenticide—4.
Word Scramble: Apples, peanuts, pears, lettuce, potatoes, oranges, mushrooms, cucumbers, egg, eggplant, pea, bananas, and plums.

Appointments

Erich W. Bretthauer is EPA's Assistant Administrator for the Office of Research and Development.

Bretthauer has served as Acting Assistant Administrator of the Office of Research and Development since November 1988. From September 1987 to November 1988, he was Deputy Assistant Administrator of that office.

Bretthauer began his federal career in 1962 as a Commissioned Officer in the U.S. Public Health Service. He has held other senior positions at EPA headquarters, as well as serving as director of EPA's Environmental Monitoring Systems Lab in Las Vegas, Nevada.

In 1979, Bretthauer received the EPA Gold Medal for directing the Agency's emergency radiological monitoring program at Three Mile Island. He earned his bachelor's and master's degrees in chemistry from the University of Las Vegas, Reno.

The new Deputy Assistant Administrator for EPA's Office of Research and Development is Dr. **John H. Skinner**.

Dr. Skinner has been Acting Deputy Assistant Administrator since 1988. From 1985 to 1988, he was Director of the Office of Environmental Engineering and Technology Demonstration and from 1982 to 1985, he was Director of the Office of Solid Waste. He joined the Agency in 1972.

A 1964 graduate of Hofstra University, Skinner earned his doctorate in Aeronautical Engineering from Rensselaer Polytechnic Institute in 1968. He has earned EPA's Presidential Meritorious Executive Award, the Gold Medal for Exceptional Service, and the Silver Medal for Superior Service.

EPA's Deputy Assistant Administrator for the Office of Solid Waste and Emergency Response is **Mary Gade**.

Gade has served as Acting Deputy Administrator since November 1989. She joined the Agency in 1978 as a staff attorney in Region 5, and has served as the Associate Division Director for Superfund and as the Deputy Director in Region 5's Waste Management Division and as a Branch Chief in the Region 5 Office of Regional Counsel.

From 1980 to 1989, Gade was an instructor at Roosevelt University in Chicago, where she taught a number of environmental courses. She earned her bachelor's degree in environmental studies and Italian from the University of Wisconsin-Madison. In 1977, she received her law degree from Washington University School of Law in St. Louis, Missouri.

EPA's new Assistant Inspector General for Audit is **Kenneth A. Konz**.

Konz served as Deputy Assistant Inspector General for Audit from 1984 to 1989. Previously, he served as Director of the Eastern Audit Division; Director of the Technical Services Staff; Special Assistant to both the Inspector General and the Assistant Inspector General for Audit; and Special Assistant to the Commissioner of the New Jersey Department of Environmental Protection.

A graduate of the University of Denver, Konz joined the Agency in 1971 as one of the original members of the audit staff. Before joining EPA, he participated in and supervised audits for the Army and the Department of Health, Education, and Welfare. Konz is a Certified Internal Auditor and a member of the Institute of Internal Auditors and the Association of Government Accountants.

Bretthauer

Skinner

Gade

Konz

The new Director of EPA's Office of Modeling, Monitoring Systems, and Quality Assurance is **Rick A. Linthurst**.

Linthurst has been Acting Director since September 1988. Before joining the Office of Research and Development's Office of Modeling, Monitoring Systems, and Quality Assurance as Acting Deputy Director in January 1988, he was Director of the Agency's Acid Deposition Aquatics Effects Research Program.

A 1972 graduate of Lebanon Valley College, Linthurst earned his master's and doctorate degrees in ecology and botany, respectively, from North Carolina State University. He is an adjunct assistant professor at North Carolina State University and author of nearly 100 publications and reports, many dealing with acid deposition effects on streams and lakes and salt-marsh ecology.

The Director of EPA's Office of Pollution Prevention is **A. Henry "Hank" Schilling**.

From May 1987 until January 1990, Schilling was EPA's legislative counsel. He joined the Agency in 1985 as Special Assistant for Legislative Development in the Office of Policy, Planning, and Evaluation.

Before joining the Agency, Schilling spent more than a decade with the Battelle Memorial Institute researching science and environmental policy issues. A 1967 graduate of Harvard, he earned his master's degree from Princeton University in 1971 and his law degree from Rutgers Law School in 1974.

George R. Alexander, Jr. is EPA's Regional Counsel for Region 6, which is headquartered in Dallas, Texas.

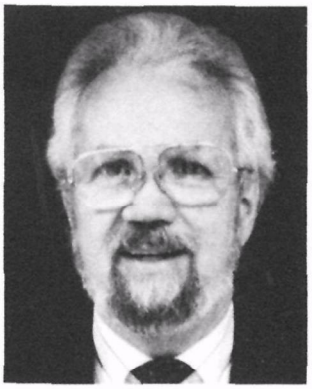
Alexander was a senior partner with the Fort Worth, Texas, law firm of Alexander and Tiffany from 1978 to 1984. He was the Agency's Regional Administrator for Region 5, headquartered in Chicago, Illinois, from 1976 to 1978. He served in the Office of the Adminstrator and as Deputy Regional Adminstrator of Region 6 in the early 1970s.

Before joining the Agency, Alexander was executive vice president of Continental Life Insurance Company. A graduate of Southern Methodist University, he earned his law degree from the same institution in 1958.

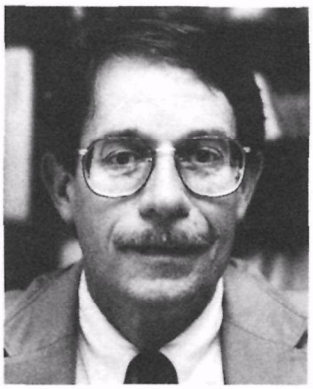
James O. Rauch is EPA's new Deputy Assistant Inspector General for Audits.

Rauch joined the Agency in 1973 as a field auditor. Since that time, he has served in various positions including Chief of the Quality Control Staff; Director of Audit Operations; and Director of the Technical Assistance Staff.

Rauch earned a bachelor's degree in accounting from the University of Arkansas in 1968. He earned his master's of business administration from George Mason University in 1982 and a master's of taxation from Southeastern University in 1983. Rauch is a Certified Internal Auditor and a Certified Public Accountant (CPA). He is a member of Certified Public Accountants and the Association of Government Accountants. He also serves on the board of trustees of the American Institute of CPA's Benevolent Fund. □



Alexander



Schilling

Rauch

Tanimura & Antle photo.

Crops as well as carpets can now be vacuumed. This leviathan, dubbed "Salad Vac," is being used on lettuce by a large grower in the West. It sucks up aphids, thrips, worms, lygus, leafminers, and whiteflies. (See article on page 41.)

Back Cover: Two villains in closeup—corn earworms. Photo by Runk/Schoenberger for Grant Heilman Photography.