Pests Prevail Despite Pesticides

For farmers around the world, insecticides once seemed a sure and reliable weapon in the battle against pests. Gradually, growers began to realize they were firing blanks against enemies like the tobacco budworm, the Colorado potato beetle, and the diamondback moth. The insects developed resistance to the chemicals and, in many cases, became immune to one, two, three, and, in some cases, many pesticides, leaving farmers to resort to more toxic and more expensive chemicals, if any were left at all.

According to a new report and an international conference on the subject recently held at the National Academy of Sciences, the problem of resistance is worsening, but little is being done to come up with a comprehensive solution. The overriding message in the report and from the meeting is that a great deal more research is needed. Scientists do not understand how resistance develops or how to monitor it, much less how to prevent it. But not much progress has been made in the United States in part because none of the players involved with pesticides—chemical companies, the Agriculture Department, the Environmental Protection Agency (EPA), or the other policy analysts—can agree what roles each should assume.

Between 1970 and 1980, the number of arthropods that have become resistant to pesticides has almost doubled, from 224 to 428, according to the new report written by Michael Dover of the World Resources Institute in Washington and Brian Croft of Oregon State University. Resistant insects pose agricultural and public health problems. For example, 25 species of beetles, caterpillars, mites, and other insects that attack cotton plants in 36 countries now resist pesticides. In the United States, one of these resistant bugs nearly devastated cotton farming along the Gulf Coast of Texas during the 1960's and 1970's. The problem of resistance is also illustrated dramatically by *Anopheles*, the species of mosquito that transmits malaria. The mosquito now resists one or more of the major insecticide groups in 84 countries and the number of cases of malaria, once under control, doubled between 1972 and 1976. Various species of fungi and rodents have also developed resistance to chemicals intended to kill them.

Although the world of chemistry may seem limitless, the ability to synthesize new and effective chemicals will be increasingly difficult because the compounds are structurally more complex and harder to manufacture, says Dover and Croft's report. The study is the first policy paper to be published by the institute, a nonprofit organization established 2 years ago by a MacArthur Foundation grant. Resistance needs to be detected and monitored much earlier in the game to extend the useful life of chemicals. Market forces, they argue, respond too slowly to the resistance problem. By the time a farmer realizes a pesticide no longer works, it is too late to try and develop ways to intervene.

Scientists at the conference, which was held 27 and 28 November, disagreed over the biological mechanisms that insects develop to adapt to pesticides and the ways to overcome resistance. Some participants suggested that farmers use a mix of two or more pesticides or alternate the use of different chemicals, but other researchers said these methods would not make any difference. Some types of insects tend to develop resistance more readily than others, but scientific techniques to determine this trait systematically have not been established.

Dover, who presented his report at the meeting, proposes an elaborate plan to spur more research in these areas. A former official in EPA's pesticide office, he advocates a strong role for EPA, which, in his opinion, has been dragging its feet. Dover suggests that EPA require a manufacturer to submit efficacy data when a new chemical is registered. When a company asks EPA to approve a chemical for emergency use, the firm should be required to report resistance problems with the compound it is replacing. In addition, the agency's research staff should study monitoring techniques in collaboration with industry and the Agriculture Department agencies.

Dover's opinion contrasts sharply with that of Edwin Johnson who, until June, was head of the agency's pesticide office for many years but is now director of the agency's water regulations. Johnson, who was to speak at the conference but was unable to attend, said in prepared remarks that he had deep reservations that EPA should play a major role in managing resistance. "Specifically, it is not altogether clear that one should . . . extend the effective life of a pesticide," he says. A longer market life for a chemical may reduce a company's incentive to develop new chemicals aggressively.

Perhaps more to the point, Johnson noted that EPA and other regulatory agencies around the world have limited resources and that most of them are worried about the effects of chemicals on human health and the environment, rather than the problem of effectiveness.

While there is wide agreement that better education of the farmer is needed, there is no consensus how to go about this. Ray Frisbie of Texas A&M University urged the cooperative extension service to start paying attention to the resistance problem and provide more information to farmers. "Farmers deal with pesticides on an ad hoc basis—from crisis to crisis. Resistance is still not a major consideration in the way a farmer selects or uses a pesticide."

Dover and Croft suggest two ways to raise money to fund the necessary research and management programs: impose a federal tax on the chemical industry and farmers, who will benefit the most from the research, and establish a research foundation or special fund supported by the chemical industry. Neither, however, is politically likely given the strength of the agriculture lobby. Charles Delp, head of fungicide development at Du Pont, said at the meeting that companies are "very much aware of pesticide resistance." He noted, however, "There's a need for cooperation among companies. But because of the overwhelming competition, one company can nullify the good intentions of others." There is worry that cooperation among chemical companies might spawn antitrust litigation.

Charles Benbrook, staff director of the academy's agriculture board, suggests that product liability ultimately may be the driving factor that goads companies to respond to the resistance problem. Once farmers realize that their crop failures were caused by ineffective chemicals, they are likely to sue the companies, Benbrook says.

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