PUBLIC HEALTH

More Pesticide Research

Report of the President's Science Advisory Committee analyzes situation and charts plans for control and inquiry of chemical and other methods of pest control.

➤ MORE RESEARCH on pesticides is likely to result from the report of the President's Science Advisory Committee panel issued by the White House.

In order to develop safer and more specific controls of pests, the Government is advised to provide more research support for selectively toxic chemicals, non-persistent chemicals, selective methods of application, and non-chemical control methods such as the use of attractants and the prevention of reproduction.

The report, excerpted here, recognizes the hazards as well as the gains to mankind from the use of chemicals.

The modern organic chemicals are remarkably effective, the report said, in facilitating both the control of insect vectors of disease and the unprecedented production of food, feed and fiber. The use of pesticides associated with the production of our food is carefully controlled by the growers and supervised by agricultural specialists and the Food and Drug Administration. As a result, the residue levels measured on foods intended for interstate and foreign commerce are low and rarely above Federal tolerance limits.

The report declared that the use of pesticides must be continued if we are to maintain the advantages now resulting from the work of informed food producers and those responsible for control of disease. On the other hand, it has now become clear that the proper usage is not simple and that, while they destroy harmful insects and plants, pesticides may also be toxic to beneficial plants and animals, including man.

Their toxic effects in large doses are well known and precautions can be taken to see that humans are never needlessly exposed. But we must now also take measures to ensure that continued exposures to small amounts of these chemicals in our environment will not be harmful over long periods of time.

Gains From Pesticides

Our material standard of living has been greatly elevated during the twentieth century by increased control over the environment. Few recent developments have been so effective or have had application in such a wide range of human endeavor as the pesticide chemicals. Although pesticides have been used for centuries as adjuncts in pest control, the great advances of the last 20 years resulting from the discovery, manufacture and application of new compounds have changed their role in many instances to that of the principal and frequently sole control measure.

Pesticides have made a great impact by facilitating the production and protection of food, feed and fiber in greater quantity and quality; by improving health; and by keeping in check many kinds of nuisance insects and unwanted plants. Agricultural needs have entailed the largest applications of pesticides in this country. Productivity has been so increased that famine is an unknown experience to the people of the developed nations.

Mechanization, improved fertilizers, and the breeding of productive and disease-resistant crops have also contributed importantly. In addition, pesticides have made possible the economical production of many crops which otherwise would be available only to a limited number of wealthy consumers.

While reducing food losses, pest control has also resulted in foodstuffs of the highest quality. Today, for example, sweet corn, potatoes, cabbage, apples and tomatoes are all available unmarred, and the American housewife is accustomed to blemish-free products. Citrus fruits are seldom damaged or lost because of scale insects, fruit flies or diseases, and the cost of animal protein is lower because large losses of cattle from tick fever and grubs no longer occur.

Colorado College

WILD FALCON—Prof. James Enderson of Colorado College is shown placing a Government band on the leg of a wild prairie falcon. These bands will help Dr. Enderson, who is conducting a long-range study of these birds, to check their migratory habits and to find whether they are a disappearing species.

Modern agricultural efficiency is maintained not only through the use of insecticides, but also by means of herbicides, fungicides, rodenticides, nematocides, plant growth regulators and other chemicals. Their benefits extend beyond crops raised for direct human consumption. They permit efficient production of forage and grains, which in turn are needed for a productive livestock economy. In addition, they allow profitable yields of non-food crops such as cotton, tobacco and timber.

Pesticides have not, however, reached an optimum of effectiveness. More than 100 established pests have developed resistance to one or more previously effective chemicals, and new pests are occasionally introduced by international traffic.

Rapid population growth and concomitant decrease in land available for agriculture necessitate greater crop yields per acre and reduction of losses and spoilage in stored foods. Moreover, many products must be protected during the process of manufacture and distribution.

Besides enabling spectacular increases in agricultural production, pesticides have freed man from communicable diseases to an unprecedented extent. In less developed areas of the world, malaria, typhus and yellow fever, previously controlled only with great difficulty, are now limited and in some locations eradicated. In each case, pesticides have facilitated control of the insect vector.

At some stage of their natural history a number of the major communicable diseases involve an intermediate host or vector. Most successful disease control programs have been directed at eliminating this link in the chain of transmission, rather than treating man after he has contracted the disease.

However, control programs have not achieved disease eradication. Malaria is still the disease responsible for the largest number of deaths in the world each year, although new cases are rare in the United States. Yellow fever, schistosomiasis, plague and some rickettsial diseases are almost unknown in the mainland of North America, but they still take a large toll of human lives in the rest of the world.

Furthermore, reservoirs of disease in animals, and insects which can transmit them, will remain with us for the predictable future both in this country and in other parts of the world, thus requiring a continued effort to control them.

An additional complication in disease control is that the insect vectors, such as mosquitoes that transmit malaria, may produce resistant populations capable of transmitting the resistance to pesticides from generation to generation. In order to keep up with the successive threats of insect vectors as they develop resistance to one chemical after another, it is important to enlarge and improve our capability for controlling pests.

Pesticides also have made control of many nuisance insects and plants financially feasi-

ble. Were the cost higher, the funds for their control would be used by other more critical demands on the economy. For example, it might be too expensive to control the varieties of mosquitoes that breed in marshes and estuaries which do not transmit disease, but limit man's enjoyment of some of the most desirable recreational areas. Similarly, elimination of roaches from kitchens, aphids from roses and fungi from golf greens are very desirable but nonessential benefits.

Efficient agricultural production, protection of health and elimination of nuisances are now required and expected by modern man. The methods used to accomplish these ends must continue to improve, although their present scope and magnitude far exceed the few examples included here. It is certain that coming years will witness sophistication of methods and new uses for which pesticides were not originally conceived.

Hazards of Pesticides

Evidence of increasing environmental contamination by pesticide chemicals has generated concern which is no longer limited to citizens of affected areas or members of special interest groups. During two decades of intensive technical and industrial advancement we have dispersed a huge volume of synthetic compounds, both intentionally and inadvertently. Many, such as detergents, industrial wastes and pesticides, are now found far from the point of initial dispersal.

Today, pesticides are detectable in many food items, in some clothing, in man and animals, and in various parts of our natural surroundings. Carried from one locality to another by air currents, water runoff, or living organisms (either directly or indirectly through extended food chains), pesticides have traveled great distances and some of them have persisted for long periods of time. Although they remain in small quantities, their variety, toxicity and persistence are affecting biological systems in nature and may eventually affect human health. The benefits of these substances are apparent. We are now beginning to evaluate some of their less obvious effects and potential risks.

Precisely because pesticide chemicals are designed to kill or metabolically upset some living target organism, they are potentially dangerous to other living organisms. Most of them are highly toxic in concentrated amounts, and in unfortunate instances they have caused illness and death of people and wildlife. Although acute human poisoning is a measurable and, in some cases, a significant hazard, it is relatively easy to identify and control by comparison with potential, low-level chronic toxicity which has been observed in experimental animals.

The panel is convinced that we must understand more completely the properties of these chemicals and determine their long-term impact on biological systems, including man. The panel's recommendations are directed toward these needs, and toward more judicious use of pesticides or alternate methods of pest control, in an effort to minimize risks and maximize gains. They are offered with the full recognition that pesticides constitute only one facet of the general problem of environmental pollution, but with the conviction that the hazards resulting from their use dictate rapid strengthening of interim measures. . .

Classes of Compounds

The term pesticide broadly includes compounds intended for a variety of purposes. They are used to control insects, mites, ticks, fungi, nematodes, rodents, pest birds, predatory animals, rough fish, plant diseases and weeds; and also to act as regulators of plant growth, as defoliants, and as desiccants. As of June 1962, almost 500 compounds incorporated in more than 54,000 formulations were registered for use in the United States.

1. The chlorinated hydrocarbons containing carbon, hydrogen, and chlorine are the pesticides used in greatest tonnage. The most familiar are DDT, dieldrin, aldrin, endrin, toxaphene, lindane, methoxychlor, chlordane, and heptachlor. Among those used extensively as herbicides are 2,4-D and 2,4,5-T for control of broad-leaved weeds in lawns, pastures, cereal crops, and brush growth along highways and fences.

2. The organic phosphorous compounds, composed of phosphorus, oxygen, carbon and hydrogen, are used principally as insecticides and miticides. Parathion, malathion, phosdrin and tetraethyl pyrophosphate (TEPP) are examples.

3. Other organic compounds include the carbamates, dinitrophenols, organic sulfur compounds, organic mercurials, and such natural products as rotenone, pyrethrum, nicotine, strychnine and the anti-coagulant rodent poisons.

4. Inorganic substances with a long history of use include copper sulfate, arsenate of lead, calcium arsenate, compounds of chlorine and fluorine, zinc phosphide, thallium sulfate and sodium fluoroacetate. . .

Control Without Chemicals

Methods for controlling pests without the use of pesticides were known to farmers even in ancient times. Crops were planted in areas least liable to pest damage; crops were moved to virgin territory to leave the pests behind; rotation was practiced and crops that were less prone to disease were planted; if the pests came late in the season, crops were planted early, and vice versa. Many of these methods are used today.

The environment can also be modified indirectly; for example we use screens on windows to keep out mosquitoes, and flood or drain marshes to destroy their breeding areas. In certain cases parasites, predators and diseases control the pests without chemicals. In the United States and many other countries of the world parasites and predators have been successfully introduced to combat scale insects on citrus fruits, apples and sugar cane; and in Australia the myxomatosis virus was introduced to kill rabbits.

Entomologists have long been interested in the use of insect enemies for pest control. The U. S. Department of Agriculture has been active in this area since 1888. It has imported more than 500 species of insect destroying organisms, of which about 36 have had partial or complete success. Introduced insects have succeeded in controlling cactus in Australia and Klamath weed in the western United States. However, biological methods of insect control have received relatively little attention in the United States by comparison with the great emphasis on chemical control.

An effective method of biological control is the discovery or breeding of resistant varieties of crops. This method has worked best for plant diseases, and several varieties of wheat which are resistant to rust have been bred in this country. Another example of the use of plant resistance was provided by the grafting of French wine grapes to resistant American rootstocks when the French grapes were severely damaged by the root insect Phylloxera in the middle of the last century.

Although non-chemical methods for pest control are intriguing they also have weaknesses. Two are particularly important. In the first place, parasites and predators have adjusted over the millenia to a dynamic balance with their hosts such that they kill some but not all of them; complete host destruction would eliminate the parasite or predator by destroying its food supply.

Thus, control of the pest is seldom complete enough to prevent economic damage. Furthermore, reduction of the pest population is rarely sufficient to prevent its becoming dense again. A second limitation to the use of natural enemies is that the host may become resistant, just as it may develop resistance to chemical controls.

Australian rabbits for example, are becoming resistant to myxomatosis, and their populations once again are on the increase.

A new method of biological control is the laboratory production of sterile male insects in very large numbers, using either gamma rays or specific chemical sterilants. The males are then liberated into the natural population where their matings produce infertile eggs. Although this procedure eliminated the screwworm fly in Florida, it has not yet been investigated extensively for controlling other insects.

A still newer method is the use of sex attractants to lure male insects into traps and thus to their death. With certain species this technique has great promise and developmental research is being expanded.

More active exploration and use of these techniques may yield important benefits for the national economy and for the protection of health.

Other Subjects of Report

The report also has sections devoted to distribution and persistence of pesticides in the environment, biological effects on man and animals, and the toxicity of specific compounds.

The role of Government in pesticide regulations is discussed and recommendations are made in this connection. Eight scientists under the chairmanship of Dr. Colin M. MacLeod, New York University School of Medicine, constituted the panel.