

ENTOMOLOGY

Weapons for Fighting Insects

Atomic radiation, psychological trickery and gas are replacing sprays and powders in the modern battle against destructive insect hordes, William E. Small reports.

► **SEXUAL TRICKERY**, gas attacks, atomic radiation and psychological warfare are replacing the chemical weapons which are becoming outmoded in the battle against insect pests.

Chemical sprays and powders, once powerful tools, no longer destroy the tiny munching, sucking creatures. Immunity to insecticides is being built up and passed on from generation to generation. Pests now thrive on DDT and other chemicals that once killed them.

In recent years, however, weird but effective weapons have come into the hands of entomologists which are turning the tide, at least experimentally, against the insect world. More than two-thirds of the time and effort of the U.S. Agricultural Research Service spent on the battle against insects this year has been devoted to these new and unusual techniques.

Atomic Radiation Used

Atomic radiation, for example, has been harnessed to sterilize several harmful insects, resulting in matings which produce no young, reducing populations drastically.

Dramatic proof of this sexual trick comes from the screwworm fly campaign in southeastern United States.

The screwworm, which attacks all breeds of livestock, has caused losses averaging \$20,000,000 a year. The U.S. Department of Agriculture launched an all-out battle in Texas this summer, opening a screwworm fly-rearing plant. Millions of males were turned out each week, sterilized with radiant energy from cobalt-60.

These non-producing males, released in heavily infested areas, mate with normal females, resulting in eggs which do not hatch. Since the female screwworm fly mates only once, the race commits suicide unwittingly.

Insects cannot build up resistance or immunity to this type of treatment. Thus, the success of the program is assured. Two years ago the Department completely eradicated screwworms in Florida using the same method.

Excited about the progress made this summer, USDA scientists are testing the radiation method on the boll weevil, cockroaches, the Oriental fruit fly, the codling moth and mosquitoes in efforts to defeat these pests. But each species of insect has a different life cycle and the same treatment cannot be used effectively against all of them.

The common housefly, because of its cycle, has been tricked with chemicals instead of radiation. In tests on a small un-

inhabited Florida island, Agricultural Research Service (ARS) "bug" experts nearly wiped out a population of houseflies with a bait containing a chemosterilant—apholate.

The island was infested with flies when the tests began, scientists reported. After five weekly applications, only a few flies could be found. Ninety-nine percent of those captured were sterile.

The island was quickly repopulated with flies from nearby islands and the mainland after testing ceased, however. So scientists are searching for a completely isolated island with no chance of repopulation by prevailing winds or nearness of land to do further testing.

Chemosterilants Successful

Experiments with houseflies and several other species of insects appear very successful. The possible harmful effect on humans and beneficial animals and insects is a big drawback to widespread use of chemosterilants. Tests for Federal approval of the chemicals are being carried on across the country, and entomologists emphasize that

it may be some time before a "safe" product is found and approved.

(Ethylenimine family of chemicals has given the most promising chemosterilant derivatives.)

One advantage of chemosterilants over radiation was discovered this summer. Gamma radiation often injures and weakens the sterile male insects. Thus they do not compete on an even basis with natural wild males. This requires more sterile flies to overcome the odds. Chemical sterilants, on the other hand, produce unusual vigor and competition among mating male flies.

Another weapon being unsheathed by entomologists is a new twist to an old method. The khapra beetle, one of the world's most damaging pests to stored grain, is being gassed.

Grain elevators and storage warehouses infested with these tiny beetles are fumigated with methyl bromide gas. Giant 10-acre, gas-tight tarpaulins cover the storage buildings and tons of the gas are poured into the grain.

So far, USDA has confined this pest to isolated infestations in California, Texas, New Mexico and Arizona. In spite of inspection and eradication efforts, however, the beetle has been appearing in shipments of grain and grain products such as noodles at Atlantic, Pacific, Gulf and Great Lakes

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CHEMOSTERILANTS—Chemical that sterilizes insects is spread in a dump on a small uninhabited Florida island in tests which proved its success against houseflies in reducing the population of pests.

Weapons to Fight Insects

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ports. Should the khapra beetle reach our vital Midwest grain stores it could do incalculable damage.

Predatory insects are also being used against harmful pests. A world-wide search has been going on for insects which will attack destructive American insects and not harm other plants or helpful insects.

In the last few years, entomologists have imported 400 species of insects which might help in this war. At least 100 have proved effective and able to adjust to our climate and vegetation. "Mites Versus Spider Mites" and "Helpful Wasp Goes East" are only two in a long series of reports issued by USDA describing the helpful insects.

Scale on citrus trees has found an adversary in the Vedalia beetle. Aphids are attacked by the ladybug beetle. Thirteen species of insects attack the cottony-cushion scale.

Parasites Have Parasites

Parasites also play their role in the increasing biological warfare tactics employed by our side. The cabbage worm is succumbing to internal and external parasites. Even the parasites have parasites.

Bacteria and other microorganisms are being thrown at the alfalfa caterpillar, tobacco hornworm and budworm and the Japanese beetle.

Electronics also plays an important part in destroying insect pests. Radio and ultrasonic waves are used in granaries to kill many of the stored-grain insects. Blacklight traps are used both for counting and identifying species on the upswing around the country and for attracting the pests into electric grids for electrocution.

Chemical "perfumes" made to smell like

the attractant of several female insects are used to lure male insects to their deaths. The gypsy moth, a long-time enemy of forest and shade trees, is "psychologically" fooled by the smell of its mate, which turns out to be a synthetic compound on a trap. But the present gypsy moth campaign, for some unknown reason, is not working to the satisfaction of USDA.

The melon fly and the imported fire ant are also under the spell of synthetic "perfume," at least experimentally.

One of the most unusual techniques devised to ward off destructive insects is the cross-breeding of plants which can resist attack.

Cotton and grain sorghums have been developed which are not as attractive to, or resist in some way the bites of, the insects which normally prey on them.

Along the same lines, entomologists are studying the makeup of many of the infective insects. Cholesterol, nerves, sight and smell, all are being studied to lead to extermination techniques.

Federal inspection and quarantine and customs regulations of all imported plants and animals are, of course, main reasons for the lower number of dangerous insects invading this country annually.

Insecticides will also continue to find a place in the war. Many new and different chemicals are being added to the already large list of available sprays and powders to combat man's number one enemy. But total eradication of harmful pests is a long way in the future, and many of the new weapons will fail as others come into existence.

The battle against insects is continuous, and new methods, techniques and weapons resulting from much research are the answers protecting man's acquisitions from the insects.

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ENTOMOLOGY

Chemosterilants Tested In Anti-Fly Research

► GOVERNMENT scientists are searching for a deserted tropical island with lots of pesky flies.

Two isolated Pacific island groups are already being used for testing some of the most unusual weapons ever used against flies, Dr. L. D. Christenson, Agricultural Research Service entomologist, told SCIENCE SERVICE. These islands are ideal for testing the effectiveness of fly-killing devices and methods because flies do not migrate in from other places.

Radiation and chemical sterilization of male flies are perhaps the most effective methods under study. "Perfumes" and stomach poisons teamed together are also proving effective.

With the controversy over the possible harmful effects of insecticides caused by Rachel Carson's series of articles in the New Yorker magazine, ARS scientists are now emphasizing other insect-destroying methods which could "safely" eradicate harmful pests. But thorough testing is required before these techniques can be approved and applied in the United States.

Sterilization by radiation is being tested against the tropical and Oriental fruit flies and melon fly on the small island of Rota, a few miles north of Guam in the Pacific. This atomic attack has already proven its merit in the screwworm fly campaign in the southeastern United States. It is now a large project in Texas.

Chemosterilants (chemicals that de-sex) have been successfully tested on a Florida island against the common housefly by ARS scientists. Further testing is required before final approval, however.

In the Bonin Island group, several hundred miles southeast of Japan, an artificial attractant or "perfume" and a strong stomach poison have been teamed in a "highly successful" campaign against the large Oriental fruit fly population, according to Dr. Christenson.

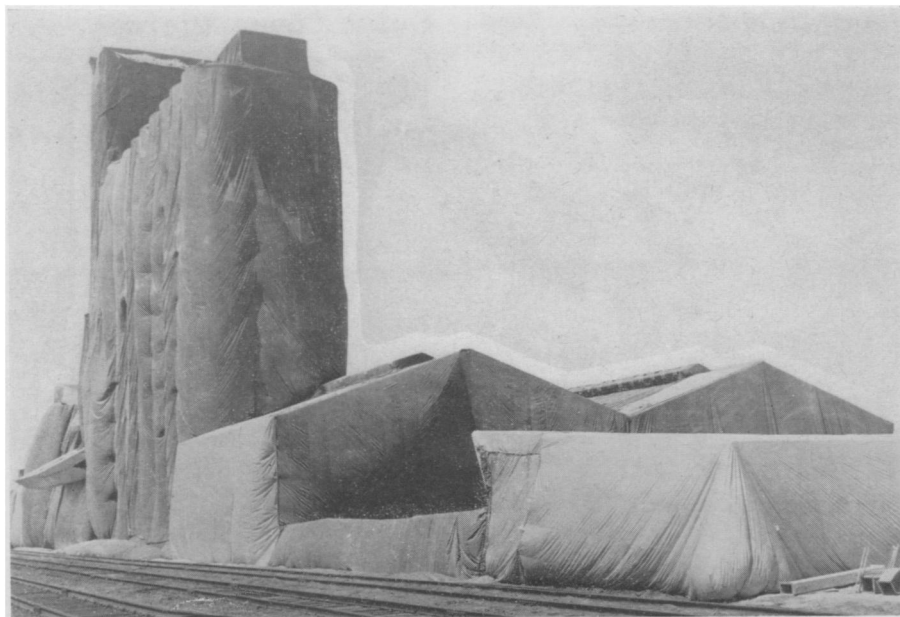
Methyl eugenol and a small quantity of dibrome are soaked into small, two-inch-square porous cane fiber boards which are dropped on the several small islands, some 70 to 80 for each square mile. The boards hold enough of the chemicals to attract and kill flies for three weeks, he explained.

Three small islands down the Atlantic Missile Range are also being used for fly-control testing, SCIENCE SERVICE learned. But details of the programs are withheld.

Uninhabited and remote desert islands are not as easy to find as motion pictures indicate, the scientists discovered. Even if humans cannot easily reach them, flies can. Flies can migrate many miles if the wind is in the right direction, completely spoiling scientific counting of kills.

Anyone knowing of a beautiful and remote tropical island with lots of pesky flies, contact the Agricultural Research Service insect scientists in Washington.

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INSECTS GASSED—Methyl bromide gas is introduced into tarpaulin-wrapped storage facilities infested with khapra beetle at five pounds per 1,000 cubic feet. The wrapping and treatment of each storage facility requires individual study.