ENTOMOLOGY

Plants That Kill Insects

New phosphorus compounds are answering farmers' most fantastic dreams of plants that kill their own insect pests. Headway being made in synthesizing insecticides.

By MARTHA G. MORROW

➤ NOW SCIENCE has plants that in effect "bite" the insects that bite them. Some plants can be made to carry in their leaves and stems poison that kills the insects which feed on them.

A number of plants are able to protect themselves naturally against insects. The flowers, leaves or roots of a few are used as insecticides. Still others, not so subtle in their action, like the Venus' flytrap, snap shut on luckless flies and spiders, beetles and ants. But that is old stuff now.

New phosphorus compounds are answering farmers' and florists' most fantastic dreams of plants that kill their own insect pests. Roses and chrysanthemums, taking these insecticides into their sap streams, can now protect themselves against such sucking insects as aphids and mites. These insect are killed by "systemic" poison in the juicy stems and leaves they suck.

Other plants, although perhaps bothered by their own insect pests, have proved themselves effective insecticides. Pyrethrum from dried daisy-like flowers, for instance, paralyzes flies, roaches, beetles and numerous other insects. Large quantities of nicotine, which likewise paralyzes, are extracted each year from low-grade tobacco.

There is news, however, even in these familiar natural insecticides:

Chemical "stretchers," called synergists by the experts, are being developed to increase many times the effectiveness of well-known but expensive insect killers.

Man also is making headway in his attempt to synthesize them.

Sap Stream Poisoned

Systemic insecticides that are taken up in the plant's sap stream seem in part created to meet agriculture's long-standing need for a selective killer. Developed in war-time Germany, some of these organic-phosphorus insecticides kill injurious chewing and sucking bugs, but do not harm others that may be beneficial. A high percentage of aphids are killed, for instance, but few ladybugs that feed on aphids.

Several of the new series of organic phosphorus compounds may become commercially available in the United States this year for the first time. Already available in experimental quantities, Systox and Metacide appear to be satisfactory control chemicals for use against greenbugs on small grains.

The price at which these insecticides will probably be available is not expected to be materially higher than for conventional insecticides. In addition, they offer long-time protection and as little as a quarter of a pound per acre gives excellent results. These chemicals can be applied either to the foliage by spraying, or to the roots by soil applications.

British research with radioactive compounds showed that the leaves absorb more of the organic phosphorus insecticide from their under surfaces than from their upper parts. Also light is essential if the plants are to absorb the insecticide; the plants take up little if kept in the dark.

Research with radioactive compounds by the U. S. Department of Agriculture has shown that systemic insecticides enter the sap stream of the plant and move up the stem from the roots or lower leaves to the upper leaves and buds. They do not move down the stem from upper to lower leaves, or from the leaves to the roots.

While highly effective as insect killers, the chemicals are extremely dangerous to handle, and the poison lingers for weeks within the plants, warns Dr. F. C. Bishopp, Asst. Chief of the Bureau of Entomology and Plant Quarantine of the U. S. Department of Agriculture. Thus care is being used in releasing the systemic insecticides to the public. Immediate use will probably be limited to non-food crops such as greenhouse flowers, ornamental shrubbery and possibly to cotton.

Pyrethrum's Toxicity Low

In marked contrast to the poisonous systemics are the pyrethrum insecticides. While capable of controlling many insects, they are low in toxicity to humans and animals. Because of this, pyrethrum insecticides are proving particularly useful in controlling some insects attacking food and food products.

Pyrethrum, the basic material used in making these insecticides, is obtained from the daisy-like pyrethrum flower. A member of the chrysanthemum family, it is botanically known as *Chrysanthemum cinerariefolium*. The maximum pyrethrin content is reached in the flower head just about the time the flower opens fully. Most of the pyrethrum available commercially today is produced in Kenya colony in Africa, but some comes from South America and some from Japan.

DUSTING GLADIOLUS—The flowers are being dusted with OMPA (octamethyl pyrophosphoramide), a systemic insecticide used in tests by scientists of the U. S. Department of Agriculture, to determine if growing plants absorb the chemical and if they will be protected later from insect attack.

While known for centuries as a safe and effective insecticide, pyrethrum alone has been in limited use because:

It is too expensive for general use.

It has little lasting power.

To take advantage of pyrethrum's quick paralyzing ability, scientists a decade or so ago began to look for chemicals that would step up its effectiveness. They were searching for synergists that, when combined with pyrethrins, would produce insecticides several times more effective than either chemical used alone.

Hundreds of synergists were tried before the U. S. Department of Agriculture discovered that a number of chemicals containing methylene dioxy-phenyl step up the effectiveness of pyrethrins several times and are as safe as pyrethrins to warm-blooded animals. An outstanding advancement then came through the discovery by scientists of the Mellon Institute that piperonyl hetoxide, piperonyl cyclonene and sulfoxide are the most effective.

Penetrate Insect's Covering

Further work brought the development of another and even better synergist for certain purposes. Called piperonyl butoxide, it is made from safrol, a plant product obtained cheifly from the roots of a South American tree. The new safrol compound penetrates the chitin or body covering of an insect, a desirable quality to combine with pyerthrin's excellent knock-down power.

Two new pyrethrin insecticides, a wheat protectant and a grain protectant, first became commercially available two years ago. Small quantities of them are to be mixed directly with stored grains. These protectants are produced by mixing and milling pulverized wheat or grain dust with a base that contains liquid pyrethrins and piperonyl butoxide.

These protectants will prove themselves particularly useful in southeastern states where many bins and cribs are not tight enough to fumigate effectively. In these areas they can help save the nine percent of stored corn that normally is lost each month during storage.

Synthesize Allethrin

A step forward in man's attempt to synthesize pyrethrin is allethrin, a new man-made product known chemically as the allyl homolog of cinerin I. Similar to one of the four chief constituents of natural pyrethin, it is an effective insecticide.

Allethrin was synthesized in 1949 by Dr. F. B. LaForge and M. S. Schechter of the U. S. Department of Agriculture. It is made by a complicated chemical process that requires 13 distinct chemical operations.

First placed on the market two years ago, allethrin has already shown promise for use on cabbage, cauliflower, lettuce and collards, to control such insects as the cabbage looper, imported cabbage worm and the diamond-back moth. It takes two to three times as much allethrin as pyrethrum, however, to control insects. As other uses of allethrin are discovered, the demand will increase and some day this new chemical may be cheaper than pyrethrin. In the meantime, the search for synthetic pyrethrin continues.

One outstanding advantage of pyrethrum is that houseflies have not built up an immunity to it, the way they have to DDT for instance. This seeming lack of resistance to pyrethrum is being investigated at the University of California College of Agriculture and elsewhere. Radioactive allethrin and pyrethrum are being used to trace its killing action in houseflies.

Nicotine is an effective insecticide. Extremely toxic to warm-blooded animals, its saving grace is its high volatility which causes it to disappear rapidly from products on which it is sprayed or dusted.

Nicotine has been obtained from at least 18 species of *Nicotiana* and a few related plants, but in this country most nicotine is produced from ordinary tobacco. It is extracted from the woody stems and leaf midribs, not suitable for smoking and chewing.

Anabasine, which contains the same number of carbon, hydrogen and nitrogen molecules as nicotine, is unique in that it was first prepared synthetically about two decades ago, then a year later found in the

wild tree tobacco native to our southwestern states and Mexico. Like nicotine, it is an effective insecticide. Although produced in Russia, it has never been developed commercially in the United States.

One of the earliest uses of insecticides was to stun fish so they could be caught easily. Natives in the East Indies, Africa, South America and India crushed various plants in water and poured the mixture into the stream they wished to "fish." Stupefied by the preparation, fish rose to the surface where they were easily caught. Derris, cube and other plants whose roots were so used all belonged to the family *Leguminosae*.

These plants have subsequently been found to contain a compound called "rotenone." Today most of our rotenone is grown in South America.

Discover Rotenone's Structure

Following years of research, the complete chemical structure of rotenone was determined almost simultaneously by groups of chemists in the United States, in Japan and in Germany. The American chemists, who published their results in 1933, were Dr. F. B. LaForge, Dr. H. L. Haller and L. E. Smith, all of the U. S. Department of Agriculture. They devised analytical methods for determining the amount of rotenone in the root dusts.

The effectiveness of rotenone, like pyrethrum, can be increased by mixing it with certain synthetic compounds. The late L. W. Brannon, Department of Agriculture entomologist working in cooperation with the Virginia Truck Experiment Station, in 1947 discovered that piperonyl cyclonene is a particularly effective synergist with rotenone.

The search for other plants with insecticidal qualities continues.

Specimens showing materials that are toxic to insects but low in toxicity to humans and animals have been collected for you by Science Service. Pyrethrum flowers, wheat protectant, grain protectant, allethrin and two other specimens are included in the kit along with suggested experiments. The kit is available for 75 cents. Write Science Service, 1719 N St., N.W., Washington 6, D. C., and ask for the Pyrethrum Insecticide Kit.

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BOTANY

NATURE RAMBLINGS

Fives and Threes

➤ COUNT PETALS on as many kinds of flowers as you can find. Opposite the name of each, put down the number of petals its flowers show, thus: wild rose, five; violet, five; trillium, three; toothwort, four; star-grass, three; and so on.

After you have made your list as long as you can, take a look at the numbers. Notice how they are dominated by five and three. Those two prime numbers are the trademarks of the two great divisions of the flowering plants.

Five is the dominant number among the plants that come up with two seed-leaves, the dicotyledons, or for short, "dicots." Three is the mark of the plants with only one seed-leaf, the monocotyledons, or "monocots."

This "fiveness" is not confined to number of petals alone. The whole flower is apt to have its parts in fives or multiples of five—five sepals, five or ten stamens, five seed-chambers in the fruit.

Similarly, the "threeness" of the monocots will run through all the structures. What appear to be six petals in lily, amaryllis, dog-tooth and tulip are really three true petals surrounded by three sepals that have become petal-like. Botanists, to avoid splitting hairs, call them "perianth-parts."

Sometimes the petals or perianth-parts have become fused together, so that the corolla is bell- or trumpet-shaped as in lily-of-the-valley and trumpet-creeper. Yet even here you are apt to find points or lobes on the margin proclaiming its origin—again three (or sixes) and fives. And the inner structure of the flower, the stamens and the parts of the pistil, will be arranged according to the old basic numbers.

There are, of course, departures from the schemes of fives and threes. The mustard-and-cress family, for example, is so strongly four-petaled and four-sepaled that the group has been named the crucifers, or cross-bearers. Also there are flowers with petals so modified that it is difficult to tell anything about the basic number scheme—Dutchman's breeches, for example, and the wild orchids.

There are also some flowers that produce simply indeterminate numbers of all parts, such as waterlily, magnolia and anemone. But after you have lived with plants for a while you get to regarding these as exceptions or aberrations, and the five-and-three arrangement as the norm.

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PSYCHIATRY

Photoshock Treats Psychos

➤ "PHOTOSHOCK" INSTEAD of electroshock is the newest thing in shock treatment for mentally sick persons. In this treatment, an intermittently flashing light is used with a sensitizing drug, Azozol, Dr. George A. Ulett of Washington University, St. Louis, reported at the meeting of the American Psychiatric Association in Atlantic City.

Although it is something like the commonly used electroshock treatment, it is less severe, has a milder onset and seems safer, especially with elderly patients.

The patient does not lose consciousness but has marked changes in his brain wave pattern. This gives an opportunity for research which may help in better understanding of the basic mechanisms underlying all shock treatments.

Electrostimulation, using less current than in conventional electroshock treatment so that convulsions are not produced, was praised by one group of psychiatrists and condemned by another.

Drs. Harry M. Berliner and Fred L. Schartenberg of the VA Hospital at Lyons, N. J., reported that use of this kind of treatment for several years showed it to be safe and effective in certain cases. Included in these are one type of schizophrenia, anxiety states, psychosomatic disorders and reduction of the irritability, anxiety and depression of epileptic patients.

But Drs. Eugene A. Hargrove and A. E. Bennett of the University of California and Dr. Frederick R. Ford of Herrick Memorial Hospital, Berkeley, Calif., reported from their experience that treatment of patients with anxiety or mild depression by electrostimulation is "a very poor second choice to treatment by psychotherapy alone."

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At least 3,000 species of *lizards* now are known.

The trumpeter swan is the largest American *bird* of the waterfowl family.