BIOPHYSICS

Plants Made Poisonous

Insecticides that are stored in plant cells to poison insects that feed on the plants are being studied in Britain by radioactive tagging.

➤ BY TAGGING plant insecticides with radioactive elements and then following the radioactivity about in the plants, British agricultural scientists have been learning a lot about how the plants lap up the insecticides and become poisonous to pests.

The pest-killers being studied are of a new type known as systemic insecticides. They are taken up by the plants and stored in the cells where, though harmless to the plants themselves, they poison insects which feed on the plants.

These systemic insecticides are all compounds of phosphorus and by preparing them from radioactive phosphorus the scientists are able to trace their course after they are sprayed onto plants.

The insecticide of this group particularly studied by Drs. S. H. Bennett and W. D. E. Thomas, of Bristol University, is bis (bis dimethylamino phosphonus) anhydride. They labelled their insect poison with P^{32}, a radioactive form of phosphorus, and then dipped their plants into this tagged insecticide, or sprayed it onto the plants with an artists' spray pencil.

Then they washed off the excess and measured the amount of radioactivity coming from the leaves. In this way they could determine the amount of insecticide the plants took up under different conditions.

This study has great practical importance. The insecticide is water soluble and that which is not absorbed by the plant is readily washed off by rain, so it is essential to insure that it is sprayed on under such conditions that maximum absorption takes place.

Drs. Bennett and Thomas made two important discoveries: Leaves absorb more insecticide from their under surfaces than they do from their upper; and little insecticide is taken up if the plants are kept in the dark.

In view of the latter discovery farmers are well advised to do their spraying of phosphonus insecticides in the morning rather than in the evening. Rain during the night will remove practically all the insecticide sprayed on the previous evening, but rain following later in the day after a morning spray will find much less unabsorbed insecticide to wash away.

Two other British researchers, Dr. D. F. Heath and Mrs. M. V. Llewellyn, of Pest Control Ltd., confirmed the findings of Drs. Bennett and Thomas that light is essential for the efficient absorption of the phosphonus insecticides. In a study of insecticide absorption by Brassicas they found that over a period of 16 hours less than 10% of the insecticide was absorbed if the plants were kept in the dark.

However, those plants kept in light after spraying absorbed over 80% of the insecticide. Almost as good absorption was found to take place when the plants were irradiated with artificially produced ultraviolet light from black bulbs.

The pest control scientists decided that the amount of insecticide absorbed depended on two factors. One of these was the amount of light they received; the other was the nature of the compound used.

In regard to the latter, the question to be settled was: Do the insecticides volatilize through the leaf surface to reach the interior, or do they diffuse across the leaf membrane?

Using P^{32} tagged insecticides, Drs. Heath and Llewellyn were able to show that the absorption by the plant follows the rule of semi-permeable membranes, that is, the size of the insecticide molecule is the determining factor, not its degree of volatility.

RUBBER-STEEL BOND — Under nearly 1,000 pounds pull, the silicone rubber link between these two steel pieces is broken, though the rubber remains firmly bonded to the steel. A new glue-like chemical developed by General Electric Company chemists is responsible for the tenacious bond.

A highly volatile member of the insecticide series will not penetrate into a leaf more quickly than the others, but one with a smaller molecule will.

This ties up well with the increased absorption produced by light, since it has been shown that light greatly increases the permeability of plant membranes to water and, therefore, presumably to substances dissolved in water.

Reporting specifically on a series of phosphonus insecticides they studied, the scientists listed their plant-penetrating powers in the following descending order: bis-dimethylamino-phosphonus fluoride; tris-dimethylamino-phosphine oxide; octamethyl-pyro-phosphoramide; bis-isopropylamino-phosphonus fluoride; tri-phosphoric acid penta (dimethylamide).

The unusual-looking word "phosphonus" means that this substance contains a combination of phosphorus and hydrogen, one to four, which is similar in chemical behavior to the nitrogen-hydrogen complex called ammonium.

ENTOMOLOGY

Carbon Dioxide Attractive To Female Mosquitoes

➤ THE THING that attracts mosquitoes to you may be the carbon dioxide formed in your body and exhaled on your breath.

Studies suggesting this are reported by Dr. W. C. Reeves of the Hooper Foundation for Medical Research and the School of Public Health, University of California.

Dry ice, which is solidified carbon dioxide, was used for the source of the gas in Dr. Reeves' studies. Primary object of the studies was to find good bait for collecting mosquitoes for research of various kinds in connection with the diseases mosquitoes spread.

In 49 trials using dry ice to bait his traps, Dr. Reeves collected 14,277 female mosquitoes of six different species. The dry ice was consistently more attractive than animal bait such as calf or chickens.

Only six male mosquitoes were collected in the dry-ice baited traps, and only three males by the animal baited traps. This, Dr. Reeves suggests, may be further evidence that the attraction of carbon dioxide for mosquitoes is closely allied to search for a source of blood.

Why some species of mosquitoes bite humans, while others prefer birds and amphibian animals, may also be explained by the carbon dioxide attraction, Dr. Reeves thinks. *Culex apicalis*, for example, might be extremely sensitive to the small amount of carbon dioxide given off by amphibians such as salamanders and frogs, but would be repelled by the larger amounts from big animals like man.

Details of the study are reported in the PROCEEDINGS OF THE SOCIETY FOR EXPERIMENTAL BIOLOGY AND MEDICINE (May).