DEPARTMENTAL NOTES

Notes on Systemic Insecticides

BY

H. E. FERNANDO

IDEALLY, systemic insecticides are compounds which exhibit the property of being taken up into a plant and translocated within its tissues sufficiently to exert insecticidal action against phytophagous insects. The use of systemic insecticides dates back to about 1935 when inorganic and organic selenium compounds and organic fluorine compounds like the methylals of fluoroethyl alcohol were employed as such. These compounds had serious disadvantages against their use, such as their marked phytoxicity, their high residual toxicity at harvest, and their prolonged residual action in the soil which prevented for many seasons the growing of cultivated crops on land treated with these chemicals.

Experiments by Schrader and Kükenthal led in 1940 to the discovery of the bis-dimethylamide of fluorophosphoric acid, but the mammalian toxicity of this compound was too high to permit its use as a systemic insecticide. In 1941, Schrader discovered the compond octamethyl pyrophosphoramide, known today as " Ompa ", " Schradan " and " Pestox ". This compound was found to be relatively less toxic to warm-blooded animals than the fluorine compounds, was detoxified in plants after some weeks and retained its residual toxicity in the soil for a limited period of time. Since the discovery of Ompa a number of compounds or mixtures thereof with similar properties have come to light, like " Hanane ", a mixture of bisdimethyl amino fluorophosphine oxide and bis-dimethylamino phosphorus anydride, and " Systox " which is a diethyl dithiophosphoric acid ester. All these new organophosphorus systemic insecticides are at present under intensive experimentation in many parts of the world and they offer some promise as weapons in man's fight against insects, particularly plant-sucking bugs which constitute a major group of insect vectors of plant diseases.

The new systemic insecticides belong to the group of organophosphorus compounds which includes compounds like parathion and tetraethyl pyrophosphate. These compounds while having marked insecticidal activity also have high mammalian toxicities and extreme precautions have to be taken in handling them. They are all nerve poisons and their toxic action is chiefly due to the inhibition of esterases especially the nerve enzyme cholinesterase which is almost universally present in the animal kingdom. Ompa which is intrinsically a poor inhibitor of cholinesterase is known to be converted in the plant tissues or the mammalian liver into a compound which is a strong inhibitor of cholinesterase. The cholinesterases of animals have been shown to vary considerably from species to species and research into the possibility

of obtaining organophosphorus compounds showing marked inhibitory activity towards this enzyme in specific orders families, or species of insects while at the same time having low mammalian toxicities, is being pursued intensively and on the results of such work will depend the greater applied value of the organophosphorus compounds as insecticides.

The fact that systemic insecticides are absorbed by and translocated within plant tissues makes it imperative that the residue hazard be very thoroughly investigated. In the case of Ompa it is known that toxic residues are very low about four weeks after treatment of the plant, depending of course on the dosage administered. Therefore after such a period of time has elapsed the consumption of harvested plants or plant products cannot cause acute poisoning. However, very little is known about the chronic effects of the long-term consumption of minimal residues of the toxicant or metabolites thereof found on such harvested plants.

Investigations in the Gold Coast on the control of the swollen shoot disease of cocoa, which is a virus disease borne by mealy bugs, have shown that Hanane offers promise of at least partially controlling this disease which threatens the country's cocoa industry. In practice capsules containing Hanane were inserted in the ground close to the stem of the tree. The Hanane was absorbed into the tree and high mortality of mealy bugs resulted for about six weeks. Further investigations on this problem are in progress at present. The Gold Coast Ministry of Agriculture has laid it down that Hanane will not be used on trees where beans are to be harvested for human consumption until the medical and agricultural authorities and cocoa manufacturers are satisfied that no trace of the original toxicity of Hanane remains in the cocoa bean at harvest time and that the keeping qualities and the flavour of the beans remain unaffected. At present therefore Hanane is used as a barrier treatment to contain the spread of the disease from infected areas. When all the trees in the barrier have shown symptoms of the disease they are removed and the spread of the disease is minimized.

While the new organophosphorus systemic insecticides offer definite promise against plant sucking and disease bearing insects their use has got to be approached with caution both on account of their high mammalian toxicites and the complex residue problems involved. It is only after very thorough investigations into the relative efficiency of these compounds as compared to other insecticides and careful examination of the hazards to man and domesticated animals involved in their use should any general recommendations be made.