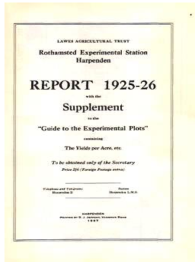
Report 1925-26 With the Supplement to the Guide to the Experimental Plots


Rothamsted Experimental Station
Harpenden
REPORT 1925-26
Supplement
"Guide to the Experimental Plots"

Full Table of Content

Insecticides

Rothamsted Research

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Once an insect attack has begun, methods of direct action must be used to cope with it. Two types are in common use, trapping or catching by some mechanical or chemical means, and poisoning by insecticides. Trapping was successfully used against *Bourletiella hortensis,* a species of Collembola, which was found in 1926 to be injuring seedling mangolds on our farm. Laboratory studies by Mr. Davies having shown the dependence of these insects upon humidity, the trapping has to be carried out early in the morning in dry weather, when the leaves are wet with dew. Later in the day the insects leave the plants for the moister soil.

INSECTICIDES.

Two kinds of insecticides are used : stomach and contact. The former are intended to poison the food of the insects and are sprayed on the leaves which they will eat. The latter are brought into contact with their systems in some other way, either as vapours, poisonous spray-fluids, or dusts.

The search for soil insecticides, using the wireworm as the test insect, revealed a number of interesting compounds, among them naphthalene, but was checked by the difficulty that these compounds, though poisonous to the wireworms, serve as food for some of the soil organisms, and are consumed when put into the ground. No way round this difficulty has yet been found.

The work on spray insecticides has been more extensive. There are two kinds :—

1. Those used in winter, which must be strong enough to kill the eggs; fortunately, the trees are dormant, so that fairly potent materials can be used.
2. Those used in summer against the active stages of insects, some of which, such as the aphids, are easily killed. But the trees, being now in leaf, are sensitive to injury, and only those substances are useful which are fatal to the insect and harmless to the tree.

Certain vegetable products completely satisfy this requirement. Nicotine is the best known, but it is expensive. Mr. Tattersfield and Mr. Gimingham have found other vegetable products at least as effective, especially certain tropical leguminous plants, used by the natives as fish poisons. *Derris elliptica,* the Tuba root of Malay, and Haiari, from British Guiana, have yielded a poisonous resin and a colourless, crystalline substance, Tubatoxin, which is excessively poisonous to insects. Other tropical plants, *Tephrosia vogelii, T. toxicaria,* and *T. macropoda,* are also highly toxic to insects, but their poisonous principles have not yet been fully identified.

Many synthetic chemical substances have been investigated, their advantage being that they can be prepared in a pure state under rigidly standardised conditions. They are studied in their proper chemical series, without regard to whether they are yet on the market, the purpose being to draw up a specification showing the types of compound required, to which a technical chemist could work.

The hydrocarbons increase in toxicity with increasing molecular weight up to the point where certain physical properties are so modified that the substance cannot affect the insect. In the aromatic series of hydrocarbons, the maximum toxicity is attained with naphthalene.

Substitution of the hydrogen atoms by various other atoms or groups, increases toxicity up to a certain point, but not beyond. For the hydroxyl group the maximum is at one, for the nitro group at two, and for chlorine at three atoms. These chlor derivatives are anæsthetics, putting the insects into a " moribund " state from which, however, they recover. There is also a position factor, but this varies with the type of compound; ortho-dichlor benzene, is more toxic than para, but paranitrophenol is somewhat more toxic than the corresponding ortho derivative. Dichlornitrobenzene is rather less toxic than chlordinitrobenzene.

The methyl group increases the toxicity when it replaces hydrogen in the ring; xylene is more toxic than toluene and toluene than benzene. But it decreases toxicity when replacing hydrogen in the OH group; the methoxy group is less toxic than the hydroxy group. The toxicity, however, increases with the number of methoxy groups introduced, so that trimethoxy-benzene (1, 2, 3), is more toxic than phenol, and much more so than pyrogallol.

The effect of introducing nitro groups into the hydroxy derivative depends very much on the number added. The first group has little effect; nitrophenol is not much more toxic than phenol. A second group greatly increases this toxicity, 2-4- and 2-6- dinitrophenol and 3-5-dinitro-ortho-cresol are highly toxic both to insects and to eggs; again, however, position comes in; neither 2-5-dinitrophenol, nor 3-5-dinitro-para-cresol being so effective. The maximum is reached with two groups, and the trinitro compounds are less toxic.

The amino group is distinctly toxic, and the imino group even more so; diphenylamine, and dibenzylamine being more toxic than the mono- or tri- derivatives. Nicotine has been closely studied. The units of which it is formed, pyridine and pyrrol, are only feebly toxic; hydrogenation increases toxicity but not to the level of nicotine.

The fatty acids increase in toxicity with increasing molecular weight up to undecylic acid; dodecylic and tri-decylic acids are less toxic; while myristic and higher acids are non-toxic. Some of these acids and their salts are promising as summer washes, and they are being further studied.

Although the work was begun only comparatively recently, it has had important practical results. Derris, Tephrosia, and Haiari, all obtainable from tropical parts of the Empire, are effective as summer washes, while a promising winter wash has been found in 3-5-dinitro-ortho-cresol which, even at the low concentration of 0.15 to 0.25 per cent., and whether free or as sodium salt, completely controlled bad infestations of hop damson aphis on plums and of currant aphis on black currants, while on apples it practically eliminated psylla and aphids, and greatly reduced winter moth; no damage was done to the trees.

The only fungicide studied extensively has been sulphur, for use in the soil. Its action is erratic; it is sometimes effective, but not always; possibly the active agent is not the sulphur itself, but some compound formed in the soil. The subject is being further examined by Mr. Roach.

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