

Insecticidal Action of Radioactive *bis*- (*bis*-Dimethylamino)-Phosphonous Anhydride

THE preparation of *bis*-(*bis*-dimethylamino)-phosphonous anhydride containing phosphorus-32 has been reported¹, and a detailed description of the methods employed is now in the press². I am indebted to the authors of the above-mentioned papers, Dr. B. A. Kilby and Mr. J. E. Gardiner, for the supplies of the radio-anhydride used in the present investigation.

The plants and insects used were chiefly broad beans infested with *Aphis fabae*, Scop.; but some young cabbages infested with *Myzus persicae*, Sul., young peas with *Acyrtosiphum orobrychidis*, Fons. and uninfested strawberry plants and newly sprouted hop sets were also employed. The plants were kept in a greenhouse at about 15–25°C. while being treated with the radio-anhydride³. The activity of the solution used was never more than the equivalent of about 10 microcuries per litre.

The assays of radioactivity were made in a liquid-type counter after treating the plant material with boiling caustic soda solution. In most of the assays no attempt was made to determine how much of the radioactivity was from unchanged anhydride in the plant and how much was from decomposition products.

Absorption from culture solution. A few hours after a bean plant is placed in a culture solution containing the anhydride, radioactivity can be detected in the leaves, and shortly afterwards the aphids on the plants begin to fall off. The level of activity increases as the culture solution is absorbed and is always higher in the washed roots than in the aerial parts of the plant. As the plant absorbs the culture solution, the radioactivity of the remaining solution is found to increase, showing that the roots selectively reject the radio-anhydride.

Absorption from sand and soil. It appears that bean plants can absorb the radio-anhydride more rapidly from sand than from soil. Thus plants growing in sand become radioactive sooner, reach a higher level of activity and loose their aphids earlier than similarly treated plants in soil.

The radioactivity of all the leaves on a bean plant growing in treated sand or soil is not the same. The bottom (oldest) leaf and the top (youngest) leaf show less radioactivity per gram of tissue than leaves from the middle part of the stem.

Concentration in the plant necessary to kill aphids. If it is assumed that the material soluble in chloroform, which can be extracted from the plant after boiling with water and treating with caustic soda under controlled conditions, is the unchanged anhydride, it can be calculated that, at a time when the plants are lethal to aphids, about 100 mgm. of anhydride per kilo of plant tissue is present. This value agrees well with that of 60–100 mgm./kilo given previously³.

Absorption and translocation following application to the leaves. When the leaves of certain plants are treated repeatedly with a 0.1 per cent v/v solution of the anhydride containing radio-anhydride, other leaves on the plant besides those treated become radioactive. It has previously been reported that aphids are killed as a result of the systemic translocation of the anhydride in this way⁵, but that the effect could not be shown with the broad bean³. By means of the radio-anhydride, it has now been possible to show that there is some translocation in the broad

bean; but the level of radioactivity reached by the untreated leaves is relatively low, and the aphids feeding on them are not killed.

In contrast to the above observation with the bean, there is much more translocation in young cabbage and pea plants, and the leaves attain a much higher level of radioactivity and the aphids on them are killed. Translocation to untreated leaves also occurs to a marked extent in actively growing hops and strawberry plants.

The strawberry, as Dr. G. H. L. Dicker has found, provides an interesting demonstration of the translocation of the anhydride within the plant. After an application made only to the leaves of the parent plant, the leaves of the runners become toxic to aphids⁶. This experiment has been repeated with the radio-anhydride, and it has been found that radioactive material passes from the leaves of the parent plant to those of the runner, especially when the runner is not rooted in soil.

The observations just described show that when radioactive *bis*-(*bis*-dimethylamino)-phosphonous anhydride is applied to the leaves of a plant, some radioactive material, probably the anhydride itself, is absorbed by them and afterwards translocated within the plant. Most of the experiments were planned to show the transference of material from the older leaves to the younger parts of growing plants. There is, however, similar, but less complete, evidence at the time of writing that the radioactive compound is translocated downwards from the leaves on the upper or the middle section of the plant to the older leaves.

Further experiments will be necessary to establish under what conditions insecticidal quantities of what is supposed to be anhydride are translocated from treated to untreated leaves.

Examination of transpired material. Experiments failed to show that any radioactive material is given off by the plants absorbing the radio-anhydride by the roots.

Examination of aphids and honey dew. Aphids which were killed by feeding on plants treated with the radio-anhydride, and also the honey dew which they produced, were found to be radioactive.

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¹ Kilby, B. A., *Research*, 2, 590 (1949).

² Gardiner, J. E., and Kilby, B. A., *J. Chem. Soc.* (in the press).

³ David, W. A. L., and Kilby, B. A., *Nature*, 164, 522 (1949).

⁴ Hartley, G. S., and Heath, D. F. (personal communication, 1950).

⁵ Ripper, W. E., Greenslade, R. M., and Hartley, G. S., *Bull. Ent. Res.*, 40, 481 (1950).

⁶ Dicker, G. H. L., Rep. E. Malling Res. Sta. (1949) (in the press).

Effect of Leaf Roll Virus on the Amino- Acid Composition of Potato Tubers

THE paper chromatographic method of Williams and Kirby¹ has been applied to extracts of potato tubers in order to study the effect of virus infection on their amino-acid content. Extracts of healthy and leaf roll tubers (Green Mountain variety) were prepared either according to the method of Dent *et al.*² using 70 per cent alcohol, or by the addition of lead acetate to aqueous extracts until complete precipitation was attained.