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UPTAKE AND EXCRETION OF ^{14}C-PHORATE BY *APHIS FABAE* SCOP. AND *ACYRTHOSIPHON PISUM* HARRIS (HOMOPTERA, APHIDIDAE) [1]

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There are few toxicological studies on uptake and excretion by aphids, and little is known about the fate of systemic insecticides after ingestion by these insects. Galley and Foerster (1973) and Devonshire and Needham (1974) have demonstrated that some toxic compounds are eliminated in the honeydew.

The use of radio-isotopes has enabled the movement of these substances, both in plants and insects, to be followed. In the present paper, the levels of uptake and excretion of phorate by *Aphis fabae* Scop. and *Acyrthosiphon pisum* Harris are compared; these are correlated with the quantities of labelled insecticide present in leaves supporting aphid colonies, following root uptake.

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MATERIAL AND METHODS

Seven adults of *A. fabae* were caged on each leaflet of the second node of bean plants (*Vicia faba* L. var. Sutton). After 24 hours the adults were removed and the progeny left on the leaflets for testing. Colonies of *A. pisum* were similarly established. The insects were confined to the lower surface of the leaflets by means of perspex cages 2.5 cm in diameter, with a muslin top. The cages were lined with filter paper at the bottom and on the sides, in order to collect the excreted honeydew (Galley, 1974). When the colonies were six days old, 22 μg of methylenelabelled ^{14}C-phorate were added to 30 ml of nutrient solution and left to translocate for 18 hours. Three replicates were used for each aphid species. Analyses of radioactivity were carried out on the leaflets supporting the colonies, and also on aphids and the honeydew.

Experimental conditions of light and humidity were those described by Foerster (1976). Insecticide extraction from plant and aphid tissues followed the procedure used by Foerster (1976), except that the volume of charcoal for aphid extraction was reduced to 0.2 g and the chloroform aliquots reduced to 15 and 10 ml in the filtering and separating funnel steps.

Honeydew extraction. The disks and strips of filter paper bearing the excreted honeydew were transferred to a 50 ml separating funnel with 10 ml of chloroform-water 1:1 ^{v}/v and shaken for five minutes. The papers were withdrawn from the funnel and washed down with 5 ml of chloroform and 5 ml of water respectively. The two phases were separated, concentrated and counted as described by Foerster (1976).

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RESULTS

In the 24 hour reproduction period, *A. fabae* produced a mean of 131 nymphs and *A. pisum* 96.

The quantities of toxic and non-toxic metabolites accumulated in the leaflets supporting the colonies and the amounts absorbed and excreted by each species is given in Table 1. Only a small fraction (0.4 and 0.35% for *A. fabae* and *A. pisum* respectively) was removed by the aphid colonies. Of the amount ingested, 27% and 29% were excreted by *A. fabae* and *A. pisum* respectively in the honeydew.

TABLE 1

Solvent soluble and water soluble metabolites found in the leaflets and quantities ingested and excreted by *A. fabae* and *A. pisum* (Values are given in nanogram equivalents of phorate)

Species	Sample	Solvent Soluble	Water Soluble
A. fabae	leaf	525	55
	aphids	1,6	15
	honeydew	0,6	11
A. pisum	leaf	513	57
	aphids	1,4	30
	honeydew	0,4	10

Water soluble metabolites were absorbed in considerable quantities by both species, particularly *A. pisum*, despite the smaller number of individuals in their colonies. *A. fabae* absorbed nearly half of these metabolites present in the leaf, whereas *A. pisum* ingested 70%. The fate of the hydrolysis products ingested was different in the two species; *A. fabae* excreted in the honeydew 42% of the quantity ingested, whereas *A. pisum* eliminated only 25%.

Table 2 shows the amounts of solvent and water soluble metabolites ingested per individual of each species. The data shows that individual *A. pisum* absorbed 15% more solvent soluble metabolites than *A. fabae* and 2.2 times more water soluble metabolites.

TABLE 2

Quantities of solvent and water soluble metabolites detected per aphid after 18 hours translocation in the plants

mean picogram equivs. per aphid

Species	Solvent Soluble	Water Soluble
A. fabae	16,6	190
A. pisum	19,2	420

DISCUSSION

The amounts of solvent soluble products removed by both aphid species were negligible in relation to the quantities present in the leaf. It was however noticeable that about 30% of the toxic fraction ingested by both species was excreted in this form.

A. pisum embibed considerably more water soluble metabolites than did *A. fabae*, even though the amounts of these products eliminated in the honeydew were markedly lower in A. *pisum*.

It is not known what proportions of these quantities had been hydrolysed by the insects, though it was probably very little. The abundance of hydrolysis products in the leaves (Table 1) suggests that most of the water soluble metabolites found in the aphids and their honeydew were removed from the plant in this form.

Differences in the rates of uptake and excretion between *A. fabae* and *A. pisum* must play an important role in toxicological studies, since greater ingestion of sap is correlated with an increased uptake of toxicant. The different patterns of retention and excretion between these two species may well represent different rates of detoxification.

SUMMARY

Rates of uptake and excretion of ^{14}C-phorate and its metabolites by *A. fabae* and *A. pisum* were assessed and compared with the quantities of insecticide present in the leaflets supporting the colonies. After feeding for 18 hours on labelled tissue, the amounts of toxic metabolites found in *A. fabae* and *A. pisum* represented less than 0.5% of the quantity accumulated in the infested leaflets.

Water soluble metabolites were ingested in large amounts; *A. pisum* absorbed considerably more than *A. fabae*, although the latter species eliminated a proportionally higher amount of these products in the honeydew.

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