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Food-chain Toxicity of Systemic Acaricides to Predaceous Mites

IT is considered that one of the theoretical advantages of systemic materials applied to roots or stems is the selective action against phytophagous pests without toxicity to their predators. This ecological selectivity was demonstrated by Ripper[1], who found that bean plants dipped in a solution of dimefox were toxic to both aphids and predators, but when dimefox was applied as a root drench, aphids were killed and predators survived.

Organophosphate materials have proved to be highly toxic to the predaceous mites *Typhlodromus fallacis* (Garman) and *Phytoseiulus persimilis* Athias-Henriot[2] and, in detailed toxicological studies, parathion was found to be three times more toxic to *P. persimilis* than to the prey mites, *Tetranychus urticae* Koch, at the LD_{95} level[3]. The use of ecological selectivity by applying root drenches of systemic acaricides seemed to be a reasonable approach to an integrated control programme for the two-spotted spider mite on cucumbers. Because several materials had been found to be effective as root drenches against the two-spotted mite[4], the effect of similar treatments on *P. persimilis* was examined.

'Burpee Hybrid' cucumbers were grown in sand with a complete nutrient solution. The systemics were dissolved in 1 ml. acetone and 99 ml. water were added to give solutions 5 ml. of which were applied to the base of each small cucumber plant. After 24 h the first true leaf was excised and placed with the bottom surface up on a wet cheesecloth pad. Thirty adult female two-spotted mites and five adult female *P. persimilis* were placed on a leaf and the temperature was held at 23° C. Predator mortality was evaluated after 24 h. The toxicity of similarly treated leaves to *Tetranychus urticae* alone was determined after exposure for 48 h.

The differential effect on predators and prey is shown in Table 1.

From previous work[4] the LD_{50} values (in μg/plant) for the same type of treatment against *T. urticae* were: dimethoate 138, phorate 93, 'Temik' 154 and thionazin 106. These systemics were all of the same order of toxicity to the two-spotted mite. If there were complete ecological selectivity, predators should not be killed by this type of treatment because they do not feed on the plants. It is obvious that there is a food-chain toxicity when predators fed on prey mites which were feeding on toxic plant juices. There were significant differences in the predator mortality caused by the various systemics and the order of decreasing toxicity was dimethoate, thionazin, phorate and 'Temik'.

The only material which consistently favoured *P. persimilis* was 'Temik'. This material is a carbamoyl oxime while the other three are phosphorothioates or phosphorodithioates. Perhaps the predator mites can metabolize 'Temik', so that it is not accumulated. The predators fed on many prey in a period of 24 h, and if they are not able to metabolize the phosphate materials there would be a "biological magnification" of the residues comparable with that found in other ecosystems[5].

Thus the application of systemic acaricides to the root zone does not provide an ecological selectivity in all cases, and materials will have to be evaluated to find those that do not show a food-chain toxicity to the predators.

Table 1. EFFECT OF SYSTEMIC ROOT DRENCHES ON TWO-SPOTTED SPIDER MITES AND THE PREDACEOUS MITE *Phytoseiulus persimilis*

Treatment	Dosage (μg per plant)	Mortality (%) Two-spotted mite	*P. persimilis*
Dimethoate	150	36	96 (25)*
	50	44	85 (13)
	35	29	93 (15)
Phorate	150	88	84 (25)
	150	86	100 (13)
	100	75	44 (16)
'Temik'	225	100	25 (16)
	200	94	30 (10)
	100	70	0 (25)
Thionazin	150	90	100 (25)
	80	89	100 (25)
	35	72	50 (16)

* Number of predators in each test.

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Regulation of Egg Output of Populations of *Ostertagia ostertagi*

THE concentration of eggs or larvae of parasitic nematodes in the faeces of host animals has long been regarded as an indication of the number of mature parasites present. Several causes of variation in the relationship between the number of worms and the faecal egg count have been considered, among them changes in the quantity of faeces passed and in its consistency, and diurnal fluctuations in count have been much studied. Moreover, it is recognized that the ovulation of parasites in a resistant host may be inhibited.

Recent work with *O. ostertagi* in cattle has contributed to an understanding of how the egg output of populations of this parasite is regulated. Groups of calves were fed infective larvae daily at different rates with the consequence that their worm burdens were maintained at different levels. The pattern of their faecal egg counts, shown in Fig. 1, was identical, rising to the same peak and declining in the same way. The mean faecal egg counts of groups of calves, carrying different numbers of worms, were the same at any given time, and, by slaughtering calves from each group at intervals and examining their worm burdens, it was found that on each occasion the total number of ova contained in the uteri of all the worms from each calf was very similar.

In groups of calves infected with different numbers of larvae on one occasion only, the faecal egg counts wert also very similar although the number of worms presene was different. Calves from each group were slaughtered at intervals and it was found that the numbers of eggs contained in the uteri of all the female worms in each calf was about the same. These findings suggest that there is a limit to the number of eggs which can be produced by the population as a whole and that, except in very small populations, the worms produce eggs at a rate considerably lower than that of which they are potentially capable.

Such a limitation might occur if the production of each egg required a fixed quantity of some factor which was present in a limited amount. There is evidence, however,