RESIDUAL LIVES OF TWO SYNTHETIC PYRETHROID INSECTICIDES APPLIED TO PASTURE

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Summary

The residual lives of two synthetic pyrethroid insecticides, permethrin and cypermethrin, when applied to Spring pasture, have been measured. Residue samples were obtained by simple solvent washing of treated foliage, and were then analysed by gas chromatography. An effective half life of 4.8 days was obtained for both chemicals.

INTRODUCTION

In recent years considerable interest has been shown in the development of highly active insect-specific chemicals to replace the more generally toxic insecticides currently in use. This interest has largely been enforced by residue problems encountered with many organochlorine insecticides, and the high toxicity of most carbamates and organo-phosphates. One of the most promising classes of compounds is the synthetic pyrethroids (Elliott 1974), which have high insect knock-down activity and comparatively low mammalian toxicity.

It is only recently that reasonably persistent synthetic pyrethroids have become available in sufficient quantities for use in field tests. Investigations into the potential of these chemicals in New Zealand agriculture and horticulture are therefore just commencing.

Dr. G.O. Osborne of Lincoln College suggested to us 3 years ago that these new synthetic pyrethroids might be useful for the control of grass grub (*Costelytra zealandica*) at the adult stage. Subsequently, we found that bioresmethrin, a synthetic pyrethroid, was very active against grass grub beetles. While this was of obvious interest, it was clear that the half life of bioresmethrin, which is 1 day on tomatoes and considerably less on cucumbers (Buick and Flanagan 1975), was too short to allow its use against grass grub adults, since a toxic cover would be required on the Spring pasture for about 3 weeks. More persistent pyrethroids are available (Elliott 1974) and some preliminary tests in Canterbury (G.O. Osborne unpublished results) have indicated they may be useful for grass grub control.

To assist in planning field trials for grass grub, values for the effective field half lives of these two chemicals on foliage were measured under field conditions as close as possible to those expected during the grass grub mating season. The information obtained could also be useful for planning treatments against pasture feeding insects such as porina caterpillar (*Wiseana* spp).

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MATERIALS AND METHOD

The chemicals tested were permethrin (50% EC) and cypermethrin (40% EC), supplied by ICI (N.Z.) Ltd and Shell (N.Z.) Ltd respectively. The tests were done on the same site as used for grass grub field trials (Henzell and Lauren 1977).

The chemicals were applied as foliar sprays using a 3.25 m boom fitted with Teejet 730308 nozzles and a pump pressure of 275 kPa.

Two 10 x 16.6 m plots were marked out 30 m apart on a mown section of pasture. Each plot was divided into five parallel 10 x 3.3 m sub-plots. Insecticide applications were made on 13 October, 1976, when the foliage was mainly 2-3 cm high. The insecticides were applied to dry pasture under warm mild conditions in mid-afternoon. Each chemical was applied at five rates, viz. 0.25, 0.5, 0.75, 1.0 and 1.5 kg/ha, using the five sub-plots in each plot for one chemical. Each rate was applied in 650 litres/ha of water by making two identical passes over the sub-plot. The lowest rate was applied first for both chemicals.

Foliage samples were collected for residue analysis 1, 2, 4, 6, 9 and 15 days after application. Samples were taken in the early evening from three randomly selected 0.5 x 0.5 m areas on each sub-plot by cutting the pasture on each area down to about 1 cm with cupped-shears. Cut areas were marked to avoid resampling. Grass samples were kept in plastic bags, and stored in a dark room at 16-20°C until the following day when they were extracted for chemical analysis. Tests showed that the amount of extractable pyrethroid was not measurably different after 6 days storage under these conditions.

One 10 g sub-sample was taken from each bag of grass and surface rinsed with 50 ml of a 3:2 mixture of petroleum ether (80/100°C) and acetone. This procedure removed at least 90% of the insecticide from the grass. The extracts were stored in a dark room at 16-20°C. No insecticide breakdown was found in samples stored for up to three weeks.

An aliquot of each extract was washed with water, then analysed for pyrethroid by gas chromatography using a 3% SE-30 column at 250°C and an electron capture detector. Samples were compared with a set of standard solutions prepared daily. The results are expressed as µg insecticide/g fresh foliage.

RESULTS AND DISCUSSION

The chemical residue results were used to prepare lines of best fit for curves of log ppm of residue on the foliage versus the number of days since application. These curves gave effective field half life values ($T_{1/2}$) for each insecticide at each rate of application. The values are listed in Table 1, along with average figures for the residue levels remaining on the foliage at each sampling day. Values obtained for $T_{1/2}$ measure the combined effects of chemical decomposition, insecticide loss due to environmental factors such as rainfall, and dilution effects caused by grass growth.

The five values obtained for cypermethrin were not significantly different ($P > 0.1$) and a pooled estimate of $T_{1/2}$ gave 4.8 ± 0.2 days.

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Differences in $T_{1/2}$ for the five rates of permethrin were significant ($P < 0.01$). These differences may have been caused by surface flooding of the permethrin sub-plots 5 days after application, giving different losses of insecticide and variations in grass growth. A pooled estimate of $T_{1/2}$ for permethrin was made assuming the half life was independent of application rate, and this gave a value of 4.8 ± 0.4 days. Thus the insecticides have similar residual lives under the conditions of this trial.

TABLE 1: Residue analysis of pyrethroids on pasture

Chemical Rate (kg/ha)	Average concentration on Foliage ¹ Days after application						T _{1/2} (days)
	1	2	4	6	9	15	
Permethrin							
0.25	39	13	7	6	4	3	4.9
0.5	45	24	9	9	7	3	3.1
0.75	69	44	30	29	12	10	5.3
1.0	97	56	35	23	19	15	5.7
1.5	114	77	56	54	25	24	6.3
Cypermethrin							
0.25	18	10	8	7	4	2	4.9
0.5	45	26	19	12	8	5	4.7
0.75	80	52	33	25	21	7	4.4
1.0	82	59	51	34	22	11	5.1
1.5	166	75	62	63	26	18	5.0

¹ Expressed as ppm of fresh foliage.

Laboratory ultraviolet degradation experiments showed that grass gives some degree of protection to the two pyrethroids. Cypermethrin on a glass petri dish was 90% decomposed after 3 days under a UV lamp, but if applied to grass on a glass petri dish, it was only 45% decomposed after the same treatment. Similar results were obtained with permethrin. Chemical degradation was slower under sunlight, but the protective action of grass was still evident.

CONCLUSION

In contrast to technical information we received which suggested that cypermethrin was three times more persistent than permethrin, these results show that on pasture in the Spring there is little difference in the effective half lives of the two chemicals. Apparently the rapid grass growth, combined with the protective action of grass, minimises any difference.

Effective half lives of about 5 days indicate that provided both chemicals show sufficiently rapid contact activity against the adults, control of grass grub should be possible with two or three applications

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of a suitable rate. This was found to be the case (Henzell and Lauren 1977).

This paper has presented effective chemical half lives for the two pyrethroids on pasture in the Spring. However, while chemical residue analyses can give absolute values, these should be used in conjunction with appropriate biological tests against the target insect. For grass grub adults, we found in laboratory bioassays of the grass samples used for residue analysis, that the activity dropped off sharply between 6 and 9 days after application for all the rates tested (0.25, 0.5, 0.75, 1.0 and 1.5 kg/ha) (Henzell and Lauren unpublished results). This fact probably indicates that the chemicals are being absorbed into the plant waxes, making them unavailable for contact activity. It is likely for chewing insects, that the biological half lives would be identical to the effective chemical half lives determined in these experiments.

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