J. Hyg., Camb. (1978), **80**, 315
Printed in Great Britain

Trials of the rodenticide pyriminil against wild house mice (*Mus musculus* L.)*

By F. P. ROWE, T. SWINNEY and A. BRADFIELD
Pest Infestation Control Laboratory, Ministry of Agriculture, Fisheries and Food, Hook Rise South, Tolworth, Surbiton, Surrey

(*Received* 13 *September* 1977)

SUMMARY

Pen and field trials were conducted to assess the performance of the acute rodenticide pyriminil against the house mouse (*Mus musculus* L.). Four types of poison treatment were carried out using penned family groups of warfarin-resistant mice supplied with alternative plain foods. In each treatment pyriminil was included at 2% in a wholemeal flour/pinhead oatmeal/corn oil bait. Mortality was highest (46/54; 85·2%) when poison bait was offered for 4 days following 3 days of pre-baiting The same pre-baiting and poisoning technique was adopted in five field trials carried out against mice infesting farm buildings The efficacy of each poison treatment was estimated from the results of pre- and post-treatment census baitings; treatment success ranged between 53·7% and 96·7%, mean 80·5% It is concluded that pyriminil treatments are best carried out after a period of pre-baiting and that when pyriminil is used in this manner it is about as effective as zinc phosphide for the control of mice

INTRODUCTION

The advent of resistance to anticoagulant poisons in commensal rodent populations stimulated a search for new and improved acute and chronic rodenticides. One result of this search has been the development by the Rohm and Haas Company of the compound pyriminil (N-3-pyridylmethyl N′-p-nitrophenyl urea), originally named RH-787. The potential of this relatively slow-acting acute rodenticide against various rodent species has been reported by Peardon (1974), and Marsh & Howard (1975) also investigated the compound in the laboratory. The results of oral intubation tests with wild mice (*Mus musculus* L.) and rats (*Rattus norvegicus* Berk.) indicated acute oral LD 50s of 98 and 4·75 mg/kg respectively. In feeding tests with wild *M. musculus* given the choice of a cereal-based bait and the same bait containing 2% pyriminil, mortality was 18/20 or 90% (Peardon, 1974). Although Marsh & Howard, (1975) concluded that pyriminil showed greatest potential for the control of rats they considered that the compound could also be effective against mice. The performance of pyriminil against free-living mouse populations was not reported however. This paper presents the results of pen and field trials carried out to determine the best mode of use and efficacy of pyriminil against infestations of mice.

METHODS

Pen trials

Laboratory-reared family groups of warfarin-resistant mice were confined in metal pens measuring $7\frac{1}{2} \times 2\frac{1}{4}$ m (Rowe & Bradfield, 1975). Each group was established for 7 days before testing and during the the conditioning and poison treatment periods the mice were offered two staple foods, whole wheat and powdered Diet 41B (Oxoid Ltd, London), and water *ad lib.* Four different poison treatment were investigated in four trials of each type. The treatment methods were (*a*) 1 day direct poisoning, (*b*) 4 days direct poisoning, (*c*) 3 days pre-baiting and 1 day poisoning and (*d*) 3 days pre-baiting and 4 days poisoning. The standard pre-bait employed comprised wholemeal flour (5%), corn oil (5%) and pinhead oatmeal (90%); proportionally less pinhead oatmeal was used in the preparation of poison bait containing pyriminil at 2%. Eight baiting joints were used in each treatment and the bait was laid in open plastic trays sited close to the long sides of the pen. The amount of pre-bait and poison bait eaten at each point was measured daily to 0·1 g. A search for dead mice was made during each poison treatment and for 10 days afterwards; surviving mice were then removed and killed.

Field trials

Trials were carried out against mice infesting isolated farm buildings, comprising three milling and food storage barns, a machinery workshop and a small poultry house. Each trial was conducted in the following manner. The infested area was first surveyed and a pre-treatment census begun. For this purpose a known weight of canary seed was laid in small wooden trays distributed 3–4 m apart. The baiting points were inspected over the next 4 days to ensure that surplus bait was available and the amount of census bait eaten was measured daily. At the end of the pre-treatment censusing the trays and excess canary seed were removed and 4 days later the poison treatment was begun. Each 4-day poison treatment, using pyriminil at 2% in wholemeal flour/pinhead oatmeal/corn oil bait, was preceded by 3 days of pre-baiting. In each trial the pre-bait and poison bait were laid at sites different from those chosen for the census. The total amount of pre-bait eaten was measured daily to the nearest 1 g. Accurate measurement of poison bait consumption was not possible because of the small amount eaten by mice and the aborption of atmospheric moisture by some poison bait laid during damp weather. At the end of the poisoning period the poison bait trays were removed and 4 days later the post-treatment census was begun. The latter was conducted in the same manner as the pre-treatment census except that the amounts of canary seed eaten were measured after 1 day and, finally, over the last 3 days. The percentage success of each poison treatment was calculated from the total amount of canary seed consumed by mice in the pre- and post-treatment censuses.

RESULTS AND DISCUSSION

The results of the pen trials are shown in Table 1. Treatment success was lowest (21·0 %) when pyriminil bait was laid directly for 1 day. Better control (47·6 %) resulted when poison bait was laid directly for 4 days, presumably due to the additional feedings that occurred on days 2–4 of each treatment period. However, the 1-day poison treatments following 3 days of pre-baiting achieved a higher kill of mice (69·1 %) and there was further improved control (85·2 %) when pre-baited mice were offered poison bait for 4 days. Peardon (1974) has stated that pyriminil is well accepted in bait formulations and its use does not cause bait shyness problems, thereby implying that pre-baiting is unnecessary before its application. Marsh & Howard (1975) however considered that pyriminil could give greater control if rodents are first pre-baited but laboratory or field findings lending support to this viewpoint were not reported. The results of the present pen trials showed the value to be gained by deploying pre-bait before the application of pyriminil against the house mouse. A similar conclusion was reached when zinc phosphide and three other acute rodenticides were examined in earlier pen trials (Rowe & Bradfield, 1975).

The daily amounts of canary seed and of pre-bait eaten by each mouse population at the censuses and during the pre-baiting period in each field trial are given in Table 2, together with the estimated percentage kills. As in the pen trials variable control was achieved (53·7–96·7 %), the mean success of the field treatments (80·5 %) and of the pen treatments (85·2 %) being similar. Most visits to the poison baits laid in the field were made on day 1 of the treatments (37 partial takes of poison bait) but additional feedings occurred on days 2–4 (16 partial takes). These findings are in keeping with those obtained in the pre-baiting/poisoning pen trials (Table 1). In the least successful field trial (53·7% control), mice visited more poison baits between days 2–4 than on day 1 (Table 2) and it is possible that in this case better control would have resulted if poison baiting had been continued for a longer period.

Zinc phosphide has had long-standing and wide use in the control of mouse infestation and the performance of pyriminil in the present study is best compared with that of this acute rodenticide in similarly conducted pen and field trials. The kills obtained in four 3-day pre-baiting/4-day poison treatments carried out in pens using zinc phosphide at 3 % in bait were 17/18, 8/16, 7/9 and 11/14. The mortality that resulted in the second of these treatments was significantly less than that found in the others ($P < 0{\cdot}05$) but the total mortality (43/57) was not significantly less ($P > 0{\cdot}25$) than that obtained in equivalent treatments using pyriminil (Table 1).

One of three field trials in which 3% zinc phosphide bait was applied for 4 days after 3 days of pre-baiting was a complete failure and the estimated kills in the other two were 73·8 and 78·7% (Rowe, Swinney & Bradfield, 1975). In the present trials (Table 2), pyriminil proved to be at least as effective as zinc phosphide. However, both of these poisons were found to be less effective than either calciferol/warfarin (Rowe, Smith & Swinney, 1974) or bromfenacoum (unpublished data) for the control of free-living house mice.

Table 1. *Results of pen trials against* M. musculus *using pyriminil*

Treatment type	Pre-bait eaten (g) Day 1	Pre-bait eaten (g) Day 2	Pre-bait eaten (g) Day 3	Poison bait eaten (g) Day 1	Poison bait eaten (g) Days 2–4	Mortality	Mortality (%)		Days to death
1 Day poisoning	—	—	—	2·0	—	3/20	15·0	21·0	1–5
	—	—	—	0·7	—	1/14	7·1		6
	—	—	—	1·1	—	2/17	11·8		2–3
	—	—	—	1·8	—	7/11	63·6		1–7
4 Days poisoning	—	—	—	1·1	0·8	6/12	50·0	47·6	2–12
	—	—	—	1·0	2·0	3/10	30·0		1–5
	—	—	—	2·0	3·1	16/20	80·0		1–9
	—	—	—	1·4	5·3	5/21	23·8		1–9
3 Days pre-baiting	19·3	23·2	21·3	1·9	—	10/16	62·5	69·1	1–7
1 Day poisoning	16·6	20·7	20·7	2·6	—	11/16	68·8		1–7
	9·6	14·3	16·0	1·8	—	10/12	83·3		1–7
	8·5	16·7	15·4	1·8	—	7/11	63·6		1–4
3 Days pre-baiting	16·9	25·2	22·6	1·4	1·6	12/16	75·0	85·2	1–6
4 Days poisoning	14·8	21·2	20·1	1·6	0·2	11/11	100		1–4
	4·2	13·3	18·6	1·5	0·9	10/13	76·9		1–5
	19·6	30·4	25·8	1·9	0·6	13/14	92·9		1–5

Table 2. *Results of field trials against* M. musculus *using pyriminil*

Treatment no.	Pre-treatment census: consumption of canary seed (g) Day 1	Day 2	Day 3	Day 4	Poison treatment: Consumption of pre-bait (g) Day 1	Day 2	Day 3	Number of takes of poison bait Day 1	Day 2–4	Post-treatment census: consumption of canary seed (g) Day 1	Day 2–4	Estimated success (%)
1	33	32	49	35	29	48	65	6	7	9	61	53·7
2	20	25	58	63	44	55	60	6	2	17	35	68·7
3	32	50	69	89	35	114	107	7	2	0	8	96·7
4	65	113	132	117	57	89	96	10	4	19	86	75·4
5	61	79	71	75	45	47	49	8	1	4	8	95·8

We are indebted to Mr C. Plant who assisted with the field trials. Pyriminil was supplied by Rohm and Haas (UK).

REFERENCES

MARSH, R. E. & HOWARD, W. E. (1975). A new series of acute rodenticides. *International Pest Control* **17**, 4–9.

PEARDON, D. L. (1974). RH-787: A new selective rodenticide. *Pest Control* **42**, 14, 16, 18, 27.

ROWE, F. P. & BRADFIELD, A. (1975). Comparative acute and chronic toxicity tests on confined colonies of wild house mice (*Mus musculus* L.). *Proceedings of the Fourth British Pest Control Conference, St Helier, Jersey*. Paper **19**, 1–6.

ROWE, F. P., SMITH, F. J. & SWINNEY, T. (1974). Field trials of calciferol combined with warfarin against wild house mice (*Mus musculus* L.). *Journal of Hygiene* **73**, 353–60.

ROWE, F. P., SWINNEY, T. & BRADFIELD, A. (1975). Field trials of the rodenticide gophacide against wild house mice (*Mus musculus* L.). *Journal of Hygiene* **74**, 109–14.