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Chemical control of the earthworm *Amynthas rodericensis* (Grube) in pots in nurseries

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Summary

Amynthas rodericensis (Grube), an introduced earthworm, is a pest in pots in nurseries in southern Queensland. Endosulfan emulsifiable concentrate (e.c.) at rates equivalent to 1.0, 1.9 and 9.5 kg active ingredient (a.i.)/ha reduced worm numbers in pots by 89, 96 and 100% respectively 28 days after treatment. Etridiazole e.c. at 35.0 kg a.i./ha and carbofuran granules at 11.1 kg a.i./ha reduced numbers by 52% and 45%. The following treatments (kg a.i./ha) were ineffective; aldicarb granules (11.1), benomyl wettable powder (w.p.) (6.4, 12.7, 79.6), etridiazole w.p. (35.0), fenamiphos granules (12.7, 31.8) propamocarb e.c. (35.0) and terbufos granules (12.7).

INTRODUCTION

The earthworm *Amynthas rodericensis* (Grube) is probably of south-east Asian origin and is widespread in southern Queensland (Easton 1982). It is common in some nurseries as a pest of potted plants. The worms enter through the drainage holes and breed in the pots reducing the potting mix to a half or a third the original volume. This occurs partly as a result of mix being pushed out through the drainage holes and partly by action on the organic matter content. The end result is that after some time the pots are only half full. The cost of repotting in extensively infested nurseries is high. Furthermore the problem may not be solved as young worms are often transferred among the roots to the new pots and the problem recurs. The direct effect of the worms has not been examined, but plants in infested pots often show poor root growth. The simplest control measure is to raise the pots off the ground but as some nurseries cover several hectares the cost of benches can be prohibitive. Chemical control was therefore considered.

Insecticides which have been shown to cause heavy reductions in worm populations in the field are DDT (Baker 1946), chlordane and dieldrin (Doane 1962), phorate (Way and Scopes 1965, 1968; Tomlin and Gore 1974), carbofuran (Thompson 1971; Tomlin and Gore 1974), carbaryl, endrin and fensulfothion (Thompson 1971). Endosulfan is recommended in Queensland by the Department of Primary Industries to control worms in bowling greens. The fungicides benomyl (Tomlin and Gore 1974; Wright 1977) and thiophanate-methyl (Wright 1977) were found to greatly reduce populations in apple orchards and pasture. Different species of earthworms differ in their susceptibility to chemicals. For example Baker (1946) found that unidentified worms died beneath elms sprayed with DDT in the USA while Fleming and Hadley (1945) were unable to control an oriental worm (probably *Pheretima hupeiensis* Michaelson) on American golf greens with up to 112 kg DDT/ha.

The aim of the trial was to investigate chemical control of *A.rodericensis* in pots in nurseries.

MATERIALS AND METHODS

Mature plants of *Aspidistra elatior*, of uniform age, growing in black plastic pots 20 cm in diameter and 20 cm high were used in this trial. The chemicals, their formulations, and the weight of active ingredient (a.i.) applied per pot are shown in Table 1. Equivalent rates in kg a.i./ha calculated on a surface area basis are presented to enable comparison of results with other workers. Fifteen treatments were used in a randomised block design with eight replicates. The plot size was one pot.

Table 1. Mean number of earthworms per nursery pot surviving 28 days after chemical treatment

Treatment	Formulation	a.i. per pot 20 cm diameter (kg a.i./ha)	Mean number of live worms per pot after 28 days
Endosulfan	125 g/L e.c.†	0.03 (9.5)	nil (1.00)*
Endosulfan	125 g/L e.c.	0.006 (1.9)	0.3 (1.10)
Endosulfan	125 g/L e.c.	0.003 (1.0)	0.8 (1.26)
Etridiazole	240 g/L e.c.	0.11 (35.0)	3.1 (2.00)
Carbofuran	100 g/kg gran‡	0.035 (11.1)	3.5 (2.03)
Aldicarb	100 g/kg gran	0.035 (11.1)	4.3 (2.28)
Benomyl	500 g/kg w.p.§	0.04 (12.7)	4.6 (2.31)
Benomyl	500 g/kg w.p.	0.02 (6.4)	5.0 (2.45)
Etridiazole	350 g/kg w.p.	0.11 (35.0)	5.1 (2.45)
Propamocarb	722 g/L e.c.	0.11 (35.0)	5.4 (2.48)
Terbufos	150 g/kg gran	0.04 (12.7)	5.4 (2.48)
Fenamiphos	50 g/kg gran	0.1 (31.8)	5.4 (2.54)
Fenamiphos	50 g/kg gran	0.04 (12.7)	5.6 (2.56)
Benomyl	500 g/kg w.p.	0.25 (79.6)	6.5 (2.64)
Control	No treatment	0 (0)	6.8 (2.74)
l.s.d. P=0.05			0.50
P=0.01			0.66

* x+1 transformation. Transformed means in parentheses.

† e.c.=emulsifiable concentrate.

‡gran=granules.

§w.p.=wettable powder.

The potting mix used was initially 75% sawdust and 25% sand but at the time of the trial most of the sawdust had broken down. The pots were placed under shade cloth and watered every 2 to 3 days. They stood on a layer of gravel over soil, the worms moving from the soil to pots and vice versa. To avoid the possible complication of chemicals acting as repellents the plants, which were pot bound, were removed from the pots with the potting mix and worms entrapped by their roots, and a flywire screening placed over the drainage holes to prevent worms escaping. Five hundred millilitres of the emulsifiable concentrate (e.c.) or wettable powder (w.p.) solution was added to each pot. Granules, which were weighed out individually for each pot, were spread on the surface and then covered with a thin layer of potting mix. Chemicals were applied on 13 October 1983. After four weeks, treatments were assessed by removing the soil from the roots of the plants and counting the worms. Pretreatment populations of worms were assessed by examining eight pots at random before the experiment.

RESULTS AND DISCUSSION

The mean number of worms per pot in the pretreatment count was 7.9± 1.17 (s.e.), which did not differ significantly from that in the control in the post-treatment assessment (6.8 worms per pot). Endosulfan was the most effective chemical and significantly reduced the number of worms below that found in any other treatment (Table 1). At the lowest rate (0.003 g a.i. per pot) there was an 89% reduction in the number of worms compared to the control and at twice that rate there was a 96% reduction. At the highest rate (0.03 g a.i. per pot) no worms survived. Etridiazole e.c. and carbofuran granules reduced the poulation to approximately 50% of the control while all other treatments produced no significant reductions.

These data demonstrate a tolerance to chemical treatments not anticipated from previous work. As an example, aldicarb and benomyl at all rates were ineffective in this trial. Stenersen (1979) found aldicarb highly toxic to all four species of worms he examined. Tomlin and Gore 1974 found that benomyl at 7.8 kg a.i./ha reduced worm populations by more than 90% in 21 days. Wright 1977 showed that a drench of benomyl equivalent to 1.55 kg a.i./ha killed 60 to 70% of worms in laboratory tests in 14 days. In this trial none of the treatments of benomyl, even at dosages above 70 kg a.i./ha, reduced numbers of *A. rodericensis* significantly. The greater tolerance of *A. rodericensis* to pesticides in this trial may be a species characteristic or it may be due to the high organic content of the potting mix.

Part of the success of endosulfan compared to the granular insecticides may be due to it being drenched-on in volume to moist (but not wet) potting mix giving good penetration and distribution. Similar results, however, were not obtained with other chemicals applied in the same manner. It is clear that the solvent of endosulfan (xylene) was not an important factor in causing mortality as xylene is also the solvent in etridiazole e.c. Approximately seventeen times more solvent was added to each pot treated with etridiazole e.c. than to each pot containing the lowest rate of endosulfan yet four times as many worms survived in the etridiazole treated pots.

Based on these data endosulfan at the rate of 0.19 g a.i./m^2 (1.9 kg a.i./ha) has been recommended as a chemical for control of *A. rodericensis* in nursery pots and has proved effective.

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