Technical Notes

Comparison of carbaryl, maldison and permethrin wettable powders as insecticidal dusts to protect potato tubers for export against potato moth *Phthorimaea operculella* (Zeller)

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Summary

Wettable powder formulations of carbaryl, maldison and permethrin were tested as insecticidal dusts for the protection of potato tubers against attack by potato moth *Phthorimaea operculella* (Zeller). Three efficacy trials and one phytotoxicity trial were conducted. Permethrin at 21.25 g a.i. per 50 kg bag was found to be the most suitable treatment for protection against potato moth attack on seed potatoes for export.

Introduction

The potato moth *Phthorimaea operculella* (Zeller) is a well known pest of solanaceous plants throughout the world, but some of the Pacific islands are among the countries which do not have this pest. In the past, certified seed potatoes destined for export from Victoria to the Pacific islands were dusted with DDT to protect the tubers from *P. operculella* infestations. However from August 1 1987 all use and sale of DDT in Victoria was banned. No alternative dusts were registered in Victoria for the control of potato moth in stored tubers. This was of considerable concern for exporters because they were required to dust produce prior to export. This paper reports on four trials conducted to find suitable dusts for the protection of seed potato tubers for export.

Materials and Methods

Wettable powder formulations of carbaryl, maldison and permethrin were chosen for these trials as they were already registered for use on potatoes in Victoria. Three efficacy trials and one phytotoxicity trial were conducted.

All efficacy trials consisted of four treatments replicated three times, with three tubers per replicate. Each group of 3 tubers was weighed and placed in a brown paper bag (8 cm x 14 cm x 44 cm).

The appropriate amount of chemical dust was added to each bag, according to the weight of the tubers. The amount of dust used was based on the old rate of 4 oz of 2% DDT product per 65 kg bag. Most bags now are 50 kg. The conversion was calculated as being equivalent to 85g. product per 50 kg bag. The amount of active ingredient per treatment applied at this rate is shown in Table 1.

Insects used were from a laboratory culture derived from larvae collected in the field from Thorpdale in March, 1987. Moths used in the tests were allowed to fly in the breeding cages for a few days after emergence, to enable mating to occur. In trials 1 and 2, 10 moths were placed in each bag, 4 hours and 14 days after dusting respectively. Trials 1 and 2 were designed to investigate the protection of tubers prior to and during transit, whereas in Trial 3, designed to investigate the suitability of the dusts to protect the tubers from larvae hatching from eggs laid on the bags, ten newly hatched larvae (24 h old) per replicate, were placed in the bags 38 days after dusting. All efficacy trials were conducted at a constant temperature of 25 ±1°C and were assessed four weeks after moth or larval introductions. Numbers of pupae and larval damage were recorded.

The results of Trials 1 and 3 were self-evident, hence there was no statistical analysis of the data. Due to the large variation in the counts in Trial 2, a Kruskal-Wallis test was used to analyse the data.

The phytotoxicity trial consisted of 10 tubers per treatment. The tubers were dusted at the same rate in the efficacy trials 5 days prior to planting out in 20 cm black plastic pots, with one tuber per pot. These were then placed on a concrete slab and observed daily. The number of days to first and last emergence of plants, as well as plant vigour and any other phytotoxic symptoms were recorded. Plant vigour was rated from strongest growth (1) to poorest growth (4), three weeks after all plants had emerged.

Table 1 Treatment details.

Treatment Code	Trade Name	Active Ingredient	Formulation: g a.i. kg^{-1}	Rate g a.i. per 50 kg
A	Hortico Carbaryl	carbaryl	WP:800	68.00
B	Chemspray Malathion	maldison	WP:50	4.25
C	Coopex Residual Insecticide	permethrin	WP:250	21.25
	Control	–	–	–

WP: Wettable Powder, g a.i. kg^{-1} = Grams active ingredient per kilogram product

Results

All chemicals gave good protection of tubers from potato moth attack in Trial 1, where moths were introduced 4 hours after dusting. However, the maldison treatment did have a few pupae present in one replicate and it was the only chemical treatment with slight potato moth damage to the tubers. All chemical treatments in Trial 2 had significantly fewer pupae than the control. Although the maldison treatment had only four pupae, 42 dead larvae were found and all tubers were damaged due to larval activity. In Trial 3 no pupae were found in any of the chemical treatments, but five dead late instar larvae were found in the maldison treatment, which was also the only chemical treatment with tubers damaged due to the feeding of potato moth larvae.

In the phytotoxicity trial the carbaryl treatment had the longest emergence time and poorest growth 3 weeks and 6 weeks after planting. The carbaryl treatment also had the lowest yield although the difference was not significant at the 5% level.

Discussion

The efficacy trials indicate that protection was afforded to potato tubers from potato moth attack for over 5 weeks by the three dusts. However, maldison gave less protection than the other two dusts, as some damage occurred to the tubers in all trials. The failure of maldison to completely protect tubers may be because the dust does not disperse through the bag very well, leaving small areas of the tubers unprotected. A greater quantity of this dust may be required to protect tubers.

Carbaryl protected tubers adequately from attack but had some phytotoxic effect on the tubers, resulting in a longer emergence time, poor plant vigour and decreased yield.

Permethrin afforded protection to tubers

from potato moth attack for over 5 weeks and had no phytotoxic effects. This dust dispersed through the bags very well giving complete coverage of tubers. These efficacy results are in contrast to those reported by Raman *et al.* (1987) where up to 35% tuber damage occurred when permethrin was used as an insecticidal spray to protect stored tubers against attack from potato moth. Since only the concentration of spray used was given (0.5 g a.i.litre^{-1}) and not the amount of spray used per tonne of potatoes, it is not possible to determine the amount of active ingredient used per tonne by Raman *et al.* To use the same amount of active ingredient in the trials reported here, the equivalent of 42.5 L of spray per 50 kg bag would have been required.

Certified seed potatoes only need to be protected from potato moth attack whilst in transit to the importing country. This usually takes up to a month. Considering the results from these trials and the transit times involved, it is considered that permethrin would be a suitable dust to protect certified seed potatoes for export, against attack from potato moth.

Acknowledgements

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References

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Similarities in the size and phenol reaction of naked Sida seeds.

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Naked seeds of *Sida acuta* Burm. f., *S. rhombifolia* L., *S. spinosa* L. and *S. cordifolia* L. often contaminate pasture seed, particularly seed of *Stylosanthes* spp., *Brachiaria* spp., *Desmodium intortum*, *Paspalum dilatatum* and *Setaria sphacelata*. Since *S. acuta* and *S. rhombifolia* appear on the Queensland list of declared seeds (Agricultural Standards Regulations 1984), these must be identified during the purity analysis of marketed seed. Sida mericarps (seeds with intact carpel walls) are distinguished readily by the morphological characteristics of the carpel walls (Friend 1983). However, damaged mericarps and naked seeds prevent identification by this means.

Samples of mericarps of *S. acuta*, *S. spinosa*, *S. rhombifolia* sens. lat. and *S. cordifolia* were obtained from Dr. J.M. Hopkinson, Walkamin Research Station, Queensland Department of Primary Industries or the Seed Testing Laboratory, Indooroopilly, Queensland Department of Primary Industries. The carpel wall was removed and dimensions of 15 seeds from each species were measured using a micrometer. Seed weight, colour, and surface texture were also recorded. Seeds were also tested for phenol reaction by the method of the Association of Official Seed Analysts (1988).

All species showed seeds of similar shape, consisting of two flat sides and a rounded back, like the sector of a sphere (Martin and Barkley 1961; Figure 1). The testas were finely pitted and varied in colour from dull brown to dull dark brown. For all species, this colour darkened further on exposure to phenol.

None of the dimensions nor seed weights distinguished the sidas because of the extent of the overlap in these measurements between species (Table 1). The width of back parameter, used as a rough guide by J.M. Hopkinson (personal communication), was the most promising to separate *S. acuta* and *S. spinosa* from *S. rhombifolia* and *S. cordifolia* but was still inconclusive.

Because of the inability of dimensions, weight and phenol reaction to distinguish these species, further work is being undertaken using gel electrophoresis.

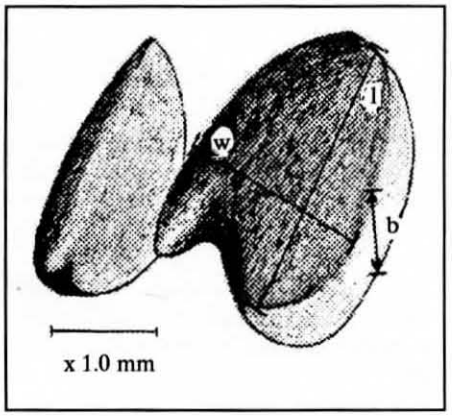

Figure 1. Measurements of length of side (l), width of side (w) and width of back (b) taken of naked seed of Sida.

Table 1. Dimensions and weights of seed of *Sida acuta*, *S. spinosa*, *S. rhombifolia* sens. lat. and *S. cordifolia*. Dimensions are defined in Figure 1. Numbers are the range in values observed for 15 seeds.

Parameter	*S. acuta*	*S. spin.*	*S. rhom.*	*S. cord.*
length of side (mm)	2.0-2.3	1.8-2.2	1.9-2.1	1.9-2.1
width of side (mm)	1.4-1.8	1.2-1.5	1.5-1.6	1.5-1.8
width of back (mm)	1.2-1.6	1.2-1.6	1.0-1.2	1.0-1.2
side width:back width	0.8-1.3	0.8-1.1	1.2-1.5	1.4-1.8
seed weight (mg)	1.2-3.0	0.8-2.6	1.4-2.4	1.7-2.3

References

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