PROTECTION OF STORED POTATOES AGAINST TUBER MOTH

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Summary

Six insecticides of low to moderate mammalian toxicity were evaluated for their ability to protect stored potato tubers from infestation by tuber moth (*Phthorimaea operculella*) when applied to potato sacking. Cypermethrin, maldison, decamethrin and fenvalerate were found to remain sufficiently active for at least 6 months after application.

INTRODUCTION

During the growth of the potato plant, tuber moth (*Phthorimaea operculella*) larvae live as miners in the foliage and stems. They infest tubers in the soil before harvest and may also attack tubers in storage (Bacon 1960) through oviposition by sheltering females or through feeding larvae, from an infestation source such as cull potatoes in the storage shed.

When infestations develop in the foliage during the growing season, many larvae and moths are present when the vines normally mature. Under the desirable drier conditions just prior to harvest, cracks appear along the tops and sides of beds in heavier soils. Moths deposit eggs on the soil and resulting larvae enter crevices and eventually invade the tubers. Partly grown larvae may also leave the dying foliage and enter soil openings to infest tubers. Thus, when the potatoes are lifted, they may be found to be infested with larvae of all stages. Stored tubers can also be infested throughout the year.

Cultural practices such as irrigation and ridging can reduce tuber infestation, and insecticidal applications are effective against foliar infestations of potatoes in the field (Foot 1974, 1979). At present, however, the only measure accepted in New Zealand for reducing the possibility of in-storage infestation of tubers is sanitation. The objective of the work reported here was to investigate the feasibility of using (complementary) insecticidal protectants applied exteriorly to the bags in which potatoes are stored.

METHOD

Insect material for testing was obtained from a laboratory colony of tuber moth maintained on potatoes at 25 °C, at which temperature a life cycle was completed in about 9 weeks.

Insecticides and rates evaluated were based on a recommendation for maldison against storage pests of bagged food commodities (Bot *et al.* 1979). These are listed in Table 1 and were chosen for their relatively low mammalian toxicity and rapid action.

Discs of 190 mm diameter were cut from a potato sack of medium grade weave. Two discs were treated with one of each of the six insecticides by first placing them on a polythene sheet and then spraying with a 'Fynspray' hand sprayer. The sprayer was calibrated to cover 1 m² with 50 ml in 25.5 sec., and held approximately 15 cm from the target discs. The discs of sack were then removed for air drying and the polythene thoroughly cleaned before the next application. This insecticidal treatment was made once only, at the start of the trial.

Glass crystallisation dishes, 125 mm in diameter, were set up away from direct sunlight in a room kept at 25 °C. Each dish contained in large potato of which the skin

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had been lightly perforated to facilitate entry by young larvae. The potato was enclosed in its glass container by an insecticide treated sack disc secured with a rubber band. A large potato was used to ensure contact between it and the sack. The apparatus is depicted in Fig. 1.

Fig. 1 The apparatus used in the tests

Visually healthy pupae were sorted from the stock colony, sexed, and each sex held separately for a few days until a sufficient number of moths had emerged. These were then anaesthetised with CO₂ (except for one instance, referred to later), and five of each sex placed onto the sacking on each glass container. A second crystallisation dish of the same dimensions was then inverted over the container and the two held together with wide masking tape.

The apparatus was regularly inspected to record moth mortalities, but left undisturbed for a period of approximately 5 weeks. At the end of this time, the containers were opened, the dead parent moths removed and any larvae and pupae present were counted and discarded together with the used potato.

Two months, and again at 4 and 6 months after the insectical treatment, the procedure was repeated using new potatoes and parent moths, but the same sack discs. When not in use, discs were stored separately in plastic bags in a drawer.

RESULTS AND DISCUSSION

A summary of results is presented in Table 1.

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TABLE 1: Total number of first generation individuals five weeks after introduction of moths

Insecticide	Approx acute oral LD50 (rats) mg/kg	Grams applied in 5 litres water/m ² bag surface	Time of moth introduction after treatment of sack discs (months)			
			0	2	4	6
Control (no insecticide)	—	—	162	182	128	82
bromophos	7000	100	0	0	21	42
phoxim	1800	150	0	2	37	0
fenvalerate	427	30	1	3	0	0
decamethrin	128	1.25	0	2	0	0
maldison	2500	150	0	0	0	0
cypermethrin	300	25	0	0	0	0

Most (parent) moths lived for more than one week on the untreated sack. At 24 hours after their introduction into the apparatus, counts showed a mean survival of 97% for untreated control; 41% and 36% for bromophos and phoxim respectively; 16%, 6% and 3% for fenvalerate, decamethrin and maldison respectively, and 0% for cypermethrin. These percentages correlate well with the number of progeny produced by surviving moths as given in Table 1.

A high number of first generation individuals were consistently found in the untreated controls at the end of each 5 week test period. Practically no infestation was able to penetrate any of the insecticide barriers up to the 2 month evaluation (Table 1).

At 4 months, the bromophos and phoxim treatments had lost some of their efficacy while the other insecticides remained effective for at least 6 months from the time of application. An expected infestation of the test potatoes in the phoxim treatment at 6 months after application did not materialise. A suspected reason is the use of diethyl ether for moth anaesthesia instead of the usual CO₂ at this time. This could have impaired mating and oviposition. Note from Table 1 that infestation in the controls was also lower than expected at this date.

ACKNOWLEDGEMENT

To R.J. Townsend for technical assistance and the commercial companies which supplied the insecticides.

CONCLUSION

The investigation demonstrated that tuber moth can be prevented from successfully ovipositing in tubers enclosed in bags treated with the insecticides tested. There was no need to treat the tubers themselves, but duration of protection depended upon the insecticide used.

This method has practical value when stored potatoes are virtually free from infestation at time of harvest. Because of the small quantity of insecticide required, this technique promises a low cost control of potato tuber moth in storage situations.

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