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INSECTICIDES FOR THE PROTECTION OF STORED POTATOES

By T. PASSLOW, M.Sc.Agr., and P. D. ROSSITER

SUMMARY

Six insecticides were tested in four trials for the protection of stored potatoes against infestation by the potato moth *Phthorimaea terrella* Walker.

Derris dust containing 1·0% rotenone was the most satisfactory and performed well with moist as well as dry tubers, including conditions of increased pest populations. DDT 2·0% dust and maldison 1·0% dust gave comparable results with dry tubers but DDT was superior to maldison when applied to freshly dug tubers carrying moist soil.

Endrin 0·5% dust was effective in limiting infestation but the toxic nature of this insecticide precludes its use for potato storage. Trichlorphon was ineffective.

Rotting of tubers was more noticeable when maldison was used as the protectant.

I. INTRODUCTION

In southern Queensland, potatoes harvested in early summer are regularly stored both as table potatoes for marketing later in the year and as seed for planting during the following autumn. Although a proportion of the storage is carried out successfully in cool stores (Passlow and Rigby 1967), many growers hold the tubers under atmospheric conditions and these tubers are highly liable to infestations by the potato moth *Phthorimaea terrella* Walker. Brimblecombe and Cannon (1949) and May (1959) demonstrated that derris dust (1·0% rotenone), and DDT (2·0% dust) mixed with the tubers prevented the development of infestation. More recently, Champ and Shepherd (1965) by topical testing demonstrated DDT resistance in *P. terrella,* and Shepherd and Champ (1965) reported that maldison had been successful in laboratory trials in preventing infestation in stored potatoes.

The present trials, therefore, were designed to test the value of maldison and a number of alternative products for protection of potatoes under conditions comparable to commercial storage.

II. MATERIALS AND METHODS

The insecticides used and the strengths of the formulations were as follows

DDT.—A dust preparation containing 2·0% w/w pp′ isomer in pyrophyllite.

Derris.—A dust preparation containing 1·0% w/w rotenone.

Endrin.—A dust preparation containing 0·5% w/w active constituent.

Pyrethrum.—A dust preparation containing 0·25% w/w pyrethrins and 2·0% piperonyl butoxide in kaolin.

Maldison.—A dust preparation containing 1·0% w/w premium grade maldison as active constituent.

Trichlorphon.—A dust preparation containing 2·0% w/w active constituent prepared for these experiments by diluting a dust containing 5·0% w/w active constituent with commercial talc.

Four trials were carried out, two during 1966 and two during 1967, at Gatton in the Lockyer Valley, the major potato production area of Queensland. The storage area was a well-ventilated shed in which ample opportunity existed for infestation of the trial tubers from adjacent untreated bulk storage and from nearby field plantings.

All trials were designed as 7 x 4 randomized blocks with plots of 31·8 kg of potatoes of the variety Sebago held in half-filled standard Chapman sacks. Trials 1 and 2 were commenced on November 2 and November 30, 1966, and trials 3 and 4 on November 20 and December 15, 1967, respectively.

In trials 1 and 3 all tubers showing visible infestation were removed before storage. In trials 2 and 4 totals of 30 and 24 infested tubers respectively were deliberately incorporated in each plot.

In all treatments in trials 1 and 2 and in the maldison treatment designated "dry tubers" in trials 3 and 4 the tubers were held for some days prior to the insecticide applications, and were then substantially free from moist soil. In the remaining treatments in trials 3 and 4 the insecticides were applied to freshly dug tubers to which some moist soil was adhering.

A total of 113 g of insecticide was applied to each plot. One-quarter of the dust was placed in the bottom of each of two 22·75 *l* drums, which were then filled with tubers, and another 28·3 g of dust were sprinkled on the top. The two drums of tubers representing the unit plot were then transferred to the sack to achieve reasonable mixing of the dust on the tubers.

At the conclusion of storage in each trial, namely 85, 83, 105 and 82 days respectively, the number of rotted tubers in each plot was recorded. From the remaining tubers four groups of 50 were taken at random from each plot and the numbers infested by *P. terrella* recorded.

III. RESULTS

Data on the percentages of infested tubers and the numbers of rotted tubers are presented in Table 1 for trials 1 and 2 and in Table 2 for trials 3 and 4.

TABLE 1

TRIALS 1 AND 2, 1966: TUBERS FREE FROM MOIST SOIL

Percentage infested and number rotted per plot

Treatment	Trial 1, Infested Tubers Not Added			Trial 2, Infested Tubers Added		
	% Infested Tubers**		No. of Rotted Tubers per Plot	% Infested Tubers**		No. of Rotted Tubers per Plot
	Transformed Mean†	Equiv. Mean (%)		Transformed Mean†	Equiv. Mean (%)	
1. No treatment	1·000	70·8	0·00	1·465	98·9	0·75
2. Trichlorphon 2·0%	0·944	65·6	1·75	1·436	98·2	4·0
3. Endrin 0·5%	0·353	11·9	1·0	0·606	32·5	1·25
4. Pyrethrum 0·25% pyrethrins + 2·0% piperonyl butoxide	0·416	16·4	0·75	0·598	31·7	1·75
5. Derris, 1·0% rotenone	0·387	14·2	0·00	0·466	20·2	0·5
6. DDT 2·0%	0·410	15·9	2·0	0·597	31·6	2·0
7. Maldison 1·0%	0·390	14·4	3·25	0·571	29·2	3·75
Necessary differences for significance { 5%	0·234			0·157		
1%	0·321			0·215		
	3, 4, 5, 6, 7 ≪ 1, 2			3, 4, 5, 6, 7 ≪ 1, 2		

† Data were transformed using the inverse sine transformation.

** F values in analyses of variance significant at the 1% level.

TABLE 2

TRIALS 3 AND 4, 1967: TUBERS CARRYING MOIST SOIL

Percentage infested and numbers rotted per plot

Treatment	Trial 3, Infested Tubers Not Added				Trial 4, Infested Tubers Added			
	% Infested Tubers*		No. of Rotted Tubers per Plot*		% Infested Tubers**		No. of Rotted Tubers per Plot‡	
	Transformed Mean†	Equiv. Mean (%)	Transformed Mean††	Equiv. Mean (%)	Transformed Mean†	Equiv. Mean (%)	Transformed Mean††	Equiv. Mean (%)
1. No treatment	1·217	88·0	1·63	2·1	1·487	99·3	0·93	0·4
3. Endrin 0·5%	0·368	12·9	1·87	3·0	0·408	15·7	1·27	1·1
4. Pyrethrum 2·0%	0·453	19·2	1·93	3·2	0·409	15·8	1·93	3·2
5. Derris, 1·0% rotenone	0·293	8·4	1·18	0·9	0·292	8·3	1·22	1·0
6. DDT 2·0%	0·271	7·2	1·64	2·2	0·317	9·7	0·93	0·4
7. Maldison 1·0%—" dry tubers " ..	0·313	9·5	2·63	6·4	0·383	14·0	1·72	2·4
8. Maldison 1·0%	0·429	17·3	2·78	7·2	0·414	16·2	1·55	1·9
Necessary differences for significance 5%	0·251		0·89		0·147		0·86	
Necessary differences for significance 1%	0·343		1·22		0·202		1·18	
	3, 4, 5, 6, 7, 8 ≪ 1		1, 3, 4, 5, 6 ≪ 7, 8		3, 4, 5, 6, 7, 8 ≪ 1		1, 3, 5, 6, 7, 8 < 4	

* F value in analyses of variance significant at 5% level.

** F value in analyses of variance significant at 1% level.

‡ F value in analyses of variance not significant.

† Data were transformed using the inverse sine transformation.

†† Data were transformed using the square root $(x + \frac{1}{2})$ transformation.

IV. DISCUSSION

All treatments with the exception of trichlorphon significantly reduced *P. terrella* population development in the stored tubers. There was no significant difference between the other treatments but it was shown that derris dust was the most reliable of the protectants tested, then DDT, closely followed by maldison.

Endrin was included in the list of test chemicals to investigate the protection afforded by this rather toxic insecticide, but as equivalent results were obtained with derris dust further studies based on this chemical are not warranted.

The effect of pest population pressure was shown by the levels of infestation between the comparable trials 1 and 2 using dry tubers. Similar differences were not shown between the comparable trials 3 and 4 using moist tubers.

In trials 1 and 2 using dry tubers derris was the best treatment, followed by maldison.

In trials 3 and 4 the insecticides were applied to freshly dug tubers carrying moist soil. This approximated the usual commercial practice in Queensland, where the protectant is applied to the tubers as they are collected into containers in the field. Under these conditions both derris and DDT were very effective and superior to maldison, which in one plot of trial 3 allowed infestation almost reaching 50%. This is sufficient evidence to conclude that, under commercial conditions, the protection afforded by maldison may be unreliable. A factor in the choice of a protectant is the development of rotted tubers. Some tuber breakdown may have followed *P. terrella* infestation, but the data suggest that a higher percentage loss occurred in the presence of maldison and pyrethrum than where derris or DDT was used as the protectant. This constitutes an additional reason for the choice of derris dust as the most acceptable recommendation for commercial use.

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The authors are officers of Entomology Branch, Queensland Department of Primary Industries, stationed at Toowoomba.