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Failure of methoxyethylmercuric silicate plus malathion or lindane to control common bunt of wheat

J. KUIPER

Agricultural Research Institute, Wagga Wagga, New South Wales Department of Agriculture, Australia

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Abstract

The cereal seed fungicide methoxyethylmercuric silicate failed to control common bunt of wheat when malathion or lindane was incorporated in the formulation. Evidence was obtained that the fungi oxicity of such formulations retrogresses during storage.

Introduction

tn 1965 a number of cases of alleged failure of methoxyethylmercuric silicate (MEMS) Io control common bunt of wheat (*Tilletia caries* and *T. foetida*) were brought to my attention. One of these was from the Agricultural Research Station, Tamworth, N.S.W., which also submitted surplus seed, dusted with a product containing MEMS plus malathion. This seed, which on sowing had resulted in a crop with 20% bunted heads, appeared to carry a light bunt infection as well as the mercurial dust.

Differences in fungitoxicity between organomercurials are known to exist but those marketed in the last decennia are all highly active though mostly of relatively low mammalian toxicity (Martin, 1959). Recommendations for their application are therefore made in general statements as, e.g.: bunt "...is readily controlled by organomercury seed dressings containing 0.6–2% mercury and applied at $\frac{3}{4}$–2 oz/bushel" (Martin, 1965).

Since MEMS has been used extensively for more than ten years in Australia and is also a popular constituent of cereal seed dressings elsewhere, it seemed desirable to investigate the validity of the claims. This paper reports the results of field trials carried out at the Agricultural Research Institute at Wagga Wagga.

Materials and methods

The collections and source of *Tilletia* spp. used were as follows:

T. caries, col. T, originating from contaminated, treated seed supplied by Tamworth Agricultural Research Station.

T. caries, col. S, ex Sydney University.

T. foetida, col. Q, resistant to hexachlorobenzene (Kuiper, 1965).

T. foetida, col. U, sensitive to hexachlorobenzene. Supplied by the Victorian Department of Agriculture.

Three formulations of MEMS, all containing 1.5 % Hg, were tested: (a) without insecticide, (b) with 0.5 % lindane and (c) with 1 % malathion added for grain weevil control. The first two were standard products, the latter was prepared under contract. They were marketed in Australia as Mercurial Dry Seed Dressing(R). Phenylmercuric acetate (PMA) as Ceresan(R) containing 1.5 % Hg, was used as reference treatment.

The seed for the pilot trial was inoculated with spores at 0.28 % of the weight of the seed. In the major trial the inoculum was applied at 0.45 % alone or diluted with nine parts of talc to give respectively 125,000 and 12,500 spores per kernel. The method of inoculation, seed treatment and field procedure have been described elsewhere (Kuiper, 1967).

In the unreplicated pilot trial, sown in 1966, the wheat varieties Mexico 120 and Olympic, treated with the MEMS–malathion formulation or PMA were sown at 120 seeds per plot and produced 120 and 240 ears respectively. In 1967 a three times replicated split plot design was used to compare the activity of the treatments listed in Table 2 on three spore collections. The spore collections were used as the main plots which were divided into sub-plots to compare the response to the fungicide at two levels of inoculation. The sub-plots were split for fungicide concentration. Each sub-sub-plot consisted of 200 Mexico 120 seeds which, on average, produced 130 plants.

Results and discussion

The results of the pilot trial (Table 1) show that MEMS plus malathion gave ineffective or very poor control of *T. faetida*, col. S. While this treatment had some effect on *T. caries* col. T, the degree of control was considerably less than that obtained with PMA, especially on the variety Mexico 120.

In the major trial (Table 2), bunt at low spore loads responded well to both MEMS and PMA. At high spore loads, however, MEMS was much inferior to PMA except against *T. foetida*, col. Q, where at 30 ppm Hg the results were similar. When combined with malathion, MEMS reduced the infection as compared to the untreated controls only when applied at 30 ppm Hg to low spore loads of *T. caries*, col. S, and *T. foetida*, col. Q. The MEMS–lindane combination at 30 ppm Hg gave excellent control of low contaminations but at 15 ppm Hg it was significantly less effective than both MEMS alone, and PMA. This combination failed when applied to maximum spore loads.

Incompatibility between organomercurials and organophosphorus compounds with

Table 1. Percentage of bunted heads in pilot trial

Wheat variety	*Bunt collection*	*Treatment and ppm Hg applied to the seed*				
		untreated	*MEMS + malathion*		*PMA*	
			15	*30*	*15*	*30*
Mexico 120	*T. caries*, col. T	43	23	4	0	0
Mexico 120	*T. caries*, col. S	77	51	30	9	0
Olympic	*T. caries*, col. T	16	3	4	1	0
Olympic	*T. caries*, col. S	60	20	10	0	1

Tabel 1. Percentage brandaren in oriënterende proef

Table 2. Mean percentage of bunted plants and degree (in parentheses) for the treatments shown on three bunt collections, each at two levels of inoculation

Treatment	ppm Hg on seed	T. caries, col. S: Treatment	T. caries, col. S: Chemical	T. foetida, col. Q (resistant to HCB): Treatment	T. foetida, col. Q (resistant to HCB): Chemical	T. foetida, col. U (sensitive to HCB): Treatment	T. foetida, col. U (sensitive to HCB): Chemical	Chemical over bunt collections
125,000 spores per seed								
Untreated		72.0 (58.1)	72.0 (58.1)	69.5 (56.5)	69.5 (56.5)	73.4 (59.0)	73.4 (59.0)	71.7 (57.9)
MEMS	15	23.3 (28.9)		12.5 (20.7)		26.2 (30.8)		
	30	11.8 (20.1)	17.2 (24.5)	0.2 (2.8)	4.2 (11.8)	9.0 (17.5)	16.8 (24.2)	11.9 (20.2)
MEMS +	15	84.1 (66.5)		75.6 (60.4)		83.1 (65.7)		
malathion	30	75.3 (60.2)	79.9 (63.4)	73.9 (59.3)	74.8 (59.9)	78.7 (62.5)	80.9 (64.1)	78.7 (62.5)
MEMS +	15	50.6 (45.3)		24.4 (29.6)		52.9 (46.7)		
lindane	30	38.0 (38.1)	44.2 (41.7)	14.7 (22.5)	19.1 (26.1)	21.8 (27.8)	36.7 (37.3)	32.0 (35.0)
PMA	15	6.7 (15.0)		2.8 (9.6)		12.5 (20.7)		
	30	2.8 (9.6)	4.5 (12.3)	0.4 (3.8)	1.4 (6.7)	0.4 (3.7)	4.5 (12.2)	3.2 (10.4)
12,500 spores per seed								
Untreated		21.2 (27.4)	21.2 (27.4)	22.3 (28.2)	22.3 (28.2)	18.1 (25.2)	18.1 (25.2)	20.4 (26.9)
MEMS	15	2.2 (8.6)		0.2 (2.5)		2.7 (9.5)		
	30	4.0 (11.5)	3.0 (10.0)	0.0 (0.1)	0.1 (1.3)	0.2 (2.3)	1.1 (5.9)	1.0 (5.7)
MEMS +	15	31.1 (33.9)		16.4 (23.9)		32.1 (34.5)		
malathion	30	4.9 (12.8)	15.7 (23.3)	8.8 (17.3)	12.4 (20.6)	23.0 (28.7)	27.5 (31.6)	18.1 (25.2)
MEMS +	15	9.9 (18.3)		3.8 (11.2)		9.2 (17.7)		
lindane	30	0.5 (3.9)	3.7 (11.1)	0.8 (5.1)	2.0 (8.1)	1.6 (7.4)	4.7 (12.5)	3.4 (10.6)
PMA	15	0.2 (2.3)		0.7 (4.9)		1.0 (5.6)		
	30	0.6 (4.5)	0.4 (3.4)	0.0 (0.1)	0.2 (2.5)	0.3 (2.9)	0.5 (4.2)	0.4 (3.4)

Least significant differences: P =	12,500 spores per seed: 0.05	0.01	0.001	125,000 spores per seed: 0.05	0.01	0.001
Between chemicals over bunt collections	(5.5)	(8.6)	(14.7)	(4.5)	(6.3)	(8.9)
Between chemicals within bunt collections	(8.1)	(11.3)	(16.0)	(7.8)	(10.9)	(15.4)
Between ppm Hg within chemicals	(5.0)	(6.9)	(9.5)	(4.6)	(6.6)	(9.0)
Between chemicals within ppm Hg	(5.8)	(8.0)	(11.0)	(5.5)	(7.6)	(10.5)
Between treatments within bunt collections	(10.0)	(13.8)	(19.0)	(9.5)	(13.5)	(18.5)
Between bunt collections within ppm Hg	(7.4)	(10.3)	(14.2)	(7.8)	(10.8)	(15.0)

Tabel 2. Gemiddeld percentage stuifbrandplanten en booggraden (tussen haakjes) voor de genoemde behandelingen; drie brandcollecties, elk op twee inoculatieniveaus

regard to the insecticide is known to exist (G. J. Shanahan, personal communication). The present investigations demonstrate that mixing malathion or lindane with MEMS affects fungitoxicity. That MEMS plus malathion gave some control of *T. caries*, col. S in 1966 but not in 1967 indicates that the deterioration in fungitoxicity progresses during storage.

In Tunisia, Valdeyron (1956) found that MEMS gradually loses its efficacy, apparently due to volatilization, but the effect became noticeable only after four years storage. It is conceivable that this process is accelerated in the presence of malathion or lindane. Alternatively, since malathion is inactivated as well, it could equally well be that a chemical reaction reduces the materials to biologically less effective components.

Because MEMS has been in use for many years, it seems strange that the reported inactivity has not been observed previously. However, bunt has become quite rare in Australia and the MEMS–malathion combination is not sold commercially. It could, furthermore, be that the formulations need to be stored for a period before the inactivation becomes noticeable. There are indications that the regression is less pronounced when lindane is added but, as the MEMS–malathion combination contains more insecticide, the breakdown could be more rapid in the latter product.

Nevertheless, because the age of the products used in these trials could not be ascertained, it can not be said with certainty that the fungitoxicity of MEMS is affected more by admixture with malathion than with lindane.

The MEMS in the product concerned has been replaced by PMA as a result of these investigations.

Samenvatting

Ondoeltreffende bestrijding van tarwestuifbrand met methoxyethylkwik silicaat plus malathion of lindaan

Het graanontsmettingsmiddel methoxyethylkwik silicaat was onwerkzaam tegen tarwestuifbrand wanneer de formulering ook malathion of lindaan bevatte.

Aanwijzingen werden verkregen dat de schimmeldodende werking van dergelijke formuleringen afneemt gedurende de bewaring.

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