SUPPLEMENTARY SEED TREATMENT TRIALS - 1964[1]

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Introduction

Forty-four seed treatment products were tested in 1964 against common bunt of wheat (mixed Tilletia foetida (Wallr.) Liro and T. caries (DC.) Tul.), oat smut (mixed Ustilago avenae (Pers.) Rostr. and U. kolleri Wille), covered smut of barley (U. hordei (Pers.) Lagerh,); against seed rot of rye, durum wheat and flax; and against a complex of soil-borne organisms causing root rot of durum wheat. These tests were sown at Winnipeg, Morden, and Brandon, Manitoba. Samples of all treated seed were placed in bottles and stored in the laboratory at room temperature. This seed was used for greenhouse emergence tests shortly after the treatments were made and again 3 - 4 months later. This seed was also used for a moist filter paper test to determine what fungi grew on the treated seed. The primary objective of these tests was to supplement the Co-operative Seed Treatment Trials (2) and gain a wider knowledge of the behaviour of seed treatments, especially non-mercurial treatments.

Materials and Methods

Kinds of seed used in the trials

Wheat bunt - Variety Red Bobs. Seed artificially contaminated (1:200 by weight) with mixed spores of T. foetida and T. caries.

Oat smut - Variety Vanguard. Seed naturally contaminated by loose and covered smut.

Barley smut - Variety Plush, Seed naturally contaminated by covered smut.

Flax seed-rot - Variety Marine. Seed of this sample was expected to respond well to seed treatment, but this did not occur.

The rye and durum seed treatment trials were added at the last moment, Difficulty was encountered in obtaining untreated seed stocks. The rye was a winter variety, made up of several lots of seed. The durum wheat was an old stock of surplus hybrid seed which germinated poorly, between 30 and 40 per cent.

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Pesticides

Forty-four seed treatment materials were tested and brief statements on their nature and source are listed below with designating numbers 2 to 49 inclusive. Nos, 2 - 29 are fungicides; of these, 2 - 11 are mercurials, and 12-29 are non-mercurials. Nos. 30 - 34 are insecticides. Numbers 35 - 47 are dual purpose pesticides, among which nos. 35 - 3%contain mercurial fungicides, and 39 - 47 non-mercurial fungicides. The dosages given are for wheat, For flax these dosages were usually doubled.

Treatment No.	P.C.P. No.	Description of Products
1		Check - Seed not treated
2	4677	A liquid containing 3.7 oz./Imp. gal, methylmercuric dicyandiamide (2.5 oz. mercury equivalent). Morton Chemical Company, Woodstock, Illinois,
3	2521	A powder containing 3.2% mercury as methylmercuric p-toluene sulfonanilide. E. I. du Pont de Nemours, Wilmington, Delaware.
4		A liquid containing 2.0% mercury as phenylmercuric acetate. Niagara Brand Chemicals, Burlington, Ont,
5		A liquid containing 2% methylmercuric iodide and 1% ethylmercuric phosphate, Niagara Brand Chemicals, Burlington, Ont.
6		A liquid containing 66.7%phenylmercuric acetate. Niagara Brand Chemicals, Burlington, Ont.
7		A liquid containing 5.5% mercury and 2.5% cadmium. Niagara Brand Chemicals, Burlington, Ont.
8	8780	A liquid containing methylmercuric -2, 3-dihydroxypropyl mercaptide (2.89%) and methylmercuric acetate (10.62%). Green Cross Products, Montreal, Que.
9		A liquid mercury of undisclosed composition. (JF 1553). Chipman Chemicals Ltd., Hamilton, Ont.
10		A liquid containing 1.5% mercury as methylmercuric dicyandiamide. Chipman Chemicals Ltd., Hamilton, Ont.

Treatment No.	P.C.P. No.	Description of Products
11		A liquid containing 1.5% mercury as methylmercuric dicyandiamide. Chipman Chemicals Ltd., Hamilton, Ont.
12	34	A liquid containing 37% formaldehyde. Standard Chemicals Ltd., Montreal, Que.
13	5841	A dust containing 75% thiram. E. I du Pont de Nemours, Wilmington, Delaware.
14		A dust containing 75% captan. Ortho Agricultural Chemicals, Oakville, Ont.
15		A dust containing 20% hexachlorobenzene and 20% captan. Ortho Agricultural Chemicals, Oakville, Ont.
16	4050	A dust containing 60% pentuchloronitro-benzene. Canadian Hoechst LM., Montreal, Que.
17	7398	A dust containing 70% p-dimethylamino-benzenediazo sodium sulfonate. Chemagro Corporation, Kansas City, Mo
18		A dust containing 70% trichlorodinitro-benzene. Chemagro Corporation, Kansas city, Mo.
19		A dust containing 35% p-dimethylamino-benzenediazo sodium sulfonate and 35% trichlorodinitrobenzene. Chemagro Corporation, Kansas City, Mo.
20		A dust containing 15% RD 8684 and 5% hexachlorobenzene. Green Cross Products, Montreal, Que.
21		A dust containing 15% RD 8684. Green Cross Products, Flontreal, Que.
22	4695	A dust containing 40% hexachlorobenzene. Interprovincial Co-operative Ltd., Winnipeg, Man.
23		A dust containing 2% Blasticidin S. Niagara Brand Chemicals, Burlington, Ont.
24		A dust containing 2.2% barium pentachloro-phenate. Niagara Brund Chemicals, Burlington, Ont.

Treatment No.	P.C.P. No.	Description of Products
25		A dust containing 30% N,N-dimethyl-carbamyl-N,N-dimethylthiocarbamyl disulfide. Niagara Brand Chemicals, Burlington, Ont.
26	2827	A dust containing 95% tetra chloro-p-benxoquinone. Naugatuck Chemicals, Elmira, Ont.
27		A dust containing 75% tetrachloro-nitroanisole. Smith Kline and French Laboratories, Philadelphia, Pa.
28		A non-mercurial dust containing Hercules 3944, hexachlorobenxene and captan. Green Cross Chemicals, Montreal, Que.
29		A suspension of 4 lbs. captan/U.S. gal. Chipman Chemicals, Ltd., Hamilton, Ont.
30, 31		A liquid insecticide containing 25 lb./Imp. gal. heptachlor. Leytosan (Canada) Ltd., Winnipeg, Man.
32	4761	A dust containing 75% gamma BHC (from lindane). Ortho Agricultural Chemicals, Oakville, Ont.
33	5065	A dust containing 50% gamma BHC (from lindane). Chipman Chemicals Ltd., Hamilton, Ont.
34	5278	A dust containing 50% aldrin. Chipman Chemicals Ltd., Hamilton, Ont.
35		A liquid containing 2.40% phenyk mercuric acetate and 30.86% aldrin. Niagara Brand Chemicals, Burlington, Ont.
36		A liquid containing 2.40% phenyl-mercuric acetate and 30.86% aldrin. Niagara Brand Chemicals, Burlington, Ont.
37, 38		A liquid containing 1.38 oz. methyl-mercuric-8-hydroxyquinolinate and 2.5 lb./Imp. gal. heptachlor. Metalsalts Corporation, Hawthorne, N.J.

Treatment No.	P.C.P. No.	Description of Products
39		A dust containing 12.5% diazinon and 37.5% captan. Chipman Chemicals Ltd., Hamilton, Ont.
40	6920	A dust containing 60% captan and 15% dieldrin Stauffer Chemical Co., North Portland, Oregon.
41	5030	A dust containing 17% gamma isomer BHC (from lindane) and 50% captan. Ortho Agricultural Chemicals, Oakville, Ont.
42		A dust containing 56.2% thiram and 18.7% aldrin. Morton Chemicals of Canada Ltd., Winnipeg, Man.
43	5071	A dust containing 14% heptachlor and 47% thiram. Green Cross Products, Montreal, Que.
44		A dust containing 40% aldrin and 8% hexachlorobenzene. Shell Oil Co. of Canada Ltd., Toronto, Ont.
45	7711	A dust containing hoptachlor 2.5 lb./Imp. gal. and 15 lb./Imp. gal. pentachloronitrobenzene. Green Cross Products, Montreal, Que.
46	6337	A liquid containing 40% aldrin and 16% hexachlorobenzene. Green Cross Products, Montreal, Que.
47		A dust containing captan and lindane.

Experimental Results (Tables 1 and 2)

Bunt

Untreated seed yielded 15.25 and 6.75% bunt at Brandon and Morden, respectively. All treatments, insecticides included, significantly reduced bunt infection. However, all insecticides, and the fungicides NIA9210 and NIA11100 permitted too much bunt infection to be considered as suitable fungicides. All mercurials and 7 non-mercurial fungicides gave complete protection against bunt. Many other non-mercurials gave good protection, since only trace amounts of bunt occurred following their application.

Table 1. Supplementary Seed Treatment Trials - 1964 - Fungicides

Treatment No.		Dosage (wheat)	Smutty heeds (%)			Emergence (%)			Root rot rating (%)
			Wheat	Oats	Barley	Flax	Rye	Durum	
	No. of Stations		2	3	3	3	1	3	3
1	Check untreated	-	11.00	19.75	15.30	72.8	42.0	29.3	6.5
	Mercurials								
2	Panogen 15	0.75	0.00	0.71	0.17	81.2	61.3	33.3	12.3
3	Ceresan M	0.50	0.00	0.00	0.04	72.6	57.0	35.4	11.5
4	NIA 102	2.00	0.00	0.67	0.13	76.3	60.3	33.8	10.3
5	Soilcin EC	2.00	0.00	1.58	0.13	59.3	27.5	25.8	10.4
6	MED 169	2.00	0.00	2.63	0.79	75.7	58.0	33.5	9.6
7	MRC 1186	0.50	0.00	5.21	1.50	75.8	60.8	33.9	9.4
8	Liquisan Conc.	0.75	0.00	.46	0.67	78.2	55.3	35.2	9.0
9	JF 1553	0.75	0.00	.42	0.17	75.0	56.5	35.6	10.1
10	JF 1571	0.75	0.00	0.00	0.08	79.1	56.8	36.2	11.7
11	JF 1727	0.75	0.00	0.04	0.00	75.7	61.5	38.4	10.1
	Non-mercurials								
12	Formalin	1/320	0.00	0.13	0.75	-	26.8	21.4	10.0
13	Arasan	1.00	0.13	3.23	1.93	66.8	60.8	31.4	9.7
14	Orthocide 75	1.00	0.07	5.42	1.00	69.0	56.0	32.3	9.1
15	Orthocide 20-20	2.00	0.00	6.04	1.15	69.4	55.0	30.3	9.0
16	Tritisan	.50	0.37	15.42	15.17	67.7	50.3	27.1	9.2
17	Dexon	1.00	0.00	3.42	14.46	70.1	49.5	29.4	7.9
18	Chemagro 2635	1.00	0.19	.17	0.50	61.8	40.5	27.9	9.9
19	Dexon Chemagro	1.00	0.00	.08	1.96	65.7	47.0	31.8	7.8
20	Green Cross 3822	2.00	0.00	12.13	10.50	68.2	40.8	32.1	8.0
21	Green Cross 3958	2.00	0.25	13.06	10.60	70.5	45.3	28.0	7.9
22	Coop Hexa	.50	0.13	18.92	17.15	64.7	44.3	25.7	8.8
23	NIA 9210	2.00	1.94	16.01	17.25	58.2	40.3	27.8	8.3
24	NIA 11100	2.00	1.82	15.04	14.67	62.0	40.8	28.4	8.4
25	MED 171	6.00	0.13	.68	0.63	58.2	49.0	36.3	7.2
26	Spergon	2.00	0.00	9.96	2.83	71.6	57.5	33.7	9.4
27	TCNA 75	.50	0.25	9.35	10.65	63.8	41.0	35.3	7.2
28	Green Cross 3944X	1.00	0.00	1.58	.04	74.4	50.5	31.7	8.4
29	Flowable Captan	2.00	0.44	8.25	2.01	73.1	57.3	31.7	8.8
	Least Sign. Diff.		1.02	3.55	2.55	4.4	8.5	4.9	2.7

Table 2. Supplementary Seed Treatment Trials - 1964 - Insecticides and Dual Purpose Fungicide-Insecticides

Treatment No.		Dosage (wheat)	Smutty heads (%) Wheat	Oats	Barley	Emergence (%) Flax	Rye	Durum	Root rot rating (%)
1	No. of Stations	-	2	3	3	3	1	3	3
1	Check untreated	-	11.00	19.75	15.30	72.8	42.0	29.3	6.5
	Insecticides								
30	Aaheptan	2.00	5.07	15.40	14.27	66.2	50.3	25.0	8.0
31	Aaheptan	3.00	5.07	26.61	14.92	64.2	45.3	23.3	8.5
32	Isotox	1.00	2.63	18.04	18.45	62.1	48.3	26.8	6.8
33	Abol	1.60	3.07	18.00	17.92	63.7	51.3	27.5	6.6
34	Aldrin	1.60	3.94	19.53	16.87	63.9	50.0	26.8	6.5
	Dual purpose								
	(a) with mercurial								
35	MEC 791	2.00	0.00	1.98	0.42	73.0	61.3	33.5	10.9
36	B 169	2.00	0.19	2.46	0.58	69.5	60.8	39.5	9.1
37	Metasol MMH	.75	0.44	0.71	3.09	72.4	61.3	34.5	9.2
38	Metasol MMH	2.00	0.07	0.00	0.13	69.7	57.8	43.5	10.9
	(b) non-mercurial								
39	Captan-diazinon	2.40	0.13	8.98	1.00	74.2	51.3	33.9	8.5
40	Captan-dieldrin	1.00	0.26	6.29	0.88	72.5	55.5	34.9	8.4
41	Ortho-Seed Guard	1.50	0.34	8.20	1.76	75.0	62.0	31.8	9.0
42	Panoram D31	1.50	0.00	4.41	2.38	71.9	60.8	29.5	81
43	Heptachlor-thiram	1.50	0.07	4.83	1.60	70.2	58.5	30.5	10.3
44	Shell-Aldrin HGB	2.50	0.00	19.13	19.04	61.2	45.0	25.2	7.5
45	Dual Purpose Bunt No More	1.25	0.13	19.13	16.79	62.2	46.3	24.7	7.4
46	Liquid " " "	2.00	0.00	9.29	11.40	65.5	40.8	25.8	7.3
47	Lindane-Captan	3.00	0.07	9.75	3.88	71.1	50.5	31.5	6.4
	Least Sign. Diff.		1.02	3.55	2.55	4.4	8.5	4.9	2.7

Oat Smut

Untreated oat seed yielded 22.5, 20.8 and 16.0 per cent smut at Brandon, Morden and Winnipeg, respectively, Oat smut was very difficult to control, Ceresan M, JF1571, Metasol MMH (2 oz.) complotoly controlled oat smut. Formalin, Chemagro 2635, Dexon-Chemagro 2635, and MED171 were very good, Green Cross 3944X is probably in this class as most of the smut that developed following its use occurred in only one plot at one station, indicating a possible error, Dual-purpose non-mercurials were not satisfactory and insecticides probably had no effect,

Barley smut

Untreated barley seed yielded 18.0 per cent smut at Winnipeg and Morden, and 9.9 per cent at Brandon. Barley smut was easier to control than oat smut, One product JF1727 gave complete control. Generally, mercurials gave satisfactory control, Formalin, Chemagro 2635, MED171 and Green Cross 3944X were also effective. Products containing captan were also fairly effective, Insecticides had no effect on barley smut,

Flax

Although this test failed to show the expected benefits duo to seed treatment the results indicate that mercurials tend to increase germination and insecticides to depress it.

Rye

Due to wet weather and the profuse stooling of the rye seedlings, emergence counts were only made at Winnipeg, Germination was significantly increased by all products containing mercury, captan, thiram and Spergon. Formalin and Soilcin EC reduced germination,

Durum Wheat

Generally, seed treatments has no effect on germination.

Root Rot

Durum wheat plants were pulled when they were near the "shot" blade stage and rated for root rot. Each 12-foot plot produced 60 - 70 plants; each living plant was given a root-rot rating of 0 - 5. These ratings were later converted to percentages, The ratings were taken when the disease was fairly light, and when the plots were on summerfallow, Average root-rot ratings were 6.8, 7.4 and 12.3 per cent for Brandon, Morden, and Winnipeg, respectively. Statistically, root-rot ratings for treatments are significant, as seed treatments were not expected to increase root rot. When the treatments are grouped into classes the root rot on plants grown from mercury-tested seed is nearly double that of the chock. (Table 3).

Table 3. Root rot ratings of treated durum wheat, when the treatments are grouped into types of treatment.

No. of Treatments	Pesticide Group	Mean Root Rot Rating	Range
1	Untreated	6.53	—
10	Mercurials	10.43	9.03 - 12.28
4	*Dual* Purpose - Mercurials	10.01	9.09 - 10.93
1	Formalin 1/320	10.00	—
17	Non-mercurials	8.53	7.20 - 9.68
9	Dual Purpose - Non-mercurials	8.10	6.43 - 10.31
5	Insecticides	7.28	6.54 - 7.98

Table 4 Fungi on treated durum seeds after incubation for 1 week on moist filter paper

No. of Treatments	Treat. Class	Alternaria Mean	Alternaria Range	No Spores (Alternaria?) Mean	No Spores (Alternaria?) Range	Penicillium Mean	Penicillium Range	Trichothecium Mean	Trichothecium Range	Streptomyces Mean	Streptomyces Range
1	Check	26.0	-	2;0	-	48.0	-	58.0	-	34.0	-
10	Mercurials	0.2	0 - 2	35.2	4-46	9.2	0-44	20	0-12	1.4	0-8
1	Formalin	14.0	-	20.0	-	100	-	12.0	-	68.0	-
17	Non-mercurials	6.8	0 -26	26.8	0-62	40.2	0-96	31.5	2-64	15.3	0-64
5	Insecticides	36.4	22-46	40	0-6	75.6	66-88	62.6	38-60	37.6	10-58
4	Dual Purpose-Mercury	5.5	0-16	38.5	18-54	19.5	4-50	11.5	0-42	11.0	0-42
9	Dual Purpose-No Mercury	10.2	0-28	24.4	6-62	40.7	4-80	40.2	10-88	7.8	0-20

Greenhouse Tests

Formalin reduced seed germination, especially in Red Bobs wheat and rye. There was a tendency to produce weak plants due to a light infection by damping-off fungi. This was especially true of Red Bobs where seed treated with insecticides, hexachlorobenaene, formalin, Chemagro 2635, NIA 9210, MED 11100, and TCNA were fairly susceptible; indicating a lack of control of soil-borne organisms. Soilcin EC at 2 oz. appears to have been used at too high a dosage as the number of poisoned seeds was high.

Moist Filter Paper Tests

Twenty-five seeds from each treatment and stock were placed in each of two Petri dishes, incubated at room temperature, and later examined for seed borne fungi. The species of fungi were identified and their frequency of appearance recorded. They appeared most commonly on durum wheat. The predominant genera were Alternaria, a non-sporulating fungus which appears to be Alternaria, Penicillium, Trichothecium, and Streptomyces. Other organisms occasionally found were Bipolaris sorokiniana, versicolor, A. niger, Fusarium and Chaetomium spp. (Table 4).

Summary

Fungicides containing mercury are widely recommended as seed treatments for the control of cereal smuts and seed borne pathogens. Although they are highly effective for this purpose their toxicity represents a hazard to operators and to consumers of contaminated grain. Several non-mercurial fungicides, some available now and others to be registered soon, proved as effective as mercurials in this and other tests (2). Some chemicals such as hexachlorobenzene and captan enhance the effectiveness of other non-mercurial fungicides indicating further possible improvement still to come in formulation in this group.

The fact that all treatments tended to increase root rot requires further research. This does not always occur. There appears to be an interaction of climate, seed, and soil which somotimes gives an adverse effect following seed treatment.

The occurrence of fungi on treated seeds placed on moist filter paper is a good bioassay test, especially if the seed lot contains mechanically injured seeds. Such seed, for example, becomes infected with Penicillium and this lowers the germination of seeds sown in soils of subgermination moisture content (3). Tho Penicillium counts for mercurials were usually low, but had a wide range among non-mercurials. Among the latter Orthocide 75, Orthocide 20-20, Chemagro 2635, MED 171, Spergon and 3944 all had low Penicillium counts, as did also those dual-purpose produots containing captan.

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