COOPERATIVE SEED TREATMENT TRIALS-1970[1]

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Abstract

Sixty-six seed treatment chemicals were tested for their efficacy in controlling bunt of wheat (Tilletia foetida), covered smut of oats (Ustilago kolleri), covered smut of barley (U. hordei), seedling blight of barley (Cochliobolus sativus), and seed rot of flax caused by a complex of seed- and soil-borne microorganisms. In addition, two formulations of Benlate and five of Vitavax were tested for their efficacy in controlling loose smut of barley (Ustilago nuda).

The results show that formulations of thiram, maneb, hexachlorobenzene, Polyram and Vitavax, used alone or in combination, depending on the crop and the disease, can be used as substitutes for mercurial seed dressings, and, in addition, that the systemic fungicides Benlate, Vitavax and Vitaflo control loose smut of barley, against which mercurials are ineffective.

Introduction

In 1970 sixty-six seed treatment chemicals were tested for their efficacy in controllina common bunt of wheat caused by Tilletia foetida (Wallr.) Liro, covered smut of oats caused by Ustilago kolleri (Wille), covered smut of barley caused by Cochliobolus sativus (Ito & Kurib.) Drechsl. ex. Dastur, and seed rots of flax caused by a complex of soil- and seed-borne microorganisms. In addition, seven formulations of systemic fungicides were tested for their efficacy in controlling loose smut of barley caused by Ustilago nuda (Jens.) Rostr..

Materials and methods

Clean seed of 'Red Bobs' wheat (Triticum aestivum L.), naturally smutted seed of 'Vanguard' oats (Avena sativa L.), and naturally smutted seed of 'Palliser' barley (Hordeum distichon L.) were used. One gram of dry spores of the appropriate smut fungus was added to each 200 g of wheat and oat seed, and the mixture was shaken well to distribute the spores over the seed. The barley seed was already heavily infested with smut spores and no additional spores were added. 'Galt' barley (H. hexastichon L.) naturally infected with U. nuda was used for the loose smut test and 'Herta' barley (H. distichon), 100% naturally infected with C. sativus, was used for the seedling blight test, 'Bolley' flax (Linum usitatissimum L.) was used in Series A and B seed rot tests and 'Linott' flax in the Series C test.

The experiment was divided into three sections. Series A was designed to test the efficacy of new experimental products; Series B was a comparison of registered nonmercurial products with the standard mercurial products; and Series C contained products that arrived too late for inclusion in Series A and also several systemic fungicides for the control of loose smut of barley. The source, product name, and chemical name where available, of the treatment materials are listed in Tables 1,2, and 3. Agrox NM and Panogen 15B (Series A), and Ceresan M and Panogen PX (Series B) were included as standards. In Series C the standard chemicals were replaced by late arriving chemicals. The appropriate amount of chemical was applied to 100 g of seed, or to 200 g of seed if the rate was less than 1 oz per bushel, by placing both in a glass jar and shaking until the seed was uniformly covered. Seed was removed from the jar after not more than 3 days; samples consisting of 200 seeds were then placed in paper envelopes and stored in polyethylene bags at 15C for not more than 4 weeks before seeding.

All series of tests were planted at Brandon and Morden, Manitoba. In addition the wheat bunt test (Series B only) was planted at Lethbridge, Alberta. Several chemicals that arrived too late for inclusion at Brandon were used at Morden only (Table 6). Each plot replicate consisted of 200 seeds planted in a row 12 ft long; all rows were planted 9 inches apart, and plots were arranaed in a randomized block desian. Emergence of barley infected with C. sativus and of flax was recorded 6-8 weeks after seeding. Disease ratings of emerged barley plants were made at the same time by examining 100 plants from each row and rating them on a 0-5 scale. For each treatment an overall rating was calculated as follows:

$$\text{Disease rating } \% = \frac{\text{ava of numerical ratings of individual plants} \times 100}{5}$$

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The percentage of smutted heads was usually based on counts of 200 heads per row; but when infection was very heavy, assessments were based on 100 heads. Most of the results are given as means of eight replicates, four from each planting site. The wheat bunt tests (Series A and C) are means of four replicates at Brandon.

Results and discussion

Bunt infection at Morden was negligible due to heavy rain and therefore results from these tests are not inlcuded. Smut infection of the untreated checks varied from 6.5% to 22.0% for wheat, 3.9% to 9.3% for oats, and 1.3% to 2.3% for barley. This low infection of barley was unexpected because the seed had carried a very high natural spore load. Some chemicals formulated as dusts or suspensions or liquids gave complete control of all covered smut diseases including bunt of wheat. Some of the systemic fungicides completely controlled loose smut of barley, as well. Emergence of untreated flax ranged from 30.6% to 57.7%; some seed treatments were phytotoxic (Series A, in part), some were ineffective, and others were very effective, increasing emergence up to 88.9%. Generally, seedling blight of barley was difficult to control; the best treatments increased emergence by only 8% and lowered the disease rating from 24% to 10%.

Because the low incidence of barley with covered smut made assessment difficult, the results with oat smut, which is more difficult to control, can be used as an indicator.

The results show that the systemic fungicides Benlate and Vitavax gave good control of all smut diseases, including loose smut of barley against which mercurials are ineffective. These products are dusts but Vitaflo is a suspension suitable for use in liquid-type seed treaters. Polyram Liquid controls bunt of wheat but requires further testing for use on oats and barley. Polyram, Kes-Q, and Agrox NM are registered products (dusts) that give good control of all smut diseases except the loose smuts; they also improve flax emergence, and decrease seedling blight of barley. Dual Purpose Res-Q and Mergamma NM have the same properties but in addition they are used for control of wireworms. As there are many coded products giving effective control of the fungus diseases, it appears that there are products to replace mercurials.

Table 1. Seed treatment materials used in the cooperative test (Series A)

Treatment no.	Source*	Product name	Chemical name
1		Untreated check	
2-11	Merck	"TN-702-269-"	identity not available
12-21	Green Cross	"SWF-"	identity not available
22-29	Chipman	"TF-"	identity not available
30-39	Nor-Am	"EP-"	identity not available
40-42	Niagara	BEJ 15	identity not available
43-47	Niagara	Liquid Polyram	zinc activated polyethylene thiuram disulfide (30%)
48,49	Niagara	Polyram	zinc activated polyethylene thiuram disulfide (53.5%)
50,51	Du Pont	Manzate D	maneb (80%)
52,53	Du Pont	Benlate	benomyl(methyl 1-[butylcarbamoyl]-2-benzimidazole carbamate) (50%)
52,53	Du Pont	Manzate D	maneb (80%)
54	Du Pont	Arasan 75	thiram (75%)
55,56	Du Pont	Arasan 75	thiram (75%)
55,56	Du Pont	Benlate	benomyl (50%)
57	Du Pont	Arasan 75	thiram (75%)
58	Chipman	Agrox NM	maneb (37.5%) + hexachlorobenzene (10%)
59	Nor-Am	Panogen 15B	methylmercuric dicyandiamide (3.7 oz/gal)
60		Untreated check	

* Merck & Co., Inc., Rathway, New Jersey; Green Cross Products, CIBA Co., Ltd. Montrbal, Qubbec; Chipman Chemicals Ltd., Hamilton, Ontario; Nor-Am Agricultural Products, Inc., Woodstock, Illinois; Niagara Chemicals, Burlington, Ontario; E.I. Du Pont de Nemours & Co., Inc., Wilmington, Delaware.

Table 2. Seed treatment materials used in the cooperative test (Series B)

Treatment no.	Source*	Product name	Chemical name
61		Untreated check	
62	Interprovincial	TCMTB	2-(thiocyanomethylthio)benzothiazole
63	Du Pont	Arasan 75	thiram (75%)
64	Du Pont	Arasan 42-S	thiram (42%)
65	Du Pont	Arasan 70-S	thiram (70%)
66	Du Pont	Benlate	benomyl (50%)
67	Du Pont	Benlate T	benomyl + thiram
68	Uniroyal	Vitavax 201	Vitavax(5,6-dihydro-2-methyl-1,4-oxathiin-3-carboxanilide) + zineb
69	Uniroyal	Vitaflo	Vitavax (17.3% a.i.) + thiram (15.4%)
70	Du Pont	Manzate D	maneb (80%)
71	Du Pont	Manzate 200	mancozeb(zinc coordinated maneb) (80%)
72	Niagara	Polyram	zinc activated polyethylene thiuram disulfide (53.5%)
73	Green Cross	Res-Q	hexachlorobenzene (20%) + captan (20%) + maneb (15%)
74	Chipman	Agrox NM	maneb (37.5%) + hexachlorobenzene (10%)
75	Chipman	Mergamma NM	maneb (37.5%) + lindane (18.75%)
76	Green Cross	Dual Purpose Res-Q	hexachlorobenzene (16%) + captan (16%) + maneb (12%) + lindane (30%)
77	Nor-Am	Panogen 15B	methylmercuric dicyandiamide (3.7 oz/gal)
78	Du Pont	Ceresan M	ethyl mercury p-toluene sulfonanilide (7.7%)
79	Nor-Am	Panogen PX	methylmercuric dicyandiamide (0.9%)
80	Standard	Formaldehyde	formaldehyde (37%w/w)

* Interprovincial Cooperatives Ltd., Winnipeg, Manitoba; E.I. Du Pont de Nemours & Co., Inc., Wilmington, Delaware; Uniroyal Chemical Division, Elmira, Ontario; Niagara Chemicals, Burlington, Ontario; Green Cross Products, CIBA Co., Ltd., Montréal, Québec; Chipman Chemicals Ltd., Hamilton, Ontario; Nor-Am Agricultural Products, Inc., Woodstock, Illinois; Standard Chemical Co., Winnipeg, Manitoba.

Table 3. Seed treatment materials used in the cooperative test (Series C)

Treatment no.	Source*	Product name	Chemical name
81		Untreated check	
82-86	Interprovincial	TCMTB	2-(thiocyanomethylthio)benzothiazole
87,88	Uniroyal	Vitavax #1	5,6-dihydro-2-methyl-1,4-oxathiin-3-carboxanilide
89-92	Uniroyal	Vitavax #2, #3	Vitavax + maneb
93-95	Uniroyal	Vitavax #4	Vitavax + thiram
96	Uniroyal	Vitaflo	Vitavax (17.3% a.i.) + thiram (15.4%)
97	Du Pont	Arasan 50-Red	thiram (50%)
98	Chemagro	B1843 (50%)	trans-1,2 bis(n-propylsulfonyl)ethylene
99,100	Rohm & Haas	"RHC-"	identity not available

* Interprovincial Cooperatives Ltd., Winnipeg, Manitoba; Uniroyal Chemical Division, Elmira, Ontario; E.I. Du Pont de Nemours & Co., Inc., Wilmington, Delaware; Chemagro Corporation, Kansas City, Missouri; Rohm & Haas Co. of Canada Ltd., West Hill, Ontario.

Table 4. Results of cooperative seed treatment trials (Series A)*

Treatment no.	Product name	Formulation**	Dosage (oz/bu)	Smutted heads (%) Wheat*	Oats	Barley	Barley seedling blight Emergence (%)	Disease rating (%)	Flax Dosage (oz/bu)	Emergence (%)
1	Untreated check			8.66	9.25	2.32	63.9	24.3		50.1
2	TN-702-269-1	L	1.00	0.00	0.00	0.04	63.3	14.4	2.00	44.4
3	TN-702-269-1		2.00	0.00	0.00	0.00	64.0	17.1	4.00	32.4
4	TN-702-269-2	L	1.00	0.00	0.22	0.00	61.2	18.2	2.00	50.6
5	TN-702-269-2		2.00	0.00	0.00	0.12	66.1	20.2	4.00	41.4
6	TN-702-269-3	L	1.00	0.32	0.00	0.00	62.6	22.3	2.00	47.9
7	TN-702-269-3		2.00	0.14	0.00	0.00	63.3	21.0	4.00	40.8
8	TN-702-269-4	L	1.00	0.14	0.00	0.08	61.8	17.8	2.00	44.8
9	TN-702-269-4		2.00	0.00	0.00	0.00	64.1	15.5	4.00	33.4
10	TN-702-269-5	L	1.00	0.00	0.04	0.04	67.9	14.4	2.00	49.1
11	TN-702-269-5		2.00	0.14	0.00	0.04	63.6	14.5	4.00	40.6
12	SWF 1150	D	1.00	0.00					4.00	82.4
			2.00		0.32	0.00	65.9	13.0		
13	SWF 2250	D	1.00	0.00					4.00	81.3
			2.00		0.20	0.00	68.8	18.1		
14	SWF 2330	D	1.00	0.00					4.00	80.5
			2.00		0.00	0.00	65.6	14.9		
15	SWF 2340	D	1.00	0.00					4.00	76.3
			2.00		0.00	0.00	68.3	13.2		
16	SWF 2350	D	1.00	0.00					4.00	80.5
			2.00		0.00	0.04	70.2	15.8		
17	SWF 2360	D	1.00	0.11					4.00	71.3
			2.00		0.05	0.00	65.6	25.9		
18	SWF 2370	D	1.00	0.23					4.00	74.3
			2.00		0.22	0.00	67.1	16.0		
19	SWF 2380	D	1.00	0.53					4.00	75.1
			2.00		0.68	0.03	65.6	18.8		
20	SWF 2390	D	1.00	0.11					4.00	88.4
			2.00		0.99	0.17	68.2	20.5		
21	SWF 2400	D	1.00	0.78					4.00	72.9
			2.00		0.00	0.00	70.4	17.6		
22	TF 5018	D	2.00	0.00	0.08	0.00	64.5	17.6	4.00	86.6
23	TF 3019	D	2.00	0.00	0.22	0.00	66.3	16.3	4.00	74.8
24	TF 3020	D	2.00	0.11	0.41	0.00	68.9	19.6	4.00	80.1
25	TF 3021	D	2.00	0.00	0.04	0.00	68.3	16.7	4.00	81.1
26	TF 3022	D	2.00	0.00	0.00	0.00	68.0	22.0	4.00	76.8
27	TF 3023	D	2.00	0.00	0.00	0.03	70.5	18.4	4.00	72.0
28	TF 3024	D	2.00	0.00	0.10	0.00	65.3	17.8	4.00	80.1
29	TF 3025	D	2.00	0.00	0.00	0.00	68.4	18.4	4.00	86.6
30	EP 406-B	SL	1.00	2.57	4.92	2.00	58.3	21.1	2.00	46.4
31	EP 406-B	SL	1.50	0.39	0.26	1.78	59.0	21.3	3.00	46.3
32	EP 406-B	SL	3.00	0.26	0.28	0.72	56.0	21.8	4.00	48.6
33	EP 407-B	SL	0.50	0.97	0.00	2.10	63.9	22.7	1.00	50.9
34	EP 407-B	SL	1.00	3.28	0.94	1.62	61.4	20.0	2.00	49.5
35	EP 461-A	SL	1.00	0.00	2.58	1.44	61.4	23.6	2.00	44.6
36	EP 461-A	SL	2.00	0.11	0.37	0.35	56.2	26.8	3.00	47.5
37	EP 461-A	SL	4.00	0.00	0.00	0.00	58.8	23.9	4.00	46.3
38	EP 493	SL	0.50	0.11	1.87	0.11	63.7	19.9	1.00	82.3
39	EP 493	SL	1.00	0.00	0.04	0.00	65.5	18.8	2.00	77.8
40	BEJ-15EC	L	1.00	0.00	0.04	1.15	54.7	18.9	2.00	47.5
41	BEJ-15EC	L	2.00	0.00	0.00	0.50	50.1	14.3	4.00	42.8
42	BEJ-15EC	L	3.00	0.76	0.00	0.66	45.1	20.3	6.00	38.8
43	Liquid Polyram	L	1.00	0.11	0.73	0.42	62.5	24.4	2.00	67.1
44	Liquid Polyram	L	1.50	0.00	0.00	0.00	64.2	19.1	3.00	81.0
45	Liquid Polyram	L	2.00	0.00	1.83	0.00	65.6	21.5	4.00	77.0
46	Liquid Polyram	L	2.50	0.00	0.26	0.17	64.9	17.1	5.00	72.9
47	Liquid Polyram	L	3.00	0.00	0.08	0.13	56.6	16.8	6.00	73.8
48	Polyram 53.5	D	1.00	0.00	1.24	0.05	67.1	17.9	2.00	68.3
49	Polyram 53.5	D	2.00	0.00	0.69	0.05	65.2	19.2	4.00	78.5
50	Manzate D	WP	1.00	0.00	0.00	0.00	71.4	16.9	1.50	83.0
51	Manzate D	WP	2.00	0.00	0.04	0.00	67.6	15.4	3.00	80.9
52	Benlate + Manzate D	WP WP	2.00 1.00	0.14	0.00	0.00	59.2	23.4	2.00 1.00	71.3
53	Benlate + Manzate D	WP WP	4.00 2.00	0.00	0.00	0.00	56.4	16.1	3.00 2.00	73.5

Table 4 (Cont'd.)

Treatment no.	Product name	Formulation**	Dosage (oz/bu)	Smutted heads (%) Wheat*	Oats	Barley	Barley seedling blight Emergence (%)	Disease rating. (%)	Flax Dosage (oz/bu)	Flax Emergence (%)
54	Arasan 75	WP	1.00	0.12	0.74	0.04	64.7	18.0	2.00	88.9
55	Benlate + Arasan 75	WP WP	2.00 1.00	0.00	0.00	0.00	55.4	22.4	2.00 1.00	67.5
56	Benlate + Arasan 75	WP WP	4.00 2.00	0.00	0.00	0.00	56.2	29.6	3.00 2.00	66.3
57	Arasan 75	WP	2.00	0.00	0.32	0.04	65.6	17.9	3.00	71.4
58	Agrox NM	D	1.00	0.00					4.00	78.3
			2.00		0.21	0.00	63.6	17.8		
59	Panogen 15B	L	0.75	0.00	0.00	0.00	68.8	15.4	1.50	80.4
60	Untreated check			6.48	3.88	1.32	65.6	22.0		57.7

* Results for wheat bunt are from the test at Brandon only. All other results are from tests at Brandon and Morden.

** Formulation code: L = liquid; D = dust; SL = slurry; WP = wettable powder.

Table 5. Results of cooperative seed treatment trials (Series B)*

Treatment no.	Product name	Formulation**	Dosage (oz/bu)	Smutted heads (%) Wheat	Oats	Barley	Barley seedling blight Emergence (%)	Disease rating (%)	Flax Dosage (oz/bu)	Flax Emergence (%)
61	Untreated check			18.57	9.32	2.08	64.6	24.1		36.0
62	TCMTB	L	0.90	0.00	0.00	0.00	63.7	22.3	1.80	43.5
63	Arasan 75	WP	1.33	0.06	0.46	0.22	64.3	18.8	2.00	45.6
64	Arasan 42S	SU	2.40	0.06	1.71	0.05	63.9	22.9	3.00	47.5
65	Arasan 70S	SL	1.43	0.19	1.96	0.16	64.3	16.5	2.00	50.3
66	Benlate	WP	2.00	0.00	0.00	0.00	61.2	33.2	3.00	30.4
67	Benlate T	WP	3.33	0.00	0.00	0.00	66.3	26.3	3.33	46.1
68	Vitavax 201	D	2.63	0.00	0.00	0.00	70.2	11.2	4.00	49.5
69	Vitaflo	SU	2.55	0.00	0.12	0.00	68.1	17.6	4.25	43.5
70	Manzate D	D	2.00	0.00	0.00	0.00	70.9	11.0	3.00	58.4
71	Manzate 200	D	2.00	0.06	0.10	0.08	68.3	12.5	3.00	59.9
72	Polyram	D	1.00	0.19					4.00	52.6
	Polyram		2.00		2.54	0.00	66.3	17.7		
73	Res-Q	D	1.00	0.00					4.00	44.0
	Res-Q		2.00		0.52	0.00	69.6	16.4		
74	Agrox NM	D	1.00	0.06					4.00	56.5
	Agrox NM		2.00		0.00	0.00	66.5	14.1		
75	Mergamma NM	D	2.00	0.06	0.04	0.00	65.1	18.3	4.00	51.5
76	Dual Purpose Res-Q	D	1.25	0.00					5.00	50.3
	Dual Purpose Res-Q		2.50		1.98	0.00	67.3	19.6		
77	Panogen 15B	L	0.75	0.06	0.08	0.00	67.8	13.8	1.50	57.8
78	Ceresan M	D	0.50	0.00	0.00	0.00	66.7	10.8	1.50	50.8
79	Panogen PX	D	2.00	0.13	0.00	0.12	66.9	10.2	5.50	48.5
80	Formalin 1/320	L				0.57	31.2	11.8		
81	Untreated check			21.96						

* Means of tests at two locations: Brandon and Lethbridge for wheat bunt, Brandon and Morden for all other tests.

** Formulation code: L = liquid; WP = wettable powder; SU = suspension; SL = slurry; D = dust.

Table 6. Results of cooperative seed treatment trials (Series C)*

Treatment no.	Product name	Formulation**	Dosage (oz/bu)	Smutted heads (%) Wheat*	Oats	Barley	Barley seedling blight Emergence (%)	Disease rating (%)	Flax Dosage (oz/bu)	Emergence (%)	Barley loose smut (%)
61	Untreated check			8.90	7.46	2.30	64.1	24.9		30.6	6.40
66	Benlate	WP	2.00								1.48
67	Benlate T	WP	3.33								1.12
68	Vitavax 201	D	2.63								0.25
82	2364 1	L	0.45	0.00	0.22	0.19	63.5	23.9	0.90	35.3	
83	2364 1	L	0.68	0.55	0.00	0.11	67.4	24.4	1.36	35.0	
84	2364 1	L	0.90	0.00	0.00	0.08	66.5	26.2	1.80	38.0	
85	2364 d	D	2.40	0.00	0.14	0.00	62.9	25.9	2.40	34.1	
86	2364 d	D	3.60	1.79	0.10	0.00	64.2	22.1	3.60	30.6	
87	Vitavax #1	SU	1.35	0.00	0.14	0.00	66.5	21.6	2.70	36.8	1.44
88	Vitavax #1	SU	1.80	0.61	0.00	0.00	64.1	21.3	3.60	35.3	0.25
89	Vitavax #2	SU	2.40	0.00	0.80	0.00	63.7	23.0	2.40	41.1	0.10
90	Vitavax #2	SU	3.60	0.00	0.00	0.00	63.2	17.2	3.60	41.8	0.00
91	Vitavax #2	SU	4.80	0.00	0.00	0.00	61.1	20.3	4.80	39.9	0.00
92	Vitavax #3	SU	2.55	0.00	0.00	0.00	65.1	19.4	2.55	39.3	0.04
93	Vitavax #4	SU	2.40	0.32	0.00	0.00	62.8	23.3	2.40	38.8	0.52
94	Vitavax #4	SU	3.60	0.00	0.00	0.00	62.5	18.3	3.60	43.4	0.04
95	Vitavax #4	SU	4.80	0.00	0.00	0.00	62.5	22.5	4.80	41.9	0.08
96	Vitaflo	SU	2.55	0.00	0.00	0.00	66.9	24.9	2.55	38.5	0.04
97	Arasan 50 red	D	2.00	0.00	0.40	0.00	66.6	21.5	3.00	41.6	
98	B 1843	WP	2.00		0.30	0.00	66.9†	24.2†	3.00	41.8†	
99	RHC 501	D	2.00		0.41†	0.00†	67.0†	20.3†	4.00	47.8†	
100	RHC 502	D	2.00		0.63†	0.00†	69.1†	22.6†	4.00	47.31.	
101	Untreated check				7.27†	1.581	64.6†	23.4†		29.8†	

* The results for wheat bunt are from the test at Brandon only. Results marked t are from tests at Morden only. The remaining figures are from tests at Brandon and Morden.

** Formulation code: WP = wettable powder; D = dust; SU = suspension.

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