SEED TREATMENT FUNGICIDES FOR CONTROL OF CONIFER DAMPING-OFF: LABORATORY AND GREENHOUSE TESTS, 1967-68

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Abstract

Sixty-one seed treatment chemicals were tested in laboratory germination tests and 25 in greenhouse damping-off control tests. Effective control of preemergence damping-off was attained with 13 chemicals for jack pine, 15 for lodgepole pine, and 6 for white spruce. Post emergence damping-off was controlled effectively by 8 chemicals for jack pine, 9 for lodgepole pine, and 3 for white spruce. Two experimental fungicides, THC 324 and DHC 324, were effective in controlling postemergence damping-off of all three conifer species.

Introduction

In an earlier report (1) the inhibition of mycelium growth of isolates of Pythium sp., Rhizoctonia sp., and Fusarium sp. by 69 different seed-treatment chemicals was shown. Results for seed germination and damping-off control under greenhouse conditions were also given for a few of the 69 chemicals. To supplement the earlier tests, results of seed germination tests and damping-off control studies for the more active of the 69 chemicals are reported here. The species of conifers testedwere jack pine (Pinus banksiana Lamb.), lodgepole pine (P. contorta Dougl. var. latifolia Engelm.), and white spruce (Picea glauca (Moench) Voss).

Materials and methods

General procedures for the germination tests and greenhouse damping-off control tests of the 61 chemicals (Table 1) were described in the earlier report (1). Lodgepole pine was substituted for red pine as a test species. The seeds were pelleted at the rate of 0.33 g of chemical per gram of seed. (In the earlier study [1], rates were 0. 25 g and 1.0 g in the laboratory germination tests and 0.5 g and 2.0 g in those for damping-off control). One hundred air-dried seeds of each tree species were used in each treatment.

Sixty-one chemicals, earlier found to have a high degree of activity against Rhizoctonia sp., Pythium sp., or both, were screened for phytotoxic effects in laboratory germination tests. Twenty-five of the chemicals were then used in greenhouse damping-off control tests because of their non-phytotoxicity to at least one of the test species, or because they were standard treatments now in use (captan and thiram).

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Results and discussion

Laboratory germination tests — Twenty-three of the 61 chemicals tested had no inhibitory effect on germination of any of the test species (Table 2) Captan and Arasan inhibited germination of all three species, and both chemicals inhibited germination of lodgepole pine and white spruce more than that of jackpine. Many of the other chemicals testedcaused only small reductions in germination and may be used in future studies on soil treatments for damping-off control.

Greenhouse damping-off control tests — Preemergence damping-off was significantly reduced by 13 chemicals for jack pine, 15 for lodgepole pine, and 6 for white spruce (Table 4). Postemergence damping-off losses were significantly less with 8 chemicals for jack pine, 9 for lodgepole pine, and 3 for white spruce.

Six of the 23 chemicals selected for greenhouse tests were used on jack pine despite minor phytotoxic effects. Significant reduction of preemergence damping-off was observed with four of the six treatments, (nos. 39,42,51, and 52) and significantly less postemergence damping-off was also observed with four of them (nos. 7, 14, 39, and 42).

The most effective chemicals for control of preemergence damping-off were 66-S-2 for jack pine and white spruce and TMHC 175 for lodgepole pine. Others of high activity were KHC 324, 66-S-3, DHC 324, and Arasan for jack pine; 66-S-2, THC 324, DHC 324, and Arasan for lodgepole pine; and THC 324 and Arasan for white spruce. Postemergence damping-off was best controlled with Polyram ZMC5-80W for jack pine: Arasan for lodgepole pine; and Arasan and DHC 324 for white spruce. Other fairly effective chemicals were 6638 and DHC 324 for jack pine: THC 324 and 66-S-2 for lodgepole pine; and THC 324 for white spruce. Several of the chemicals tested, 66-S-2, THC 324, DHC 324, and BHC 324, were fairly active against both pre- and postemergence damping-off.

Table 1. Source and identity of seed treatment materials

Treatment number	Source*	Product and formulation	Chemical name or active ingredient
1	Stauffer	Captan 50% WP	captan
2	Diamond Shamrock	Daconil 2787 75% WP	tetrachloroisophthalonitrile
3	Diamond Shamrock	Daconil 2787 (35%) & captan (35%)	tetrachloroisophthalonitrile + captan
4	Naugatuck	Spergon 95%	chloranil
6	Naugatuck	Vitavax 75% (D735)	5, 6-dihydro-2-methyl-1, 4-oxathiin-3-carboxanilide
7, 9	Naugatuck	Numbered compounds	identity not available
10	Niagara	Phygon 50%	dichlone
11	Niagara	Polyram 80%	zinc activated polyethylenethiuram disulfide
14	Niagara	Polyram ZMCS 80W	identity not available
15	Dupont	Arasan 75%	thiram
16	Dupont	Manzate D 80%	maneb
18	Dupont	Fermate 76%	ferbam
19	Dupoht	Demosan 65%	1,4 dichloro-2, 5-dimethoxybenzene
20	Chemagro	4497 50%	bis (1, 2, 3, -trichloroethyl) sulfoxide
21	Chemagro	Dyrene 50%	2, 4-dichloro-6-(o-chloroanalino)-s-triazine
22	Chemagro	Dexon 50%	p-dimethylaminobenzenediazo sodium sulfonate
23	Chemagro	Bay 47531	dichlofluanid
24	Cyanamid	Cyprex 65%	dodine
25	Green Cross	DuTer 20%	triphenyl tin hydroxide
27	Green Cross	RD8684 t Cyprex 20%	identity not available t dodine
28	Green Cross	3944X	identity not available
29	Green Cross	Drillbox Lindasan	lindane 37.5% & captan 5%
30-32	Green Cross	Numbered compounds	identity not available
35	Green Cross	RD8684 t maneb (50%)	identity not available t maneb
36	Green Cross	RD8684 t captan (50%)	identity not available t captan
37-43	Green Cross	Numbered compounds	identity not available
44-48) 50-55) 57-59)	Morton	Numbered compounds	identity not available
60, 61	Chipman	Numbered compounds	identity not available
63	Chipman	66-S-2	zinc coordinated maneb 50%
64-66	Chipman	Numbered compounds	identity not available
67	co-op	Hexa 40%	hexachlorobenzene
68	Dow	Dowicil 100 95%	1-(3 chloroallyl)-3, 5, 7-triaza-1-azoniaadamantane chloride
69-70	Hoechst	Numbered compounds	identity not available
71	Niagara	Polyram Seed Protectant 53.5%	zinc activated polyethylene thiuram disulfide

* Chemicals were supplied by: Stauffer Chemical Co. of Canada Ltd., Vancouver, B. C.; Diamond Shamrock Corp., Painesville, Ohio; Naugatuck Chemicals, Elmira, Ontario., Niagara Brand Chemicals, Burlington, Ont.; DuPont of Canada Ltd., Montreal, Que.; Chemagro Corp., Kansas City, Mo.; American Cyanamid, New York. N. Y.; Sherwin-Williams Co. of Canada Ltd. (Green Cross Products), Montreal, Que.; Morton Chemical Co., Woodstock, Ill.; Chipman Chemical Ltd., N. Hamilton, Ont.; Interprovincial Cooperatives Ltd., Winnipeg, Man.; Dow Chemical Co., Midland, Mich.; American Hoechst Corp., North Hollywood, California.

Table 2. Germination in seed germinator of conifer seeds pelleted with seed treatment chemicals

	Treatment and product	Germination (%)		
		Jack pine	Lodgepole pine	White spruce
1	Captan 50WP	76	52	55
2	Daconil 75WP	86*	38	43
3	Daconil + captan (35-35)	77	62	49
4	Spergon 95%	89*	46	80*
6	Vitavax 75%	17	20	2
7	6638	80	70*	59
9	D-735-10D	92*	65*	15
10	Phygon 50%	88*	3	11
11	Polyram 80%	67	39	40
14	Polyram ZMCS 80%	72	52	70*
15	Arasan 75%	78	34	50
16	Manzate D 80%	60	22	15
18	Fermate 76%	75	48	14
19	Demosan 65%	42	39	27
20	4497 50%	0	0	46
21	Dyrene 50%	19	28	2
22	Dexon 50%	1	1	0
23	Bay 47531	50	39	1
24	Cyprex 65%	2	0	3
25	DuTer 20%	4	9	0
27	RD 8684 + Cyprex	24	6	3
28	3944X	30	17	0
29	Drillbox Lindasan	85*	26	53
30	MHC 223	95*	74*	73*
31	TMHC 175 (2)	93*	77*	67*
32	TMHC 2222	89*	75*	77*
35	RD 8684 + maneb 50%	55	14	36
36	RD 8684 + captan 50%	77	53	44
37	KHC 324	89*	76*	61
38	MHC 324	83	64	54
39	PHC 324	75	67*	46
40	XHC 324	66	32	45
41	BHC 324	91*	72*	79*
42	DHC 324	82	73*	78*
43	THC 324	92*	81*	74*
44	EP 277 50%	5	10	10
45	EP 277 A liquid	2	0	3
46	EP 279 50%	0		
47	EP 279 A liquid	0		
48	EP 293 50%	0	0	0
50	EP 301B 50%	51	59	59
51	EP 301C	77	54	72*
52	EP 301D	83	69*	72*
53	EP 301E	86*	92*	69*
54	EP 302B	37	27	2

Table 2 (Con't)

Treatment and product	Germination (%)		
	Jack pine	Lodgepole pine	White spruce
55 EP 302C	60	30	43
57 EP 305	0	0	0
58 EP 306 75%	5	1	0
59 EP 308	73	39	20
60 65-S-1	91*	50	54
61 54-s-7	79	64	64
63 66-S-2	92*	78*	81*
64 66-S-3	90*	77*	82*
65 66-S-4	70	51	46
66 66-S-6	70	45	20
67 Hexa	93*	66*	68*
68 Dowicil 100 95%	1	58	34
69 2844	0	1	8
70 2874	0	0	2
71 Polyram S. P.	79	63	79*
Untreated control	89	80	83

* Statistically not different from the untreated controi at the 5% level.

Table 3. Seed-treatment chemicals not inhibiting conifer seed germination under laboratory conditions

Conifer	Number of chemicals	Treatment number
Jack pine, lodgepole pine, and white spruce	9	30, 31, 32, 41, 43, 53, 63, 64, 67
Jack pine and lodgepole pine	2	9, 37
Jack pine and white spruce	1	4
Lodgepole pine and white spruce	2	42, 52
Jack pine, alone	4	2, 10, 29, 60
Lodgepole pine, alone	2	7, 39
White spruce, alone	3	14, 51, 71
Total	23	
Jackpine, total	16	2, 4, 9, 10, 29, 30, 31, 32, 37, 41, 43, 53, 60, 63, 64, 67
Lodgepole pine, total	15	7, 9, 30, 31, 32, 37, 39, 41, 42, 43, 52, 53, 63, 64, 67
White spruce, total	15	4, 14, 30, 31, 32.41, 42, 43, 51, 52, 53, 63, 64, 67, 71

Table 4. Effect of seed treatment on preemergence and postemergence damping-off of conifer seedlings in natural soil in the greenhouse

	Treatment and product	Emergence (%)			Postemergence damping-off (%)		
		Jack pine	Lodgepole pine	White spruce	Jack pine	Lodgepole pine	White spruce
1	Captan	53	69*	40	68	58*	40
2	Daconil	54	†		96		
4	Spergon	77*		29	75		28
7	6638	60	44		17*	67	
9	D735-10D	63	59*		58	80	
10	Phygon	33			89		
14	Polyram ZMCS 80W	63		60*	11*		31
15	Arasan	78*	74*	67*	77	44*	24*
29	Drillbox Lindasan	76*			83		
30	MHC 223	58	64*	58*	49	54*	42
31	TMHC 175	64	82*		59	72	
32	TMHC 2222	67*	73*	40	57	56*	68
37	KHC 324	81*	59*		49	76	
39	PHC 324	70*	61*		35*	77	
41	BHC 324	74*	70*	46	31*	57*	38
42	DHC 324	78*	74*	55	25*	60*	24*
43	THC 324	66	75*	68*	43*	46*	25*
51	EP 301C	73*		49	52		33
52	EP 301D	68*	56	40	55	59*	40
53	EP 301E	66	67*		61	72	
60	65-S-1	72*			45*		
63	66-S-2	83*	81*	73*	36*	46*	53
64	66-S-3	80*	67*	59*	61	63	48
67	Hexa	55	64*	31	70	79	47
71	Polyram S.P.	-		55			41
	Untreated control	47	39	35	68	79	50

†Indicates that the treatment was not included in the greenhouse test because of its phytotoxicity to the conifer in the seed germination test at the treatment rate of 0.33 g of chemical/g of seed.

* Significantly different from the untreated control at the 5% level.

The general performance of these chemicals was better than Captan and in some cases better than Arasan. In these tests Arasan performed better than Captan.

Seed treatment chemicals that were effective in these tests had in earlier laboratory bioassay tests demonstrated high activity against Rhieoctonia sp. and Fusarium sp. and variable activity against Pythium sp. It is possible that combinations of the better chemicals may give even better control and this approach will be considered in future studies. The continued use of thiram and captan as standard seed treatments for conifer seedling damping-off seems to be in question. The better chemicals mentioned above will undergo further greenhouse and field testing in order to find a satisfactory replacement for captan or thiram, which are still the best chemicals available commercially.

Literature cited

1. Belcher, J., and L. W. Carlson. 1968. Seed-treatment fungicides for control of conifer damping-off: Laboratory and greenhouse tests, 1967. Can. Plant Dis. Surv. 48:47-52.