POTATO SEED TREATMENT FOR THE CONTROL OF VERTICILLIUM WILT AND FUSARIUM SEED PIECE DECAY[1]

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Abstract

Dust formulations of the systemic fungicides benomyl and thiophanate-methyl, when applied to potato (Solanum tuberosum) seed pieces at time of planting, proved highly effective in the control of seed-borne verticillium wilt (Verticillium albo-atrum) and fusarium seed piece decay (Fusarium coeruleum). Seed treatment with metiram or mancozeb dusts provided effective control of fusarium seed-piece decay, but these chemicals showed only minimal effectiveness in the control of seed-borne verticillium wilt.

Resume

Appliques en poudrage aux plantons de pomme de terre (Solanum tuberosum) au temps de la plantation, les fongicides endothérapiques bénomyl et thiophanate de méthyle se sont révélés très efficaces dans la lutte contre la flétrissure verticillienne (Verticillium albo-atrum) transmises par la semence et contre la pourriture fusarienne du planton (Fusarium coeruleum). Le poudrage de la semence ou métirame ou au mancozèbe a été efficace contre la pourriture fusarienne du planton, mais très peu contre la flétrissure verticillienne transmise par la semence.

Chemical treatment of potato (Solanum tuberosum L.) seed for the control of seed-borne diseases has not been widely supported by potato growers because of insufficient evidence that the costs involved were justified by better plant stands and increased yields. Before mercury formulations became unavailable, many growers treated their seed yearly with mercuric chloride or organic mercury and found this practice to be economic because of the rather broad spectrum of disease control. When mercury fungicides were banned, there was no comparable alternative among compounds registered for commercial use. The purpose of studies reported herein was to assess various chemicals in an effort to find a replacement compound with superior disease control characteristics.

Materials and methods

All materials used in seed treatment studies, whether fungal contaminants or chemical formulations, were applied to freshly cut seed pieces immediately prior to planting. Inocula of organisms for which fungicidal control was sought were grown on sterilized wheat media, and seed-pieces were contaminated by dipping in a water suspension of the fungal elements. Surface dispersal of inocula on the seed pieces was followed by thorough admixing with chemical dusts at the rate of 1 pound per 100 pounds of cut seed. Chemicals were tested for control of wilt caused by Verticillium albo-atrum R. and B., and fusarium decay caused either by Fusarium coeruleum (Lib.) Sacc. or Fusarium sambucinum Fckl, f.6 Wr. (Fusarium sulahureum Schl.). Susceptible potato varieties used were Irish Cobbler for verticillium wilt, Hunter for seed-piece decay by F. coeruleum, and Sebago for decay by F. sulphureum.

chemicals under test were: thiophanate-methyl (NF 44, Ciba-Geigy Canada Ltd., Etobicoke, Ontario); benomyl and benomyl + thiram (Benlate and Benlate T, E. I. DuPont de Nemours Inc., Wilmington, Delaware); metiram (Polyram, Niagara Chemicals, Burlington, Ontario); captan + mancozeb (TF 3177, Chipman Chemicals Ltd., Hamilton, Ontario); mancozeb (Dithane M-45, Rohm & Haas Co. of Canada Ltd., West Hill, Ontario). Hates of chemical dust treatments are presented in Tables 1 and 2. There were four randomized plots for each treatment and each plot was planted with 30 seed pieces. Controls received no treatment or inoculum treatment only.

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Table 1. The effect of seed treatment chemical dusts on yield and on verticillium wilt in Irish Cobbler potatoes

Treatment and rate	1971 % wilt	1972 Yield (lb/plot)	1972 % wilt	1973 Yield (lb/plot)	1973 % wilt
Thiophanate-methyl 5%	8.3	78.4*	0.8	79.8	0.0
Thiophanate-methyl 10%	4.2	77.0*	4.1	79.0	0.0*
Benomyl					
Benomyl 10% + thiram 10%				79.6*	0.0*
Metiram 7%	27.3	52.9	60.0	63.2	42.8
Captan 3% + mancozeb 5%		61.6*	45.8*	62.4*	44.4*
Mancozeb 8%				63.7	39.4
Control, no treatment	6.9*	66.8*	2.5*	73.3*	0.8*
Control, inoculated	53.7	37.4	80.7	42.4	85.7

* Indicates difference between inoculated control and treatment was significant at the 1% level for each year of testing.

Table 2. Influence of seed treatment chemical dusts on plant stand and yield in Hunter potatoes following seed-piece surface inoculation with *Fusarium coeruleum*

Treatment and rate	1971 % plant stand	1971 Yield* (lb/plot)	1972 % plant stand	1972 Yield* (lb/plot)	1973 % plant stand	1973 Yield* (lb/plot)
Thiophanate-methyl 5%	90.8	63.0	94.1	74.7	88.3	72.9
Thiophanate-methyl 10%	90.8	62.6	91.7	68.8	97.5	74.1
Benomyl 10%	85.0	62.7	93.3	66.4		
Benomyl 10% + thiram 10%					91.6	70.5
Metiram 7%	84.2	54.6	86.6	65.4	89.2	72.0
Captan 3% + mancozeb 5%			89.2	64.5	95.0	75.1
Mancozeb 8%					97.5	71.3
Control, no treatment	84.1	59.5	97.5	74.3	98.3	80.0
Control, inoculated	66.3	40.7	83.3	45.0	63.3	49.1

* Yields from chemically treated seed lots were not significantly different from one another, but in each year of testing all were significantly greater at the 1% level than the inoculated controls.

Results and discussion

Potato seed-piece treatment with dust formulations of the systemic fungicides benomyl and thiophanate-methyl provided highly effective control of seed-borne verticillium wilt in 3 years of testing (Table 1). Readings on wilt infection were based on symptoms evident at the end of August, at which time the plants were entering a period of natural senescence. Treatment with metiram, mancozeb, and a combination of captan and mancozeb gave minimal wilt control in tests conducted over periods of from 1 to 3 years. Tuber yields were not recorded in the 1971 verticillium wilt seed treatment trial because of moderate to severe chance infection by the blackleg organism, Erwinia atroseptica (van Hall) Jennison. None of the chemicals under test showed any effective action against this bacterial pathogen.

All chemicals under test were effective in reducing or preventing fusarium seed-piece decay when applied to seed lots that had first been dipped in spore suspensions of Fusarium coeruleum. Inoculated seed receiving no chemical treatment contracted moderate to severe seed-piece decay, resulting in poor stands, weak plants, and lowered yields (Table 2). Yields from chemically seed-treated plots were not significantly different from one other, but all were in excess of yields from the inoculated controls.

When the same chemicals were applied to Sebago seed that had been inoculated with Fusarium sambucinum f.6 there were no significant differences in plant stand or yield between chemically treated plots and inoculated controls, and tabulated data are, therefore, not recorded in this paper. F. sambucinum f. 6 is an important potato storage rot organism, but it became apparent in tests conducted by the author that seed-piece surface inoculation just prior to planting caused insufficient set decay to affect plant establishment and subsequent growth.

No phytotoxic action on seed-pieces or on the growing plants was observed following application of the various seed treatment chemicals. Cole et al. (3) found benomyl to be phytotoxic to seed-piece tissues, but the rates they employed were in excess of that used by the author. Mancozeb, metiram, captan, and thiram are not regarded as being phytotoxic to most plant tissues, and there is little data other than that reported in this paper on the possible phytotoxic effects of thiophanate-methyl as a potato seed treatment. Certain other chemicals tested earlier (1,2) proved fungicidal against verticillium wilt but were phytotoxic to seed-piece tissues and in such cases there appeared to be a narrow range of safety between rates causing phytotoxic effects and those providing effective fungicidal action.

Benomyl and thiophanate-methyl appear to be the most promising fungicidal replacements for the organic mercurial fungicides which in the past provided moderate protection against verticillium wilt, blackleg, and fusarium seed-piece decay (4). Chemicals under test showed no bactericidal effect on chance occurrences of blackleg, and the various formulations were not screened for control of such diseases as common scab and rhizoctonia.

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