PYTHIUM CONTROL FOR CONTAINER-GROWN LONGLEAF PINE SEEDLINGS

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Pyroxychlor and ETMT alone or with thiophanate methyl controlled damping-off and were not phytotoxic. OAC-2582 and PCNB + ETMT controlled **Pythium**, but reduced seedling growth.

Damping-off is a major problem in growing conifer seedlings in containers *(3)*. Close spacing and high fertilization in humid greenhouses promote disease spread and intensification. At the Stuart Project in central Louisiana losses have been heavy, especially on longleaf pine. *Fusarium*, *Rhizoctonia,* and *Pythium* species are the organisms that have been responsible *(2)*. Many fungicides effective against one organism fail to control others; therefore, controls often must be developed for each pathogen. In this study, 10 fungicides were tested and compared for controlling *Pythium* on longleaf pine.

Seven of these fungicides are registered for *Pythium* control on various horticultural or ornamental crops and three are experimental fungicides known to inhibit *Pythium*.

Methods

Twenty longleaf pine seeds were sown in 7-inch diameter bulb pots using Jiffy Mix soil medium. All seeds were previously soaked 1 hour in a 30 percent hydrogen peroxide solution to reduce the chance of introducing seed-borne pathogens *(1)*. The day before sowing, soil in half the pots was infested with *Pythium ultimum* Trow that had been growing for 1 week on wheat grain. Inoculum was mixed at 5 ml of dry grain per liter of soil (about 10 ml of inoculum per pot). Equal amounts of noninfested wheat grain and soil medium were mixed to fill the other pots.

Immediately after sowing, and every 2 weeks for 8 weeks, all pots were drenched with the appropriate fungicide treatment. Fungicides were tested at three concentrations in 250 ml of water (table 1). Fertilizer was applied at 150 p/m each of N, P, and K through the watering system beginning late in the third week and continuing throughout the study.

Seedlings were counted 3 and 12 weeks after sowing. Differences between the two counts were used to determine postemergence damping-off. When the final counts were made, surviving seedlings were collected and washed, and the average seedling dry weight from each pot was determined. The study was replicated 10 times using a randomized block design with location in the greenhouse determining the blocks. The data were analyzed using an analysis of variance with each fungicide dosage at each level of inoculation comprising a treatment. Significance was tested at the 0.05 level by Duncan's multiple range test.

Results

Preemergence damping-off.—For the 10 replications, the mean number of germinated seeds per pot ranged from 9.5 to 14.7. Uninfested control pots averaged 12.2 seedlings and infested controls averaged 10.8 seedlings. None of the differences in germination were significant, indicating that preemergence damping-off was not affecting seedling emergence.

Postemergence damping-off.—Seedling loss in the *Pythium*-infested control was high, averaging 86.3 percent; loss in the uninfested control was 12.1 percent (table 2). Captan, Busan 72, Bunema, chloroneb, and fenaminosulf at all levels failed to reduce loss in the infested pots. Seedling loss in 11 infested treatments was not significantly different from the uninfested control. These treatments were the medium level of OAC-2528, the medium and high levels of pyroxychlor and PCNB + ETMT, and all levels of ETMT and thiophanate methyl + ETMT.

At 40 mg, seedling loss with OAC-2582 was 38 percent in the infested soil. Increasing the concentration to 80 mg ai per pot reduced loss to 16.9 percent. At 160 mg, however, loss increased to 51.9 percent in the infested pots and was 64.8 percent in the uninfested. The increase in mortality at the high concentration was likely due to phytotoxicity as other tests with this chemical have shown it can be phytotoxic.[1]

[1]Unpublished data by author.

Table 1.—*Fungicides and treatment levels.*

Fungicides		Levels tested		
Chemical name	Common name	(mg ai/7-in. pot)		
		Low	Medium	High
N-Trichloromethylthio-4-cyclohexene-1,2-dicarboximide	Captan	20	40	80
2-(Thiocyanomethylthio)-benzothiazole	Busan 72	5	10	20
Potassium N-hydroxymethyl N-methyldithiocarbamate	Bunema	2.5	5	10
1,4-Dichloro-2, t-dimethoxybenzene	chloroneb	20	40	80
p-(Dimethylamino) benzenediazo sodium sulfonate	fenaminosulf	20	40	80
3-Hydroxy-5-methyl isoxazole	OAC-2582	40	80	160
2-Chloro-6-methoxy-4 (trichloromethyl) pyridine	pyroxychlor	5	10	20
5-Ethoxy-3-(trichloromethyl)-1,2,4, thiadiazole	STMT	20	40	80
Pentachloronitrobenzene + ETMT	PCNB +. ETMT	20	40	80
Dimethyl 4-4-o-phenylenebis (3-thioallophanate) + ETMT	thiophanate methyl + ETMT	20	40	80
Control[1]				

[1] No control used.

It may also have suppressed certain soil organisms allowing other pathogenic fungi to become established. Although Jiffy Mix is presumed to be free of pathogenic organisms, pathogens other than *Pythium* may have been present or have become established during the study. Since disease seedlings were not cultured, the presence of pathogens other than *Pythium* cannot be excluded. However, since loss was high in both infested and noninfested media, phytotoxicity was probably the major contributing factor.

With pyroxychlor and with PCNB + ETMT, loss decreased as concentration increased. At the highest concentrations tested, loss was 9.3 percent for pyroxyclor and 9.8 percent using PCNB + ETMT.

Thiophanate methyl + ETMT at all levels controlled damping-off. Best control was at 40 mg with a loss of 6.3 percent. Loss was 11.8 percent at 80 mg. As the dosage rate increased in the uninfested pots, seedling loss increased from 1.4 to 9.3 percent.

Dry weight.—Based on dry-weight measurements at 12 weeks in the uninfested pots, and compared to the uninfested control, ETMT at 80 mg, PCNB + ETMT at 40 and 80 mg, and OAC-2582 at 40, 80, and 160 mg per pot reduced seedling growth (table 3). Low levels of Busan 72 and Captan significantly improved dry weights, but the reason is not known. For corresponding fungicides and levels, with the exception of 20 mg ETMT and 160 mg OAC-2582 per pot, seedling growth in the infested media was less than growth in the uninfested media. The most meaningful weight comparisons for fungicide

Table 2.—*Seedling mortality from 3 to 12 weeks in uninfected and Pythium infested soil*

Fungicide	Uninfested soil			Infested soil		
	Fungicide levels			Fungicide levels		
	Low	Medium	High	Low	Medium	High
	percent					
Captan	3.7	4.9	6.3	91.7	93.8	91.0
Busan 72	3.7	0.7	2.8	95.4	96.2	95.7
Bunema	5.6	2.7	4.1	95.1	93.6	93.6
chloroneb	9.9	3.0	3.6	90.4	88.2	79.9
fenaminosulf	4.7	5.8	7.6	51.6	60.6	53.1
OAC-2582	2.4	5.7	64.8	38.0	16.91	51.9
pyroxychlor	3.7	6.0	5.8	41.0	23.61	9.3[1]
ETMT	6.7	17.5	24.9	10.31	17.71	25.0[1]
PCNB + ETMT	6.7	10.1	12.3	43.3	20.11	9.8[1]
thiophanate methyl + ETMT	1.4	8.3	9.3	15.3 [1]	6.3[1]	11.8[1]
		Control 12.1			Control 86.3	

[1] Seedling losses in these infested treatments were not significantly different from the uninfested control, Duncan's Multiple Range Test, 5 percent level.

Table 3.—*Average dry weight after 12 weeks in uninfested and Pythium infested soil*

Fungicide	Uninfested soil			Infested soil		
	Fungicide levels			Fungicide levels		
	Low	Medium	High	Low	Medium	High
	mg / seeding					
Captan	249	232	232	153	122	148
Busan 72	237	212	200	152	80	154
Bunema	193	215	198	141	121	121
chloroneb	215	235	223	152	137	131
fenaminosulf	222	212	194	174	178[1]	152
OAC-2582	173	133	80	149	123	91
pyroxychlor	227	223	219	189[1]	192[1]	195[1]
ETMT	192	211	178	200[1]	1841	173
PCNB + ETMT	203	183	167	157	154	149
thiophanate methyl + ETMT	215	199	211	186 [1]	1771	1791
		Control 206			Control 141	

[1] Average seedling dry weights in these infested treatments were not significantly different from the uninfested control, Duncan's Multiple Range Test, 5 percent level.

effect are between control seedlings from the uninfested medium and weights of seedlings from the infested soil. Average weights of seedlings from nine treatments were not significantly different from the weight of the uninfested control. Numerically, the largest seedlings developed at low concentrations of ETMT and thiophanate methyl + ETMT and at all concentrations of pyroxychlor.

This study identified several chemicals and dosages that adequately control *Pythium.* Additional tests could refine the data. Testing Pyroxychlor between 15 and 30 mg per pot should identify the best rate. ETMT and thiophanate methyl + ETMT were not phytotoxic, and controlled *Pythium* at ETMT concentrations of 15 to 30 mg. Additional testing of ETMT fungicides within these levels should identify the best rates.

Literature Cited

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