Pentachlorophenol and captan effects on containerized red and jack pine seedlings

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The data presented here demonstrate that fumes from pentachlorophenol-treated wood cause extensive mortality to red pine and jack pine seedlings grown under greenhouse conditions in containerized systems. They also demonstrate the phytotoxic effects of captan seed treatment on the same species grown under similar conditions.

Rearing of conifer seedlings for reforestation using containerized systems has become quite popular throughout western Canada. In many cases the containers are held in wooden trays throughout the rearing periods. To protect the wood from rotting under warm and humid greenhouse conditions, a variety of chemicals is used as wood preservatives, one of which is pentachlorophenol (PCP).

The phytotoxic effect of pentachlorophenol fumes has been reported for horticultural crops (*5*) and conifer seedlings (*3,4*), and described in terms of crop mortality. Conifers tend to differ in their reaction to PCP. Ferguson (*3*) reported high mortality for slash pines (*Pinus caribaea* Morel.), loblolly (*P. taeda* L.), and shortleaf (*P. echinata* Mill.); while longleaf pine (*P. palustris* Mill.) sustained no mortality, but did show symptoms of PCP injury. PCP has also been shown to cause mortality and yellowing of *Pinus patula* (*4*).

Captan seed treatment of conifers to control damping-off has been shown to be phytotoxic to a number of different species (*1,2*). However, its effect in conjunction with PCP fumes and in containerized seedling systems has not been described.

This article describes the development of PCP injury symptoms in red pine (*P. resinosa* **Ait.**) and jack pine (*P. banksiana* **Lamb.**) seedlings grown under greenhouse conditions, and the effects of captan seed treatment on containerized seedlings.

Materials and Methods

Strips of wood were treated on both sides with a 5 percent pentachlorophenol base preservative and were dried in a fume hood for 3 weeks. Eight plastic-covered, airtight chambers 2 ft x 2 ft x 2.5 ft (10 cubic ft in volume), were specially built to eliminate the dispersal of PCP fumes throughout the greenhouse and between experimental blocks. Treated wood was placed in four chambers and nontreated wood in the other four chambers. The treated surface area of the wood was 75.7 sq in per chamber. This figure corresponds to the volume of treated wood that would be used for trays in a greenhouse with an air volume of 7,285 cu. ft.

Jack pine and red pine were sown in Spencer-Lemaire plastic containers (2.5 cu in) filled with commercial sphagnum peat. One half of each tray (48 cavities) was seeded with captan-treated seed (1 g captan for 4 g of seed) and the other half with non-treated seed. One tray of each species was placed in each of the eight chambers 10 days after seeding. The seedlings were watered as needed to keep the peat medium from drying. Greenhouse temperatures ranged from 89° F to 55 ° F during the experiment, which lasted 9 days in the chambers.

Seedlings from chambers 1 and 2, PCP and no PCP respectively, were removed daily for visual examination and photographs. Seedlings in the other chambers (3, 5, and 7 with

PCP; and 4, 6, and 8 without PCP), were observed daily, but not sampled or counted until the end of the experiment. The entire experiment was repeated.

Results

Captan-treated seeds of both species germinated more slowly than the non-treated seed and were from 3 to 5 days behind in development. Even before placing them in the chambers there was evidence of curled hypocotyls in the captan-treated seedlings, similar to those shown in figure 1.

Symptoms of PCP injury first showed up in the nontreated seedlings 2 days after their initial exposure to the fumes (fig. 1). The tips of the cotyledonary needles became chlorotic and slightly twisted and developed more slowly than seedlings not exposed to PCP fumes. Three days after exposure the cotyledonary needles became severely twisted and the tips were necrotic. These conditions progressed until the seedling drooped over at the base of the cotyledonary needles and died (fig. 2). The sequence of events was similar for both red and jack pine, but red pine appeared slightly more resistant to the fumes.

Data on seedling mortality and curled seedlings 9 days after placement in the chamber are shown in tables 1 and 2 on page 34. These data are the combination of two separate runs of the experiment, as both runs were statistically similar. Pentachlorophenol fumes were more phytotoxic to nontreated seedlings than to captan-treated seedlings. The relation of captan in modifying the effect of PCP was not studied. However, one possible explanation could be that the captan-treated seedlings developed more slowly and at the end of the experiment were not in the critically susceptible stage of development.

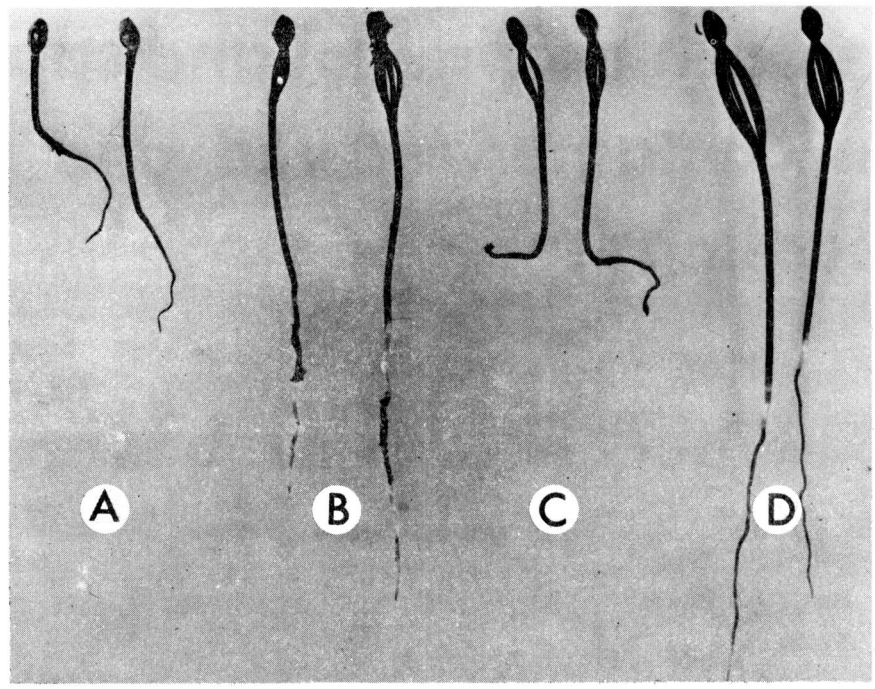

FIGURE 1.—Red pine seedlings 2 days after initial exposure in chambers: *A*. PCP-treated; *B*. PCPand captan-treated; *C*. captan-treated; *D*. nontreated.

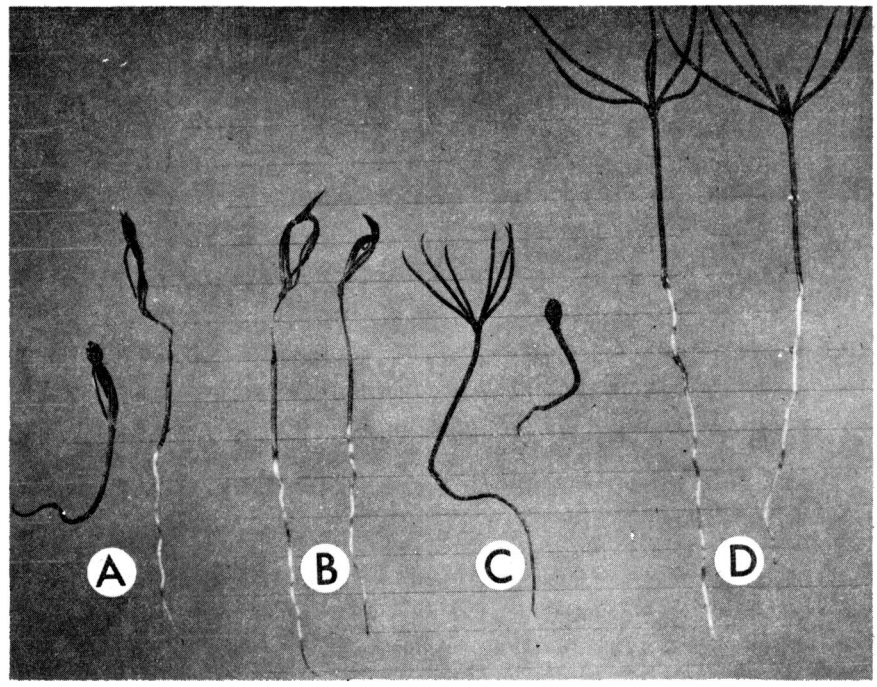

FIGURE 2.—Red pine seedlings 9 days after initial exposure in chambers: *A*. PCP-treated; *B*. PCPand captan-treated; *C*. captan-treated; *D*. nontreated.

There was no seedling mortality in treatments not exposed to PCP fumes, but captan-treated seedlings showed considerable amount of injury: 47 percent curled seedlings for jack pine and 64.3 percent for red pine, compared with 4 and 1.3 percent respectively where no treatment was used. The data also suggested that the PCP treatment combined with captan seed treatment resulted in fewer curled seedlings than captan seed treatment alone. This cannot be proven because seedlings could have been curled before mortality occurred.

It is recommended that pentachlorophenol should not be used for treating wooden trays in which containerized seedlings are grown, and that captan should not be used as a seed treatment in similar programs.

TABLE 1.—Effects of pentachlorophenol and captan on red pine

Treatment	Dead	Curled	Seedlings observed
	Percent	*Percent*	
PCP	77.8 a[1]	2.4 b	533
PCP and captan	27.6 b	51.7 a	498
Captan	0 c	64.3 a	484
No treatment	0 c	1.3 b	517

[1]The small letters indicate Duncan's multiple range groupings of treatments which do not differ significantly at the 5 percent level.

TABLE 2.—Effects of pentachlorophenol and captan on jack pine

Treatment	Dead	Curled	Seedlings observed
	Percent	*Percent*	
PCP	84.4 a[1]	1.5 b	702
PCP and captan	53.9 b	33.6 a	626
Captan	0 c	47.1 a	605
No treatment	0 c	4.0 b	688

[1]The small letters indicate Duncan's multiple range grouping of treatments which do not differ significantly at the 5 percent level.

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