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 captantreated seed (1 g captan for 4 g of seed) and the other half with nontreated 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 89^0 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 (lied (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 I 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.

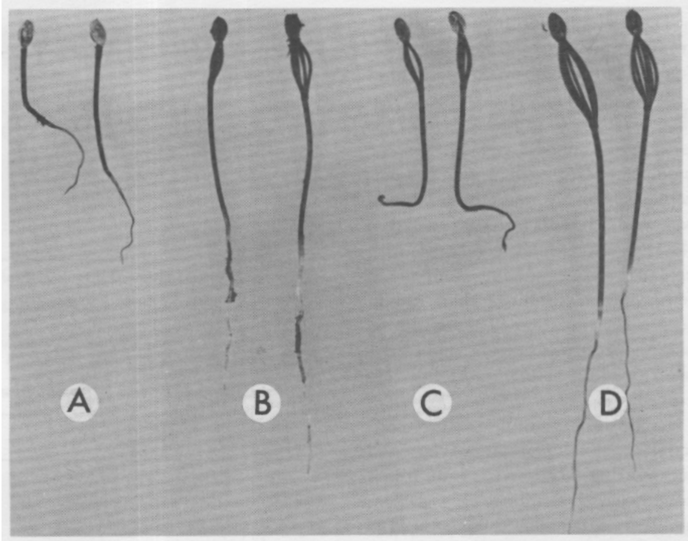

FIGURE 1.—Red pine seedlings 2 days after initial exposure in chambers: *A.* PCP-treated; *B.* PCPand captan-treated; *C.* captan-treated; *D.* nontreated.

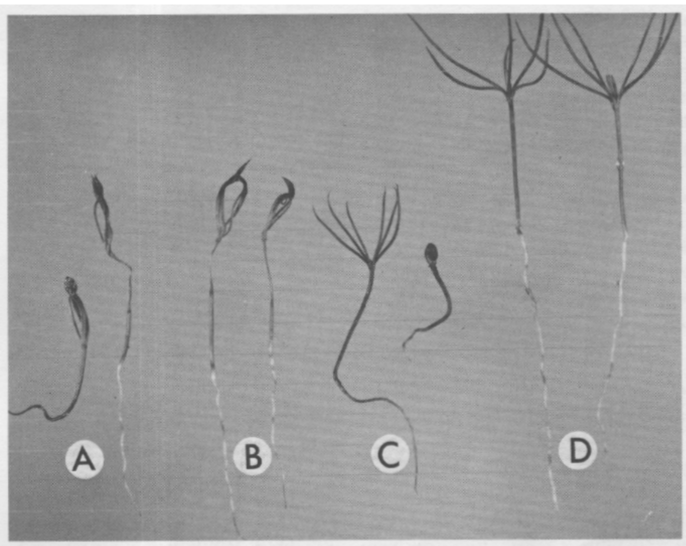

FIGURE 2.—Red pine seedlings 9 days after initial exposure in chambers: *A.* PCP-treated; *B.* PCPand captan-treated; *C.* captan-treated; *D.* nontreated.

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 and that captan should not be used as a seed treatment in similar programs.

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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.

New Publications

(Continued front p. 26)

Boldt, Charles E., and James L. Van Deusen
1974. Silviculture of Ponderosa pine in the Black Hills: the status of our knowledge. Rocky Mt. For. Range Exp. Stn., Ft. Collins, Colo. 52 p. USDA For. Ser. Res. Pap. RM124

This paper. intended as a guide for professional foresters. describes major silvicultural conditions likely to be encountered in the Black Hills. reasonable treatment options, and probable results and implications of these treatments. It also describes silvical characteristics and behavior of Black Hills ponderosa pine, and a variety of proven silvicultural tools.

Skilling. Darroll D., and Thomas H. Nicholls.
1974. Brown spot needle disease biology and control in Scotch pine plantations. North Cent. For. Exp. Stn., St. Paul, Minn. 19 p., illus. USDA For. Serv. Res. Pap. NC-109
An application section briefly describes and illustrates the symptoms. hosts, life history of the brown spot needlecast fungus (Scirrhia acicola), and recommends chemical and cultural control methods. A documentation section details the research on the biology and control of the fungus.

(Continued on p. 37)

Fifth-year survival obtained in this experiment was high, probably the result of using older stock that had been overwintered on site. Larger plantations established the following year at the same location, with younger stock that had not been overwintered, gave fifth-year survival of 53 percent for jack pine and 40 percent for black spruce (3).

Height growth

The absence of statistically significant differences in height growth between treatments for jack pine and black spruce is probably due to the large tree-to-tree variation, as shown by standard deviations, amounting to 50 percent of the mean value. However, as jack pine planted without tubes had a mean height growth 10 cm (25 percent) superior to the tube-planted category. the trend indicates a detrimental effect of the tube on height growth. As this effect appeared only after 5 years, and only for jack pine, we concluded that the negative effect of the tube on tree growth may well be more detrimental with time. It is probable that the slower growing black spruce planted in the tube will begin to show signs of reduced growth performance over the next few years. Similar trends, indicating a negative influence of rigid containers on the growth performance of some species, but not on others, has been noted by (I).

Conclusions

After five growing seasons in the field, survival of jack pine and black spruce tubelings was over 70 percent for all treatments. Removing the tube at planting had a statistically significant positive effect on fifth-year survival of jack pine. but not on black spruce. This difference may reflect the greater space needed by jack pine because of its faster juvenile growth.

The height growth of jack pine with the tube removed was 10 cm (25 percent) superior to the growth of tube

plan led seedlings. This difference was not statistically significant, due to large tree-to-tree variation (standard deviation was around 50 percent). On sandy sites such as this, one would expect wildlings of jack pine to be twice the height of black spruce after five growing seasons in the field, which was the result obtained with these container-grown seedlings.

The four planting dates did not result in any significant survival and height growth differences for either species or treatments.

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New Publications

(Continued from p .34)

Egging, Louis T.. and David F. Gibson

1974. Helicopter logging: a model for locating landings. Intermt. For. Range Exp. Stn. Ogden, Utah. 36 p. USDA For. Ser. Res. Pap. INT-155

Presented are a model and an accompanying computer program that optimally locate landing areas for a helicopter logging operation. Given a haul road, unit centroids, volumes of timber to be harvested, and helicopter operating parameters. landings are located so as to minimize yarding, hauling, and landing construction costs. The model considers constraints such as areas that are not suitable for landings. and topographical obstacles. Written in FORTRAN IV, the computer program affords several evaluation and output options. Two examples are provided.

Jones. John R.

1974. A spot seeding trial with southwestern white pine and blue spruce. Rocky Mt. For. Range Exp. Stn., Ft. Collins, Colo. 8 p. USDA For. Ser. Res. Note RM-265

Following rodent reduction, 300 seed spots each of southwestern white pine and blue spruce were sown on three mixed conifer clearcuttings. Germination was abundant. Despite favorable slope aspects, absence of heavy herbaceous competition, good cold air drainage, and initial rodent reduction, very few seedlings survived to the middle of the third summer. Major known causes of death were frost heaving. predation, and burial by soil movement. Importance of these factors differed between species. Additional seeding trials should emphasize broadcast seeding.

Nicholls, Thomas If., and Darroll D. Skilling

1974. Control of *Lophodermium* needlecast disease in nurseries and Christmas tree plantations. North Cent. For. Exp. Stn., St. Paul, Minn. 11 p., illus. USDA For. Serv. Res. Pap. NC 110

Presents fungicide and cultural control recommendations for the disease. *Lophodermium pinastri.* which has recently caused serious losses in red pine and Scotch pine nurseries and plantations in the United States and Canada. Written primarily for land managers for use in developing operational control programs.