Post planting fungicide application to reduce losses to damping-off fungi may be detrimental

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There is seed and seedling loss which occurs between seed-sowing and the time the seedling is established in the seedbeds due to a group of fungi collectively known as "damping-off" fungi. These fungi (of the genera *Pythium, Corticium, Fusarium, Rhizoctonia, Cylindrocladium)* are generally most destructive under moist conditions like those in seedbeds, and are generally found in nursery soils. "Damping-off" in general is divided into two phases; *pre-emergence* and *post-emergence.* These terms indicate infection and killing of seeds and/or seedlings before they emerge from the soil and shortly after they emerge from the soil (and generally before they become woody) .

Study Plan

Soil fumigation at the USDA Forest Service's Coeur d'Alene Nursery in North Idaho, has been somewhat effective in minimizing the "damping-off" problem in conifer seed beds, but it appears that the seed sowed to seedling-produced ratio is still too high. There are three ways of dealing with this problem: (1) Treating the seed prior to sowing (this idea has been dropped because of repeated han- (fling of tree seed that is required up to sowing time and related hazards of poisoning), (2) pretreatment of beds prior to sowing in spring (this was rejected from an operational standpoint and the fact that we are only concerned with the thin surface layer of soil which will be moved before sowing), (3) application of chemicals immediately after sowing of the. seed (this alternative was selected for the study) .

Application of chemicals after sowing has several distinct advantages: (1) Treatment is confined to the thin layer of soil the damping-off fungi are in, (2) to a degree, the seed itself is treated in its sowed position, (3) it is operationally convenient. Some disadvantages might be: (1) Injuring, weakening, or killing the seed, (2) not enough benefit to merit the expense and effort. Recent work in some Southern States indicates possible success for this method in increased survival of seedlings per square foot of seedbed.

Two chemicals which appeared to be the most promising, were selected for study dealing with the "damping-off" problem. The chemicals were:

(a) "Susan" 2 - (thiocyanom ethylthio) benzothiazole in a 60 percent active emulsi fiable concentrate. (Manu factured by Buckman Lab oratories.)

(b) "Terraclor" (Penta) chloro nitrobenzene in a 75 percent active wettable powder. (Manufactured by Olin.)

Study Plots

The test was conducted on study plots of Douglas-fir, *(Pseudotsuga rnenziesii, var. glauca)* from three different seed lots. Study plots were of equal dimensions for both chemicals applied and the same size as control plots for comparison. All plots were sown at the same rate from the different seed lots. The chemical fungicides were applied to their respective study plots at a single rate of application. Care was also taken to establish the actual counting segments of the plots in from the ends and edges of seedbeds to help insure an even application of the fungicides. Within each treatment and control plot, a count of seedlings within 1.5 lineal feet of a drill row was taken starting with #2 drill. The second count began in #3 drill where count #1 ended, and so on. When the count in #6 drill was completed, the next count returned to #5 drill, etc., until seven plot counts were made. Most seedbeds contained seven rows per bed. The same pattern was used on all fungicide-treated plots, as well as the control plots. Only the number of trees per seven plot counts were recorded, and observations on their color and/or vigor contrasts between treated and untreated plots were noted.

The "Busan" was applied immediately after planting in a solution of 3 pounds per 120 gallons of water to the acre. "Terraclor" was also applied immediately after planting in a solution of 10 pounds

[1] Study by McDonald, Supervisory Forester; executed by Isaacson, Supervisory Forestry Technician and Mrs. Fisher, Forestry Technician, at Coeur d'Alene Nursery, Coeur d'Alene National Forest, Idaho Report written by Raymond, nursery guide.

of the chemical in 100 gallons of water per acre.

The Douglas-fir seed was sown in the morning of June 9, 1971, and sprayed with the two chemical fungicides at 11 o'clock that same day. Irrigation was also applied the same afternoon for not over 30 minutes.

Germination was complete by July 12, and counts were taken for total seedlings and mortality then and periodically through the summer and fall.

Results

Figure 1 and Tables I and 2 show total seedling counts, mortality counts, and percent of mortality in the treated and untreated control plots. The control areas showed better germination and less mortality in the first two counts taken in July. The counts taken in August showed mortality in the control area was greater than in the treated areas. The same pattern also tends to show up in the counts taken in October.

Observation showed the seedlings in the "Busan" treated area were very much similar in size and color to the seedlings in the con

TABLE 1. — *Seedling Mortality[1] Count*

	Treatment			
	T	C	B	C
7 -12-71	52	38	81	55
7 -30-71	20	12	9	6
8 -20-71	12	43	16	46
10- 5-71	8	29	6	19

[1] Data variations possibly due to seedlings dying, withering off and being blown away between counts.

trol area. The "Terraclor" treated seedlings were somewhat chlorotic and smaller.

During "mortality" counts, dead seedlings were removed from the beds.

TABLE 2. — *Percentage of Mortality[1]*

	Treatment			
	T	C	B	C
7 -12-71	12.5	6.3	17.8	9.2
7 -30-71	5.5	2.2	2.3	1.2
8 -20-71	3.5	7.9	4.3	8.7
10- 5-71	2.4	5.6	1.8	3.9

[1] Data variations possibly due to seedlings dying, withering off and being blown away between counts. T represents "terrachlor," B represents "Busan," C represents "Check or control."

Conclusions

From the graphs, it can be seen that both of the fungicides seem to have an adverse effect upon the germination of stratified Douglasfir seed. In every plot, the controls (or untreated areas) exhibited higher total seedling counts than the treated plots. The mortality graph shows that the fungicides had an adverse effect on seedling survival in July, while they had a beneficial effect in reducing the amount of mortality in the late summer months. This late summer surge of seedling mortality in untreated Douglas-fir is a normal phenomenon at this nursery and generally appears to be associated with a group of "root rots" rather than "damping-off" fungi which seem to cause serious mortality earlier in the first year of growth.

In view of the costs involved in purchase and application of fungicides, and their apparent adverse effects upon stratified seed germination, their field use has not been implemented.

The beneficial effect of fungicides exhibited as a late summer suppression of mortality does not offset initial procurement and applications costs and seed losses most likely associated with these chemicals. It is possible that they would be much more useful at this nursery if we were sowing unstratified seed or for application on older seedlings. Such seed might not imbibe the chemicals along with water through the seed coat quite so readily, but this is only conjecture and the benefits of seed stratification in earlier and more uniform germination appear to be more important now than possible benefits from the fungicides.

Figure 1.—Total seedlings.