EFFECTS OF FUNGICIDES AND PARTIAL SHADING ON FOLIAGE DISEASES OF ARIZONA CYPRESS SEEDLINGS IN NURSERY BEDS

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In Alabama, benomyl and captafol were applied as foliar sprays to control *Phomopsis* blight and *Curvularia* tip-blight of Arizona cypress seedlings in nursery beds. Benomyl applied to shaded plots was the most effective treatment.

Foliage diseases have been a continuing problem in the production of Arizona cypress (*Cupressus arizonica* Greene) seedlings in nurseries in the southeastern United States. *Phomopsis* blight, caused by *Phomopsis juniperovora* Hahn, has been considered the most serious foliage disease of Arizona cypress seedlings in southeastern nurseries (*4*) and of eastern redcedar seedlings *Juniperus virginiana L*.) throughout the United States (*6*). In Alabama, a tip blight caused by *Curvularia intermedia* Boedijin also resulted in extensive damage to both tree species in nurseries (*1, 2*). In Georgia, *Sclerotium bataticola* (Taubenhaus and a species of Alternaria were associated with dying terminals and laterals of Arizona cypress seedlings (*3*).

Little information concerning control of foliage diseases of Arizona cypress and eastern redcedar seedlings is available. Until mercuric compounds were banned for agricultural use, phenylmercuritriethanol ammonium lactate (Puratized Agricultural Spray) was widely used to control *Phomopsis* blight on these hosts (*5, 6, 7*). More recently, the incidence and severity of Phomopsis blight on Arizona cypress seedlings in Mississippi were reduced by treatment with benomyl; copper hydroxide and captafol were not effective (7). No published information is available concerning control of *Curvularia* tip-blight of Arizona cypress seedlings.

Earlier research at the Auburn University Agricultural Experiment Station (W.D. Kelley, unpublished data) indicated that (1) foliage diseases of Arizona cypress seedlings may be extremely damaging one year and be sparse or absent the following year; (2) most damage to seedlings occurred during the hottest part of the summer (July and August); and (3) many necrotic lesions apparently of physiological origin were present on the seedlings each year.

This article reports results of a 2-year study to evaluate two fungicides for control of foliage diseases of Arizona cypress seedlings in shaded (63 percent) and nonshaded nursery beds.

Materials And Methods

Tests were conducted on first-year Arizona cypress seedlings growing in the Stauffer State Nursery (Alabama Forestry Commission) in Lee County, Ala. Plots were established in beds containing 8 rows of seedlings spaced about 13.5 cm apart. Beds were sown with seed in April of each year.

Plots were established in two adjacent beds in randomized complete blocks with three replications for each test; plot size was 1.2 m by 4.6 m (4 ft. by 15 ft.). Each block contained six treatments that were randomly assigned to plots; the six treatments were comprised of single rates of two test fungicides and an untreated control, each of which was duplicated under shaded (63 percent) (Saran Shade Fabric, Chicopee Manufacturing Co., Cornelia, Ga.) and nonshaded conditions. The shade fabric was placed over individual plots on wooden rails constructed 60 cm above the soil level. Shading was included in the study to evaluate its effect in reducing disease incidence and/or physiological damage to the seedlings.

The test fungicides were methyl 1-(butylcarbamoy 1)-2-benzimidazole-carbamate (benomyl, Benlate 50 WP) applied at a rate of 0.09 kg active/100 gal of water and *cis* N-[1,1,2,2,-tetrachloroethyl) thio]-4-cylohexene-1,2-dicarbox-imide (captafol, Difolatan 4 F) applied at a rate of 0.57 kg active/100 gal of water. Seedlings were sprayed to run-off on a 14-day spray schedule beginning June 1 and ending August 31 of each year; fungicides were applied with a hand-operated pressure sprayer. No adjuvant was included in the fungicide mixtures.

Data were taken once each year within a week following the final spray date. Two subplots (30.5 cm^2) were selected randomly within each plot and all seedlings therein were measured for heights and evaluated for disease and form. Individual seedlings were rated subjectively for disease on a scale of 1 through 5. Ratings were: 1 = 0-20 percent diseased or dead tips; 2 = 21-40 percent; 3 = 41-60 percent; 4 = 61-80 percent; and 5 = 81-100 percent. Ratings for seedling form also were subjective and ranged from 1 through 4. Ratings were 1 = excellent form; 2 = good; 3 = fair; and 4 = poor. Seedlings height was measured in centimeters.

All data were subjected to analysis of variance; means within years were compared for significant differences by Duncan's Multiple Range Test ($p < .05$); and means between years were compared for least significant difference ($LSD_{0.05}$).

Results And Discussion

Disease index values were high for all plots each year (table 1). In the first year of the study, both fungicides resulted in lower disease index values in shaded and non-shaded plots; however, the only fungicide resulting in a disease index value significantly lower than the control was benomyl in shaded plots and captafol in nonshaded plots. During the second year neither fungicide was effective in either shaded or nonshaded plots. When data from the 2 years were combined, only benomyl in shaded plots resulted in a significant reduction in disease index value. By comparing the overall mean for shaded plots with that for nonshaded plots it is apparent that disease incidence and/or severity was less under shade.

The fungicides had little effect on seedling form (data not shown); the only significant difference was between captafol and the control for the first year in nonshaded plots. However, seedling form in shaded plots was significantly better than in nonshaded plots for each year and for the 2 years combined.

Table 1.— *Disease index values of Arizona cypress seedlings treated with the indicated fungicides and grown under shaded or nonshaded conditions*

Treatment and rate of active ingredients per 100 gal of water[1]	Disease Index[2] Shaded[3] First year	Shaded Second year	Shaded Years comb.	Nonshaded First year	Nonshaded Second year	Nonshaded Years comb.	Grand mean
Control	2.17 a[4]	2.27 a	2.22 a	2.27 a	2.66 a	2.46 a	2.34 a
Difolatan 4-F, 0.57 kg	1.83 ab	2.27 a	2.05 a	1.50 b	2.77 a	2.13 a	2.09 a
Benlate 50W, 0.09 kg	1.67 b	1.87 a	1.77 b	1.93 ab	3.00 a	2.46 a	2.12 a
First Year Mean	1.89 A			1.90 A			
Second Year Mean		2.14 A			2.81 B		
Overall Mean			2.01 A			2.35 B	

[1]Seedlings were sprayed to run-off on a 14-day schedule.
[2]Disease index on a scale of 1 to 5: 1 = 0-20 percent of growing tips diseased; 2 = 21-40 percent; 3 = 41-60 percent; 4 = 61-80 percent; and 5 = 81-100 percent (dead).
[3]Shaded plots were covered with Saran Shade Fabric erected 60 cm above the ground and providing 63 percent shade.
[4]Numbers within a column that are followed by the same lowercase letter are not significantly different from one another (Duncan's Multiple Range Test, p=0.05); numbers within a row that are followed by the same upper-case letter are not significantly different from one another ($LSD_{0.05}$)

Seedlings in shaded plots grew taller than those in nonshaded plots (data not shown); few differences were observed among treatments within either shaded or nonshaded plots.

In collecting data for calculating disease index values, no attempt was made to differentiate damage due to *C. intermedia, P. juniperovora*, or other causes. However, close examination of some necrotic lesions during the second year revealed what appeared to be insect damage. Subsequent investigations showed the damage was caused by the lesser corn-stalk borer. This un controlled variable complicated interpretation of disease data and probably contributed to the high disease index values recorded. Control of the lesser corn-stalk borer will be necessary before critical evaluations of fungicides for disease control can be accomplished.

Shading was included in the study to determine if lower soil and/or foliage temperatures and reduced radiation would affect disease incidence and severity. Mid-day soil temperature in shaded plots averaged 9° C below that recorded in nonshaded at a depth of 5 cm. The fact that disease index values of shaded plots were lower than those of nonshaded plots indicates that shading had a positive effect. The reason for this effect is not known, but results of this study indicate that shading should be considered as a variable in future studies.

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