Fungicides for Control of Sirococcus Tip Blight of Pine at a Northern California Nursery

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Fungicides that could be used as an alternative to chlorothalonil for control of sirococcus tip blight of Jeffrey pine (Pinus jeffreyi *Grev. & Balf.) were evaluated in field trials. Three triazole fungicides (propiconazole, penconazole, and triadimefon) applied at 8-week intervals were as effective as chlorothalonil applied at 4-week intervals.* Tree Planters' Notes 40(2):30-32; 1988

Historically, the fungicide chlorothalonil has been used to control sirococcus tip blight of Jeffrey *(Pinus jeffreyi* Grev. & Balf.) and ponderosa (*P. ponderosa* Laws.) pines, caused by *Sirococcus strobilinus* Preuss, at the Humboldt Nursery (USDA Forest Service) in coastal northern California. In 1981, the nursery terminated the use of the fungicide because chlorothalonil was detected in a tributary stream adjacent to the nursery property. The stream receives overflow from sumps containing drainage and runoff water from production beds during periods of peak rainfall. In 1982, losses in pines due to *S. strobolinus* infection increased dramatically.

Subsequently, a study was initiated to determine the efficacy of fungicides other than chlorothalonil for the control of sirococcus tip blight of Jeffrey and pondersa pines. If any are efficacious, their registration will be pursued with the U.S. Environmental Protection Agency.

Methods

Trial 1 (initial field screening). Fungicide evaluation tests were conducted on a 4-foot-wide by 200-foot-long bed of 1 + 0 Jeffrey pine at the Humboldt Nursery. Five fungicides were evaluated at the recommended label dosages (table 1). The fungicides were mixed with water at the dosages shown and applied to appropriate plots at the rate of 1 gallon per 200 square feet. Fungicides were selected because of past effectiveness against the disease (1) or recently demonstrated systemic activity in controlling other similar diseases.

The experimental design used was alternate treated and untreated plots (4 by 5 feet) with the test fungicides assigned randomly to every other plot, giving a system of paired plots (treated and untreated) in which the treatments were randomly placed. This system was replicated four times down the bed of Jeffrey pine (40 plots total).

Treatment began in September 1982 and continued at approximately 1-month intervals until June 1983. Cankered pine seedlings were counted and removed from each plot monthly. At the termination of the experiment, all remaining seedlings were counted to obtain a total count per plot, and percentage of cankered seedlings was determined. Percentages underwent arc sine transformation for data analysis, and statistical differences between paired plots were determined by a t-test.

Trial 2 (frequency of application). The two most efficacious alternatives to chlorothalonil found in the initial screening—propiconazol and triadimefon—were further tested in 1983-84 to determine the most effective frequency of application. The trial was initiated in November 1983. A randomized complete block design for the following five treatments was used in a 1 + 0 bed of Jeffrey pine.

1. no fungicide.
2. 75% chlorothalonil (2 pounds of Bravo W-75 per 100 gallons) at 4-week intervals.
3. 50% triadimefon (8 ounces of Bayleton 50 WP per 100 gallons) at 4-week intervals.
4. 50% tridimefon (8 ounces of Bayleton 50 WP per 100 gallons) at 8-week intervals.
5. 130 ml of propiconazole (Tilt 3.6 EC) per 100 gallons at 4-week intervals.
6. 130 ml of propiconazole (Tilt 3.6 EC) per 100 gallons at 8-week intervals.

Dr. A. H. McCain, Extension Plant Pathologist, University of California at Berkleley, provided technical advice during initial stages of this study.

Table 1—*Fungicides and application rates evaluated at the Humboldt Nursery, trial 1 (1982–83)*

Common name	Trade name	Rate/100 gal water
chlorothalonil	Bravo W–75	2.0 lb
triadimefon	Bayleton 50 WP	8.0 oz
iprodione	Chipco 26019	1.5 lb
vinclozolin	Ornalin	1.5 lb
etaconazole	Vangard 10W	20 oz

Table 2—*Percentage of Jeffrey pine seedlings infected by* Sirococcus strobilinus *at the Humboldt Nursery, trial 1 (1982–83)*

	Percent seedlings infected	
Fungicide	Treated Plots	Untreated Plots
chloro-thalonil	2	47
etaconazole	3	46
triadimefon	5	57
vinclozolin	66	60
iprodione	76	54

Table 3—*Percentage of Jeffrey pine seedlings infected by* Sirococcus strobilinus *at the Humboldt Nursery, trial 2 (1983–84)*

Treatment	Percentage of seedlings infected
propiconazole (Tilt 3.6 EC)	
4-week intervals	2.2 a
8-week intervals	4.4 ab
triadimefon (Bayleton 50 WP)	
4-week intervals	6.3 ab
8-week intervals	9.5 b
chlorothalonil (Bravo W–75)	
4-week intervals	7.9 ab
control	25.1 c

Means followed by the same letter do not differ significantly (P = 0.05) according to Duncan's multiple range test.

Propiconazole, a fungicide of similar chemical structure as etaconazole, was used instead of etaconazole because it was further along in the registration process for the State of California. The experiment was replicated four times. Each replicate covered 18 linear feet of bed (six 3- by 4-foot plots), with the six treatments randomized in each replicate. Efficacy of treatments was evaluated by counting and removing dead or cankered seedlings in July 1984. Remaining seedlings were counted to obtain a total count per plot, and percentage of seedlings infected by *S. strobilinus* in each treatment was determined.

Trial 3 (comparison of triazole fungicides). This trial was begun December 1984. A randomized complete block design for the following three treatments was used in a bed of 1 + 0 Jeffrey pine.

1. no fungicide.
2. 8 ounces of triadimefon (Bayleton 50 WP) per 100 gallons per acre at 8-week intervals.
3. 130 ml of propiconazole (Tilt 3.6 EC) at 8-week intervals.
4. 20 ounces of penconazole (CGA-71817 10W) per 100 gallons at 8-week intervals.

The experiment was replicated five times. Each replicate covered 20 linear feet of bed (five 4-by 5-foot plots), with the four treatments randomized in each replicate. Efficacy of treatments was evaluated by counting and removing dead or cankered seedlings in July 1985. By that time, the experimental bed had been treated three times (February, April, and June). Remaining seedlings were counted to obtain a total count per plot, and percentage of seedlings infected by *S. strobilinus* in each treatment was determined.

Results and Discussion

Although scattered infections appeared in both treated and untreated plots (trial 1) throughout the winter months of 198283, most cankering occurred in April and May, when warmer spring storms arrived. By June 1983 the disease had spread throughout the experimental bed, and differences in infection levels among treatments were obvious. Chlorothalonil, as expected, was most efficacious (table 2). An average of 2% of the seedlings were cankered in plots treated with chlorothalonil, compared to 47% in the adjacent untreated plots.

Etaconazole and triadimefon also effectively controlled the disease. Plots treated with etaconazole and triadimefon had 3 and 5% of the seedlings infected, compared to 46 and 57% infection in adjacent plots. Plots treated with vinclozolin and iprodione had more infected seedlings than adjacent untreated plots; iprodione appeared to increase disease levels.

When chlorothalonil, propiconazole, and triadimefon were compared in trial 2 (1984-85), all five fungicide treatments tested resulted in less than 10% infection and gave significantly better control of sirococcus tip blight than no fungicide treatment (table 3). Although propiconazole at 4- or 8-week intervals and triadimefon at 4- or 8-week intervals were effective, they did not give significantly better protection against the disease than the currently used practice of chlorothalonil at 4-week intervals. However, either of the two fungicides applied at 8-week intervals were as effective as chlorothalonil applied at 4-week intervals. Propiconazole at 4-week intervals gave significantly better control than triadimefon at 8-week intervals.

When a third triazole fungicide, penconazole, was compared directly with prepiconazole and triadimefon in trial 3 (1984-85), all three fungicide treatments were similar in efficacy, resulting in less than 9% infection, and gave significantly better control of sirococcus tip blight than no fungicide treatment (table 4). The penconazole treatment was as effective as the propiconazole treatment.

Table 4—*Percentage of Jeffrey pine seedlings infected by* Sirococcus strobilinus *at the Humboldt Nursery, trial 3 (1984–85)*

Treatment	Percentage of seedlings infected
propiconazole (Tilt 3.6 EC)	
8-week intervals	4.8 a
penconazole (CGA–71818 10W)	
8-week intervals	6.3 a
triadimefon (Bayleton 50 WP)	
8-week intervals	8.4 a
control	21.8 b

Means followed by the same letter are not significantly different (P – 0.05) according to Duncan's multiple range test.

These results suggest that Humboldt Nursery could replace the current treatment of chlorothalonil at 4-week intervals with a treatment of triadimefon, propiconazole, or penconazole at 8-week intervals and obtain the same level of control over sirococcus tip blight. The three triazole fungicides have several advantages over chlorothalonil. They are systemic, ergosterol biosynthesis inhibitors, readily taken up by plants, and would less likely to be washed off by the frequent rains that occur at Humboldt Nursery during the period most favorable to infection. Because they can be applied at half the frequency of chlorothalonil, the amount of pesticides introduced into the nursery environment would be reduced. Propiconazole and penconazole are not yet registered in California as a Section 3 Registration. However, Special Local Need Registration for triadimefon (Bayleton 50 WP) is available. The current label for Bayleton 25 WP lists use for control of *S. strobilinus.*

Alternating fungicides for the control of a specific disease to reduce the risk of resistant fungus strains developing is a standard nursery practice. Humboldt Nursery could alternate triadimefon with the currently used chlorothalonil treatment. For example, if fungicide application for control began in January, triadimefon could be used during this rainy period. Treatment in March (8 weeks later) with chlorothalonil, followed by treatment in April with triadimefon would protect the seedlings over a 6-month period with three fungicide treatments, instead of the six needed if chlorothalonil alone was used.

Literature Cited

1. Smith, R.S., Jr.; McCain, A.H.; Srago, M.; Krohn, R.F.; Perry, D. 1972. Control of Sirococcus tip blight of Jeffrey pine seedlings. Plant Disease Reporter 56:241-242.