CYPRESS CANKER CONTROL WITH FUNGICIDES

by Arthur H. McCain

Abstract. Cypress canker caused by *Seiridium cardinale* was controlled by benomyl and chlorothalonil but not by tribasic copper sulfate.

Cypress canker has been present in California since 1927 where it has caused considerable damage to planted Monterey cypress, *Cupressus macrocarpa* (6). The popularity of this California native range and usually canker disease appears, but some uninformed people still plant it out of its native rane and usually canker disease appears, detracting from the beauty of the tree or weakening the tree to the extent that it dies. The disease can be equally severe on × *Cupressocyparis leylandii* (unpublished observation). The fungal pathogen, originally named *Coryneum cardinale,* is now known as *Seiridium cardinale* (5).

Wagener and Dimock (8) recommended spraying bordeaux mixture shortly after the start of the rainy season and an additional spray during the winter or early spring. They also suggested painting a thin bordeaux on wounds. Govi et al (1) evaluated nine fungicides for control of the disease on *C. sempervirens.* Benomyl and dichlofluanid were the most effective and other products including bordeaux and copper oxychloride gave good results. Parrini et al (4) found that benomyl, thiophanate-methyl, oxycarboxin, thiram, dichlofluanid and captan reduced infection; benomyl and thiophanate-methyl were the most effective fungicides evaluated. None of the fungicides evaluated by Govi and Tunioli (2) had any curative activity; benomyl and dodine provided the best protective control. In 1980 Marchetti and D'Aulerio (3) reported that copper oxychloride and benomyl proved to be the most effective fungicides, while carbendazim and fenarimol gave poorer results. With the exception of the Wagener and Dimock (8) research, the fungicide trials have been on *C. sempervirens.* The purpose of the research reported here was to determine the most effective fungicides for use in managing the disease on *C. macrocarpa* and *C. leylandii.*

Materials and Methods

Conidia were produced on propyleneoxide-sterilized needles of *Sequoia sempervirens* imbedded in 1.5% water agar in petri dishes. Conidia were washed from the plates and adjusted to give 1×10^5/ml. Fungicides were incorporated into melted potato-dextrose-agar (PDA). One ml of conidial suspension was applied to the surface of the hardened agar in 9 cm plastic petri dishes. Germination counts were made 24 hr following inoculation. Circular discs 4 mm in diameter cut from 10-day-old PDA plates were placed in the center of 9 cm plastic petri dishes containing solidified PDA in which the fungicides were incorporated. The diameter of growth was measured 10 days later. Incubation of all plates was in a fluorescent lighted laboratory where the temperature varied from 21-22 C.

Cypress trees were grown in a sand-peat potting mixture in 20 × 22 cm plastic containers. Greenhouse-grown plants were fertilized daily with the irrigation water and the plants grown out-of-doors were fertilized using 14-14-14 slow release fertilizer. Plants were 70 to 90 cm high when sprayed and inoculated. Trees were wounded in the main stem by making ten incisions 1.0 to 1.5 cm long in the stem extending into the xylem. After wounding, 5 plants for each treatment were sprayed to run off with the fungicides. Chlorothalonil was applied at 1.35 g/liter, benomyl at 0.3 g/liter and tribasic copper sulfate (53% Cu) at 6.0 g/liter. The control trees were sprayed with water.

In the first trial conducted in February 1981 with *C. leylandii,* wounds were inoculated by spraying a conidial suspension 24 hours after fungicide application. The trees were out-of-doors and were covered with polyethylene bags for 48 hours following inoculation. Disease evaluations were made in May, 90 days following inoculation.

The second trial was initiated in September

1982 in the greenhouse where the temperatures ranged from 20 to 26 C. *C. macrocarpa* trees were wounded as before and the same three fungicides were sprayed following wounding. The sprays dried in one hour and the wounds were then inoculated as before. The plants were covered with polyethylene bags for 48 hours. Disease evaluations were made 77 days after inoculation.

Results

Chlorothalonil prevented spore germination at all levels tested and retarded mycelium growth (Table 1). Benomyl allowed germination of conidia but the germ tubes were short and distorted and the spore germination process did not proceed further. No radial growth of mycelium occurred on benomyl-amended PDA (Table 2). Tribasic copper sulfate had no effect on spore germination and radial growth of mycelium was not appreciably affected except at 1000 g/liter.

Benomyl and chlorothalonil provided a high degree of control of cypress canker (Table 3). Tribasic copper sulfate was no better than the control in the greenhouse test and the amount of cankering was greater than the control in the out-of-doors trial with *C. leylandii* (Table 3).

Table 1. Germination of *S. cardinale* on fungicide amended PDA.

	Percent germination				
	*g/liter**				
Fungicide	*1000*	*500*	*100*	*10*	*0*
Tribasic copper sulfate	96	100	100	100	—
Benomyl	—	80	100	100	—
Chlorothalonil	0	0	0	0	—
Control (unamended)	—	—	—	—	100

* Average from 2 plates after 24 hours.

Table 2. Growth of *S. cardinale* on fungicide amended PDA.

	*Radial Growth (mm)**				
	g/liter				
Fungicide	*1000*	*100*	*10*	*1*	*0*
Control (unamended)	—	—	—	—	51
Tribasic copper sulfate**	15	43	47	53	—
Chlorothalonil	8	12	13	18	—
Benomyl	0	0	0	0	0

* Average of 8 plates after 10 days incubation
** Based on 53% Cu; 1000 g/liter Cu, etc.

Table 3. Control of cypress canker with fungicides.

	*Average number of infections per plant**	
Treatment	*C. leylandii*	*C. macrocarpa*
benomyl	0.75	0.4
chlorothalonil	0.25	2.0
tribasic	9.5	4.2
control	6.3	4.6
LSD 0.05	3.0	1.3
LSD 0.01	4.2	1.8

*Average of 5 plants; 10 wounds/plant.

Discussion

Wagener and Dimock (8) did not present data to support their recommendation for spraying bordeaux mixture, although they stated that the recommendations were based on a series of laboratory and field tests extending over a period of 2 years. Marchetti and D'Aulerio (3) also recommended a copper fungicide (copper oxychloride) as a treatment to prevent canker of *C. sempervirens*.

In this trial, tribasic copper sulfate failed to prevent spore germination and growth on PDA, and failed to prevent infection. It seems obvious that the fungus used in this trial is not sensitive to cupric ions. It would be of interest to learn if the fungus used by the Italian researchers (2,3,4) was sensitive to cupric ions.

Since benomyl was effective in all of the trials in which it was used, it would seem to be the best fungicide to use in a control program.

Literature Cited

1. Govi, G. and F. Tagliani and F. Tunioli. 1975. *Ricerche biologiche e prove di lotta sul Coryneum cardinale Wag.* Informatore Fitopatologica 25(4): 11-17.
2. Govi, G. and F. Tunioli. 1977. *Interventi chimichi contro il Coryneum cardinale.* Informatore Fitopatologico 27(1): 11-13.

3. Marchetti, L. and A.Z. D'Aulerio. 1982. *Indacazioni di lotta chimica contro l'agente del cancro del cipresso (Coryneum cardinale) Wag.* Informatore Fitopatologico 32(3): 55-58.
4. Parrini, D., M. Intini and A. Panconesi. 1976. *Prove di lotta in vivaio contro il Corineo del cypresso.* Informatore Fitopatologico 26(4): 5-9.
5. Sutton, B.C. and I.A.S. Gibson. 1972. Seiridium cardinale. CMI Description of Pathogenic Fungi and Bacteria No. 326.
6. Wagener, Willis W. 1928. *Coryneum canker of cypress.* Science 67: 584.
7. Wagener, Willis W. 1939. *The canker of cupressus induced by Coryneum cardinale n. sp.* J. of Ag. Res. 58: 1-46.
8. Wagener, Willis W. and A.W. Dimock. 1943. *Prolonging the life of Monterey cypress windbreaks.* California Citrograph 29(2): 31, 43.

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EFFECT OF ROOT PRUNING AT TIME OF PLANTING ON SUBSEQUENT ROOT DEVELOPMENT OF TWO SPECIES OF EUCALYPTUS

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Abstract. *Eucalyptus mannifera* subsp. *maculosa* (brittle gum) and *E. polyanthemos* (red box) were subjected to four root treatments immediately prior to transplanting from 0.5 liter and 4 liter poly bags, respectively. When plants were dug after 2½ years it was observed that the combination of vertical slicing and removal of the bottom 25 mm of the root ball significantly increased the number of vertical roots and largely eliminated root curling with both species. Despite the severity of this treatment it had no significant effect on shoot growth of *E. mannifera* subsp. *maculosa* and only inhibited shoot growth of *E. polyanthemos* during the first 6 months.

The development of an extensive, balanced root system is critical for the successful establishment and growth of woody plants transplanted into the landscape. Flemer (2) has observed that root curling can result in relatively large trees blowing over despite good early growth. Examination of the root system of such plants has shown poor root growth into the surrounding soil. Even where curling roots extend normally into the surrounding soil, they have been implicated in plant decline through the formation of girdling roots which reduce stem conductivity and radial communication between tissues (3).

It has been suggested that in nursery production the development of root curl is associated with the use of rigid containers and the problem can largely be eliminated by the use of flexible plastic polybags (1,4). Despite the fact that flexi-