FUNGICIDAL SEED TREATMENT AND FOLIAR SPRAY IN RELATION TO *Rhizoctonia solani* INFECTION IN COFFEE

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ABSTRACT

***In vitro* seed treatment with carboxin, carbendazim, benomyl, quintozene, triadimefon and thiophanate-methyl enhanced the percent germination of *Coffea arabica* and *C. canephora*. The percentage of seed germination and the relative growth of hypocotyl were closely related to the concentration of the fungicide used. There were no phytotoxic symptoms in the seedlings obtained from the treated seeds except those treated with triadimefon. Either seed treatment or foliar spray of the fungicides generally reduced *Rhizoctonia solani* infection *in vitro*. Of the fungicides used, carboxin either as seed dressing or foliar spray gave the most promising results followed by thiophanate-methyl and carbendazim.**

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KEY WORDS: Fungicide. Differential application. Phytotoxicity. Coffee. Percent infection. Collar rot. *Rhizoctonia solani.*

INTRODUCTION

Collar rot caused by *Rhizoctonia solani* Kuhn is taking a heavy toll in the seedbeds of coffee nurseries (Gomez and Baeza, 1978). Both *Coffea arabica* (arabica) and *C. canephora* (robusta), the commercially important species of coffee, are susceptible to this pathogen.

Several researchers have attempted using different fungicides to control collar rot of coffee (Anon 1961, 1965; Venkataramaiah, 1964; Filani, 1975; Venkatasubbaiah and Muthappa, 1981). So far there has been no report yet about the phytotoxic level of seed treatment and foliar spray of different fungicides on coffee. This study was therefore conducted to determine the desirable concentration of fungicide which will not impede seed germination, and the residual effect of fungicidal seed treatment and foliar spray *in vitro*.

MATERIALS AND METHODS

The fungicides used in the experiments were carboxin (5,6-dihydro-2methyl-1,4-oxathiin-3-carboxanilide), carbendazim (2-methoxy-carbamoyl benzimidazole), benomyl (methyl-butyl-carbomyl-2-benzimidazole carbamate), quintozene (pentachloronitrobenzene), triadimefon (1-(4-chlorophenoxy)-3,3-dimethyl-1 (1,2,4- triazol-1-yl)-2-butanone), and thiophanate-methyl (1,2-bis(3-methoxy-carbonyl-2-thioureide) benzene). They were prepared in various concentrations, i.e., 1000, 2000, 3000, 4000 and 5000 ppm using sterile distilled water.

Dry seeds of *C. arabica* and *C. canephora* were then treated with these solutions for 12 hr. Untreated seeds were used as control. Excess solution was drained off and then seeds were allowed to germinate in petri plates lined with moist filter paper. Two ml of sterile distilled water was added daily to each petri plate. Each treatment was replicated twice and 200 seeds were tested per replicate. Seed germination counts and measurements of hypocotyl length were taken after 25 days. The hypocotyl length values in various treatments are averages of 12 readings each.

Seed Treatment. — *C. arabica* seeds susceptible to *R. solani* (Venkatasubbaiah et al., 1983) were treated *in vitro* using the dry coating method (Venkatasubbaiah and Muthappa, 1981) with 0.1% and 0.2% of carboxin, carbendazim, benomyl, quintozene and thiophanate-methyl. Untreated seeds served as control. Twenty-five and 35 days after both treated and untreated seeds were sown on wet blotters, fungicidal effectivity was tested by placing the *R. solani* grown on potato dextrose agar (PDA) near the collar region of the seedlings. Percent infection in 50 seedlings per treatment was recorded.

Foliar Spray. — Twenty-five day old *C. arabica* seedlings, about 1.0 to 1.5 cm long and grown on moist blotters, were treated by spraying 0.2% solutions of carboxin, carbendazim, benomyl, quintozene and thiophanate-methyl. The treated seedlings were transferred to petri plates lined with moist blotters. The protection conferred by the fungicides to the seedlings was determined at 10-20 days after treatment by placing *R. solani* inoculum disc near the collar region of the seedlings. The inoculum disc was taken from the margin of the four-day-old colony of the fungus grown on PDA. Inoculated but untreated seedlings served as control. The percent infection in 50 seedlings per treatment was determined.

RESULTS AND DISCUSSION

The rate of growth as expressed in hypocotyl elongation was better in the treated seeds except those treated with triadimefon than in the untreated control (Table 1). Moreover, the relative growth of hypocotyl was closely related to the concentration of the fungicides

Table 1. Effect of fungicidal seed treatment on germination and hypocotyl length of *Coffea arabica* and *C. canephora*.

Fungicide	Concentration (ppm)	*Coffea arabica*		*C. canephora*	
		% germination[1]	Hypocotyl length (cm)[2]	% germination[1]	Hypocotyl length (cm)[2]
Carboxin	1000	95	1.55	79	1.55
	2000	92	1.50	80	1.65
	3000	90	1.60	80	1.70
	4000	89	1.60	82	1.60
	5000	92	1.65	84	1.85
Carbendazim	1000	96	1.45	79	1.25
	2000	96	1.60	80	1.35
	3000	92	1.65	80	1.30
	4000	94	1.70	82	1.45
	5000	95	1.80	90	1.45
Benomyl	1000	90	1.60	80	1.00
	2000	89	1.75	82	1.00
	3000	87	1.70	80	1.15
	4000	85	1.40	85	1.20
	5000	88	1.85	84	1.20
Quintozene	1000	90	1.30	81	1.15
	2000	92	1.40	81	1.25
	3000	90	1.70	80	1.30
	4000	95	1.70	79	1.45
	5000	95	1.75	80	1.50
Triadimefon	1000	93	1.20	71	0.85
	2000	89	0.70	70	0.75
	3000	93	0.70	69	0.65
	4000	90	0.75	68	0.50
	5000	90	0.80	64	0.45
Thiophanate-methyl	1000	90	1.50	79	1.25
	2000	92	1.65	78	1.45
	3000	94	1.70	78	1.50
	4000	94	1.80	79	1.60
	5000	95	1.95	80	1.60
No fungicide (control)	0	91	0.80	78	0.75

[1] Average of 400 seeds.

[2] Average of 25 seedlings.

used, i.e., the higher the concentration, the faster the growth of the hypocotyl. However, triadimefon at different concentrations were observed to be phytotoxic to the seeds. This corroborates the findings of Venkatasubbaiah and Muthappa (1981) that phytotoxic symptoms occurred in the nursery seedbed when seeds were treated with triadimefon.

No phytotoxic symptoms were generally observed in the germinated seeds treated with different concentrations of the fungicides. However, triadimefon caused abnormal dwarfing and stunted growth of the hypocotyl at 20 days after germination. None of the carboxin-treated seeds and seedlings showed symptoms of the disease. Quintozene-treated seeds (at 0.1%) exhibited 10% infection after 35 days. There was no marked difference in seed germination among the treatments. However, percent germination was higher in the treated *C. arabica* seeds than in *C. canephora*. Treated seeds generally showed less percent infection (0.6-10%) than the untreated control where 81% and 76% infection was noticed after 25 and 35 days, respectively (Table 2). Moreover, the seedlings pretreated with different fungicides were relatively more robust than the control.

Foliar spray with the different fungicides was also very effective in controlling the disease (Table 3). A maximum of 9% and 10% infection

Table 2. Effect of fungicidal seed dressing on *Rhizoctonia solani* infection *in vitro*.

Fungicide	Concentration (%)	Percent Infection [1]	
		25 days after sowing	35 days after sowing
Carboxin	0.1	0	0
	0.2	0	0
Carbendazim	0.1	4.33 ± 0.58	9.00 ± 2.00
	0.2	0.67 ± 0.58	6.00 ± 1.00
Benomyl	0.1	6.33 ± 3.06	9.00 ± 2.00
	0.2	3.33 ± 0.58	7.00 ± 1.00
Quintozene	0.1	6.33 ± 2.08	10.00 ± 2.64
	0.2	0.67 ± 1.15	2.33 ± 0.58
Thiophanate-methyl	0.1	1.67 ± 0.58	4.67 ± 1.53
	0.2	—	1.67 ± 0.58
No fungicide (control)	—	81.00 ± 2.64	76.33 ± 2.08

[1] Mean ± standard deviation.

Table 3. Effect of fungicidal foliar spray on *Rhizoctonia solani* infection *in vitro*.

Fungicide[1]	Percent Infection[2]	
	10 days after treatment	20 days after treatment
Carboxin	0	0
Carbendazim	0	6.00 ± 1.00
Benomyl	3.33 ± 1.15	9.00 ± 2.64
Quintozene	6.00 ± 1.73	10.33 ± 2.08
Thiophanate-methyl	3.33 ± 1.53	7.67 ± 1.53
No fungicide (control)	85.33 ± 1.53	80.00 ± 2.00

[1] 0.2% solution of all fungicides was used.

[2] Mean ± standard deviation.

was observed 20 days after spraying with benomyl and quintozene, respectively. Control seedlings showed 85 and 80% infection 10 and 20 days after spraying, respectively.

The above results indicate that seed treatment and foliar spray can confer resistance to coffee against *R. solani* infection up to 50-60 days. Both coffee seeds and seedlings are susceptible to the disease up to 50-60 days (Venkatasubbaiah et al., 1983). However, seed treatment followed by foliar spray may be the best method to control collar rot in coffee seedlings. Of the fungicides tested, carboxin both as seed dressing and foliar spray gave the most promising results followed by thiophanate-methyl and carbendazim.

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