EFFECT OF CULTURAL PRACTICES IN THE CONTROL OF COLLAR ROT INFECTION IN COFFEE SEEDLINGS

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ABSTRACT

Incorporation of sand in the soil influenced the disease severity of collar rot in coffee while lime significantly reduced the occurrence of the disease. Rice-straw mulching was found to increase the growth and degree of infection of *R. solani* while exposing the seedbeds without mulching was found unsuitable for seed germination. The percent seed germination increased and disease severity was considerably reduced when seedbeds were covered with polythene sheets. Irrigation of seedbeds at different intervals did not significantly affect seed germination and mortality of coffee seedlings due to collar rot. However, plants which received water once in 24 hr were slightly vigorous than those which received water once in 48 hr.

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KEY WORDS: Soil composition. Mulching. Irrigation. Behavioral influence. Collar rot. *Rhizoctonia solani.* Coffee.

INTRODUCTION

Various cultural practices have been reported to influence collar rot infection in coffee caused by *Rhizoctonia solani.* Addition of decomposable organic amendments and inorganic salts to the soil has been known to control collar rot infection (Blair, 1943; Sanford, 1947; Kendrick and Zentmyer, 1957; Das and Western, 1959; Davey and Papavizas, 1959; Manning and Crossan, 1969; Tu et al., 1975; Kannayiyan and Prasad, 1981). The practice of mulching the seedbeds after sowing may provide a food base to build up the inoculum level of the pathogen already present in the mulching material or soil.

While coffee seeds require high moisture and temperature for germination (Visweshwara and Suryakantharaju, 1972), this condition is also ideal for growth of *R. solani* in the seedbeds. Valdez and Acedo (1963) reported that moisture level in coffee nursery beds has direct influence on collar rot incidence. The common practice of watering the seedbeds twice daily for 10 days and once a day thereafter predis-

poses the seedlings to *R. solani* infection (Visweshwara and Suryakantharaju, 1972).

The present study tried to determine the influence of common cultural practices of soil preparation and use of mulching material on *R. solani* infection. An attempt was also made to assess the effect of irrigation at different intervals on seed germination and collar rot incidence.

MATERIALS AND METHODS

Effect of Soil Composition.— Two sets of soils of different compositions (Table 1) were prepared. Each set was treated differently, i.e., soils were either naturally inoculated with *R. solani* present in the soil or artificially inoculated. Artificial inoculation was done by mixing 25-day old culture of *R. solani* grown on Rawa meal sand medium with the soil (Sasi and Wilson, 1979). The experiment was replicated thrice on 1 m x 1 m seedbeds. Seed sowing and plant care were done following the method described by Venkatasubbaiah and Muthappa (1981). Per cent germination and collar rot incidence were recorded at 60-100 days after sowing.

Effect of Mulching. — After sowing, seedbeds were mulched with different materials like rice straw, fallen leaf litter and polythene sheet. The control bed had no mulch. Seeds were either exposed to the natural inoculum present in the soil or to artificial inoculation. The experiments were replicated thrice on separate 1 m x 1 m seedbeds. Seed sowing and plant care were similar to those adopted in the previous experiment. Watering was done daily in beds mulched with rice straw, fallen leaf litter and in the control beds while those covered with polythene sheets received water once in 3 days. Seed germination and collar rot incidence were recorded at 50-100 days after sowing.

Effect of Frequency of Irrigation.— Seedbed preparation and all other agronomic practices were the same as in the previous experiments, except that forest leaf litter was

Table 1. Combination of the soil media used in the seedbeds.

Soil medium	Per cent Composition
Forest soil	100
Forest soil + Compost	57 + 43
Forest soil + Compost + Sand	44 + 34 + 22
Forest soil + Compost + Sand + Lime	40 + 30 + 20 + 10
Forest soil + Compost + Lime	50 + 37.5 + 12.5

Table 2. Seed germination and collar rot incidence in coffee on seedbeds with different soil compositions.

Soil medium	Under naturally inoculated condition		Under artificially -infested condition	
	Mean % seed germination	Mean % collar rot incidence	Mean % seed germination	Mean % collar rot incidence
Forest soil	77.7	15.3	41.0	52.3
Forest soil + Compost	86.7	9.3	64.7	41.0
Forest soil + Compost + Sand	73.7	20.7	43.7	49.7
Forest soil + Compost + Sand + Lime	76.0	8.7	55.0	31.0
Forest soil + Compost + Lime	81.0	6.7	62.0	21.0
SE_m (10 df)	± 1.82	± 1.26	± 2.64	± 1.60
CD (5%)	4.8	3.96	8.32	5.06

used as mulch. Seedbeds were exposed to *R. solani* either through natural or artificial inoculation. Each treatment was replicated thrice on 1 x 1 m seedbeds. Frequency of irrigation was varied, i.e., once in 24 hr or once in 48 hr. Per cent germination and collar rot incidence were recorded at 60-100 days after sowing.

RESULTS AND DISCUSSION

Seeds started germinating after 40 days in all the treatments. In the presence of natural inoculum, a considerable increase in germination percentage and a decline in the degree of collar rot infection occurred when forest soil was mixed with compost (Table 2). The addition of sand decreased the germination percentage and increased disease incidence. However, the disease incidence significantly decreased as lime was added. The combination of forest soil and compost gave healthier seedlings than the other treatments. Nevertheless, seedlings were normal in all the treatments.

Disease incidence in *R. solani*-amended seedbeds was higher in all the treatments compared to those exposed to natural inoculum. The incorporation of lime also decreased the occurrence of the disease. Per cent germination was highest in seedbeds prepared from forest soil incorporated with compost and lime. Reduction in seed germination and an increase in disease incidence was likewise observed when sand was incorporated along with other soil components. The increased collar rot incidence in the presence

of sand may indicate that sand makes the soil loose and enables *R. solani* to easily colonize and infect the seedlings.

It is evident that under natural conditions where the inoculum density was less, the disease incidence was also less: Consequently, there was an increase in the percentage of seed germination.

Decrease in the disease incidence with the addition of lime may indicate that lime alters the mycoflora in the rhizosphere and rhizoplane. Succession in the activities of bacteria, fungi and actinomycetes in degrading organic matter in the soil has been observed by Alexander (1971). Also, there might be a stimulation of microbial growth when compost was added to the soil. This would indicate that the addition of organic amendments, either directly or indirectly through microbial antagonism, reduces the activity of the pathogen in the soil. Thus, the addition of different soil compositions may disturb the microbiological balance of the soil and can be disadvantageous to the pathogen by encouraging the development of antagonistic species.

It is evident from Table 3 that mulching greatly affects seed germination and collar rot incidence. Under natural inoculation, the highest per cent germination was observed in seedbeds covered with polythene and lowest in unmulched beds. In rice straw and leaf litter-covered beds, per cent germination was 73 and 80%, respectively. Disease incidence was highest in rice straw-mulched beds and lowest in the polythene-covered beds.

Germination was considerably reduced in artificially-inoculated beds irrespective of the mulching material used. The highest per cent germination was still observed in polythene-covered beds and lowest in unmulched beds. Disease incidence was high in all the treatments but highest with rice straw-mulched

Table 3. Seed germination and collar rot incidence in coffee as influenced by different mulching materials.

Mulching Treatment	Under naturally inoculated condition		Under artificially infested condition	
	Mean % seed germination	Mean % collar rot incidence	Mean % seed germination	Mean % collar rot incidence
Rice straw	73.0	13.0	50.7	45.0
Fallen leaf litter	80.0	11.3	56.7	35.0
Polythene sheet	93.7	3.7	70.0	24.3
Control (without mulch)	31.7	4.7	29.7	11.7
SE_m (8 df)	± 2.39	± 1.75	± 2.67	± 1.65
C.D. (5%)	7.8	5.7	8.7	5.38

beds and lowest in the open beds. Moderate disease incidence was observed in the case of polythene-covered beds and those covered with fallen leaves.

Of the 4 mulching materials used, polythene sheet was the best. The temperature of polythene-covered beds is higher and conservation of moisture is also better. Aside from creating the required micro-climate for seed germination and suppressing the collar rot incidence (Vishweshwara and Suryakantharaju, 1972), polythene covering does not carry any residential microflora unlike other mulches. Also, it is readily available and helps in saving labor costs and water requirements.

Higher post-emergence disease incidence was observed in rice straw-mulched beds which may indicate that *R. solani* colonization in the rice straw increases disease severity. *R. solani* was consistently found in the rice straw samples used for mulching and the isolates were found to be pathogenic. The rice straw could have increased the inoculation level in addition to the inoculum already present in the soil. On the other hand, dead leaves supported good germination under natural conditions but not in artificially-infested soil.

The exposed control beds showed poor germination which may be due to lack of suitable moisture and temperature. Consequently, the disease incidence was also less in the exposed beds. This indicates that *R. solani* requires sufficient moisture and temperature for colonization and infection.

Frequency of watering either daily or once in 48 hr did not significantly alter the germination percentage and collar rot incidence (Table 4). However, seedlings which received water once in 24 hr showed better growth than the plants which received water once in 48 hr. Vishweshwara and Suryakantharaju (1972) stated that watering rice straw-mulched beds twice a day for 8 to 10 days followed by once-a-day watering resulted in good germination.

Under natural condition, per cent germination was more than 80% in both irrigation treatments

Table 4. Seed germination and collar rot incidence in coffee as influenced by different irrigation intervals.

Irrigation intervals (hr)	Under naturally inoculated condition		Under artificially-infested condition	
	% germination*	% collar rot incidence*	% germination*	% collar rot incidence*
24	83.67 ± 2.08	9.67 ± 2.08	56.00 ± 6.24	36.00 ± 1.99
48	81.33 ± 1.02	9.00 ± 1.99	57.33 ± 3.05	30.33 ± 1.52

*Mean ± standard deviation.

and consequently, disease incidence was also less. Under artificially infested condition, the per cent germination was considerably reduced by pre-emergence damping-off. Consequently, the disease incidence was high in both treatments.

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