

RELATIONSHIP BETWEEN SOIL CONDITIONS AND THE OCCURRENCE OF ROOT ROT DISEASE IN A FOREST NURSERY AT KUMBALPOLA.

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ABSTRACT

Soil conditions influence the seasonal development and geographical distribution of soil-borne fungi and development of root diseases. Diseased seedlings and soil samples were collected from Kumbalpola nursery which is one of the largest Teak nurseries in Sri Lanka. The results of the survey showed that almost 17% of seedling were affected by root rot. *Rhizoctonia* species, one of the soil inhabitants, was identified as the causal organism of root rot of Teak. The fungal populations of infested and non-infested soils of the nursery were studied. The environmental factors which influence the severity of the disease, including soil moisture, soil pH, soil temperature, organic carbon, organic matter and nitrogen contents, were compared in both soils.

INTRODUCTION

Teak is a valuable timber species in Sri Lanka. At the seedling stage, Teak is susceptible to several diseases. Root rot of Teak seedlings was reported in Sri Lanka at Kumbalpola nursery in 1993. Kumbalpola is located in Kurunagella district. The altitude is 0 to 100 m, mean annual temperature is 25 to 27.5°C and the annual rainfall is 1500 to 2000 mm. The soil of Kumbalpola nursery consists of red yellow podzolic soil with strongly mottled sub soil and low humic gley soil. The soil is well drained, moderately fine textured and strongly acidic. A *Rhizoctonia* species was identified as the causative organism of root rot disease. It causes serious visual damage to tiny Teak seedlings.

Studies were undertaken to understand the effect of soil environment on the incidence of root rot disease in the Kumbalpola nursery.

MATERIALS AND METHODS

A field survey was carried out at Kumbalpola nursery in 1993 to estimate the economic loss due to root rot disease at the nursery stage (about 52%). Soil samples were collected from different depths, (ranging from 0 to 3", 3 to 6", 6 to 9") of non-

infested and infested soils of the nursery beds. The soil samples were stored in polythene bags with a view to determine moisture content, pH, organic carbon, organic matter content, nitrogen content and soil fungal population. Czapek-dox agar medium was used for the study of the fungal population of the soil. Soil temperatures were also measured at the sample spots.

SOIL ANALYSIS

The following steps were taken:

- Moisture content was obtained by taking the fresh weight of the soil before obtaining the dry weight after drying in an oven at 105°C.
- The pH was measured using a pH meter.
- The percentage of organic carbon and organic matter of the soil was determined by the Walkley Black method.
- The total nitrogen content of the soil at different depths for both soil types was determined by the Kjeldhal method.
- The number of fungal colonies in the soil samples was determined by means of the soil dilution plate method. Morphological characteristics of the mycelium, such as colour of the mycelium, septation, together with shape and kind of spores, reproductive structures and fungal tissues were used for identification.

RESULTS

The highest temperature was recorded in the top soil of the non-infested region and the lowest temperature was recorded in infested deeper soil (Table 1). The soil moisture content was as high as 35.9% in infested soil whereas in the non-infested soil it was 27.15% (Figure 1). The soil pH was higher in the top soils than in the lower soils for both sites (Figure 2). Both soil organic carbon and organic matter contents were higher in the infested top soil than in the non-infested soils (Figures 3 and 4). The highest value for the soil nitrogen content was observed in the infested top soil (0.066%) (Figure 5).

Table 1 Temperature of Soil at different depths

Soil Depth	Temperature °C	
	Infested soil	Healthy soil
0 to 3" (0-7.6 cm)	33	34
3 to 6" (7.6-15.2 cm)	31	33
6 to 9" (15.2-22.9 cm)	28	33

Ambient temperature was 32°C

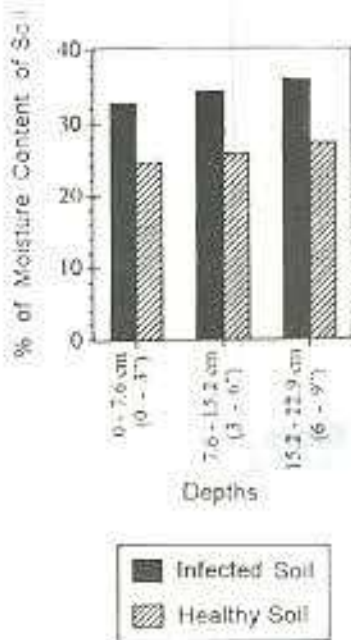


Figure 1 - Percentage Moisture Content of soil in nursery beds

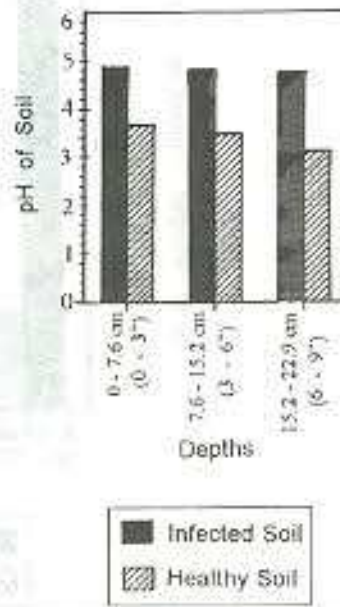


Figure 2 - Soil pH in nursery beds

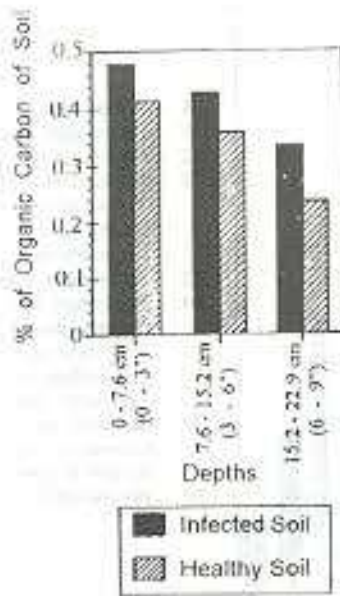


Figure 3 - Percentage Soil Organic Carbon in nursery beds

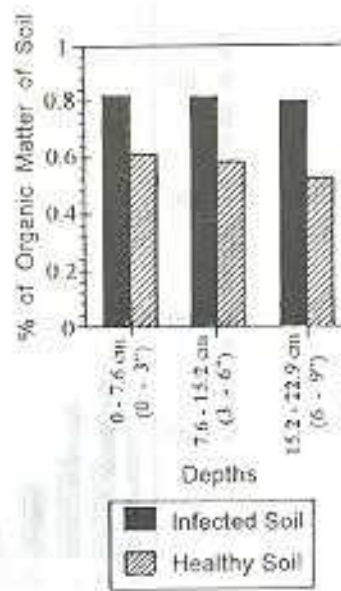


Figure 4 - Percentage Organic Matter Content of healthy and infested soil in nursery bed

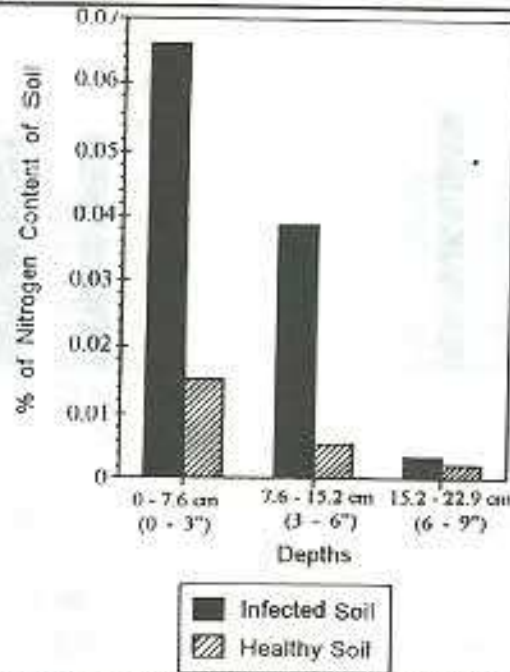


Figure 5 - Percentage nitrogen content of soil at different depths of nursery beds

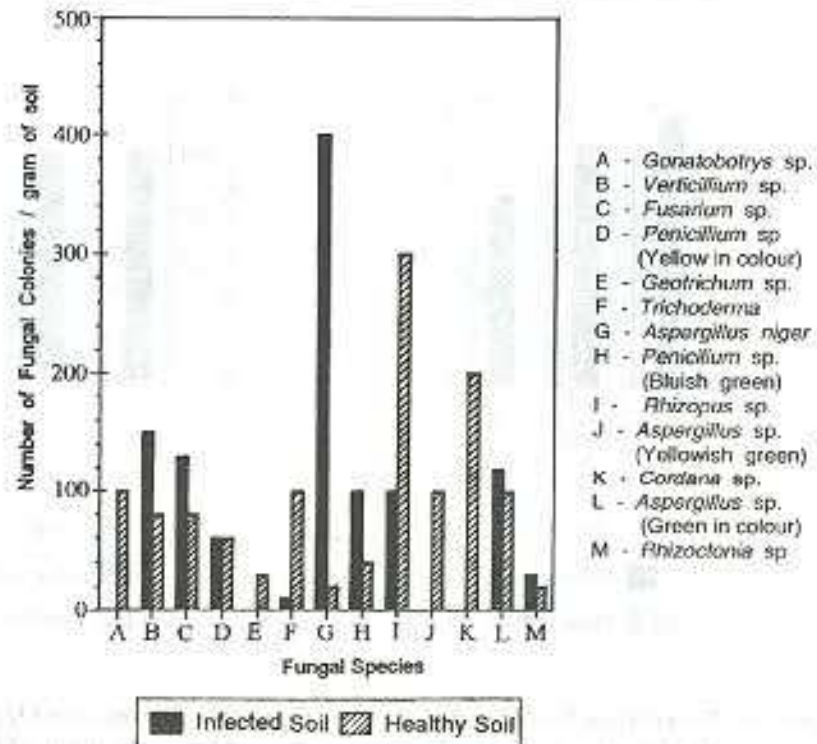


Figure 6 - Soil microbial population in the nursery beds

The distribution of the soil fungal population in infested and non-infested regions of nursery beds was determined. The numbers of *Aspergillus* species (G & L), *Penicillium* species (H), *Verticillium* species and *Fusarium* species were higher in infested soil than in non-infested soil. The *Rhizopus* species count was higher in healthy soil. *Gonatotryps* species, *Geotrichum* species, *Aspergillus* species (J) and *Cordana* species were only present in healthy soil. The number of *Trichoderma viridae* was lower in infested soil than in non-infested soil (Figure 6).

DISCUSSION

Normally, the temperature of top soil is higher than that of deeper soil since the surface soil is in direct contact with the sunlight. But in an infested region, the soil temperature values were lower than in healthy soils. This result indicates that a relatively low temperature may be suitable for the growth of the pathogen. The pH of soil is an important factor regarding the occurrence and severity of plant disease caused by certain soil-borne pathogens (Fungi are acid tolerant and can grow at a pH as low as 3.5 although their optimum range is pH 5 to 6). Diseases are more serious in areas where soil pH favours particular pathogens. Infested soil showed a relatively low pH range which is probably suitable for the growth of the pathogen. The higher carbon content in top soil when compared with deeper soil may be due to the addition of considerable amounts of organic matter and organic debris from dead leaves and fertilizer. The higher level of nitrogen content in top soils, also indicates a high degree of decomposition of the litter layer and fertilizer use. The number of *Rhizoctonia* species was higher in infested soil than in healthy soil. In the order Agromycetales however, growth characteristics are such that hyphae alone can compensate for lack of sporulation. These characteristics include adaptability of hyphae to a wide range of soil conditions, rapid growth rate and resistance of hyphal fragment or sclerotia to adverse environments because of special wall and photoplasmic properties. It has been found that *Trichoderma viridae* can be used as a biological control agent to control some fungal pathogens. The results show that a large number of *Aspergillus* and *Penicillium* species appear in infested soil. This may be attributed to their production of a large number of small thermo-tolerant conidia that can survive better in soil.

CONCLUSION

Physical factors, chemical factors and biological factors such as temperature, aeration, moisture content, pH, organic matter content, organic carbon content, nitrogen content and *Trichoderma viridae* seems to determine the soil fungal population and the occurrence of disease incidence in Teak nurseries.