Spatial distribution of Arbuscular Mycorrhiza (AM) Fungi in the tailing modADA deposition areas

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Introduction

Arbuscular mycorrhizal (AM) fungi are ubiquitous in soils and establish symbioses with most agricultural plants (Smith and Read 1997). There has been relatively little investigation of the spatial variation in infectivity of AM fungi and its relationship to soil characteristics in mine tailing areas. A study of the spatial variability of AM fungi spores from two natural plant communities showed that the number of spores varied according to plant distribution and soil properties (Carvalho *et al.* 2003). The spatial pattern of mycorrhiza infectivity of AM fungi using a glasshouse bioassay from soils at six sites from a successional chronosequence demonstrated that AM infectivity decreased with time and 44-50% of the total variance in AM infectivity was associated with pseudostripmine site and active soybean field (Boerner *et al.* 1996). In contrast, a bioassay assessment of the infectivity of AM fungi in a forest soil was uniform, which may indicate that the actual scale of the patches of infectivity need to be determined (Jasper *et al.* 1991). Geostatistics provides tools to describe spatial variation and to extend point samples through spatial interpolation (Goovaerts 1999). They have been used to analyze the spatial distribution of soil microorganisms especially in illustrating that soil microorganisms are structured at different spatial scales (Wollum and Cassel 1984; Webster and Boag 1992; Robertson and Freckman 1995; Boerner *et al.* 1996; Robertson *et al.* 1997; Cannavacciuolo *et al.* 1998; Klironomos *et al.* 1999), as are the distributions of microorganisms on the soil surface (Rossi *et al.* 1992).

Materials and Method

In this study, the spatial distribution of the infectivity of AM fungi has been examined in the tailing deposition areas of Freeport Indonesia Mining Company in Timika-Papua. Some soil properties such as soil moisture content, soil pH and soil phosphorus were also examined. The percentage of root colonization by AM Fungi was examined from the root of plants growth in the areas. A geostatistical technique was used to examine the distribution of the infectivity across the tailing areas.

Results

Percentage of Root Colonized by AM Fungi and Spore Number

Table 1 shows the percentage root colonized by AM fungi and the number of spores across the tailing deposition areas. The percentage of root length colonized by AM Fungi range from 0 to 45.08%. Most of the plants growth in the tailings areas were infected by AM Fungi, however no colonization was found in the root of *Phragmites karka* which is one of the plant used commonly in tailing reclamation areas. The highest infection by AMF was in the legume crops (45.08%). The number of AM Fungi spores across the tailing ModADA areas range from 1-17 spores/100 gr soil.

Table 1. The summary of statistics for %RLC and spore numbers of AM fungi in tailing ModADA deposition area

Variable (n=198)	Mean	Median	Standard Deviation	Kurtosis	Skewness	Min	Max	CV (%)
% RLC	21.19	22.77	11.42	-0.54	-0.43	0.00	45.08	53.92
Number of Spores	6.55	6	3.82	-0.17	0,70	1	17	29.84

Soil pH in this areas ranges from 4.65 to 8.67 and the soil phosphorus range from 45 ppm to 101 ppm. The high of soil phosphorus in some sample points across the tailing areas tend to mask the number of spores and % RLC for AM fungi. However, the texture of tailing also affected the distribution of AM fungi in this areas in which the fine texture of the %RLC was higher than for the coarse texture of the tailings.

Spatial Model

The semivariogram model of % RLC and Spore Number of AM fungi is presented in Table 2. The semivariogram model of AM fungi infectivity and spore number was spherical with the distance >450 m and the spatial dependence was considered strong (19%) for % RLC and medium (48%) for number of spores.

Table 2. The semivariance analysis of % RLC and spore numbers of AM fungi in tailing modADA deposition areas

Variable (n=198)	Nugget (Co)	Sill (C=Co+(C1))	Range (m)	Relative Nugget Effect (Co/C)	Spatial Dependence (C1/C)	Model
% RLC	59.78	73.86	1581.13	0.81	0.19	Spherical
Number of Spores	3.86	7.39	486.20	0.52	0.48	Spherical

In general, the percentage of root infection was correlated with the distribution of vegetation and soil texture in the tailings areas. In the fine texture areas the percentage of infection was higher than for coarse soil texture.

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