Utilizing Potential Soil Microorganisms, Humic Acid, Grasses and Legumes Forages in Marginal and Degraded Lands in Indonesia

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ABSTRACT

Marginal and degraded lands in Indonesia are considerably extensive and include many kinds of soil, for instance acid soil and post mining soil. The efforts which can be conducted are the use of biological fertilizers, soil conditioners, grasses and legumes forages. Biological fertilizers such as arbuscular mycorrhizal fungi (AMF), phosphate solvent microorganisms (MPP), and nitrogen fixing microorganisms (MPN). The soil conditioners such as humic acid. The forages such as, *Pueraria phaseoloides, Centrosema pubescens, Panicum maximum*, and *Setaria splendida.* The objectives of this research were to obtain new formulation of biological fertilizers which constitute a consortium of AMF and MPP, MPN, humic acid which could increase its ability to supply nutrients and help to increase forage plant survival in less favourable environment; to get grasses and legumes tolerances in marginal and degraded lands. There were 6 formulas of biological fertlizers which were tested in this research, namely (a) AMF with addition of MPP isolates 1, 2 and 3; (b) AMF with addition of Azospirilum isolates 1, 2 and 3; (c) AMF with addition of Rhizobium isolates 1, 2 and 3; (d) AMF with addition of humic acid; (e) AMF with addition of MPP, Azospirilum or Rhizobium; (f) AMF with addition of MPP, Azospirillum or Rhizobium and humic acid. Legumes and grasses were used *Centrosema pubescens, Pueraria phaseoloides, Panicum maximum*, and *Setaria splendida.* The results showed that the four test plant species responded differently to the latosol and post gold mining. In general, the four kinds of plants were not supported by single bio-fertilizer, but require a consortium of several types microorganisms and the results will be better when it was combined with humic acid. Growth response to the four types of plants in soil latosol was better compared to gold post-mining soil. At planting media from gold mine tailings many plants died, especially in the control treatment which was a treatment without the addition of bio-fertilizers.

Key words: soil potential microorganism, humic acid, legumes, grasses forages

INTRODUCTION

Marginal and degraded land in Indonesia was a lot, such as acid lands and post-mining lands. The existence of such lands in Indonesia is very high that covers 30% or 0.51 million km^2 of land area in Indonesia spread over the area of West Java, Sumatra, Kalimantan, Sulawesi and Irian Jaya. The main problems in acid soil are (1) decrease the solubility of P and Mo. (2) decrease the concentration of macro elements such as N, Mg, Ca and K. (3) increase concentrations of Al, Mn and Fe which can cause poisoning (4) inhibits root growth and water absorption, causing nutrient deficiencies, drought stress and increase nutrient leaching (Maschner, 1995). Post-mining land in addition to problems with acid conditions, as well as problems that may result is a heavy metal contamination.

The problems of acid soil can be overcome with the use of bio-fertilizers. Bio-fertilizers are the arbuscular mycorrhizal fungi (AMF), microorganism solvent phosphate (MPP) and Nitrogen Fixing Microorganisms (MPN). Arbuscular mycorrhizal fungi can help plants to supply and absorp of elements of low P availability in acid soil and have ability to adapt to acid soil (Koslowsky and Boerner, 1989). Phosphate solvent microorganisms are soil microorganisms that can improve the provision of P in acid soil by producing organic acids so that the solubility of Al can be reduced because it is bound by organic acids (Illmer *et al.*, 1995). Malate, citrate and oxalate are organic acids that have high affinity to metal having such as Al^{3+} and Fe^{3+} (Jones and Brassington, 1998; Karti, 2003). Nitrogen fixing bacteria like *Azospirillum* and *Rhizobium* are bacteria that can cause