DIVERSITY AND SYMBIOTIC EFFICIENCY OF RHIZOBIA ISOLATED FROM EMBU, KENYA

George Mutegi Mwenda

A thesis submitted in partial fulfillment for the Degree of Master of Science in Biotechnology in the Jomo Kenyatta University of Agriculture and Technology

2010

ABSTRACT

A major strategy towards addressing soil fertility depletion is the conservation and sustainable use of rhizobia that are able to fix nitrogen in the soil in association with legumes. However, for maximum exploitation of rhizobia, studies are necessary to describe locally available species and strains and their potential to fix nitrogen as bio inoculants since foreign strains have been shown to poorly adapt after their introduction. The study assessed the diversity of rhizobia in Embu, a central Kenya highland district and how various farm-use systems in the area affected this diversity. Areas in the district representing six farm-use systems were identified and sampling points systematically selected with the aid of a GPS system. The six land use types in the area were; maize-based mixed farming system, coffee, tea, fallow, Napier grass and undisturbed natural forest. Soils were collected from the sampling points and rhizobia were isolated from nodules of Siratro plants (*Macroptilium atropurpureum*) which were used as trap plants. Isolated rhizobia were characterized morphologically and genetically. Genetic characterization involved DNA extraction, PCR amplification of 16S rRNA, RFLP and sequencing of 16S rRNA genes. Symbiotic efficiency tests of the isolates were also done in association with Siratro. Genetic characterization revealed that rhizobia in the area belonged to five species in the genera *Rhizobium, Bradyrhizobium, Mesorhizobium* and *Agrobacterium*. Land use had a significant effect on the diversity of rhizobia ($P<0.05$) with soils under tea having the highest mean ribotypes richness of 3.71±0.18 and soils sampled from natural forest having the lowest mean richness of 1.29±0.28. Tea had four

of the five species found in the area whereas natural forests had two. Diversity was positively correlated with soil pH and negatively correlated with soil nitrogen content. These results indicate that diversity of rhizobia does not necessarily decrease with agricultural intensification as hypothesized. Isolated rhizobia strains formed effective nodules on Siratro. However, the level of fixation varied among isolates. Some strains had excellent ability to fix nitrogen, with symbiotic efficiency (SE) of up to 112% observed, which was well above that of nitrogen supplemented plants. Further studies are recommended to obtain a clear understanding of the relationship between soil rhizobia diversity and land use and management. Symbiotic potential of the rhizobia isolates identified in this study should be assessed using different crops and in diverse sites in the country.