Abstract of thesis entitled

SYMBIOTIC NITROGEN FIXATION BY NATIVE WOODY LEGUMES (LEGUMINOSAE) IN HONG KONG, CHINA

Submitted by

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For economic reasons, previous legume-rhizobia symbiosis studies have concentrated on a few crop legumes, therefore leaving 80% of legume species unstudied. Despite increasing researches on woody legumes elsewhere, Hong Kong native woody legumes have received no particular attention. This study investigated the legume-rhizobia symbiosis in native woody legumes in Hong Kong through nodulation surveys, examinations of rhizobial diversity and planting experiments.

Nodulation surveys on 28 native woody legumes showed that 20 species were nodulating and 8 non-nodulating. Five species were new records to the world's nodulation inventory. Nodulation was more profuse in shrub species while inconsistent in most tree species. More senescent nodules were noted in the dry season than in the wet season. All nodules examined were effectively nitrogen-fixing, with nitrogenase activity ranging from 1 $\mu molC_2H_4g^{-1}h^{-1}$ to 22.7 $\mu molC_2H_4g^{-1}h^{-1}$.

Sequencing of 16S rRNA gene revealed high a diversity of rhizobia nodulating in three native *Ormosia* trees in the wild. Phylogenetic analysis clustered the 22 isolates into seven groups which corresponded to at least 7 known rhizobia species in 4 genera (with 96-100% similarity), namely *Bradyrhizobium*, *Rhizobium*,

Sinorhizobium and *Burkholderia*. Phenotypic characterization showed wide tolerance range of pH (4-10), temperature (35-40^{o}C) and salt concentration (1-4%). All except t 4 isolates nodulated at least three of the five test legumes and were therefore considered to have low host specificity.

The growth performance of *Ormosia emarginata*, *O. pachycarpa* and *O. semicastrata* were evaluated in controlled, semi-manipulated and natural field environments for 15-24 months. The three species had similar growth rates in the three planting experiments. They all had >90% survival rates but grew relatively slowly in terms of height increment (<10 cm), basal diameter increment (<0.5 cm) and dry mass (0.1-1.5 g). Effective nitrogen-fixation was established in all inoculated seedlings and some un-inoculated seedlings which might imply that rhizobia were not limiting in those planting sites.

Mixed planting of a non-legume *Syzygium hancei* with *Ormosia* spp. did not confer any advantage to its growth in degraded sites as no significant difference in height increment, basal diameter and dry mass were found among treatments. Changes in soil nitrogen also did not differ significantly among the treatments, probably due to the short experimental period.

This study showed that many native woody legumes were able to form root nodules and effectively fix nitrogen in degraded hillsides of Hong Kong and the diversity of rhizobia nodulating these legumes was high. However, the three *Ormosia* spp., although effectively nitrogen-fixing, grew too slowly to confer any positive effect on both other plants and soil in degraded hillside and therefore limited their field applications. This study has built up a basis for more comprehensive examination and screening of legumes and rhizobia for forest restoration in Hong Kong.