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Nitrogen Complementarity in Timber Based Hedgerow Intercropping Systems on an Acid Upland Soil in the Philippines

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Abstract

Complementarity in agroforestry systems is when trees take up water and nutrients, which would not be available to the associated annual food crops. Hedgerow systems of *Acacia mangium* (N₂-fixing) and *Gmelina arborea* (non-N₂-fixing) were studied to determine from which soil profiles these trees take up N in relation to the maize crop, and to assess their N contribution. (¹⁵NH₄)₂SO₄ (40 atom %) was injected at 20 and 100 cm depth using a ceramic porous cup in order to assess ¹⁵N uptake by trees and crop. This study was conducted at Claveria, Philippines (8°°30' N 124°°53' E) on a fine mixed isohyperthermic, Ultic Haplorthox soil with 3500 mm rainfall per year distributed throughout the year. Nitrogen recycled in tree systems was substantially higher than in the conventional maize monocrop system through pruning of lateral branches and N uptake from safety-net zone. *A. mangium* system provided two times more N recycling through prunings compared to the equally fast growing *G. arborea*. *A. mangium* derived 42% of its N from atmospheric N₂ fixation and 52% from safety-net zone (>100 cm depth). This counterbalanced the mineral N uptake by *A. mangium* from the upper soil depths, leading to higher maize yields and a positive system N balance. *A. mangium* had more fine roots even at lower depths, which provided good opportunities for safety-net and nutrient pumping functions compared to *G. arborea*. The maize in *A. mangium* system benefited with 28% of its N uptake through transfer of fixed N₂, e.g., through the application of lateral branches prunings and root turnover, as indicated by the ¹⁵N natural abundance method. *A. mangium* was less competitive with maize than *G. arborea*, and was thus more appropriate as a hedgerow species. Timber hedgerow system is a better farming option than the conventional maize system due to the N uptake by trees from lower soil depths regardless of species being used.

Keywords: Hedgerow intercropping, N complementarity, timber trees