Enrichment planting in naturally recovering secondary forests or in tree plantations is increasingly being used as strategy to restore later-successional, large-seeded tropical forest trees. We seeded two tree species (Otoba novogranatensis and Ruagea glabra) in three agricultural sites in Southern Costa Rica: abandoned pastures, eight to ten year old secondary forests and three year old tree plantations (containing two N-fixing of four total tree species). We measured micrometeorological conditions, soil water content, plant water potential, leaf area, foliar C and N, and photosynthesis to better understand mechanistic responses of seedlings to conditions in the different successional habitats. Micrometeorological conditions, soil water content, and plant water potential were generally similar across habitats. Certain aspects of leaves (such as Specific Leaf Area and foliar N content), and photosynthesis (e.g. quantum yield and electron transport rate) were highest in the plantations, intermediate in the secondary forests, and lowest in abandoned pastures. Enhanced rates of photosynthetic biochemistry (such as Vcmax and Jmax) and Photosystem II efficiency (e.g. thermal energy dissipation) occurred in leaves from the plantations compared to the abandoned pastures, which may be related to higher leaf %N content. Results suggest that foliar N may be of greater importance than soil water content and micrometeorological factors in driving differences in photosynthetic processes across planting habitats. Planting seeds of these two species in plantations containing three year old trees (including two N-fixing species) enhances certain aspects of their photosynthesis and growth, compared to seedlings in abandoned pastures with non-native grasses, and thus can help increase forest recovery on abandoned agricultural lands. Rev. Biol. Trop. 61 (3): 1493-1507. Epub 2013 September 01.

Keywords
Chlorophyll a fluorescence, forest restoration, gas exchange, leaf N content, Photosystem II, tropical secondary forest.