



Tropentag, October 7-9, 2008, Hohenheim

“Competition for Resources in a Changing World:
New Drive for Rural Development”

Identification of Tree Growth Limiting Soil Parameters in the Savannah Regions of Northern Brazil

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Abstract

Since 1999, savannah areas located in northern Brazil, Federal State of Roraima, have been afforested with *Acacia mangium* Willd with the objective of timber production on marginal sites. Thereby the added value of this economically underdeveloped region is increased and new jobs are created.

A. mangium is generally well adapted to acid and nutrient poor tropical soils. Nevertheless growth differences can be observed within the Brazilian plantation sites. Depending on their growth performances, three different yield classes have been defined. The aim of the current study was to investigate, by means of analysis of soil and foliar nutrition levels, whether these growth differences can be referred to nutrient deficiencies or imbalances. Results of these investigations were compared with data from nearby natural forest stands. Furthermore the impact of *A. mangium* plantations on physical and chemical soil parameters in the course of time was studied.

In terms of soil and leaf nutrient contents variance analysis reveals no significant differences between the yield classes. However, natural forest stands show significant higher contents of organic matter ($>20 \text{ mg dm}^{-3}$) than the plantation areas ($13\text{--}17 \text{ mg dm}^{-3}$). Overall, most nutrient stocks both in soils and leaves are on a very low level according to several literature studies. Especially N, P, K, Ca, Mg and S contents range in the deficit level. In contrast Fe, Mn and B can be found on optimum levels or even above.

Furthermore pH values of plantation soils decrease after afforestation. Accumulation of organic matter does not occur in the expected dimensions therefore no enrichment of organic matter was observed with increasing plantation age. Slightly negative correlations between tree growth performances and soil nutrient contents were found.

The results reveal that inadequate growth performances cannot be explained by lack of nutrients. Nevertheless, periodic refilling of the soil nutrient stocks probably provides beneficial effects regarding tree growth.

In future, potential afforestation sites should be selected more carefully, especially regarding the water availability during the dry season since this seems to be the most important factor influencing tree growth.

Keywords: *Acacia mangium*, Brazil, savannah-afforestation, soil and foliar analysis, tree growth limitation