“One of the tree families that is relatively scarce in the rubber agroforests is the Dipterocarpaceae, the main timber producers of the lowland forests. With increasing scarcity, it becomes interesting for farmers to enrich their agroforests with such trees. Is that difficult?”

“My PhD research is supported by a number of institutions. The starting point is the requirement of Dipterocarpaceae for an ectomycorrhiza (EM) partner. If that is no longer present in the soil, after disturbance, it will have to be introduced in the nursery stage, with costs & effort to find a good match.”

“The current ‘paradigm’ (researched in Kalimantan) is that it is indeed difficult to get Dipterocarpaceae started in reforestation or enrichment planting efforts, because the main EM fungi are themselves sensitive to forest disturbance (exposure of the soil to sunshine). Inoculation is thus essential.”

“Natural forest in Sumatra is dominated by Dipterocarpaceae, which produce valuable timber and NTFP.

Dipterocarps has close association with ectomycorrhiza (EM) fungi — nutrient and water absorption

Deforestation → forest area decrease

Farmer managed rubber agroforest (RAF) has become a major reservoir of forest biodiversity and forest services

Enrichment planting with Dipterocarps → an option for landscape restoration

Efforts to re-introduce forest trees may be limited by survival of these fungal partners in the soil

Survival of forest EM fungi in different land use types probably depends on the type of vegetation and on the possibilities for these fungi to find suitable hosts.

Existing Paradigm of EM

A. Mechanism

• Dominant EM Fungi: Basidiomycetes, such as Russula, Amanita, Scleroderma, Boletus, Laccaria (Smits, 1995)
• Sensitivity to land cover change: very sensitive to open soil

B. Consequence

• Forest regeneration: dipterocarp species are not easily establish in open vegetation
• Silviculture: EM inoculation is essential

Hypothesis

Inoculum of ectomycorrhizal fungi will survive in the soils for limited time after a change to a different land use type; the need for artificial mycorrhization in the nursery of dipterocarps can thus be predicted from the plot history
“The past decades of land use change in Jambi province have provided an ‘experiment’ that allows us to test the decline of inoculum potential of soils for Dipterocarps, along a habitat gradient from forest to crop fields and Imperata grasslands. The Belowground Biodiversity project set up a series of sites.”

“Survey data were collected from the lowland peneplain in Muara Kuamang and Kuamang Kuning, and the lower piedmont zone in Rantau Pandan – both in Jambi. Soils on the sites (Ultisols and Inceptisols) are typical for the respective zones.”

“Soil from a range of land use histories was brought to Bogor for an inoculum test with two Dipterocarp tree species. The growth of tree seedlings was recorded and their roots were analyzed for mycorrhiza (nearly all roots), followed by identification of fungal species using molecular taxonomy.”
"To our surprise, the tree seedlings planted in soil from *Imperata* grasslands in the Kuamang Kuning area were growing very well. In fact land use history proved to be unimportant for this site; overall growth was slightly less on the Rantaupandan soils, again without clear advantage for the forest soils."

"Soil chemical analysis provides some clues to a possible explanation. Soils from Kuamang Kuning had rather high available phosphorus levels, while those for Rantaupandan are poorer. All soils are very acid, with pH (KCl) around 4.0 and exchangeable aluminium at 10-40% of ECEC."

"Identification of the mushrooms (‘sporocarps’) collected in the plots brought some surprises. In fact the higher fungi (Basidiomycetes) were infrequent, but DNA analysis showed an abundance of Ascomycetes. This analysis is still ongoing, so results are preliminary."
“Compared with the initial paradigm and expectations, however, we notice a number of contrasts. It appears that groups of fungi that survive under land use change are effective EM partners for the Dipterocarps so the need for inoculation is probably less than usually assumed.”

“In fact we have to review the existing paradigm of sensitive ectomycorrhizal fungi as limitation on Dipterocarp growth. If inoculation is not necessary, enrichment planting may be easier than assumed. It is possible that Sumatran soils and fungi differ from those in Kalimantan/Borneo.”

“Next steps in this research will aim to provide more detailed evidence. A field trial with inoculated/non-inoculated Dipterocarps in rubber agroforests of different age is under way. A new experiment will test stepwise soil sterilization. So maybe our forests can be restored after all...”