Shifting the paradigm of ectomycorrhiza as constraint to dipterocarp enrichment planting in Sumatra

Correspondence:
Hesti L. Tata[1,2,3] (H.tata@cgiar.org), Meine van Noordwijk[2], Marinus J.A. Werger[3]

NOTE:
[1]Forest Research and Development Centre, Bogor, Indonesia;
[2]the World Agroforestry Centre (ICRAF-S.E. Asia), Bogor, Indonesia;
[3]Department Plant Ecology and Biodiversity, Utrecht University, the Netherlands

Background

- Enrichment planting with dipterocarp species in rubber agroforest is an option to meet local demand for timber, but it is not widely practiced in Jambi.
- Finding ectomycorrhiza partner for dipterocarp seedlings is supposed to be a critical step for dipterocarp enrichment planting in lowland Sumatra.


Ladies group participate to transfer Shorea seedlings into rubber garden


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Study site on RAF_5yr derived from forest


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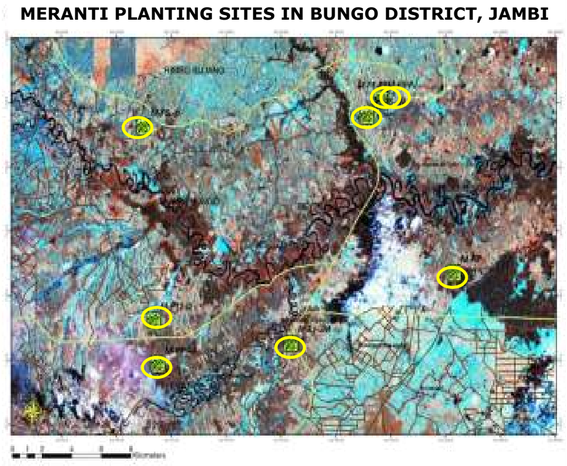
A young lady is planting Shorea seedlings in her parents' rubber garden


MERANTI PLANTING SITES IN BUNGO DISTRICT, JAMBI

Aerial map of dipterocarp enrichment planting in Bungo-Tebo, Jambi


Shorea selanica after 1yr planting in RAF_1yr old derived from RAF


Ladies group participate on slashing as land preparation before enrichment planting


Dipterocarp nursery could be developed in rubber seedlings/clone-stock


Shorea lamellata after 2yr planting in RAF_1yr old derived from RAF

Issue	Dominant initial paradigm		Finding
Tree species richness in rubber agroforests (RAF)	Dispersal-limited richness of forests for late-successional species	⟺	• Tree diversity high in seedling/sapling stage, before main farmer selective cutting. Within area of forest and RAFof 0.32 ha each, we encountered species number of tree stage: 9.6 in forest and 6.0 in RAF; sapling stage: 11.2 and 10.6; seedling stage: 15.4 and 15.7, in forest and RAF, respectively. • No major 'succession signature on wood density profile, but few trees depend on ectomycorrhiza (EcM) were found in RAF compare to forest (relative abundance = 0.5% and 10.6%).
Ectomycorrhiza fungi dependence	Basidiomycetes dominant in forests and mainly late-stage fungi	⟺	• Species number of EcM fungi found in forest and RAF plot was 7 and 4, respectively. Genera dominant in the the two plots was *Russula*. • Roots of host trees contain ectomycorrhiza and root endophyte fungi of Basidio- and Ascomycetes.
Ectomycorrhiza inoculum potential	Survival of wood-wide and spores beyond 'forest' is limited	⟺	• Soil from land uses >30 years after forest conversion still contains EcM inoculum. • Inoculation response in field is small survival and absent for growth; strongest positive effects in the forest plots • Heating soil 150 ^{o}C for 3 hours does not eliminate inoculum potential, about 41% EcM colonization • We expect those EcM were either very persistent species or had a very efficient dispersal mechanism.
Host-fungus relationship	High specificity of fungal – tree relationship; many Dipterocarp germinate within root zone of 'mother –tree'	⟺	• Field planting experiment showed that five morphotypes of EcM persist through many treatments/situations – associated with different groups of fungi. • Morphotype_1 (i.e. monopodial regular pinnate and white brownish mantle color) were the most common type colonized roots of inoculated and non inoculated seedlings at nursery stage
Mycorrhiza roles for tree	Mycorrhiza essential for nutrient (especially P) uptake	⟺	• Inoculation of dipterocarp (*Shorea lamellata* and *S. selanica*) with EcM (*Scleroderma columnare*) in nursery stage did not increase shoot N & P total uptake. • Effect of inoculation on early survival suggest 'avoidance of root-born disease' as main benefit.
Biodiversity and ecosystem function	Biodiversity enhances ecosystem function because those components that appear redundant at one point in time become important when some environmental change occurs (Swift et al. 2004)	⟺	• Reduction in **fungal diversity** in forest > RAF > Imperata grassland, however less evidence on critical loss of function. • Different effect might occur for higher taxa of plant and animal kingdom.
Conservation policies	Forest conservation essential to maintain options for future use, e.g. Dipterocarp domestication for plantation forestry	⟺	• No major constraint yet in use of dipterocarp for enrichment planting. • This may weaken the conservation argument, but is good for forest restoration or agro-reforestation.
Practical application	Enrichment planting requires specialized nurseries and technology	⟺	• Farmer interest in planting timber trees is slowly increasing. Availability of seeds and wild-seedlings are constraint, but simple techniques of seedling production and vegetative propagation is sufficient.

No soil biological constraint to enrichment planting