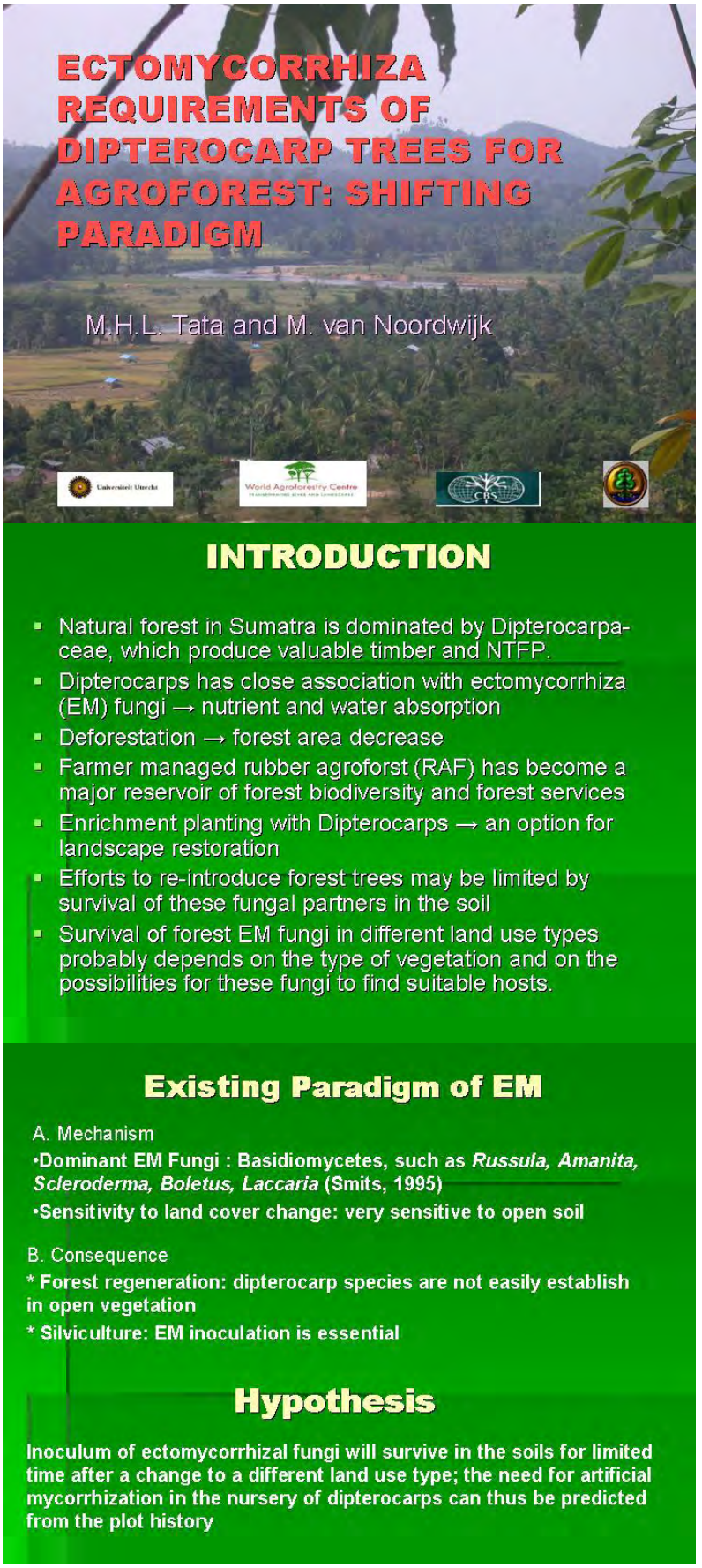
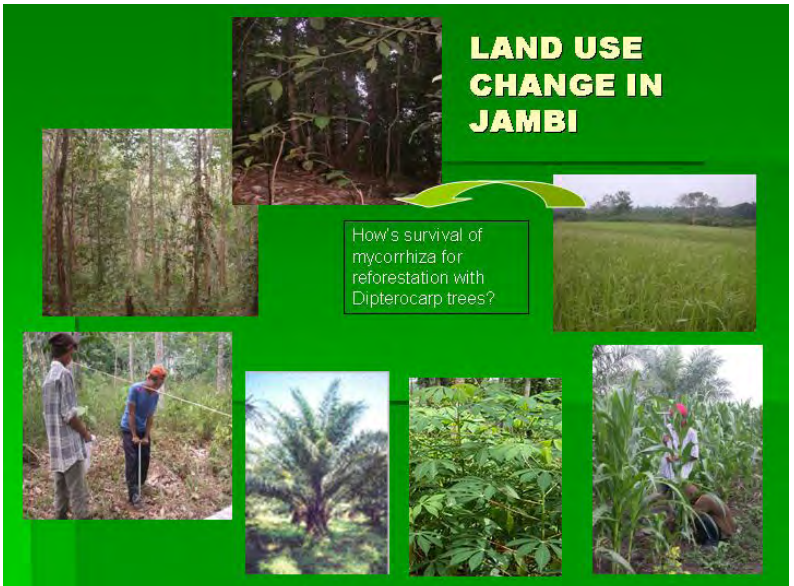


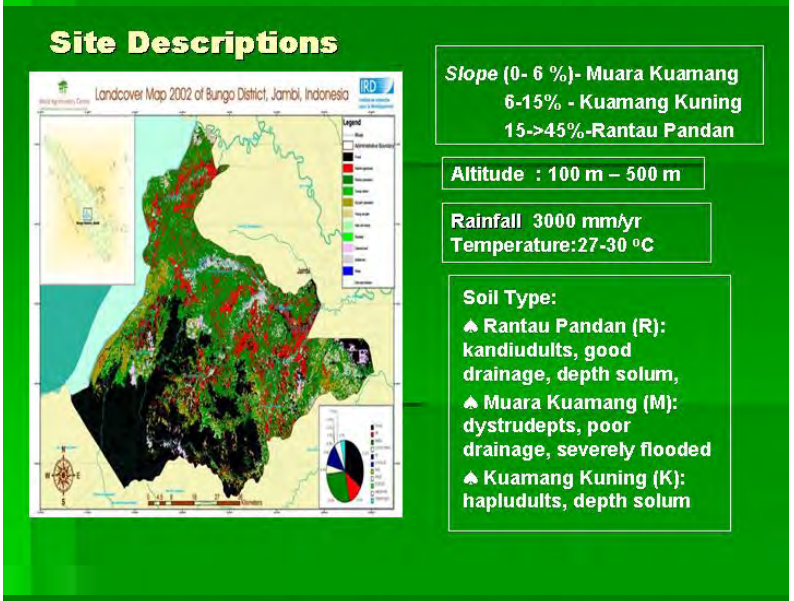
"One of the tree families that is relatively scarce in the rubber agroforests is the *Dipterocarpaceae*, the main timber producers of the lowland forests. With increasing scarcity, it becomes interesting for farmers to enrich their agroforests with such trees. Is that difficult?"

"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."

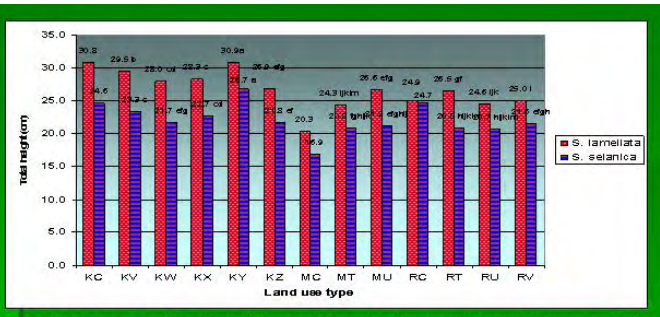


"The past decades of land use change in Jambi province have provided an 'experiment' that allows us to test the decline of inoculum potential of soils for Dipterocarps, along a habitat gradient from forest to crop fields and *Imperata* grasslands. The Belowground Biodiversity project set up a series 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."



Mean of total height of *S. lamellata* and *S. selanica* seedlings at the age of 10 months. (V= rubber monoculture, W=oilpalm, X=cassava, Y=agriculture, Z=Imperata grassland, K=Kuamang Kuning, M=Muara Kuamang, R=Rantau Pandan, C=Control)

S. lamellata, 10 months

"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."

Table 1. Soil chemical properties at different LUT in Jambi

	pH		Bahan organik			HCl 25%		Bray 1	Nilai Tukar Kation (NH_4-Acetat 1N, pH7)						KCl 1N	Total	Koreksi Kadar Air
			Walkley	Kjeldahl													
LUT	H_2O	KCl	C	N	C/N	P_2O_5	K_2O	P_2O_5	Ca	Mg	K	Na	Jumlah	KB *	Al^{3+}	Fe	
			%			mg/100 g		ppm	cmol+/kg					%	cmol+/kg	%	
MU	4.35	3.87	1.55	0.11	14.34	13.47	3.58	17.51	0.50	0.17	0.06	0.03	0.75	1.50	0.35	1.37	1.07
MT	3.76	3.74	3.25	0.26	12.58	42.84	11.91	25.46	0.73	0.45	0.12	0.01	1.30	4.95	0.68	4.30	1.27
RU	3.88	3.71	2.53	0.17	15.05	15.47	6.43	7.51	0.61	0.21	0.10	0.01	0.93	4.50	0.65	2.21	1.25
RT	3.70	3.69	3.21	0.22	14.96	19.61	7.78	11.49	0.76	0.24	0.11	0.00	1.11	4.52	0.67	2.43	1.21
RV	4.15	4.01	1.90	0.13	14.54	13.44	4.77	8.87	1.29	0.35	0.06	0.00	1.69	1.87	0.32	1.76	1.11
KW	4.35	4.02	1.84	0.13	14.30	22.42	6.36	26.89	1.27	0.34	0.10	0.02	1.73	1.70	0.25	2.53	1.10
KV	4.45	4.00	2.21	0.15	15.06	17.90	4.46	14.63	1.46	0.47	0.06	0.02	2.02	1.69	0.35	2.72	1.16
KX	4.36	4.06	1.59	0.11	14.77	17.56	5.57	17.22	1.37	0.43	0.08	0.00	1.87	1.36	0.29	2.26	1.11
KZ	4.40	3.99	1.87	0.13	14.38	19.04	6.59	15.83	1.57	0.48	0.10	0.03	2.18	1.58	0.35	2.10	1.11
KY	4.13	4.03	3.39	0.22	15.17	17.21	4.97	29.15	1.91	0.59	0.07	0.07	2.64	1.51	0.30	0.52	1.07

(Note: T=forest, U=RAF, V=rubber monoculture, W= oilpalm, X=cassava, Y=agriculture, Z=imperata, M=Ma. Kuamang, R=R. Pandan, K=K. Kuning)

"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."

EM Fungi Identification

Sporocarp surveys :

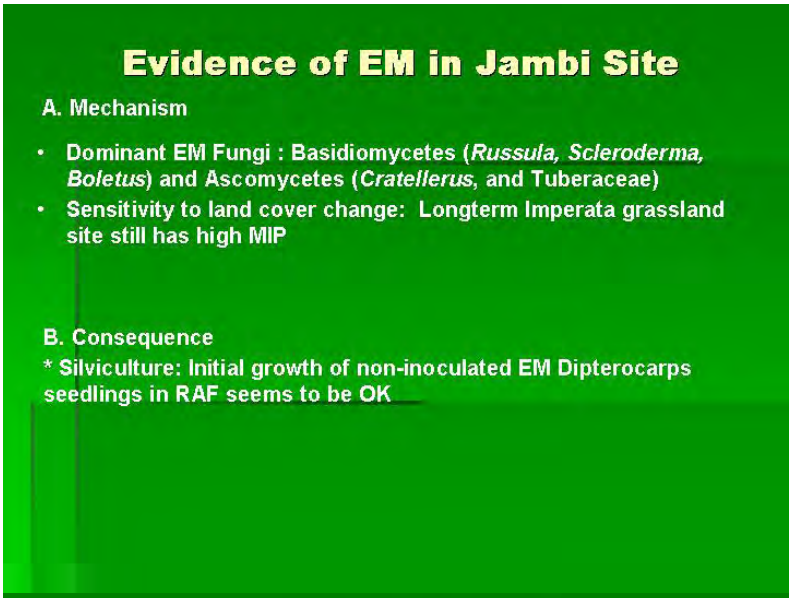
Suspected EM fungus:

- *Scleroderma, Boletus, Russula, Clavaria, Handkea, Thelephora*

Molecular Analysis:

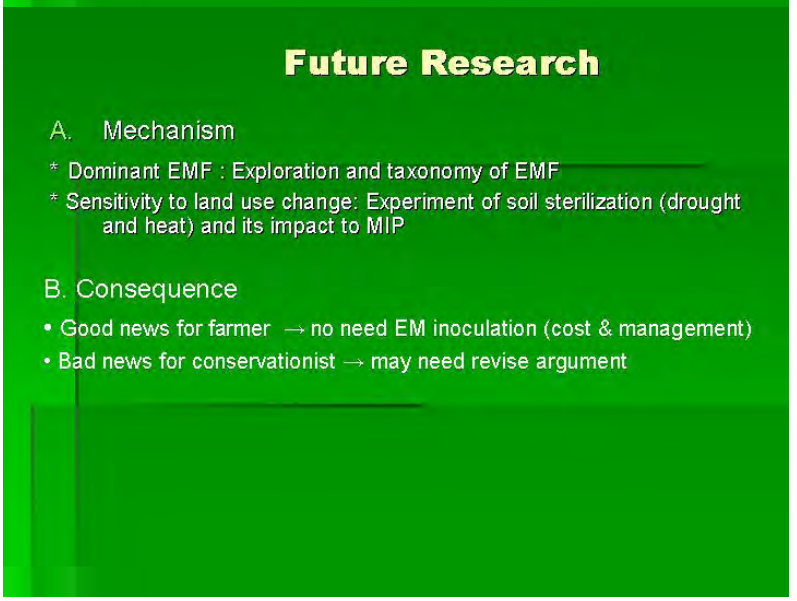
- REF and mycorhizosphere fungus colonize *Shorea* seedlings planted in the soil from 7 LUT.
- REF and mycorhizosphere present at all LUT
- Identification based on 28S DNA: Thelephoraceae, *Cortinarius callisteus* and *Laccaria* sp., several Ascomycetes group of Fusarium, Pestalotiopsis, Nectria, Aspergillus, Trichoderma, Phoma, Phomopsis

"Identification of the mushrooms ('sporocarps') collected in the plots brought some surprises. In fact the higher fungi (*Basisiomycetes*) 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…"