Nodulated tree legumes and their symbiotic *Bradyrhizobium* in African and South-American Tropical Rainforests

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The Leguminosae family

- 650 genera, 18,000 species
- Three sub-families:
 - **Caesalpinioideae (about 26% nodulated)**
 - 1,900 species (woody perennials, tropics)
 - **Mimosoideae (about 95% nodulated)**
 - 2,700 species (woody perennials, tropics)
 - **Papilionoideae (about 97% nodulated)**
 - 13,400 species (herbaceous to trees, temperate to tropical)

A wide diversity of nodule types in tropical rainforest trees from West Africa (Guinea) and South America (French Guyana)

Occurrence of nodulation in leguminous species of the primary rain forest in Guinea (West Africa)

Sub-family / Tribe /Species	Plant habit and height	Location	Nodulation	New species observed	New genus observed
CAESALPINIOIDEAE					
CAESALPINIEAE					
<i>Bussia occidentalis</i>	T ; 25 m	Ziama	-	yes	yes
<i>Chidlowia sanguinea</i>	T ; 25 m	Ziama	+	yes	yes
<i>Delonix regia</i>	T ; 12 m	Nimba	-	no	no
<i>Erythrophleum ivorense</i>	T ; 40 m	Ziama	+	N	N
<i>Erythrophleum suaveolens</i>	T ; 40 m	B' ro	+	N	N
<i>Mezoneuron benthamianum</i>	S ; 5 m	Dĩ'c k'	-	yes	N
CASSIEAE					
<i>Cassia aubrevillei</i>	T ; 15 m	Nimba	-	yes	no
<i>Cassia sieberiana</i>	T ; 15 m	B' ro	-	N	N
<i>Chamaecrista mimosoides</i>	H ; 1.5 m	Nimba	+	no	N
<i>Dialium aubrevillei</i>	T ; 30 m	Ziama	-	yes	N
<i>Dialium dinklagei</i>	T ; 20 m	Dĩ'c k'	-	c	N
<i>Dialium guineense</i>	T ; 15 m	B' ro	-	no	N
<i>Dialium pobeguinii</i>	T ; 15 m	Ziama	-	yes	N
<i>Distemonanthus benthamianus</i>	T ; 35 m	Ziama	-	N	yes
<i>Duparquetia orchidacea</i>	S ; 8m	Nimba	-	N	N
<i>Senna podocarpa</i>	S ; 5 m	Nimba	-	N	no
<i>Senna siamea</i>	T ; 20 m	B' ro	-	no	N
CERCIDEAE					
<i>Bauhinia thonninguii</i>	T ; 9 m	Pic de Fon	-	yes	no
<i>Griffonia simplicifolia</i>	S ; 5m	Nĩ' r'k or'	-	N	yes
DETARIEAE					
<i>Afzelia africana</i>	T ; 30 m	B' ro	-	no	no
<i>Afzelia bella var.gracilior</i>	T ; 35 m	Ziama	-	yes	N
<i>Copaifera salikounda</i>	T ; 30 m	Ziama	-	N	N
<i>Daniellia ogea</i>	T ; 30 m	B' ro	-	N	yes
<i>Daniellia thurifera</i>	T ; 35 m	Ziama	-	N	N
<i>Detarium heudelotianum</i>	T ; 20 m		-	N	N
<i>Detarium macrocarpum</i>	T ; 25 m	Dĩ'c k'	-	N	N
<i>Detarium senegalense</i>	T ; 25 m	B' ro	-	N	N
<i>Guibourtia copallifera</i>	T ; 25 m	Ziama	-	N	no
<i>Guibourtia ehie</i>	T ; 30 m	Ziama	-	N	N
<i>Guibourtia leonensis</i>	T ; 30 m	Dĩ'c k'	-	N	N
<i>Tessmannia baikiaeooides</i>	T ; 10 m	Nimba	-	N	yes
AMHERSTIEAE					
<i>Anthonothea crassifolia</i>	T ; 20 m	B' ro	-	yes	no
<i>Anthonothea fragrans</i>	T ; 30 m	Ziama	-	no	N
<i>Anthonothea macrophylla</i>	T ; 12 m	Dĩ'c k'	-	yes	N
<i>Cryptosepalum tetraphyllum</i>	T ; 25 m	Ziama	-	N	N
<i>Gilbertiodendron bilineatum</i>	T ; 15 m	Ziama	-	N	N
<i>Gilbertiodendron limba</i>	T ; 15 m	Ziama	-	N	N

Nodulation of leguminous species from Guinea (*continued*)

Sub-family / Tribe /Species	Plant habit and height	Location	Nodulation	New species observed	New genus observed
MIMOSOIDEAE					
PARKIEAE					
<i>Parkia bicolor</i>	T ; 30 m	Nimba	-	yes	no
<i>Parkia biglobosa</i>	T ; 15 m	B̃ ro	-	no	N
<i>Pentaclethra macrophylla</i>	T ; 25 m	Ziama	+	N	N
MIMOSEAE					
<i>Adenopodia scelerata</i>	V ; 30 m	Nimba	-	yes	yes
<i>Aubrevillea kerstingii</i>	T ; 30 m	Ziama	-	N	N
<i>Aubrevillea platycarpa</i>	T ; 30 m	Ziama	+	yes	yes
<i>Calpocalyx aubrevillei</i>	T ; 25 m	Ziama	+	N	no
<i>Calpocalyx brevibracteatus</i>	T ; 25 m	Ziama	-	N	N
<i>Dichrostachys cinerea</i>	S ; 8 m	B̃ ro	+	no	N
<i>Entada africana</i>	T ; 12 m	B̃ ro	+	yes	N
<i>Entada gigas</i>	V ; 30 m	Dĩ c k̃	+	N	N
<i>Entada mannii</i>	S ; 15 m	Ziama	+	N	N
<i>Mimosa invisa</i>	S ; 0.5 m	Dĩ c k̃	+	no	N
<i>Newtonia aubrevillei</i>	T ; 30 m	Ziama	-	yes	N
<i>Newtonia duparquetiana</i>	T ; 25 m	Nimba	-	N	N
<i>Piptadeniastrum africanum</i>	T ; 40 m	Ziama	+	no	no
<i>Tetrapleura tetraptera</i>	T ; 20 m	Ziama	+	yes	yes
<i>Xylin evansii</i>	T ; 25 m	Dĩ c k̃	+	N	no
INGEAE					
<i>Albizia adianthifolia</i>	T ; 20 m	Dĩ c k̃	+	no	no
<i>Albizia altissima</i>	T ; 20 m	Ziama	+	yes	N
<i>Albizia ferruginea</i>	T ; 20 m	B̃ ro	+	no	N
<i>Albizia glaberrima</i>	T ; 15 m	Nimba	+	N	N
<i>Albizia zygia</i>	T ; 20 m	Ziama	+	N	N
<i>Samanea dinklagei</i>	T ; 20 m	Ziama	+	yes	N

Nodulation of leguminous species from Guinea (continued)

Sub-family / Tribe /Species	Plant habit and height	Location	Nodulation	New species observed	New genus observed
PAPILIONOIDEAE					
SWARTZIEAE					
<i>Bobgunnia fistuloides</i>	T ; 15 m	Di'c k'	-	yes	no
SOPHOREAE					
<i>Amphimas pterocarpoides</i>			+	yes	yes
<i>Angylocaryx engaphynas</i>	S ; 4 m	Nimba	-	N	N
<i>Baphia nitida</i>	T ; 10 m	Nimba	+	no	no
<i>Baphia capparidifolia</i>	T ; 8 m	Di'c k'	+	yes	N
DALBERGIEAE					
<i>Dalbergia afzeliana</i>	V ; 35 m	Nimba	-	yes	no
<i>Dalbergia bignonae</i>	V ; 25 m	B' ro	+	N	N
<i>Dalbergia hostilis</i>	V ; 15 m	Ziama	+	N	N
<i>Dalbergia oblongifolia</i>	S ; V ; 10 m	Di'c k'	-	N	N
<i>Pterocarpus erinaceus</i>			+		
<i>Pterocarpus mildbraedii</i>			+		
<i>Pterocarpus santalinoides</i>			-		
MILLETTIEAE					
<i>Dalbergiella welwitschii</i>	S ; V ; 20 m	Nimba	-	yes	no
<i>Leptoderris brachyptera</i>	S ; V ; 20 m	Ziama	+	N	N
<i>Leptoderris fasciculata</i>	S ; V ; 20 m	Nimba	+	N	N
<i>Lonchocarpus cyanescens</i>	S ; V ; 30 m	Nimba	-	N	N
<i>Millettia dinklagei</i>	S ; V ; 15 m	Nimba	+	N	N
<i>Millettia griffoniana</i>	T ; 15 m	Nimba	-	N	N
<i>Millettia lucens</i>	S ; V ; 15 m	B' ro	-	N	N
<i>Millettia rhodantha</i>	T ; 12 m	Ziama	+	N	N
<i>Millettia zechiana</i>	S ; 10 m	Ziama	+	N	N
<i>Platysepalum hirsutum</i>	S ; V ; 20 m	Nimba	-	N	yes
<i>Tephrosia flexuosa</i>	S ; 1.5 m	Nimba	-	N	no
DESMODIEAE					
<i>Droogmansia scaettaiana</i>	H ; 2 m	Nimba	+	yes	no
PHASEOLEAE					
<i>Dioclea reflexa</i>	S ; V ; 15 m	Nimba	-	no	no
<i>Dolichos dinklagei</i>	S ; 1.5 m	Nimba	-	yes	N
<i>Dolichos tonkouiensis</i>	SZ ; 1.5 m	Nimba	+	N	N
<i>Erythrina milbraedii</i>	T ; 30 m	Ziama	+	N	N
<i>Erythrina senegalensis</i>	S ; 8 m	Di'c k'	+	no	N
<i>Mucuna flagellipes</i>	SZ ; VZ ; 5 m	B' ro	-	yes	N
<i>Mucuna poggei</i>	S ; V ; 20 m	B' ro	+	no	N
<i>Physostigma venenosum</i>	S ; V ; 6 m	B' ro	-	yes	yes
AESCHYNOMENEAE					
<i>Kotschya lutea</i>	S ; 2 m	Nimba	+	yes	no
<i>Kotschya ochreatea</i>	S ; 2.5 m	Nimba	+	N	N
<i>Ormocarpum megalophyllum</i>	S ; 1.5 m	Nimba	-	N	N
CROTALARIEAE					
<i>Crotalaria lathyroides</i>	S ; 2 m	B' ro	+	no	N

Occurence of nodulation in leguminous tree species of the Amazonian bassin (French Guyana)

Sub-family / Tribe /Species	Nodulation	New species observed	New gen us observed
CAESALPINIOIDEAE			
CAESALPINIEAE			
<i>Dimorphandra polyandra</i>	+	yes	no
<i>Tachigali melinonii</i>	+	no	N
<i>Tachigali myrmecophila</i>	+	yes	N
CASSIEAE			
<i>Chamaecrista diphylla</i>	+	no	no
DETARIAE			
<i>Macrolobium bifulium</i>	-	yes	no
MIMOSOIDEAE			
MIMOSEAE			
<i>Stryphnodendron pulcherrimum</i>	+	no	no
INGEAE			
<i>Hydrochorea corymbosa</i>	+	no	no
<i>Inga disticha</i>	+	N	N
<i>Inga sertulifera</i>	+	yes	N
<i>Zygia latifolia</i>	+	no	N
<i>Zygia cataractaeae</i>	+	N	N
PAPILIONOIDEAE			
SWARTZIEAE			
<i>Bocoa prouacensis</i>	-	no	no
<i>Swartzia polyphylla</i>	+	N	N
SOPHOREAE			
<i>Diploctropis purpurea</i>	+	no	no
<i>Ormosia coutinhoi</i>	+	N	N
<i>Spirotropis longifolia</i>	+	yes	yes
DALBERGIEAE			
<i>Andira inermis</i>	+	no	no
<i>Dalbergia monetaria</i>	+	N	N
<i>Hymenolobium flavum</i>	+	N	N
<i>Machaerium lunatum</i>	+	N	N
<i>Paramachaerium ormososioides</i>	+	N	N
<i>Pterocarpus officinalis</i>	+	N	N
<i>Vatairea erythrocarpa</i>	-	N	N
BRONGNIARTIEAE			
<i>Poecilanthé hostmannii</i>	+	no	no
PHASEOLEAE			
<i>Clitoria fairchildiana</i>	+	no	no
<i>Erythrina amazonica</i>	+	yes	N

Confirmation of nodulation status in nursery

Chidlowia sanguinea

Piptadeniastrum africanum

Erythrophleum ivorense

Tetrapleura tetraptera

Phylogeny of 16S rDNA

— 0.01 changes

ITS phylogeny of Bradyrhizobium rDNA

Plant Genus species: Amazonian species

Plant Genus species: Guinean species

Inoculation trials in Republic of Guinea

- Inoculation in nursery (50 replicates)
- Transplantation to the field after 3 months
- Field growth response after 4 months

Effect of rhizobial inoculation on growth of *Albizia* spp. and *Samanea dinklagei* (after 4 months)

Height

Effect of rhizobial inoculation on growth of *Millettia* spp. (after 4 months)

Height

Effect of rhizobial inoculation on growth of *Erythrophleum* spp. (after 4 months)

Height

CONCLUSION

- Tropical rainforests = huge reservoirs of symbioses
- Predominance of the genus *Bradyrhizobium*
- Need for collaborative research between plant and bacteria phylogenists
- Large potential of applications for reforestation with endangered species

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