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On the alkaloid content of the Zambezian dry evergreen climax forest and its herbivory co-evolution significance

Concernant les alcaloïdes de la forêt dense sèche climacique zambézienne et de la signification co-évolutive de son herbivorie

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Abstract : The aim of this study is to approach the alkaloid identification in diverse organs of plant species occurring in the climacic vegetation of Haut-Katanga and to analyze the implications concerning their consumption by herbivores. First, considerations related to plants secondary products and in particular to alkaloids are approached on the basis of diverse papers. Secondly, the contents of some studies dealing to this theme for climacic tropical vegetation are presented. The methodology used for putting in evidence the presence of alkaloids is developed. The results are set out and discussed. They concern 126 plant species related to 44 families and 91 genera. In conclusion, the importance of alkaloids for the ecosystem studied are far from being negligible, but nevertheless are set back of the published values for African equatorial dense forests.

Key words : Alkaloids, Dry evergreen forest, Haut-Katanga,

Résumé : L'objectif de cette étude est d'aborder l'identification des alcaloïdes dans divers organes des espèces végétales de la végétation climacique du Haut-Katanga et d'en analyser les implications concernant leur consommation par les herbivores. En premier lieu, des considérations relatives aux produits secondaires des plantes et en particulier aux alcaloïdes sont abordées sur base de divers articles. Ensuite, le contenu de quelques études concernant ce thème pour des végétations climaciques tropicales est signalé. La méthodologie utilisée pour mettre en évidence la présence d'alcaloïdes est développée. Les résultats obtenus sont présentés et discutés. Ils concernent 126 espèces végétales réparties en 44 familles et 91 genres.
En conclusion, l'importance des alcaloïdes dans l'écosystème étudié est loin d'être négligeable, mais se situe néanmoins en retrait des valeurs publiées pour des végétations de forêt dense équatoriale africaine.

Mots-clés : Alcaloïdes, Forêt dense sèche, Haut-Katanga,

INTRODUCTION

Plants produce secondary metabolites. These natural products include alkaloids, terpenoids, flavonoids, phenolics, cyanogenic/glycosides, non-protein amino-acids and other compounds considered unessential for basic processes and therapeutic effects (BRUNETON, 2016). The occurrence of secondary products has received attention in several fields of research. Firstly, they have been recognized as a useful factor in assessing systematic relationships, both at lower levels, mainly those of species and genus (e.g. BRAEKMAN et al., 1974, 1980). Secondly they have been studied from a phytochemical point of view (e.g. OHIRI et al., 1983). Third, they have been selected for an ecosystem screening approach in the discussion of co-evolution of herbivores

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(HLADIK & HLADIK, 1977). Fourthly, a broad discussion has been taken into consideration regarding whether these products are plant defense compounds or not (ROBINSON, 1974 ; JANZEN et al., 1977). Lastly, they are the subject of books, notably AZIMOVA & YUNUSOV (2013), BRUNETON (2016), as well as concerning ecogeographic perspective (LEVIN & YORK, 1978).

Alkaloids are divided into several large groups, such as pyrrolidine, pyridine, quinoline, isoquinoline, indole, quinazoline, and so forth (AZIMOVA & YUNUSOV, 2013). They are also divided into mains groups including peptides and cyclopeptide alkaloids, and true-, proto-, polyamine-, and pseudo-alkaloids (MEMARIANY et al., 2020).

The alkaloids are the largest group of secondary metabolites and one of the most structurally diverse one. Therefore the simple presence or absence of alkaloids constitutes only a first step of approach. If simple indol alkaloids are widespread in higher plants, remaining indole alkaloids are produced in a more complex biosynthetic route. Seco-loganin-type alkaloids, for instance, are almost completely confined to three closely related families : the Apocynaceae, the Loganiaceae and the Rubiaceae (KISAKUREK & HESSE, 1980 : LEEUWENBEG, 1980 ; GERSHENZON & MABRY, 1983). In the same way, benzylisoquinoline alkaloids are found predominantly in the Magnolidae (GUINAUDEAU et al., 1975). The distribution of a number of other classes of alkaloids is so scattered that it can only be explained by convergent evolution. Such is the case of tropane alkaloids (EVANS, 1979), pyrrolizidine alkaloids (SMITH & CULVENOR, 1981) and alkaloids of isoprenoid origin (PELLETIER & MODY, 1980).

GOMES & GOTTLIEB (1980) have suggested that, as angiosperms evolved from a woody to an herbaceous habit, their chemical strategies changed. According to them, the most primitive alkaloids were produced from the ordinary amino-acids such as ornithine and lysine and were superseded successively by phenylalanin, tyrosine, anthranitic acid and mevalonic acid.

The dry evergreen forest scattered through the Zambezian Region, sensu WHITE (1983), is generaly regarded as a climax vegetation type (SCHMITZ, 1963). On the one hand, its relationship to the equatorial rain forest is obvious, but on the other hand it constitutes the first step of a regressive succession « dry evergreen forest – open forest – wooded savannah » generally recognized for Upper Katanga (MALAISSE, 1982, 1983). The dry evergreen forest of Upper Katanga has been the subject of several important studies, notably DIKUMBWA (1990), DIKUMBWA et al. (2020), MALAISSE (1993) and MALAISSE et al. (2000). The presence of alkaloids in equatorial rain forest has been studied for Africa in Gabon (HLADIK & HLADIK, 1977), in Cameroon and Uganda (GARTLAN et al., 1980).

The particular position of the Zambezian dry evergeen forest makes it a useful subject of alkaloids prospection in view of pinpointing a strategy evolutionary shift from equatorial rain forest to dry tropical forest. This is the aim of the present paper.

METHODOLOGY

The methodology used is that previously used by MALAISSE et al. (1979) accordingly to the semi-quantitative method suggested by ABISCH & REICHSTEIN (1960). Alkaloids were considered to be present only if the six Abisch and Reichstein reagents produced a precitipate. This method permits detection of alkaloids values of less than 0.01% on samples of one g. The six reagents used are :

1.- Hager's reagent : 1% m/w aqueous solution of picric acid

2.- Sonnenschein's reagent : 5% m/w phosphomolybdic acid in 10% HNO_3

3.- Mayer's reagent : 1.358 g of $HgCl_2$ in 60 ml of water (Sol. A), 5 g of KI in 10 ml H_2O (Sol. B). Sol A and Sol B are mixed together before use and diluted up to 100 ml with distilled water

4.- Dragendorff's reagent : Solution A : 1.7 g basic sub-nitrate bismuth nitrate in 100 ml water/acetic acid (4 :1). Solution B : 40 g potassium iodide in 100 ml of water. Before use, 5 ml A, 5 ml B, 20 ml acetic acid and 70 ml water are mixed together

5.- Silicotungstic acid (12 % m/v in distilled water)

6 ;- Wagner's reagent (Iodo-potassium iodide) : 2 g of iodine and 6 g of KI are simultaneously dissolved in 100 ml of water.

Regarding the sample preparation, the plant specimens were led to dessicate at room temperature for 10 hours. After grinding, 1 g dry powder samples were macerated overnight with 10 ml methanol and during four hours at 50°C. The solutions were then filtered, concentrated to dryness, ressuspended in 2 ml of 1% hydrochloric acid and again filtered to discard unsolubilized product. The aqueous solutions were than alkalinized with concentrated ammonium hydroxyde (32% m/m NH_3) and finally extracted with 15 ml chloroform. The chloroformic extracts were concentrated to dryness and rediluted in exactly 0.5 ml chloroform which were transfered in small glass tube to be extracted with 0.5 ml 1% hydrochloric acid. Six drops of the aqueous phases (from Pasteur pipettes) were deposited on glass plates and tested for alkaloids with the six above metionned reagents.

The occurrence of alkaloid in a plant sample was considerd positive providing that all six reagents gave a precipitate. With such procedure, the limit of detection was of 0.01 $^{o}/_{o}$ alcaloid in 1 g dry sample.

RESULTS

We have checked up 126 plant species related to 44 families and 91 genera (Table 1). Concerning prsence of alkaloids, for the leaves we have 33(+), 93(-), for stems (mainly bark) we have 23(+), 84(-), for roots (mainly bark) we have 35(+), 65 (-), for the flowers we have 13(+), 27(-), for the floral axis we have 0(+), 1(-), for the floral base we have 1(+), 0(-), for the petal we have 0(+), 1(-), for the ripe fruit we have 5(+), 22(-), for the fruit pulp we have 0(+), 1(-), for the unripe fruit we have 2(+), 0(-), for the fruit envelope (exocarp and mesocarp) we have 4(+), 12(-) ; for the seed we have 4(+), 22(-), and for the unripe seed we have 1(+), 0(-), this putting the great total to 454 tests.

The tests on alkaloids' presence were positive for 48 species or 38,1%. Regarding organs, we obtain the following sequence, taking into account only organs with more than 20 tests available : roots (53,8% > flowers (48.0%) > leaves (35.5%) > stems (29.8%) > ripe fruits (22.7%) > seeds (18.2%).

According to the identification of alkaloids in the different families of the collected species, there are finally 21 species studied of the family Verbenaceae, among which 16 species contain alkaloids. In this family, alkaloids are more frequent in leaves (87.5%), the three other organs, roots, stems and flowers having the same percentage (56.3%). Secondly of the 19 Rubiaceae harvested, only 4 contain alkaloids, 2 species have alkaloids in the flower, one species in the fruit envelope and seed , one species in the root organ. Third, out of 9 Fabaceae collected, 3 species contain alkaloids, one in four organs (leaves, stems, roots and fruit envelope), one in two organs (stems and roots) and one only in roots. .

It is also noted that the 5 Annonacae harvested contain all alkaloids (100%). In this family, roots contain the most alkaloids (100%), followed by stems (60%) and leaves (40%). In the same way, 7 Apocynaceae were harvested and only 3 species contain alkaloids, one in the seven organs tested, one in three organs and one only in leaves. In addition, all three species of Loganiaceae contain alkaloids (100%) and the 2 species of Opiliaceae also (100%). Finally, out of 4 Lamiaceae harvested, there are only two species that contain alkaloids (50%).

DISCUSSION AND CONCLUSION

The Apocynaceae *Tabernaemontana pachysiphon* allows a special comment. It is the only species, coming from the Luiswishi dry evergeen forest that has positive results concerning alkaloid content for seven organs studied. This medium size evergreen tree, with a dense canopy and dark green shiny leaves, occurs in light forest and riverine forest. Its presence in Luiswishi evergeen climax forest in thus not surprising.

Six other species present alkaloid content for three organs studied (leaf, stem and root). They are: *Artabotrys collinus, Monanthotaxis schweinfurthii, Erythroxylon emarginatum, Strychnos lucens, Cissampelos owariensis* and *Teclea nobilis.* We will shortly review some of them. First, *Erythroxylon emarginatum* is an evergreen shrub of small tree up to 6 m height. He is mostly observed in evergreen fringing forest. His presence at Luiswishi site is thus not surprising. Similarly, *Strychnos lucens* is a woody evergeen climber that has been quoted for fringing forest and riverine forest (WHITE, 1962).

On the other hand, *Entandrophragma delevoyi*, a semi-evergeen tree, which can grown to 27-35 meters tall and which is strickly restricted to the Zambezian dry evergreen forest, in Katanga and Zambia (WHITE, 1962), as no alkaloid content for the three organs studied (leaf, stem and root).

Concerning the Verbenaceae, the frequent presence of alkaloids in various organs is confirmed. *Duratia repens* takes the top position with 8 positive results. Just behind are *Clerodendron uncinatum* (6 positive results) and *Clerodendrum tanganyikense* (5 positive results). It should be remain that those plants are not providing from the Luiswishi site but from other places in High-Katanga.

In conclusion, the importance of the alkaloids of the Zambezian dry evergreen climax forest are far from being negligible, but nevertheless are set back of the published values for African equatorial dense forests.

More over, it should be noted that we are unable to distinguish the nature of the predators for each species and thus also families and this in relation with the host plant or foodplant. The further researchs could concern the relations between predators and hosts and also the ways of metabolisation of alkaloids extracted from plants in order of better understanding if it processes from defense, feeding or detoxification.

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Table 1.- Research of alkaloids in the plant species of the dense dry climax evergreen forest of Luiswishi (Presently Upper-Katanga) and 22 species from other sites of Upper-Katanga. Vouch : Voucher references : F = Malaisse François ; KM = Kisimba Kibuye-Muzinga Yumba ; LS = Lumbu Simbi ; Vouchers deposited at Botanical Garden Meise.

(a) leaf ; (b) stem ; (c) root ; (d) flower ; (e) floral axis ; (f) floral base ; (g) petal ; (h) ripe fruit ; (i) fruit pulp ; (j) unripe fruit ; (k) fruit envelope ; (l) seed ; (m) unripe seed.

Family	Vouch.	Plant species	a	b	c	d	e	f	g	h	i	j	k	l	m
1. Anacardiaceae	F11889	*Lannea antiscorbutica* (Hiern.) Engl.	-	-	-										
	F9279	*Sorindeia katangensis* Van der Veken	-	-	-									-	
2. Annonaceae	F8680	*Artabotrys collinus* Hutch.	+	+	+										
	F8669	*Artabotrys monteiroae* Oliv.	-	+	+									-	
	F11893	*Melodorum gracile* (Engl. & Diels) Verdc.	-	-	+										
	F8975	*Monanthotaxis schweinfurthii* (Engl. & Diels) Verdc.	+	+	+										
	F7818	*Uvaria angolensis* Oliv. var. *angolensis*	-	-	+	-									
3. Apocynaceae	F9168	*Dichtyophleba lucida* (K.Schum.) Pierre	-	-	-										
	F10161	*Landolphia buchananii* (Hall.f.) Stapf	+	-	-					-					
	F9845	*Landolphia eminiana* Stapf	-	-	-										
	F10156	*Landolphia parvifolia* K.Schum. var. *parvifolia*	-	-	-										
	F11544	*Secamone erythradenia* K.Schum.	-	-	-	-					-			-	
	F9876	*Strophanthus welwitschii* (Baill.) K.Schum.	-	+	+	+							-	-	
	F9368	*Tabernaemontana pachysiphon* Stapf	+	+	+	+				+			+	+	
4. Capparaceae	F7863	*Ritchiaea quarrei* Wilczeck	-	-	-	-									
5. Chrysobalanaceae	F8577	*Parinari excelsa* Sabine	-	-	+					-				-	
6. Clusiaceae	F9596	*Garcinia huillensis* Welw. ex Oliv.	-	-	-										
	F11079	*Garcinia volkensii* Engl.	-	-											
7. Combretaceae	F11118	*Combretum acutifolium* Exell	-	-	-					-					
	F8674	*Combretum gossweileri* Exell	-	-	-									-	
8. Connaraceae	F9710	*Byrsocarpus orientalis* (Baill.) Baker	-	-	-					-				-	
9. Cucurbitaceae	F12390	*Coccinia subhastata* Keraudren	-												
	F12655	*Diplocyclos decipiens* (Hook.f.) C.Jeffrey	-	-											
10. Cyperaceae	F10470	*Cyperus phaeorhizus* K.Schum.	-	-	-	-									
11. Dichapetalaceae	F9086	*Dichapetalum bangii* K.(F.Didr.) Engl..	-	-	-					-				-	
12. Dipterocarpaceae	F7391	*Marquesia macroura* Gilg.	+	+	+									-	

13. Ebenaceae	F9593	*Diospyros hoyleana* F.White subsp. *hoyleana*	-	-	-	-				-					
	F7619	*Diospyros mespiliformis* Hochst. ex A.DC.	-											-	
	F6047	*Euclaea schimperi* (A.DC.) Dandy	-	-											
14. Erythroxylaceae	F9154	*Erythroxylum emarginatum* Thonn.	+	+	+										
15. Euphorbiaceae	F11033	*Sapium schmitzii* J.Léonard	-	-	+								-	-	
16. Fabaceae	F9751	*Abrus pulchellus* Thw. subsp. *tenuiformis* (Benth.) Verdc.	-	-	-										
	F6483	*Albizzia adianthifolia* (Schumach.) W.F.Wight	-	-	+									-	
	F9751	*Baphia capparidifolia* Bak. subsp. *bangweolensis* (R.E.Fries) Brumitt				-							-	-	
	F7842	*Brachystegia spiciformis* Benth. var. *schmitzii* Hoyle	-	+	+	-								-	
	F6560	*Brachystegia taxifolia* Harms	-	-	-										
	F7803	*Dalbergia hostilis* Benth.	-	-	-										
	F9545	*Erythrophleum suaveolens* (Guill. & Perr.) Brenan	+	+	+								+	-	
	F9112	*Leptoderris nobilis* (Welw. ex Baker) Dunn	-	-	-	-							-	-	
	F12620	*Rhynchosia albiflora* (Sims) Alston	-	-	-										
17. Flacourtiaceae	F1820	*Rawsonia lucida* Harv. & Sond.	-	-	-								-	-	
18. Hypericaceae	F9268	*Psorospermum tenuifolium* Hook.f.	-	-	-					-				-	
19. Icacinaceae	F9982	*Apodytes dimidiata* E.Mey. subsp. *dimidiata*	+	-	+									-	
	F6750	*Rhaphiolstylis beninensis* (Hook.f. ex Hook.) Planch. ex Benth. in Hook.	+	-	+					+					
20. Iridaceae	F12654	*Crocosmia pauciflora* Milne-Red.	+	-	+					+					
21. Lamiaceae	LS 04	*Vitex fischeri* Gürke	+	-	-										
	F8619	*Vitex fischeri* Gürke	-	-	-								-	-	
	LS 02	*Vitex madiensis* Oliv. subsp. *milanjensis* (Britten) F.White	+	-	-										
	LS 03	*Vitex mombassae* Vatke	-	-	-										
22. Loganiacae	F7762	*Antotocleista schweinfurthii* Gilg.	+	+	+										
	F7806	*Strychnos angolensis* Gilg.	-	+	+										
	F7837	*Struchnos lucens* Bak.	+	+	+										
23. Loranthaceae	F12938	*Agelanthus zizyphifolius* (Engl.) Pohl. & Wiens subsp. *vittatus* (Engl.) Pohl. & Wiens	-												
24. Melastomataceae	F12370	*Memecylon flavovirens* Bak.	-	-	-										
25.Meliaceae	F9890	*Entandrophragma delevoyi* De Wild.	-	-	-									-	
26. Menispermacae	F9297	*Cissampelos owariensis* P.Beauv. ex DC.	+	+	+										
27. Moraceae	F7777	*Ficus artocarpoides* Warb.		-	-										
	F7845	*Ficus craterostoma* Milb. & Burret	-	-	-					-					
	F11882	*Ficus ottonifolia* (Miq.) subsp. *macrosyce* C.C.Berg	-												

28. Myrtaceae	F9923	*Syzygium guineense* (Wild.) DC. subsp. *afromontanum* F.White	-	-	-										
29. Ochnacae	F12615	*Ochna afzelii* R.Br. ex Oliv.	-	-	-										
	F8654	*Ochna puberula* N.Robson	-	-	-	-									
30. Opiliaceae	F7870	*Opilia celtidifolia* (Guill. & Perr.) Endl.	-	-	+					-				-	
	F7866	*Rhopalopilia marquesii* (Engl.) Engl.	+	-	-					-				-	
31. Orchidaceae	F9296	*Cynorkis kassnerana* Kraenzl. subsp. *kassnerana*.	-												
	F9651	*Microcoelia koechgleri* (Schl.) Summerh.	-												
32. Passifloraceae	F9976	*Adenia rumicifolia* Engl. & Harms var. *rumicifolia*	-	-	-								-	-	
33. Phyllanthaceae	F6789	*Bridelia cathartica* Bertol.	-	-	-										
	F8960	*Bridelia duvigneaudii* J.Léonard	-	+	+										
	F12928	*Cleistanthus milleri* Dunkley	+	-	-										
34. Poaceae	F7881	*Bromulonia gossweileri* Stapf & Hubb.	-												
	F12759	*Megastachya mucronata* (Poir.) P.Beauv.	-												
	F12618	*Oplismenus hirtellus* (L.) P.Beauv.	-												
	F12606	*Panicum lineatum* Trin.	-												
35. Proteaceae	F11083	*Faurea saligna* Harv.	-												
36. Rubiaceae	F9400	*Aidia micrantha* (K.Schum.) F.White var. *msonju* (K.Krause) Petit	-	-	-					-					
	F7851	*Canthium gueinzii* (Sond.) Hiern	-	-	-					-					
	F9353	*Canthium venosum* (Oliv.) Hiern	-	-	-					-				-	
	F9908	*Craterispermum laurinum* (Poir.) Benth.	-	-	-										
	F9396	*Cremaspora triflora* (Thonn.) K.Schum..											-	-	
	F9653	*Geophila obvallata* (Schumach.) F.Didr. subsp. *ioides* (K.Schum.) Verd.	-												
	F8688	*Mussaenda arcuata* Lam. ex Poir.	-	-	-	-				-					
	F9689	*Othiophora scabra* Zucc. var. *scabra*	-	-	-										
	F9398	*Psychotria linearisepala* Petit var. *linearisepala*	-	-	+										
	F7979	*Rothmania whitfieldii* (Lindl.) Dandy	-	-	-	-							+	+	
	F8656	*Rutidea fuscescens* Hiern. subsp. *fuscescens*	-												
	F9601	*Rytigynia umbellulata* (Hiern.) Robyns	-	-		+									
	F9587	*Rytigynia* sp.	-												
	F9607	*Sericanthe andongensis* (Hiern) Robbrecht var. *mollis* Robbrecht	-	-	-	-									
	F13411	*Tarenna neurophylla* (S.Moore) Bremek.	-	-											
	F13425	*Tarenna pavettoides* (Harv.) Sim. subsp. *gilmannii* Bremek. ex Bridson	-	-	-										

	F9595	*Tricalysia myrtifolia* S.Moore	-	-		+									
	F9355	*Tricalysia nyassae* Hiern	-	-	-										
	F9122	*Vangueriopsis lanciflora* (Hiern) Robyns	-												
37. Rutaceae	F12522	*Teclea nobilis* Delile	+	+	+										
38. Sapindaceae	F12558	*Allophylus abyssinicus* (Hochst.) Radlk.	-	-	-					-				-	
39. Sapotaceae	F11035	*Afrosersalisia cerasifera* (Welw.) Aubrév.	-	-	-								-	-	
	F9802	*Bequaertiodendron magalismontanum* (Sond.) Heine & J.H.Hemst.	-	-	-										
40. Sterculiaceae	F12808	*Sterculia tragacantha* Lindl.	-	-	-					-				-	
41. Thymelaeaceae	F9922	*Craterosiphon schmitzii* A.Robyns	-	-	-										
42. Tiliaceae	F8683	*Grewia schmitzii* Wilczek	+							-					
	F9763	*Triumfetta pedunculata* De Wid.	-	-	-										
43. Verbenaceae	KM 10	*Clerodendrum aff. ugandense* Prain	-	-	-					-					
	LS 11	*Clerodendrum buchneri* Gürke	+	+	+	+								-	
	LS 06	*Clerodendrum capitatum* (Wild) Schum. & Thonn.	+	+	+	+		+						-	
	KM 18	*Clerodendrum corbisieri* De Wild.	-	-	-										
	LS 23	*Clerodendrum formicarinum* Gürke	+	+	+	+									
	LS 21	*Clerodendrum laxicymosum* De Wild.	+	+	+	+	-		-			+			
	KM 03	*Clerodendrum myricoides* R.Br. var. *chartaceum* Moldenke	+	+		+				-					
	LS 18	*Clerodendrum quadrangulatum* Thomas.	+	-	-										
	KM 01	*Clerodendrum schweinfurthii* Gürke	-	-	-	-									
	LS 20	*Clerodendrum splendens* G.Don.	-	-	-	+									
	LS 05	*Clerodendrum tanganyikense* Baker	+	+	+	+							+		
	LS 07	*Clerodendrum uncinatum* Schinz.	+	+	+	+				+				+	
	F9922	*Clerodendrum wildii* Moldenke	+												
	LS 17	*Duranta erecta* L.	+	+	+	+				+		+		+	+
	LS 15	*Gmelina arborea* Roxb.	+	+	+	-				-			-	-	
	LS 01	*Lantana camara* L.	-	-	-	-					-		-		
	LS 10	*Lantana virbunoides* (Forssk.) Vahl	-	-	+	-									
	LS 08	*Lippia javanica* (Burm. F.) Spreng.	+	-	-	-				-			-		
	LS 26	*Lippia plicata* Baker	-	-	-	-									
	LS 12	*Premna angolensis* Gürke	+	-	+										
	LS 29	*Premna senensis* Klotzsch.	+	-	-	-				-					
44. Vitaceae	F12837	*Cissus aralioides* (Welw. ex Bak.) Planch.	-	-	-										
	F9999	*Cissus petiolata* Hook.f..	-	-	-										
	F12504	*Cyphostemma hildebrandtii* (Gilg.) Descoings.	-	-	-										