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Assessment of the infestation of Loranthaceae on shade trees in cocoa-based agrosystems: case of the experimental field of the site of the University Jean Lorougnon Guédé (Côte d'Ivoire)

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ABSTRACT

In Côte d'Ivoire, in agrosystems, many trees and shrubs are tolerated because of the shade they provide to crops. However, these woody plants are attacked by Loranthaceae and make them privileged hot of infestation in orchards. The inventories by surface surveys were carried out in the experimental cocoa field on the Jean Lorougnon Guédé University site to identify the species of Loranthaceae and their host. In total, two (2) parasitic species (P. capitata and T. bangwensis) were encountered. The taxonomic diversity of host plants is 23 species belonging to 20 genera and 14 families. Fabaceae (13.63%) is the richest family in infested species. The results revealed a high infestation rate based on the DBH of the host taxa. The infestation rate of the hosts taken together is in the order of 27.624% and the infestation intensity is 1.87 tufts/tree. The field presented an infestation rate of the order of 15.97±6.81% and an infestation intensity of 2.39±0.34 tufts/tree.

INTRODUCTION

In sub-Saharan Africa, the destruction of forests year after year by the improper felling of trees and shrubs has manifold ecological consequences. In Côte d'Ivoire in agrosystems, the woody species spared in orchards for the shade they provide to crops have over time become focal point of Loranthaceae infestation commonly called "African mistletoe" for these crops (Amon *et al*., 2010). Today, few trees and shrubs are not parasitized by Loranthaceae (Amon, 2006). Indeed, these epiphytoid hemiparasitic phanerogams attack and invade in large numbers the shade species encountered particularly in cocoa field (Soro *et al*., 2009). According to Boussim (2002), the Loranthaceae, once implanted on the trunk or the

branches of the host, take with the helper of a system called sucker, the water and the mineral salts of the latter to ensure their own development. By this process of infestation, they are able to produce their own photosynthesis and live as long at the expense of this host; which makes these parasitic plants real dangers for any cultivated or spontaneous woody species that they parasitize (Salle, 2004; Soro, 2006). Despite the numerous inventories carried out in Côte d'Ivoire, in order to understand these parasitic plants and their host plants (Traoré *et al*., 2003, Soro, 2010; Amon, 2014), no specific study on the degree of infestation of species shading by these same phytoparasites in cocoa-based agrosystems has not been carried out to our knowledge in the Central-West of Côte d'Ivoire, an important cocoa production area (N'Guessan *et al*., 2014). It therefore seems important to carry out a qualitative inventory of woody plants tolerated as shade species in the experimental cocoa growing field on the site of the University Jean Lorougnon Guédé and to assess their state of infestation by species of the family of Loranthaceae.

MATERIAL AND METHODS

Study area

The study area is located in the department of Daloa, in the Central-West of the Côte d'Ivoire between 06º51′40.7″ North latitude and 006º21′22.6″ West longitude (Fig. 1). It is in the Guinean domain characterized by an equatorial type climatic regime comprising two rainy seasons and two dry seasons (Eldin, 1971). Monthly precipitation varies between 1300 mm and 1800 mm. Its vegetation is from the mesophilic sector of the Guinean domain, today, made up of a mosaic of forests and savannas (Guillaumet & Adjanohoun, 1971; Monnier, 1983).

Material

The plant material was composed of Loranthaceae and woody plants found in the experimental field of cocoa. The technical equipment includes a geographical positioning device (GPS), a digital camera, a tape measure, sisal wires and data sheets.

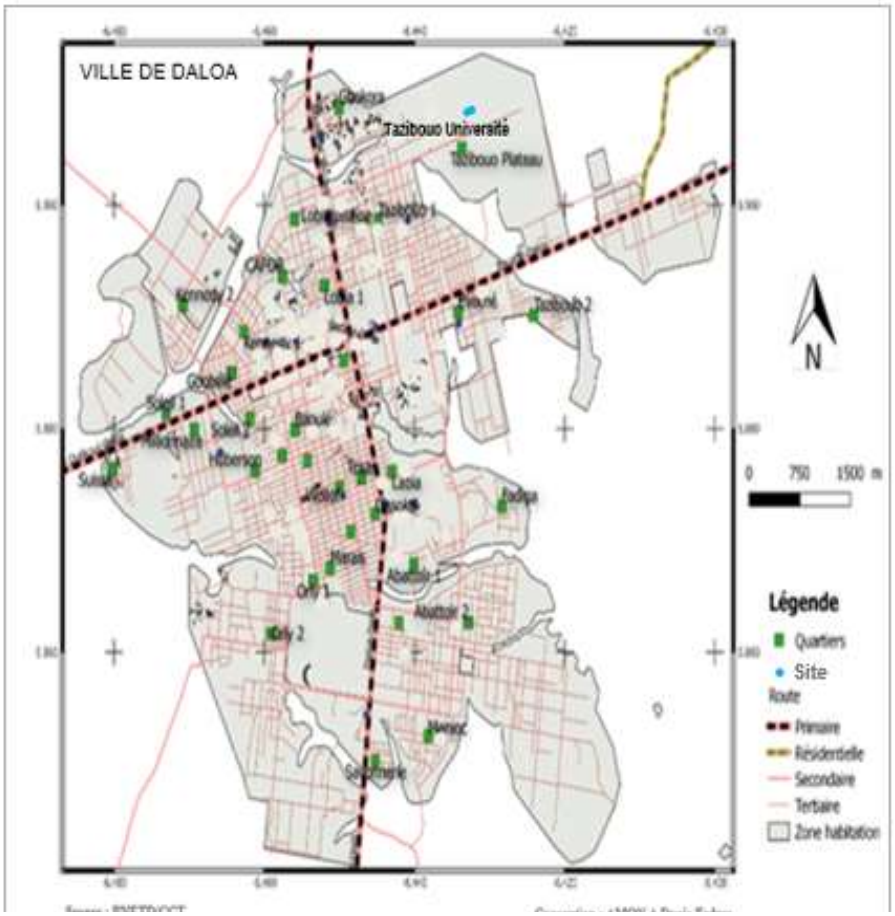

Figure 1: Location of the prospected site in the Daloa city

METHODS

Data collection

For the floristic inventory of shade species, hosts of vascular plants of the Loranthaceae family, the surface survey method which consists of listing shade trees and shrubs encountered on square or rectangular areas (Hall & Swaine, 1981), coupled by direct observations in order to note the presence or absence of Loranthaceae species (Soro, 2010) were adopted in the experimental cocoa field on the Jean Lorougnon Guédé University site. The inventory consisted of counting the non-parasitized individuals and those parasitized of shade trees and shrubs, the parasitic species and the number of their tufts on each woody plant was carried out from three survey plots of 20m×20m (400m²) delimited in the field. The total height of individuals of shade trees and shrubs and their diameter at breast height (DBH at 1.30 m from the ground) were also registered. The presence or absence of the parasite and the number of its clumps by these woody plants have been noted. The data collected made it possible to determine the rate and intensity of infestation of Loranthaceae in the experimental cocoa cultivation plantation according to the formula used by Amon (2006):

- Infestation rate (Txi):

$$Txi = \frac{Nip}{Nti} \times 100$$

with Txi - Infestation rate; Nip - Number of parasitized individuals; Nti - Total number of individuals identified;

- Intensity of infestation (Ii):

$$Ii = \frac{Nt}{Ntii}$$

with Ii - Intensity of infestation; Nt - Total number of Loranthaceae tufts; Ntii - Total number of infected individuals identified.

Statistical analysis

The data generated were subjected to one-way analysis of variance (ANOVA) to compare the mean values of the infestation rates and intensities of Loranthaceae on shade species. Statistical analysis was performed using STATISTICA version 7.1 software. This program provides, in the event of significant differences, for a comparison of the means (Dagnelie, 1980), by Duncan's test at the 5% threshold ($\alpha < 0.05$).

RESULTS

Loranthaceae species encountered

Two species of Loranthaceae were found on cocoa trees and woody shade plants in the orchard. These are *Phragmanthera capitata* (Spreng.) Ballé (Fig. 2) and *Tapinanthus bangwensis* (Engl. And K. Krause) Danser (Fig. 3). *T. bangwensis* is the most common and abundant species with 77% of the host spectrum registered.

Figure 2: Flora twigs of *P. capitata*

Figure 3: Inflorescences of *T. bangwensis*

Loranthaceae host shade species

Twenty-two (22) shade species hosts of Loranthaceae belonging to 20 genera and 15 families were inventoried in the experimental field in cocoa trees studied on the University Jean Lorougnon Guédé site (Table 1). The Fabaceae are the richest family in host species with 3 species, either 13.63% of the total host species. It is followed by the Apocynaceae the Bignoniaceae, the Bombacaeae, Meliaceae and the Rubiaceae with each 2 species (9.09%). The remaining families each have between 1 species (4.54%). In terms of numbers of species, the richest genus are *Albizia* (3 species, either 15% of total genera) and *Citrus* (3 species, or 7.31% of total genera). All other 21 genera have a separate taxon (4.54%). We cite other *Annona, Adansonia, Alstonia,*

Bombax, Ceiba, Cola, Morinda, Newbouldia and *Persea*.

Morphologically, the shade host species identified are divided into 4 groups: mesophanerophytes (mp) with 13 infested species (59.09%), microphanerophytes (mP) with 5 infested species (27.72%), megaphanerophytes (MP) with 3 infested species (13.63%) and lianescent mesophanerophytes (Lmp) with 1 infested species (4.54%).

Table 1: Lists of shade species hosts of Loranthaceae and their degree of infestation

Nº	Epecies	Families	Types biological	Parasitic species		Inft rate (%)	Intensity inft
				Pc	*Tb*		
1	*Spondia mombin* Linn.	Anacardiaceae	mP	+	+	31.57	2.50
2	*Annona* sp Linn.	Annonaceae	Lmp	-	+	7.15	1.25
3	*Alstonia boonei* De Wild	Apocynaceae	MP	-	+	45.33	2.10
4	*Hollarhena floribona* (G. Don) Dur. & Schinz var.	Apocynaceae	mP	+	-	21.70	1.18
5	*Albizia adianthifolia* (Schumach.) W. Wight	Fabaceae	mP	+	+	35.44	2.46
6	*Albizia lebbeck* (Linn.) Benth.	Fabaceae	mp		+	40.33	2.09
7	*Albizia zygia* (DC.) J. F. Machor.	Fabaceae	mP	+	+	41.25	2.20
8	*Newbouldia laevis* (P. Beauv.) Seemann	Bignoniaceae	mp	-	+	8.22	1.00
9	*Spathodea campanulata* P. Beauv.	Bignoniaceae	mp	+	-	11	1.85
10	*Bombax buonopozense* P. Beauv.	Bombacaceae	MP	+	+	50	2.50
11	*Ceiba pentadra* (L.) Gaertn.	Bombacaceae	MP	-	+	47.85	3.53
12	*Persea americana* Mill.	Lauraceae	mP	+	+	43.27	2.48
13	*Theobroma cacao* Linn.	Malvaceae	mp	+	+	25	1.60
14	*Milicia excelsa* (Welw.) C. C. Berg	Moraceae	mP	-	+	17	1.00
15	*Cedrela odorata* C. V. Linné	Meliaceae	mp	+	-	18.95	1,00
16	*Trichilia megalantha* Harms	Meliaceae	mp	+	-	9.25	1.15
17	*Psidium guajava* Linn.	Myrtaceae	mp	-	+	35	2
18	*Margaritaria discoidea* (Baill.) G.L.Webster	Phyllanthacea e	mp	-	+	8.33	1.25
19	*Morinda lucida* Benth.	Rubiaceae	mp	+	-	25	1.80
20	*Citrus sinensis* (L.) Osbeck	Rutaceae	mp	+	+	35.38	2.25
21	*Coffea canephora* A. Froehner	Rutaceae	mp	-	+	7.35	1.15
22	*Cola nitida* (Vent.) Schott & Endl.	Sterculiaceae	mP	+	+	43.35	3.00
Total				13	17	27.62	1,87

NB : *Pc - Phragmanthera capitata*, *Tb - Tapinanthus bangwensis*, inft - infestation

Prevalence of shade species infestations

Table 1 shows the rate and intensity of infestation of Loranthaceae on the 22 shade species inventoried in the experimental cocoa field. Loranthaceae host infestation rates vary between 7.15 in *Annona* sp. and 50% in *Bombax buonopozense*. Among these host taxa, field megaphanerophytes (PM) have high rates of infestation (Fig. 4). Mention is made of *Bombax buonopozense* (50%), *Ceiba pentadra* (47.85%) and *Alstonia boonei* (45.33%).

Then come the microphanerophytes (mP) among others *Cola nitida* with an infestation rate of 43.35%, *Persea americana* (43.27%), *Albizia zygia* (41.25%), *A. lebbeck* (41.25%) and *A. adianthifolia* (39.44%). Likewise, in the cohort of 22 hosts, the weakest attacks were registered in mesophanerophytes with the species *Annona* sp. (7.15%).

Figure 4: Some shade species, hosts of Loranthaceae: *A. lebbeck* (a), *C. pentandra* (b), *B. buonopozense* (c) and *P. americana* (d)

Regarding the intensity of the infestation, the averages obtained vary between 1 and 3.53 tufts/tree (Table 1). Shade host species such as *C. pentadra* (3.53 tufts/tree), *Cola nitida* (3 tufts/tree), *Spondia mombin, B. buonopozense* and *P. americana* (2.48) show high infestation intensities. In addition, the lowest infestation intensities (1%) were registered in two host species. We cite: *Newbouldia laevis* and *Milicia excelsa*.

Overall, the rate of infestation of shade species inventoried by Loranthaceae in the experimental cocoa farming field of the Jean Lorougnon Guédé University site is around 27.62% and the infestation intensity is 1.87 tufts/tree (Table 1).

Infestation according to the height and diameter classes of shade species

Figure 5A indicates the levels of infestation of Loranthaceae in relation to the diameter classes of individuals of trees and shade shrubs identified. The rate of infection increases with the diameter of the host species. The strong hosts are the most infested. The classes determined differ from others in terms of the rate of infestation. In the diameter classes (16-20 years) and (> 20 year), the average rates of infested individuals are 21.60±10.50% and 29.08±10%, respectively. The low rate of infestation (5.33±2.90%) is recorded in the diameter class (0-5 years). Analysis of variance indicates a significant difference according to Duncan's test (p=0.02; F=4.77) between 5 statistically different groups a, ab, abc, bc and c (Figure 5A).

Regarding the height analysis, we also note a significant difference between the infestation rates of Loranthaceae on shade species according to their height classes. The infestation rates are statistically distinguished according to Duncan's test (p=0.03; F=6.33) through 3 homogeneous groups a, ab and b for the different height classes of shade trees and shrubs with a higher class infestation rate (> 20 year) (Figure 5B).

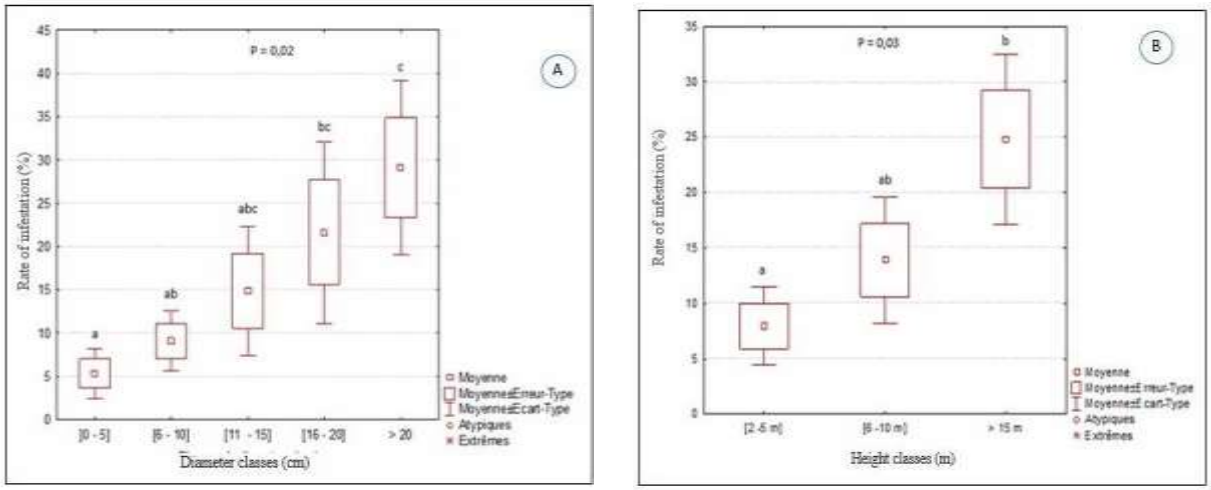

Figure 5: Rate (A) and intensity of infestation (B) of Loranthaceae on shade species according to diameter and height classes

Infestation of the experimental field

The values of the infestation rate of cocoa trees by Loranthaceae registered in the experimental field of the Jean Lorougnon Guédé University site vary from 18.18% to 21.42% (Table 2). Individuals of cocoa trees in plot 1 (Pl1) are the most parasitized with an infestation rate of around 21.42%. Then come those of plot 3 (Pl3) with a rate of 18.18%. The cocoa trees in plot 2 (Pl2) are the least infested with Loranthaceae (8.33%). Regarding the infestation intensity, Pl1 registered a high infestation intensity of the order of 2.67 tufts/tree (Table 2). Likewise, the lowest intensity of infestation is recorded in individuals of Pl2.

Table 2: State of infestation of the experimental field by Loranthaceae

Experimental field	Total number of plants/plot	Number of parasitized plants/plot	Number of tufts/plot	Infestation rate (%)	Infestation intensity
Plot 1	14	3	8	21.42	2.67
Plot 2	12	1	2	8.33	2
Plot 3	11	2	5	18.18	2,5
Total	37	6	15	15.97±6,81	2.39±0.34

DISCUSSION

The study identified two species of Loranthaceae (*Phragmanthera capitata* and *Tapinanthus bangwensis*), parasites of shade trees and shrubs in the experimental cocoa cultivation field at the Jean Lorougnon Guédé University site. The number of two species encountered is lower than the four Mrankpa species (2018) inventoried on the University Jean Lorougnon Guédé site. The difference noted could be explained by the size of the prospected area. Indeed, Mrankpa (2018) made an inventory over the entire Jean Lorougnon Guédé University site.

Twenty-two (22) shade host species of Loranthaceae belonging to 20 genera and 15 families were inventoried in this experimental field. This number is significantly lower than those of the 41 host species and 21 families obtained by Sako (2019) in the village fields in the surrounding areas of the University Jean Lorougnon Guédé. These results also corroborate those of Amon (2006), in Côte d'Ivoire and Houenon (2012), in Benin who have already reported the polyphagous character of parasitic vascular plants of the Loranthaceae family which parasitize different families of trees and shrubs in sub-Saharan Africa.

The rate of infestation of shade species by Loranthaceae registered in the experimental cocoa field is of the order of 27.62%. This value of the infestation rate obtained is significantly lower than that of 35.25% registered by Sako (2019) in cocoa agrosystems in surrounding areas of the University Jean Lorougnon Guède. This observed difference could be explained by the level of cared of the plots. Indeed, the field studied by this author were fewest cared and aged.

The enumerated cohort of shade host species exhibited numerically high infestation rate values

according to diameter and height classes. These results confirm the work of Mranpka (2018).

The infestation rate of the experimental cocoa field is of the order of 15.97±6.81%. This rate is clearly lower than the 42.86±7.02% of Amon *et al*. (2020) obtained by in agrosystems based on cocoa trees in riparian areas of the University Jean Lorougnon Guédé. This difference could be justified by the age of the farms as well as by the care. Indeed, the plantations studied by this author are older and poorly cared.

CONCLUSION

Loranthaceae pose a serious threat to cocoa trees and other woody shade plants in orchards. The experimental cocoa farming field at the Jean Lorougnon Guédé University site parasitized by two species of Loranthaceae (*P. capitata* and *T. bangwensis*). This field abounds within 22 species of shade hosts of Loranthaceae belonging to 20 genera and 15 families. The infestation rate values of these woody plants by Loranthaceae vary from species to species and also according to their diameter and height classes. The field presented an infestation rate of the order of 15.97±6.81% and an infestation intensity of 2.39±0.34 tufts/tree. The results of this study could be used as an implement in making decisions concerning the conservation of certain species in fields for a sustainable agriculture.

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Conflict of Interests

Authors declare that they have no conflict of interest.

REFERENCES

Amon A. D. E. (2006). Les plantes vasculaires parasites de la famille des Loranthaceae rencontrées dans le Département de Grand-Bassam, au Sud de la Côte d'Ivoire. Mémoire de DEA de Botanique, Université de Cocody, UFR Biosciences Abidjan, Côte d'Ivoire, 57p.

Amon, A. D. E. (2014). Les Loranthaceae (guis), hémiparasites vasculaires des arbres et des arbustes des agroécosystèmes de la région du Sud-Comoé, en zone de forêt dense sempervirente de la Côte d'Ivoire. Mémoire de Thèse de l'Université Félix Houphouët-Boigny, option Agroforesterie, 213p.

Amon, A .D. E., Soro D., N'guessan K. & Traore D. (2010). Loranthaceae : Vascular parasitic plants of trees and shrubs in south-east Côte d'Ivoire. *Journal applied Biosciences* 25, 1565-1572.
http://www.m.elewa.org/JABS/2010/25/25-january-2010.html

Amon, A. D. E., Koulibaly, A.V. & Sako, H. (2020). Parasitism of Loranthaceae on crops: case of plantations in rural area on the periphery of Jean Lorougnon Guédé University of Daloa, Central-West Côte d'Ivoire. *World Journal of Advanced Research and Reviews*, 07(02), 155-167.
https://doi.org/10.30574/wjarr.2020.7.2.0293

Boussim, I. J. (2002). Les phanérogames parasites du Burkina Faso : inventaire, taxonomie, écologie, et quelques aspects de leur biologie. Cas particulier des Loranthaceae parasites du karité. Thèse de Doctorat d'Etat ès Sciences Naturelles, FAST, Université de Ouagadougou, 285p.

Dagnelie, P. (1980). Théorie et méthodes statistiques, application agronomique. Vol. 2. Gembloux, Belgique: *Presses agronomiques de Gembloux*. http://www.dagnelie.be/autrepub.html. [Consulted 15/06/2020].

Eldin, M. (1971). Le climat. *In* : Le Milieu naturel de Côte d'Ivoire. Editions ORSTOM. Paris, 77-108.

Guillaumet, J. L. & Adjanohoun, E. (1971). La végétation. *In* : le milieu naturel de la Côte d'Ivoire. Mémoire ORSTOM, 50 : 157-263.

Hall, J. B. & Swaine M.D. (1981). Distribution and ecology of vascular plants in a rain forest vegetation in Ghana. *Geobotany*, 383p.

K. Soro, G.M. Gnahoua, & D. Traoré. 2009. Parasitisme des Loranthaceae dans les plantations de Légumineuses arborescentes en zone forestière de la Côte d'Ivoire. *Agronomie Africaine* 21 (1), 59-69.

Monnier Y., 1983 - Carte de la végétation de la Côte d'Ivoire. *In* **:** Vennetier P. et Laclavere G**.** (eds.). Atlas de la Côte d'Ivoire.2e éd., *Jeune Afrique*, Paris, France, 16-19.

Mrankpa, A. S. (2018). Diversité des Loranthaceae (guis) et des plantes hôtes du site de l'Université Jean Lorougnon Guédé, Côte d'Ivoire. Mémoire de Master de Bioressources et Agronomie, Option: Foresterie, Université Jean Lorougnon Guédé, Daloa, 60 p.

N'guessan, A. H., N'guessan K. F., Kouassi, K. P., Kouamé, N. N. & N'guessan, P. W. (2014). Dynamique des populations du foreur des tiges du cacaoyer, *Eulophonotus mymeleon* Felder (Lépidoptère: Cossidae) dans le région du Haut-Sassandra en Côte d'Ivoire. *Journal of Applied Biosciences* 8: 1-11. http://dx.doi.org/10.4314/jab.v83i1.11

Sako, H. (2019). Parasitisme des Loranthaceae sur les cultures : Cas des plantations des zones riveraines de l'Université Jean Lorougnon Guédé (Côte d'Ivoire). Mémoire de Master de Bioressources et Agronomie, option : Foresterie, Université Jean Lorougnon Guédé, Daloa, 58P.

Salle G. (2004). Les plantes parasites, 14p. http://www.futura-sciences.com/magazines/ botanique-plantes parasites. [Consulted 17/05/2020].

Soro, D. (2006). Le karité, *Vitellaria paradoxa* Gaertn.f. (Sapotaceae). Variabilité de quelques caractères morphologiques, production en fruits et moyen de lutte par émondage contre les Loranthaceae parasites. Le cas du parc naturel à karité de

Tengrela, Nord de la Côte d'Ivoire. Mém. de thèse, UFR Biosciences, Université de Cocody (Côte d'Ivoire), 142p.

Soro, K. (2010). Les Loranthaceae (guis) des agroécosystèmes dans l'Ouest de la Côte d'Ivoire: flore, parasitisme et usages dans les Départements de Oumé, de Gagnoa et de Soubré. Mémoire de Thèse de l'Université de Cocody-Abidjan, option Agroforestérie, 183p.

Traoré, D., Da K. P., Soro D. (2003). Lutte contre les plantes vasculaires parasites du Karité, dans le Nord de la Côte d'Ivoire. Cas du parc naturel à karités de Tengrela. Université de Cocody. U.F.R. Biosciences. Laboratoire de Botanique. Rapport du P.E.P. A.I.S.A.-CI, 116 p.

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