Chapter

Aspects of the Biology and Ethnobotany of Parasitic Angiosperm Species in Nigeria

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Abstract

Parasitic plants continue to gain research attention due to their remarkable lifestyle pattern that clearly cites them as a typical example of a biological oddity. They have defiled the basic characteristics of plants to become dependent on other plants for existence. Aside from their unique heterotrophic mode of feeding, host range and preference, seed germination clues, distribution patterns vary across different parasitic plants, which has partly ensured their presence in virtually every plant community. Among the above-listed factors, host range and preference, in particular, appears to be a major significant factor that shapes their distribution around the world, enabling certain species to thrive in various microclimates. The Nigerian environment has heterogeneous vegetation, traversing mangroves, rainforest, savannah vegetation, and its home to host parasitic plant species, including endemic, natives, and exotic ones. The present chapter gathered and synthesized available information regarding parasitic plants in Nigeria, particularly their biology and the host species supporting their population. Aside from the devastating menace some parasitic plants are known for, this report recognizes their ethnobotanical relevance. Thereby stimulating research interest in these highly specialized plant groups.

Keywords: Ethnobotany, Parasitic plants, host species, Nigeria

1. Introduction

Parasitic plants are an exceptional group of plants that have defiled plants' basic characteristics of solely synthesizing their own organic nutrient into dependent on other plants for survival [1]. Consequently, they have adapted to an association with a host plant using a physiological bridge known as the haustorium, where water and organic nutrients are transported [2]. This form of association enables the host plant to shape the distribution of the parasite. Based on the degree of host dependence, parasitic plants can exert their impact on an individual or community basis; some parasitic plants, for example, *Striga*, can severely reduce host performance, leading to host death, while others like *Thonningia sanguinea* exert a mild effect on its host. On a community scale, parasitic plants can significantly orchestrate changes in community structure, diversity, vegetation cycling, and zonation by either altering the competitive balance between host and nonhost plants [3] or necessitating an irregular uptake of host solutes which consequently

Order	Parasitic Evolutionary Linages	Nature of Parasitism			Parasitic		Hemiparasitism		Holoparasitism	
		R	E	S	Genera	Species	Facultative	obligate	Solely	obligate
*Piperales	Hydnoraceae	+			2	~18		+		+
*Laurales	Lauraceae	+			1	~16		+		
Zygophyllales	Krameriaceae	+			1	18	+	+		
Cucurbitales	Apodanthaceae		+		3	23				+
Malpighiales	Rafflesiaceae		+		3	~19				+
Malvales	Cytinaceae	+			2	~11				+
*Santalales	Loranthaceae	+		+	167	~2147	+	+		+
	Santalaceae									
Saxifragales	Cynomoriaceae	+			1	2				+
*Lamiales	Orobanchaceae	+			90	1800	+	+		+
Boraginales	Boraginaceae	+			2	~5				+
*Solanales	Convovolaceae			+	1	145		+		

R-root, E-endophyte, S-stem.
**Order having a representative genera in Nigeria.*
Compiled from: The Angiosperm Phylogeny Website (APG III, & VI); [5], and Christenhusz, and Byng [6]

Table 1.
Systematic presentation of the diversity of parasitic angiosperm.

affect other trophic level organisms (such as herbivores and pollinators). These impacts also result in a ripple effect that may extend to the abiotic environment, including impacts on nutrient cycling, soil water relations, local temperature, and atmospheric CO_2 concentrations. Importantly, such major impacts can occur even when parasitic plants are minor components of the ecosystem [4].

Despite the uniqueness of plant parasitism, its evolution is polyphyletic [1]. It is reported to have evolved approximately 12 or 13 in the angiosperm phylogeny (**Table 1**). There are approximately 4,500 species in about 280 genera belonging to 20 families [3]. While some angiosperm families, like Balanophoraceae, consist entirely of parasitic members, others have only a few representatives, for example, Lauraceae. Parasitic plants also exist in different life forms, including annuals and perennials, e.g. (*Hydnora* spp. and *Thonningia sangunea*), climbers (e.g., *Cassytha*), shrubs (*Tapinanthus globiferous*), and Tree (e.g., *Okoubaka aubrevillei*). Parasitic plants can be characterized based on the presence or absence of photosynthetic pigments, in which case hemiparasites like *Cassytha filiformis, Agelanthus spp., Globimetula spp.* etc., have the ability to photosynthesize to some extent due to the presence of chlorophyll or holoparasite like *Hydnora* spp., *Thonningia sanguinea*, *Balanophora* sp. *Cuscuta* derived their entire organic nutrient from the host plant due to chlorophyll deficiency. Parasitic plants could also be categorized as stem parasites. For example, *Cassytha filiformis, Agelanthus spp., Globimetula spp.* are attached to the host stem or root parasites, e.g., *Thonningia sanguinea, Hydnora spp.* attached to the host plant's root.

Parasitic plants are virtually present in all plant communities throughout the world. Moreover, a positive relationship between nonparasitic and parasitic plants has been established [4]. By implication, plant-rich ecosystems are also expected to be rich in parasitic plants. The strategic position of Nigeria in West Africa has endowed it with wealthy biodiversity, distributed within different ecological zones, comprising: mangrove, rainforest, montane, and the savanna- Guinea, Sudan, and Sahel [7]. These different eco-geographical zones support a huge diversity of parasitic plants, including endemic ones. Even though some parasitic plant species are important pests of human agriculture and forestry, many are highly valued for food, wood, and medicinal properties [8]. Therefore, the present chapter aims to utilize available literature regarding parasitic plants in Nigeria to document their biology, identified host plants, and their ethnobotanical relevance.

2. Materials and methods

The author obtained information on the biology and ethnobotany of parasitic plants in Nigeria from various sources, which include; Published materials in the form of journals from databases, such as Google Scholar, Elsevier, Web of Science, and SCOPUS, and textbooks, particular checklists, monographs, floras (see references). Herbaria visited include Forest Herbarium Ibadan (FHI) and the Edo State University Herbarium (EUH). Also, personal communication with experts about parasitic plants in Nigeria was valuable to completing this report.

3. Distribution of parasitic plants in Nigeria

The strategic position of Nigeria in the tropics just above the equator within Latitudes 10 ^{0}N and 14^0 N has endowed it with very rich yet heterogeneous vegetation. The temperature is high and ranges from 25–34°C. The mean annual rainfall ranges from 500 mm in the north to 2500 mm in the coaster region.

The phytogeography of Nigeria could broadly be categorized into two major regions; the Sudano-Zambezian and the Guineo-Congo [9]. The Northern part of the country falls under the Sudano-Zambezian region, comprising the Sudanian and Sahelian domains. The Guineo-Congo region of Nigeria is made up of Guineo domain to which the west and central part of the country belongs, and the Congo domain has the eastern part of the country. The different domains support various plant species, some of whom are notable host species to the parasitic plants domiciled in the Nigerian environment. For the current discourse on the distribution of parasitic plants, the Nigerian environment will be characterized into two, Northern Nigeria, predominately, savannah, and Southern Nigeria, where the rainforest forest belt is located.

3.1 Northern Nigeria

Northern Nigeria has a Savannah ecoregion, comprising the Guinea savanna bordering the rainforests, the Sudan savanna, and the Sahel bordering the desert. The guinea savanna is found in Kaduna, Kwara, Kogi, and Benue states; the Sudan savanna, in Kano and parts of Borno, Sokoto, Niger, and Bauchi states; and the Sahel around the Lake Chad. The savanna ecoregion is renowned for a climate that has a short wet and long dry season. The average monthly temperatures are around 29°C during the hot season and around 18°C during the cool season. The total annual rainfall varies greatly from around 500 mm in regions on the semi-desert fringes to about 1500 mm in regions bordering the rain forests. The savanna rainfall is insufficient to support a rich growth of trees but is mostly dominated by perennial grasses with few tree clumps. In the Guinea savanna, the grasses grow tall during the rainy season. Trees occur quite close together, especially along the rain forest fringe. The grass is shorter in the drier Sudan savanna, and the trees are fewer and more scattered. In the Sahel, which is borders the Sahara desert, the land is quite bear with clumps of short grass and a few isolated shrubs and trees. During the dry season, the grass is usually dry and brown, and bush fires are common occurrences. The underground parts of the grasses survive the dry season and fires and grow again when the rains come. In terms of the parasitic plant distribution, the Nigerian Savanna is home to one of the most devastating parasitic genus, *Striga.* The species are found on cultivated lands, abandoned farmlands, and waste and weed-infested sites, depending on the presence of the host crop. *Striga astiatica*, *S. aspara*, *S. hermonthica*, *S. gesnerioides* are some of the species found in the savanna habitat. The basis for their occurrence only in the savanna part of the country is yet to be fully ascertained. Mohamed et al. [10] reported that the rain forest's high rainfall and moisture levels result in a "wet dormancy" of *Striga* seeds, consequently precluding its occurrence in the zone. Notwithstanding, most host crops, such as Corn, sorghum, and sugar cane, are cultivated majorly in the savanna part. *Hydnora abyssinica,* a root holoparasitic plant, was recently spotted around Nekong, Wusali ward, Kanke Local Government Area, Plateau State, Nigeria [11]. Notable members of the Loranthaceae family like *Agelanthus dodoneifolius, A. heteromorphus, Globimetula cupulata, Tapinanthus cordifolius, T, globiferous, T. pentagonia*, and *T. preussii* are attached to trees and shrubs in this zone. **Table 2** shows potential distribution and host species of common parasitic plants of Nigeria

3.2 Southern Nigeria

The Southern part of Nigeria experiences heavy and abundant rainfall due to its proximity to the equatorial belt. It comprises majorly the rainforest and the swarm forest that borders the Southern Atlantic Ocean. The rainforest belt occurs in the regions that lie between the equator and latitude 5° – 10 °N and S. The climate in

Species	Family	Potential Distribution	Herbarium voucher number	Host species	Literature
Agelanthus brunneus (Engl.) Balle & Halle	Loranthaceae	SN: Edo, Ogun, Ondo	FHI 16684	*Carissa edulis, Crateva religiosa, Diplorhynchus, Ficus, Funtumia, Gossweilodendron, Ipomaea, Landolphia heudelotii, Ochna sp, Kigelia africana*	[5, 12]
Agelanthus dodoneifolius (DC.) Polhill &Wiens	Loranthaceae	NN; Kano, Bauchi, Yola SN: Oyo	FHI 16279	*Acacia* spp., *Afzelia* spp., *Ceiba, Mimosa, Parkia, Piliostigma, Pterocarpus erinaceus, Tamarindus* sp.	[5, 13]
Agelanthus heteromorphus (A. Rich.)	Loranthaceae	NN: Sokoto, Zamfara, Bauchi, Yola	FHI 15893	*Anogeissus leiocarpus, Parkia biglobosa, Terminalia avicenioides*	[14]
Alectra sessiliflora var. monticola	Oronbanchaceae	SN: Oyo	FHI 13735	parasitic on some members of the poaceae family	[12]
Alectra sessiliflora var. senegalensis	Oronbanchaceae	NN: Niger, Bauchi SN: Ondo	FHI 24448	parasitic on some members of the poaceae family	[12]
Alectra vogelii Benth	Oronbanchaceae	NN: Sokoto, Niger, Kogi, Bauchi, Ilorin	FHI I9265 FHI 25638	Semi parasitic on members of papilionoidae	[12]
Cassytha filiformis L.	Lauraceae	Widespread	EUI 00018	*Dodonaea viscosa, Casuarina stricta, Mangifera indica, Myristica fragrans, Persea americana*	[15]
Cuscuta australis R.Br.	Convolulaceae	widespread	FHI 23459 EUH 00015	*Cassia marginata. Acacia arabica, Azadirachta indica*	[16]
Englerina gabonensis (Engl.) Balle	Loranthaceae	SN: Ogun, Ondo	FHI 173041	*Ficus* and *Platysepalum chevalieri*	[17]
Globimetula cupulata (DC.) Van Tiegh	Loranthaceae	widespread	EUH 00019	*Dacryodes edulis*, *Ceiba pendandra, Morinda germinata, Neocarya macrophylla*	[18]
Globimetula braunii (Engl.) Van Tiegh	Loranthaceae	SN: Ogun, Anambra, Lagos, Cross River	FHI 6679	*Ceiba pendandra*	[18]
Helixanthera mannii (Oliv.) Danser	Loranthaceae	SN: Cross River	FHI 33216	Coffea, Citrus, *Ficus*	[5, 13]
Helixanthera spathulata Wiens & Polh.	Loranthaceae	SN: Cross River		Coffea, Citrus, *Ficus*	[12]
Hydnora abyssinica A. Br.	Hydnoraceae	NN: Plateau		*Acacia hockii* De Wild, *Piliostigma thonningii* (Schum.) Milne-Redh., and *Tamarindus indica* L.	[19]

Species	Family	Potential Distribution	Herbarium voucher number	Host species	Literature
Okoubaka aubrevillei Pellegr. & Normand.	Santalaceae	SN: Edo, Cross River and Osun	EUH 00011	Companion tree plant species	[20, 21]
Phragmanthera capitata (Spreng.) Balle	Loranthaceae	NN: Niger SS: Oyo, Cross River.	FHI 3420	*Alchornea, Anacardium occidentale, Annona senegalensis, Bauhinia, Citrus aurantium, Coffea, Cola nitida,*	[12, 13]
Phragmanthera kamerunensis (Engl.) Balle	Loranthaceae	NN: Niger, Kogi SN: Cross River;		*Milicia excelsa* and *Isoberlinia doka*.	[22]
Phragmanthera nigritana (Hook. f. ex Benth.) Balle.	Loranthaceae	NN: Kogi, Adamawa SN: Ogun, Cross River;		*Morinda lucida*	[23]
Phragmanthera talbotiorum (Sprague) Balle	Loranthaceae	SN: Akwa Ibom, Cross River;		*Morinda lucida*	[12, 24]
Striga asiatica (Linn.) O. Ktze	Oronbanchaceae	NN: Niger, Kaduna, Adamawa	FHI 24389	Corn, sorghum, and sugar cane	[12]
Striga aspara (Willd.) Benth	Oronbanchaceae	NN: widespread	FHI 4557	rice, wild grasses	[5, 25]
Striga gesneriodes (Willd.) Vatke	Oronbanchaceae	NN: Sokoto, Adamawa		Cowpea	[5, 25]
Striga hermonthica (Del.) Benth	Oronbanchaceae	NN: widespread	EUH 00022	Sorghum roots	[5, 25]
Tapinanthus bangwensis (Danser.	Loranthaceae	SN: widespread	EUH 00029	*Cola nitida, Coffea liberica, Terminalia catappa* and *Theobroma cacao*.	[5, 26]
Tapinanthus cordifolius	Loranthaceae	NN: widespread	FHI 24389	*Sysygium eucalyptoides; Psidium guajava; Citrus auranthifolia; Citrus medica*	[12]
Tapinanthus globiferous (A. Rich.) Tiegh.	Loranthaceae	NN: Zamfara, Kano, Bornu	FHI 15683	*Acacia nilotica, Adansonia, Bauhinia rufescens, Butyrospermum parkii*	[5, 13]
Tapinanthus pentagonia (DC.) Van Tiegh	Loranthaceae	SN: Oyo	FHI 3442	*Acacia, Butyrospermum, Ceiba, Ficus, Gardenia, Landolphia heudelotii*	[12, 13]
Tapinanthus preussii (Engl.) Tiegh.	Loranthaceae	SN: widespread	EUH 00101	*Parkia biglobosa*	[5, 13]

Species	Family	Potential Distribution	Herbarium voucher number	Host species	Literature
Thonningia sanguinea (Vahl.)	Balanophoraceae	SN: Edo, Cross River, Oyo, Ondo, Ogun, Bayelsa	EUH 00055	*Guarea cedrata Lophira alata*, *Musanga cecropioides*, *Myrianthus arboreus* and *Ricinodendron heudelotii Hevea brasiliensis* and *Theobroma cacao*	[27, 28]
Viscum congolense De Wild.	Loranthaceae	SN: Akwa Ibom, Cross River	EUH 00121	*Albizia, Combretodendron africanum, Hevea Funtumia elastica, Polyalthia*	[27]
Viscum decurrens (Engl.) Bak. & Sprague	Loranthaceae	Rain forest: Akwa Ibom, Cross River	EUH 00122	*Symphonia globulifera*	[2, 27]

NN, Northern Nigeria; SN, Southern Nigeria; FHI, Forest herbarium Ibadan; EUH, Edo university herbarium.

Table 2.
Potential distribution and host species of common parasitic plants of Nigeria.

the tropical rainforest region is hot and wet throughout the year. The mean annual temperature is 27°C while the mean total annual rainfall is 2000 mm. The rainforest is characterized by dense and stratified vegetation, comprising various broad-leaved tree species sandwiched by lianas and herbaceous climbers. The rain forest covers Oyo, Edo, Delta, Imo, Cross River, Ogun, Ondo, and Rivers state, while the swarm forest is situated across the Niger Delta region. Parasitic plants are very much represented in the Nigerian rainforest. The largest parasitic tree, *Okoubaka aubrevillei*, is found here. It is believed to parasitize neighboring trees as an adaptive mechanism for creating light spaces in the normally thick rain forest environment. A recent report indicates that the parasitic tree is currently facing a decline in its Population due to forest degradation. Consequently, further isolating the few remnants stands in some forest areas of Edo, Cross River, and Osun States. Another interesting parasitic species found in the Nigerian rain forest is the ground-dwelling, herbaceous plant- *Thonningia sanguinea*, commonly refer to as 'ground pineapple' because they bear morphological similarities. The plant shows a special preference for native host trees such as *Guarea cedrata*, *Lophira alata Musanga cecropioides Myrianthus arboreus*, and *Ricinodendron heudelotii*, and few exotics like *Hevea brasiliensis* and *Theobroma cacao*. It is mostly found growing along forest trails, indicating its preference for disturbed parts of the forest environment. Notable members of the Loranthaceae family like *Agelanthus brunneus*, *A. dodoneifolius, Englerina gabonensis, Globimetula braunii, Helixanthera mannii, Phragmanthera capitata*, *P. kamerunensis, P. talbotiorum,* and *Tapinanthus bangwensis* are present in the luxuriant vegetation of the rain forest, attached on the branches of host trees. Other stem parasites like *Cassytha filiformis* and *Cuscuta australis* have a widespread distribution spanning rainforest and the savanna. Parasitic members of the Orobanchaceae scarcely sighted, only represented in this zone by *Alectra sessiliflora var. monticola*. **Table 2** shows potential distribution and host species of common parasitic plants of Nigeria.

4. Systematic presentation of parasitic angiosperm in Nigeria

4.1 PIPERALES: *hydnora abyssinica* (Hydnoraceae)

Members of the genus *Hydnora* are subterranean, holoparasitic, and lack leaves or scales [19]. Several species of *Hydnora* have been recognized *H. africana* Thunb., *H. esculenta* Jum. & H. Perrier, *H. johannis* Becc. and *H. triceps* Drege & Meyer as distinct species; however, The family-Hydnoraceae is represented in Nigeria by *Hydnora abyssinica* A. Braun [11]. The first and only report of its existence was around Nekong, Wusali ward, a lowland area in the Sudan-savanna zone in Kanke Local Government Area, Plateau State, Nigeria [11]. *Hydnora abyssinica* is a perennial herb composed entirely of roots with extremely reduced vegetative morphology. It only emerges above ground when fruiting or flowering. *H. abyssinica* grows in a semiarid environment. The adaptation for such an environment might be related to the fact that water availability affects flower growth, including perianth splitting [29]. The flowers of *H. abyssinica* are protogynous; however, both cross and self-pollination can occur. Carrion flies and dermestid beetles carry out pollination. Generally, *Hydnora* species use a system similar to the pitcher traps of Carnivorous plants by trapping insects that fall into the flower tube, ensuring they do not escape [25].

4.2 LAURALES: *cassytha filiformis* (Lauraceae)

The genus *Cassytha* consists of about 17 species globally, with *Cassytha filiformis* being the predominant species in Nigeria. *Cassytha filiformis* is a perennial, leafless

twining plant with a stem turning clockwise around the support plant [30]. It is less selective in terms of the choice of the host; hence any plant may be used as a host [29]. Stems are green to orange, filiform, and glabrous. Leaves are reduced to minute scales, ca. 1 mm long, easiest seen near tips of stems. Flowers are sessile and few in spicate inflorescences 1(−2) cm long, each subtended by an ovate bract and two ovate bracteoles. The inflorescence is a short raceme or spike. *C. filiformis* produces false fruits enclosed in the accrescent floral tube; dried floral parts persist in the fruiting stage. Information regarding the pollination biology in *Cassytha filiformis* is scanty. However, the floral characteristics point to wind pollination, while on the other, the presence of gland in the flowers point to insect pollination. Birds disperse fruits. Bush fire has been reported to promote the germination of *Cassytha* seeds [29].

4.3 SANTALALES: nigerian loranthaceae

Loranthaceae is the largest family in Santalales with about 73 genera and over 900 species [29]. It has a wide distribution particularly in the southern hemisphere, including both subtropical and tropical areas. Members of Loranthaceae have mostly stemmed parasites, with exception of a few root parasites. They possess both primary and secondary haustoria. Loranthaceae leaves are usually evergreen, leathery, and simple with smooth edges but variable forms, from broad flat leaves to cylindrical succulent leaves. Flowers are nearly always bisexual, with 4–7 perianth members who normally are of the same color. Stamens occur in the same number as the perianth parts, but there is only one pistil. Insects and birds, especially sunbirds pollinate flowers. The fruits are berry-like, single-seeded and of different color depending on species. Birds are the main disperser. The family- Loranthaceae is represented in Nigeria by *Agelanthus brunneus* (Engl.) Balle & Halle, *Agelanthus dodoneifolius, Englerina gabonensis* (Engl.) Balle, *Globimetula cupulata* (DC.) Van Tiegh, *Globimetula oreophila* (Oliv.) Danser, *Helixanthera mannii* (Oliv.) Danser, *Helixanthera spathulata* Wiens & Polh. *Phragmanthera capitata* (Spreng.) Balle, *Phragmanthera kamerunensis* (Engl.) Balle, *Phragmanthera nigritana* (Hook. f. ex Benth.) Balle, *Phragmanthera talbotiorum* (Sprague) Balle, *Tapinanthus bangwensis (Engk. & K. Krause) Danser, Tapinanthus cordifolius*, *Tapinanthus globiferous* (A. Rich.) Tiegh, *Tapinanthus pentagonia* (DC.)Van Tiegh, and *Tapinanthus preussii* (**Figure 1**). Generally, these representative species are distributed into two main groups distinguished by the flower bracts, the Tapinanthoid and the Taxilloid group.

The Tapinanthoid group has simple to branched hairs. There are three flower types in this group. Some possess relatively small, non-explosive flowers, which are mostly adapted to pollination by insects. They are considered primitive for example is *Helixanthera mannii*, *H. spathulata.* Others like *Agelanthus* and *Englerina* have explosive flowers, and their corolla is vented. Corolla venting occurs when there is a split in the corolla and the number of splits corresponding to the number of fused petals below the corolla tip. *Agelanthus* is the most species-rich Loranthaceae in Africa. It flowers all year-round depending on the host species and the location, usually much more abundant during the rainy period. *Englerina* is mostly shrubs up to 2 m in size. The flowers are clustered in pedunculate umbels and often standing erect from horizontal branches. The corolla tube is relatively short, adapted to pollination by short-beaked birds. The opening mechanism of the flower with the obvious vents serves as signals to the pollinators that the bud is mature. *Tapinanthus* and *Globimetula.* are non-vented but explosive. The flowers explode without opening first by splits. *Tapinanthus* is a common genus in Nigeria. They are characteristically known to have a swollen tip of the corolla in the bud stage. The tip often has a color

Figure 1.
Some common parasitic plants of Nigeria (A) male inflorescence of Thonningia sanguinea*, (B) flowers of* Globimetula braunnii *(C) and (D)* Tapinanthus globiferus Syn. Agelanthus dodoneifolius, *(E)* Tapinanthus dodoneifolius, *(F)* Cuscuta camprestris, *(G)* Striga gesnerioides*, (H)* Striga asiatica*, (I) fruits of* Tapinanthus *sp., (J) leaves and inflorescence of* Tapinanthus bangwensis, *(K)* Hydnora *infloresence, (L) a sapling of* Okoubaka aubrevillei.

different from the rest of the corolla and becomes darker as the bud matures. Such a dark color also serves as a signal to the pollinators that the bud is mature. It flowers all year-round depending on the host species and the location, for usually much more abundant during the dry period. *Globimetula* species are known to have just a primary haustorium. The buds have a prominent swelling at the tip like *Tapinanthus*.

The Taxilloid group has stellate hairs and has a flower that is both explosive and vented. Example *Phragmanthera,* which is the largest genus in this group. It has a large single primary haustorium. Several species of this genus are considered pests in plantations.

4.4 SANTALALES: *okoubaka aubrevillei* (Santalaceae)

Okoubaka aubrevillei is a rare tree endemic to West Africa (**Figure 1**). It is the largest parasitic plant and also produces the largest seeds known for any hemiparasite. It is a monoecious, deciduous tree that grows up to 40 m high [31]. The tree is thought to be useful for various folk medicinal purposes by different ethnic groups in all of its native ranges [21]. *Okoubaka aubrevillei* is perhaps one of the most controversial plants in Africa in terms of taxonomy and ethnobotanical information. It is believed that no tree grows within 80 feet of a 60 feet *Okoubaka* tree, except for *Myrianthus arborea, Musanga cecropoides, Cola attiensis* [31]. Its presence has been confirmed in three state locations in Nigeria: Edo, Cross River, and Osun States [32]. As exercised by *Okoubaka aubrevillei*, parasitism might be for nutritional purposes and as a means of competition for light since it dwells only in a rainforest habitat.

The leaf blade is ovate to oblong, simple and entire in shape, arranged in an alternate to almost opposite. Flowers are green in color and arranged on spines around older branches. Flowers are green in color. Unisexual flowers are present, with the female flowers slightly larger than male flowers [33]. The flowers develop into hard, yellow-colored ellipsoid drupes containing a single large seed that weighs up to 100 g. The tree is monoecious. Hence, it is expected that the plant undergoes self-fertilization (allautogamy), leading to genetic stability. Although little is known about the pollination biology, the pollination type is likely either by ants (myrmecophily) or bats (cheiropterophily) due to the small greenish flowers that preclude its chances of being pollinated by birds [32]. Seeds are speculated to be dispersed by large forest animals such as elephants.

4.5 SANTALALES: *viscum* spp. (Santalaceae)

Viscum congolense De Wild. And *Viscum decurrens* (Engl.) Bak. & Sprague are two representative species of the family in Nigeria. Reports on these species, particularly, *Viscum decurrens* are scanty. V. *congolense* is a dioecious, globose shrub that grows up to 50 cm tall and is found in humid forests, secondary forests, and plantation forests. Leaves are variable, elliptic-oblong in shape. The fruits are small, smooth and greenish-white in color [12].

4.6 Santalales: *thonningia sanguinea* (Balanophoraceae)

Thonningia sanguinea Vahl (Balanophoraceae) is a monotypic, rare, cryptic obligate holoparasitic plant endemic to tropical Africa (**Figure 1**). Its distribution is restricted to the forest environment, where it parasitizes forest trees [27, 28]. *Thonningia sanguinea* is a fleshy dioecious herb growing from an underground tuber. It is parasitic on other plants via its tuber. The branching yellow tuber extends horizontally up to 10 or 15 centimeters through the soil. It forms bulb-like swellings at the points where it attaches to the roots of its host plants which could either be

exotic or native species. These swellings, or galls, can reach over 18 centimeters wide [34]. The stem is coated with spirals of scale-like leaves. The leaves lack chlorophyll, as the plant obtains nutrients from hosts and does not need to photosynthesize. The flowering stem emerges from the ground to produce a bright red or pink inflorescence containing male and female flowers. The crowded flower heads are covered in scales. The inflorescence is up to 15 to 20 centimeters long [34]. Studies on its reproductive phenology suggest that *T. sanguinea* flowers all year round. The ant *Technomyrmex* species are the most common floral visitors, and it is hypothesized to be the pollinating agent [27, 28].

4.7 LAMIALES: *alectra* spp. (Orobanchaceae)

Alectra is also known as the yellow witchweed. Representative species in Nigeria include *Alectra sessiliflora var. monticola, Alectra sessiliflora var. senegalensis, and Alectra vogelii Benth*. Generally, *Alectra* grows erect, emerging from a small bulb (haustorium) attached to the root of the root plant. The leaves are lanceolate, simple, subsessile, and arranged in an opposite or alternate pattern. Flowers are borne by a short peduncle and yellow in color. The fruit is a globular dehiscent capsule containing many seeds. At maturity, it opens in 2 valves. The seeds are tiny and ovoid. Seeds are dispersed mainly by wind. *Alectra* species, particularly *Alectra sessiliflora* var. *senegalensis,* are a serious threat to agriculture since they can use members of Papilionoideae such as cowpeas, peanuts, soybeans and other legumes as host.

4.8 Lamiales: *striga* spp. (Orobanchaceae)

Striga, often refer to as 'witchweed' because several species, despite their beauty, seem to perform "evil magic" like a witch. *Striga* is most common in semi-dry vegetation. *Striga* species are annuals or rarely perennials. Representative species in Nigeria include; *Striga asiatica* (Linn.) O. Ktze, *Striga aspera* (Willd.) *Benth, Striga gesnerioides* (Willd.) Vatke, *Striga hermonthica* (Del.) Benth.

The life-cycle of *Striga* spp. is quite complex [48]. It begins a long period of seed dormancy that could persist for up to after which the seeds then need sufficiently warm and humid conditions for one to two weeks to enter into a condition in which they can germinate (pre-conditioning). Subsequently, they need host-derived signals that stimulate germination [25]. After germination, a special organ, called the haustorium, through which nutrient materials are siphoned from the host [25]. The above-ground part of the parasite emerges after haustorium development and proper attachment to the host. This is accompanied by flower bloom, pollination, and subsequently shedding the seeds as the capsules ripen. Pollination is by insects, probably butterflies; the seeds are tiny, produced in vast numbers and dispersed mainly by wind, but also stick with mud to hoofed and clover-trotted mammals [17].

4.9 SOLANALES: *cuscuta australis* R.Br. (Convulvulaceae)

Cuscuta, commonly referred to as dodder, is the only parasitic genus in Convolvulaceae, belonging to the order, Solanales. The species is represented in Nigeria by *Cuscuta australis*. *Cuscuta* spp. bear a close similarity to *Cassytha* in appearance. However, some notable differences include that most *Cuscuta* spp. are annuals, unlike *Cassytha*, a perennial herb. Also, while *Cassytha* is a hemiparasite, *Cuscuta* is holoparasitic. Also, *Cuscuta* is a more advanced parasite than *Cassytha* due to the presence of a direct phloem contact [16].

Cuscuta australis possess tiny, stalk or sessile flowers that are clustered in dense heads. Flowers are pollinated by insects; however, birds are responsible for seed dispersal [29].

5. Ethnobotanical relevance of parasitic plants

The term Ethnobotany was first used by Harshberger [35] to denote the study of plants used by primitive aboriginal people subsequently; different workers have defined the subject, greatly enlarged the scope and accepted it as an interdisciplinary science for a holistic approach to man–plant relationship, hence different definitions of the concept of ethnobotany exist. Allem, [36] defined the concept as the biological, economic and cultural inter-relationship between people and plants in the environment where they exist. Schultes and Raffauf [37] broadly defined the subject as human evaluation and manipulation of plant materials, substances and phenomena in societies. Jain [38] related it to the study of how people make use of plants. According to Pushpangadan and Kumar [39], it is the entire realm of useful relationship between plant and humans. These definitions point out a relationship between people of a given community or society, the environment and the plant diversity in that particular community.

Ethnobotany has now been recognized as an integral part of indigenous/local knowledge of a particular society. Thus, different societies or communities have their own knowledge about plants and their uses. Indigenous knowledge represents an immense valuable database that provides humanity with an insight into how numerous communities have interacted with the changing environment, providing local solutions for local problems and suitable ways for coping with challenges posed by specific conditions. According to Warren and Cashman [40], ethnobotanical knowledge is how most communities survived for centuries by adapting themselves to their environment, using their intrinsic knowledge of associated resource management.

Parasitic plants are keystone species in plant communities, exhibiting a unique and important ecological role [3]. They are common in many natural and semi-natural ecosystems, from tropical rain forests to the savanna. Although some parasitic plant species are important pests of human agriculture and forestry, many are highly valued for food and wood as well as for their medicinal and esthetic properties [8].

The study and management of parasites have historically focused on the control, and even elimination, of parasite populations, for example, researchers have intensified efforts to eradicate several mistletoe species, *Cuscuta*: *Striga*, and broomrapes which attack food crops [35]. Despite this ecological and economic importance, parasitic plants have often been overlooked and excluded from most ethnobotanical checklist and flora assessment surveys [8]. Literature survey reveals that only in few instances have parasitic plants been recognized for their ethnobotanical value [41, 42].

The importance of indigenous knowledge is overwhelming especially with regard to parasitic plants. Aiyeloja and Bello [43] valued it as the sum of the experience that forms the basis for decision making for familiar and unfamiliar problems and challenges in a local community. The overall ethnobotanical uses of parasitic plants are quite high. However, the traditional knowledge of these plants have been widely threatened by current trends of economic globalization that promote intensive agriculture, industrialization, and the migration of rural populations to urban areas. Consequently, it is crucial to record this fast-disappearing knowledge before it is lost along with the present generation of elderly persons. **Table 3** shows the ehnobotanical relevance of parasitic plants.

Species	Geographical location; plant parts use; ethno-uses	References
Agelanthus dodoneifolius (DC.) Polhill & wiens	In West Africa, the leaves of *Agelanthus dodoneifolius* are used by some ethnic groups for headache relief. The leaves and fruit are aphrodisiacs.	[14]
Alectra sessiliflora var. *monticola* (Engl.) Melch	In Western Kenya, the flowers and leaves of *Alectra sessiliflora* are used to remedy toothache, diarrhea, kwashiorkor, and oral thrush in children, gastrointestinal and sexually transmitted infections. It is also used to hasten childbirth and to treat scars caused by leprosy.	[44, 45]
Cassytha filiformis L.	Several tribes use the whole plant of *Cassytha filiformis* in Nigeria in the treatment of cancers and gonorrhea. Also, to ease labour pains, quicken labour time, and lubricate the birth canal during childbirth.	[46]
Cuscuta campestris Yunck.	In Saudi Arabia, the whole plant of *Cuscuta campestris* is used as a purgative and also during constipation.	[47]
Englerina gabonensis (Engl.) Balle	In Libreville (Gabon), the leaves of *Englerina gabonensis* are used to cure rheumatism. It is also used to heal fractures and scabies, treat mental illness, epilepsy and in performing magic (protection against robbery)	[17]
Globimetula cupulata (DC.) Van Tiegh	In the Southeast part of Nigeria, the Leaves and fruits of *Globimetula cupulata* are used in the management of high blood pressure and diabetes mellitus	[48, 49]
Helixanthera mannii (Oliv.) Danser	In West Africa, *Helixanthera mannii* is used for religious ceremonies, superstitions, magic purposes too.	[46]
Hydnora abyssica A. Br.	In Southern Mozambique, the inflorescence of *Hydnora abyssica* is used to treat diarrhorea, piles, acne, menstrual problems, stomach cramps, and to stop bleeding	[50]
Okoubaka aubrevillei Pellegr. & Normand.	In Southern Nigeria, the bark and the seeds of *Okoubaka aubrevillei* are used to treat convulsion, for rituals and prevention of miscarriage and as an anaphrodisiac. The bark and leaves are used for reducing swollen testicles (orchitis). The branch is tied on a broken limb along with other plants for the healing of the limbs. Use of the bark infusion or maceration in water to treat skin problems (including those caused by syphilis and leprosy). In contrast, external applications of bark preparations are used to counteract poisoning.	[32, 46, 51]
Phragmanthera capitata (Spreng.) Balle	**In Logbessou, in the North of Douala (Cameroon),** the leaves and branches of *Phragmanthera capitata* are used for treatments of Nerves attacks, convulsions, chronic muscular pains, diabetes, respiratory dysfunctions, rheumatism related pains, epilepsy, dizziness, uterine hemorrhage, hypertension, hypotension, back pains, kidney pains, menopause, headache, heart palpitations, general purifications, irregular menstruations and nose bleeding.	[22, 24]
Phragmanthera kamerunensis (Engl.) Balle	In southwest Nigeria, the leaves of *Phragmanthera kamerunensis* is used for the treatment of gastric ulcer.	[23]
Striga asiatica L.	In South Africa, the stem and leaves of *Striga asiatica* are used for treating hemorrhoids, or smoldering smoke is used to kill off warts, or charred remains are used as a dressing on wounds to dry or rubbed on legs for oedema.	[52]
Striga hermonthica (Del.) Benth	In Northern Nigeria, the stem and leaves are used to treat dermatosis, leprosy ulcer, pneumonia and jaundice	[53]
Tapinanthus bangwensis (Engk. & K. Krause) Danser.	Southwest Nigeria leaves; the whole plant is used to treat circulatory and respiratory disease problems, malaria, diabetes, hypertension and sterility in cows.	[54, 55]

Species	Geographical location; plant parts use; ethno-uses	References
Thonningia sanguinea (Vahl.)	In Southern Nigeria, the whole plant is used with other materials against anemia, asthma, diarrhea, infant illness, rheumatism, skin infection, sore throat, stomach upset. It is also valuable as (a) an aphrodisiac	[8]

Table 3.
Ethnobotanical relevance of parasitic plants.

6. Conclusion

Parasitic plants play a vital role in plant communities, and their diversity is quite huge, with various species inhabiting the different ecosystems in Nigeria. The study and management of parasites have historically focused on controlling and even eliminating parasite populations. Although some parasitic plant species are important pests of human agriculture and forestry, many are highly valued for food and wood and their medicinal properties. The current chapter provides an update on the various potential uses of parasitic plants in Nigeria from an ethnobotanical perspective. Therefore it is important to look beyond just their economic implications and approach the conservation of parasitic plants holistically. Next time you walk along nature trails in the forest, look out for some stem parasites on the branches of trees and root parasites at the base of host plants.

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