African Journal of Environmental Science and Technology Vol. 2 (11). pp. 371-378, November, 2008
Available online at http://www.academicjournals.org/AJest
ISSN 1996-0786 © 2008 Academic Journals

Full Length Research Paper

Parasitism of host trees by the *Loranthaceae* in the region of Douala (Cameroon)

Dibong Siegfried Didier[1*], Din Ndongo[1], Priso Richard Jules[1], Taffouo Victor Desiré[1], Fankem Henri[1], Salle Georges[2] and Amougou Akoa[3]

[1] The University of Douala, Faculty of Science, Department of Plant Biology P. O. Box. 24157 Douala-Cameroon.
[2] The Université Pierre et Marie Curie (Paris IV), Laboratoire de Parasitologie végétale, 4 place Jussieu, case courrier 155, 75252 Paris cedex 05 (France).
[3] The University of Yaoundé I, Faculty of Science, Department of Plant Biology and Physiology, .P. O. Box. 812 Yaoundé-Cameroon.

Accepted 14 September, 2008

The *Loranthaceae* constitute the most important parasite plants that cause variable damages: morphological, technological, ecological and socio-economic. These numerous and damaging effects make some parasitic angiosperms true agronomic threats, especially in developing countries.The *Loranthaceae* is represented in Cameroon by 26 species gathered into 7 genus. The study area includes four sites: a traditional plantation of *Cola nitida* situated at Penja (70 km Nord of Douala), the main road to Douala airport, one quarter (Logbessou) and Makondo village (80 km East of Douala) in an orchard dominated by *Citrus*. A total of 2643 individuals of DBH (diameter at breast height) greater or equal to 5 cm were inventoried. 637 individuals were parasitized. Eight known species were identified. *Phragmanthera capitata* is more frequent and more abundant (76.14%). The infested host trees belong to 16 species gathered into 12 genus and 10 families. The most parasitized host family is *Sterculiaceae*. The most sensitive host species to the parasitism of *Loranthaceae* is *P. americana* (21.51%), followed by *C. nitida* (17.27%) and *Terminalia mantaly* (13.65%). *Lauraceae* is infested by 7 *Loranthaceae* out of 8 parasites investigated. The consequences of the parasitism of the *Loranthaceae* demonstrate the need for establishing comprehensive ecosystem management programs.

Key words: Host trees, inventory, *Loranthaceae*, parasites plants.

INTRODUCTION

The parasitic plants regroup more than 3000 distributed species in 18 families (Thorne, 1992). They occupy an important place in several plant groupings. The *Loranthaceae* constitutes the largest group of it with about 950 distributed species in 77 genus (Engone et al., 2006). Some *Loranthaceae* are of real pestilences in the natural forests, plantations, orchards and ornamental plants through the world where they reduce the outputs appreciably or affect the quality of the harvests (Sonké et al., 2000; Boussim et al., 2004).

These parasites are represented in Cameroon by 26 species belonging to 7 genus: *Agelanthus*, *Englerina*, *Globimetula, Helixanthera, Phragmanthera, Tapinanthus and Viscum* (Balle, 1982). They are met in most plant groupings described in Cameroon, including the mangroves (Letouzey, 1985). All are parasites of the xylem tissue and depend from their hosts for water, nutriments and some carbon compounds. This dependence is added to their interdependence with the birds for their pollination and their dissemination (Ehleringer et al., 1985).

In the aim at elaborating the strategies to fight against the parasitism of the *Loranthaceae*, the specific objecttives of this research are: (1) to take an inventory of the *Loranthaceae* species and their host trees in the region; (2) to determine the ecological factors that influence the spatial distribution of the parasitic species met and (3) to identify the specific relations between hosts and parasites.

---

*Corresponding author. E-mail: didierdibong@yahoo.fr. Tel. (+237) 99 15 14 71.

MATERIALS AND METHODS

The survey areas

The region where this study was carried out is located in the Gulf of Guinea with Douala as the pilot station (03° 40' - 04°11' N and 09° 16' - 09° 52' E, altitude 13 m). According to Din et al. (2008), the climate of this region is uniform and is described as a particular equatorial type called "camerounian" marked by a lengthy rainy season (at least nine months), abundant rainfall (about 4000 mm per annum), high and stable average annual temperatures (26.7°C).

The mean of the minimum calculated in Douala for 30 years (19961 – 1990) is 22.6°C in July and the mean of the maximum temperature is 32.3°C in February. The relative air humidity remains high throughout the year with a mean value of 82.6%. The lowest value being around 60% in February and the highest one is 100% in the rainy season (Din et al., 2008).

The study area includes four sites: a traditional plantation of *Cola nitida* situated at Penja (70 km Nord of Douala), the main road to Douala airport, one quarter (Logbessou) and Makondo village (80 km East of Douala) in an orchard dominated by *Citrus*.

Methodology

The inventories of parasites have been made according to two methods. In plantation and orchad, a parcel of 50 x 100 m (0.5 ha) has been defined. Along road and quarter, investigations have been conducted 50 m wide (25 m x 2) and 2 km long (10 ha). In every site, all infected trees of DBH (diameter at breast height) greater or equal to 5 cm have been inventoried.

All trees parasitized by the *Loranthaceae* have been marked and their determined diameter as well as the number of parasite tufts. All met parasitic species have been harvested and identified. The collection of samples has been made by climbing on trees with the assistance of students. The influence of the host trees height on the distribution of the *Loranthaceae* in the plantation of *C. nitida*, has been studied, while using the stratification of trees (Amougou, 1989).

RESULTS AND DISCUSSION

Inventory of the *Loranthaceae* and host trees

In the region of Douala, 4 genus of *Loranthaceae* have been identified on the 7 known: *Globimetula* Van Tieghem, *Helixanthera* Loureio, *Phragmanthera* Van Tieghem and *Tapinanthus* Blume. The genus *Helixanthera*, the most primitive of the african *Loranthaceae*, is the only one to have flowers adapted to the pollinisation by insects (Polhill and Wiens, 1998). *Phragmanthera* and *Tapinanthus* are ubiquitous and more abundant in the studied sites. The first covers almost entirely the area of division of the *Loranthaceae* into South of Sahara (Balle and Hallé, 1961).

2643 individuals of DBH greater or equal to 5 cm have been inventoried and 637 individuals carried at least a parasite. The host trees belong to 16 species gathered in 12 genus and 10 families (Table 1). Eight *Loranthaceae* have been drawn up into inventories: *Globimetula braunii* (Engler) van Tieghem*, Globimetula dinklagei* (Engler) Van Tieghem *Globimetula opaca* (Sprague) Danser*, Helixanthera mannii* (Oliver) Danser*, Phragmanthera capitata* (Sprengel) S. Balle*, Tapinanthus globiferus* (A. Richard) Van Tieghem*, Tapinanthus preussii* (Engler) Van Tieghem and *Tapinanthus ogowensis* (Engler) Danser (Table 1). The relative frequence of the *Loranthaceae* in the region of Douala is of 32%. Among the *Loranthaceae* counted, three are helio-sciaphilous. The are: *Phragmanthera capitata* which is a species frequent enough in all region of Douala and in general in the forest zone of Cameroon; *Helixanthera mannii* which is a species only present in Penja; *Tapinanthus ogowensis* present in Penja and Makondo. The five others *Loranthaceae* are heliophilous. They have a tendency to become fixed at the extremity of the host foliage. The helio-sciaphilous species develop as well within as without the foliage. In the case of *P. capitata*, the variety growing by the darkness has bigger, more green and less tough leaves than the one growing by the light. Heliophilous or sciaphilous behaviour of the *Loranthaceae* allows a partition of the ecological niche (Table 1).

Of all the *Loranthaceae* drawn up into inventories, *P. capitata* is the most abundant with 485 parasited host individuals that is a rate of parasitism average of 76.14% (plate 1). The other *Loranthaceae* infest only 152 hosts individuals (23.86%). *P. capitata* is also the most frequent parasite and finds itself in all the studied localities. On the other hand, *Globimetula opaca has* been met only in *Citrus* and only in the locality of Makondo. The average rate of infestation in the four localities studied is of 25% and divided as follows: Penja, 37.99%; Makondo, 24.65%; Logbessou, 20.09%; main road airport-Bonanjo, 17.27%; The most abundant hosts species in the studied sites are: *Theobroma cacao* (20.62%), *Coffea robusta* (16.76%) and *Citrus* spp. (12.03%). The others hosts species have and abundance less than 10 %; they are: *Persea americana, Dacryodes edulis, Terminalia mantaly, Cassia javanica, Cola nitida, Spondias mangifera, Psidium guajava, Delonix regia*, *C. spectabilis*, *Annona muricata* (Table 2).

The most parasited host family is the one of the *Sterculiaceae*. The rate of infestation is of 27.47%. Another host familly showing a parasitism greater to 20% is the one of the *Lauraceae*. The host families with a rate of infestation between 10 and 13% are the *Rutaceae* (11.93%) and the *Anacardiaceae* (10.83%). The others families show the rate of infestation less than 5%. They are : *Burseraceae* (4.08%), *Fabaceae* (4.86%), *Myrtaceae* (2.35%), *Rubiaceae* (2.20%), *Annonaceae* (0.78%). The most sensible host species to the parasitism of the *Loranthaceae* is *P. americana* (21.51%), then follow *C. nitida* (17.27%) and *Terminalia mantaly* (13.97%). This *Lauraceae* is infested by 7 *Loranthaceae* upon the 8 counted; Only *Globimetula opaca* does not parasite her on the scale of our observations. It's also the host species present on all the studied sites.

The host species abundant in the region but not drawn up into inventories, because of his resistance to the para-

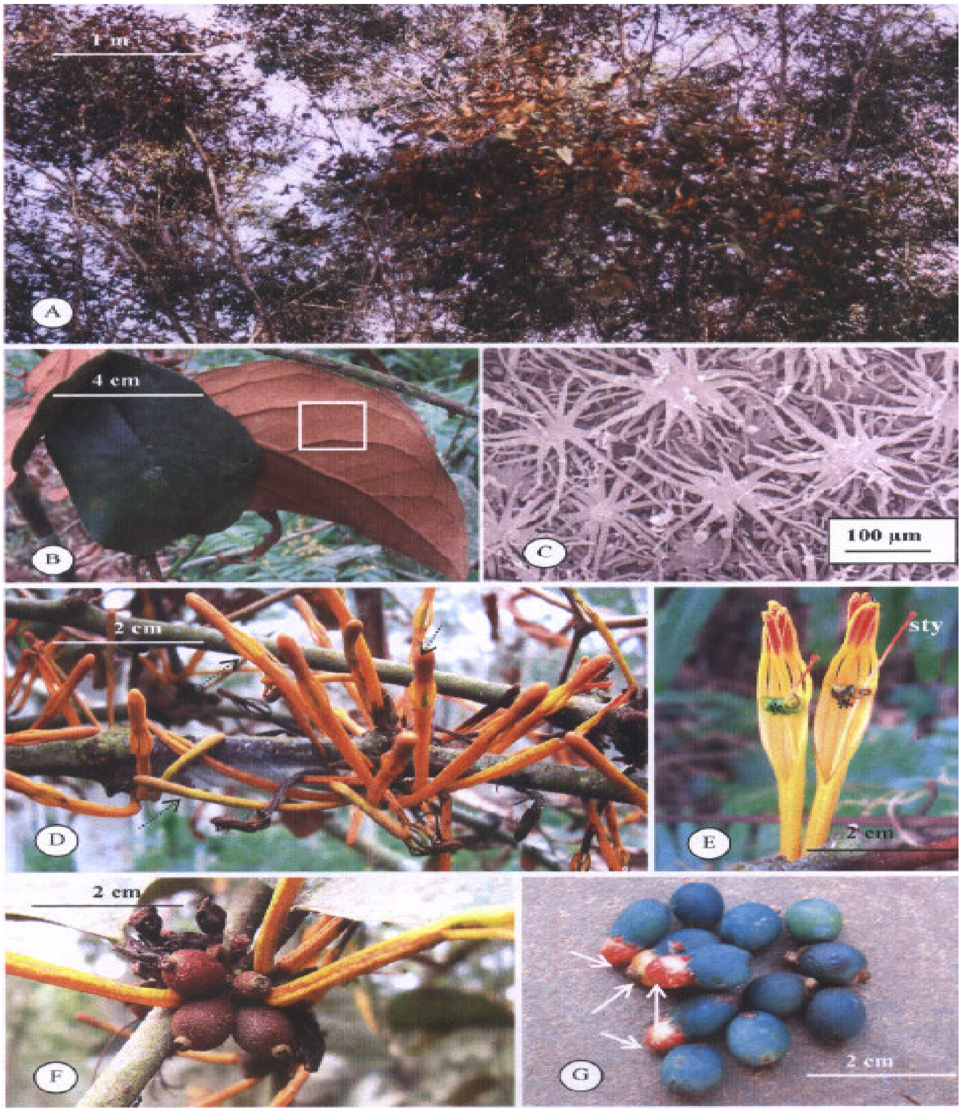

Plate 1. *Phragmanthera capitata* (Sprengel) S. Balle
A ; General aspect of tufts on a host ; B. Aspect of leaves preserving their tomentum; C. Detail of B insert, showing the starry aspect of the hair covering the inferior skin of leaves, MEB; D. Branch with floral buttons, dotted arrow; E. Detail of the two flowers in full bloom; etamins,*, get hoarsed on themselves toward inside and discover the style, sty, two-coloured, yellow in it inferior part and red in his superior part; F. Young berries covered with hair giving them a yellowish aspect; G. Adult berries, smooth, containing a seed covered by an orange or red viscin, arrow.

Parasitism of the *Loranthaceae*, is *Mangifera indica* (*Anacardiaceae*). Nevertheless in Edéa, a town situated at sixty kilometres of Douala, this *Anacardiaceae* is parasited by *P. capitata* and remains the only case known in the country.

The *Loranthaceae* are widely distributed on the woody species cultivated edible or ornemental of Douala region. The level of parasitism is higher in the sites (Logbessou and Makondo) situated by the edge of secondary forests damaged and fragmented. The sites that are remote from it: main road airport-Bonanjo and Penja show average rates of less high infestation. Others floristical inventories tied to parasitism of the *Loranthaceae* have given average rates of infestation sometimes superior or equal to 60 % in Burkina Faso (Boussim et al., 1993a), Cameroon (Sonké et al., 2000) and Gabon (Engone and Sallé, 2006). The sites and the trees infested bear one, two, three, four indeed five *Loranthaceae*. In the site of Penja where five *Loranthaceae* (*Helixanthera mannii, Phragmanthera capitata*, *Tapinanthus ogowensis*, *Tapinanthus preussii and Tapinanthus ogowensis*) are present, their association doesn't seem to follow any rate. They can, all the five, parasite the same host like *Theobroma cacao* in the plantation of *C. nitida.* The observations made on the

Table 1. Distribution of *Loranthaceae* on the cultivated and spontaneous fruit trees of the region of Douala

Loranthaceae	**Number**	**%**	**Host species**	**Host family**
Globimetula braunii (Engler) Van Tieghem	13	2.04	*Citrus* spp. *Dacryodes edulis* *Psidium guajava*	*Rutaceae* *Burseraceae* *Myrtaceae*
Globimetula dinklagei (Engler) Van Tieghem	25	3.92	*Dacryodes edulis* *Spondias mangifera*	*Burseraceae* *Anacardiaceae*
Globimetula opaca (Sprague) Danser	1	0.16	*Citrus* spp.	*Rutaceae*
Tapinanthus ogowensis (Engler) Danser	41	6.44	*Citrus* spp. *Cola nitida* *Dacryodes edulis* *Persea americana* *Theobroma cacao*	*Rutaceae* *Sterculiaceae* *Burseraceae* *Lauraceae* *Sterculiaceae*
Helixanthera mannii (Oliver) Danser	29	4.55	*Citrus* spp. *Coffea robusta* *Persea americana* *Theobroma cacao*	*Rutaceae* *Rubiaceae* *Lauraceae* *Sterculiaceae*
Phragmanthera capitata (Sprengel) S. Balle	485	76.14	*Annona muricata* *Cassia* spp. *Citrus* spp. *Coffea robusta* *Cola nitida* *Delonix regia* *Persea americana* *Psidium guajava* *Spondias mangifera* *Terminalia mantaly* *Theobroma cacao*	*Annonaceae* *Fabaceae* *Rutaceae* *Rubiaceae* *Sterculiaceae* *Fabaceae* *Lauraceae* *Myrtaceae* *Anacardiaceae* *Combretaceae* *Sterculiaceae*
Tapinanthus Globiferus (A. Richard) Van Tieghem	39	6.12	*Citrus* spp. *Cola nitida* *Persea americana* *Psidium guajava* *Spondias mangifera* *Theobroma cacao*	*Rutaceae* *Sterculiaceae* *Lauraceae* *Myrtaceae* *Anacardiaceae* *Sterculiaceae*
Tapinanthus preussii (Engler) Van Tieghem)	4	0.63	*Persea americana* *Theobroma cacao*	*Lauraceae* *Sterculiaceae*
Total	637	100		

the tray of Logbessou show that the presence of a *Loranthaceae* species can exclude the fixation of another one on the same host. Likewise the relative abundance of *Loranthaceae* on a particular host excludes the presence of another on this environment. This is the case of *D. edulis* which individuals represent 2/3 of the counted cultivated fruit trees. This host species is only parasited by *T. ogowensis*, whereas the 1/3 of the remaining trees is parasited by *P. capitata*. The existence of this competition is tied to the ecological factors or/and genetic, responsible of repulsive chemical secretions (Hoffmann et al., 1986; Horkworth and Wiens, 1996).

P. capitata and *T. ogowensis* are the most davastating species. On the parasited hosts trees, in 82.58% of the cases, these two species are present in association or not. The ubiquity of *P. capitata* is remarkable and is suitable for all the ecological variations of Douala region. Very intrusive on parasited hosts, it has a spectre of hosts very wide compared with the other *Loranthaceae*. It infests all the parasited hosts identified, with exception of *D. edulis, Citrus maxima* and *Citrus sinensis*. It is average rate of parasitism is of 76.14% and justifies the fullness of damages more and more considerable of this hemiparasite in Central Africa (Sonké et al., 2000; Engone et al., 2006). Today, due to the development of bad climatic conditions, *P. capitata* has become a real

Table 2. Percentage of abundance and of parasitism by *Loranthaceae* on host species of the investigated areas.

Host species	Abundance (%)	Parasitism (%)
Theobroma cacao	20.62	10.20
Coffea robusta	16.76	2.20
Citrus spp.	12.03	12.24
Persea americana	9.38	21.51
Dacryodes edulis	8.63	4.80
Terminalia mantaly	7.41	13.65
Cassia javanica	5.71	0.94
Cola nitida	4.99	17.27
Spondias mangifera	4.69	10.83
Psidium guajava	4.12	2.35
Delonix regia	2.30	2.82
Cassia spectabilis	1.70	1.10
Annona muricata	1.63	0.78

scourge against which an energic battle is essential. Nevertheless, peasants don't seem very informed and pre-occupied by the presence of the *Loranthaceae* which cause important damages on the harvests.

The most parasited host species is *P. americana*. This parasitism of the avocado by the *Loranthaceae* is higher in the region of Yaoundé (Centre of Cameroon) and varies from 43.30 to 69.44% between localities (Sonké et al., 2000). The fruits rich in vitamins, mineral salts and proteins are very appreciated by the population concerned. This yield from now promoted to the fall is more limited by the action of various devastators and diseases relative to mushrooms.

The site of Logbessou has permitted to note that *Globimetula braunii* can coexist by becoming fixed on itself, detecting its capacities of autoparasitism (Boussim et al., 1993b). The situations of hyperparasitism and autoparasitism are frequent in the Angiosperms epiphytes parasites. Wellman (1964) distinguishes within the *Loranthaceae* eight levels of parasitism.

Factors of the spatial distribution of *Loranthaceae*

Vertical stratification

It has been noted in *C. nitida* plantation a vertical gradient of infestation according to the height of the fruit trees and the enlargement. While following the terminology of the stratification (Amougou, 1989), 45.45% of *C. nitida* infested occupy the B stratum, 40.08% of *P. americana* and *T. cacao* infested met in the C stratum and the under strata, D1 D2, D3 are occupied respectively by *Citrus* spp. (5.79 %), *Coffea robusta* (5.79 %) and *Psidium guajava* (2.89%) infested.

Other similar results in relation with the rate of infestation and the vertical dissemination have also been gotten (Monteiro et al., 1992). The parasitism of trees of the lower strata would be reinforced by the seeds of *Loranthaceae* that would pick up branches of the big trees when their fixing is not there effective (Roxburgh and Nicolson, 2005).

The host trees of the arch outside of the emergent belong to *C. nitida* and *D. edulis*. Only the first species is parasitized permanently by the *Loranthaceae*. *Tapinanthus ogowensis* that parasitizes *D. edulis* on a tray of Logbessou is absent on the branches of this host species. The parasite seems to have more preference for *C. nitida* which specific affinity would be raised more than *D. edulis*. The degree of specialization of *C. nitida* is influenced by the time of association with *T. ogowensis*. Because the old individuals of this species are at least 70 cm diameter and are of around 20 years old as affirmed the owners. In fact, the second rule of Manter stipulates that a long association between the host and the parasite generates a great specificity (Brooks and Mc Lennan, 1993). Moreover, according to Shaw (1994), the parasite has a limiting host number emerging first among the other species and the most abundant host types. The evolution of the interface host-parasite depends also on the competition which settles between the host polyphenols metabolism and the growth speed of the young parasite succour (Sallé and Aber, 1986; Hariri, 1989; Hariri et al., 1990; Hariri et al., 1992). A general tendency exists among the parasites that infest more than a host to infest hosts systematically closed (Norton and Carpenter, 1998). It is the case of the two species of this stratum that belong to the family of *Sterculiaceae* for the *C. nitida* species and of the *Burseraceae* of the *D. edulis* species. The most elevated infestation rate in relation to all *Loranthaceae* is also noted in this same B stratum (45.45%). The relation between the size of the tree and the prevalence of infestation would result at a time from the preference for the disseminators to perch and to eat on the big trees (Aukema and Martinez, 2002) and the old infested trees (Overton, 1994).

Effect of border on the parasitism of *Loranthaceae*

In Penja locality, the climatic gradients and the historic evolution determined the installation of the different *Loranthaceae* species. These remarks are our owns observations after, conversing with the peasants of the region. Following the partition and terracing, the fragments of this forest let to the peasants practicing the food-producing agriculture on burnt land encouraged the reduction of the infestation rate (in relation to their rate in the original forest) as affirmed by the peasants themselves. Indeed, the *Mistletoes* are very sensitive to fire (Kelly, 1993). After the fire, the *Mistletoes* need a long dissemination time to reinstall themselves whereas the populations of host trees develop the mechanisms allowing them to persist immediately after the passage of fires. According to Alexander and Hawksworth (1975) and Turner (1991), the burn constituted an agent of natural control of *Mistletoes*. The burn linked to agriculture of subsistence had a regularity of two to three years because it was necessary to let the soil in fallow. The *Loranthaceae* decreased then and their rate of infestation lowered. In the same time, the pollination and the disseminator agents correlated to the abundance or the reduction of the *Loranthaceae* decreased also.

Furthermore, the opening of the forests decreases the rate of parasites (Norton et al., 1995) and constitutes one of the present major facts and preoccupying problems of conservation in all its components. It is currently proven that the borders alter the available resources and the microclimate (Laurance et al., 1998), as well as the animal interactions, including the herbivores, the agents of pollination, the seed disseminators and the seed predators (Restrepo and Vargas, 1999).

With the introduction of the pension cultures (citrus fruits; cacao, coffee, kola, and pear trees), bush fires associated to human activities were rarefied. The *Loranthaceae* reacquired their life cycle and the rate of parasitism became high. In the same time, the receding of the forest leads to the predators decrease (Saunders et al., 1993).

In *C. nitida* plantation, the high rate of parasitism is also in relation with the migration of the disseminators and pollination agents. In fact, most farmers' plantations neighbouring are regularly maintained and the parasitic *Loranthaceae* seen on the host trees are immediately burnt. The pollination agents and avian disseminators unsettled in their food regimes move towards the plantation less kept and install themselves while increasing the rate of infestation (personal obs.).

Leakage

The only method of fight practiced by the peasants is leakage. The cut branches are heaped and burnt. This method of fight, very executed, is less expensive and essentially curative. It however requires the implication of the whole local community especially as the efforts to eradicate the *Loranthaceae* of the some could be annulled by the laxity of others.

Some practices that consist in abandoning the pruned branches no far from the place of picking are dangerous. These forsaken tufts are likely to increase the role played by the pollination agents and disseminators when they are in bloom and in fruits.

The slash must take place upstream of the parasite fixing point in order to eliminate the totality of the endophyte system (Clerk, 1978; Frochot and Sallé, 1980). The simple deletion of the parasite tufts can save some elements that could regenerate very quickly in new branches of *Loranthaceae*. In fact, the parasite possesses cortical cords that circulate in the host branches and develops secondary succours (Sallé and Aber, 1986). The abundance of this species can be explained by the setting up of this supplementary haustoriale structure.

However it is not necessary to disregard the manual destruction of the tufts because this practice contributed in several regions, to the reduction of homes of infestations and to the reduction of the stock of the parasite seeds, thus facilitating the life saving of the trees no infested yet. This technique proved to be very efficient in Ghana while fighting against *T. bangwensis* in *C. nitida* plantations (Clerk, 1978), and in Switzerland for the elimination of *Viscum album* (Sallé et al., 1993).

Mimetism

In several cases, camouflage is remarkable for the *Loranthaceae*. The tufts of the parasite unite discreetly to the host branches (long raining season, between June and November) so that the parasite is difficulty recognizable far away. The mimetism is a strategy to conceal and to escape to the action of predators. The leaves of *P. capitata* present a polymorphism that would assimilate them to the plant on which it is fixed.

The young leaves *T. ogowensis* are reddished and mime those of *D. edulis*. The phenomenon is very remarkable on *D. edulis* when observe the summit far away. The reddish foliage of the stems extremities doesn't allow the predators to see the parasite. Other organs of the parasites can be concerned by this mimetism: at *P. capitata*, the fruits look by their shape and their size like those of *T. mantaly* that it infests and would pass unobserved far away to the birds that savour them.

The mimetism is especially owed to the genetic selection bound to the hormonal compatibility during the adaptation process to the specific host. In fact, the morphogenesis that determines the host shape would also affect those of the parasite. A narrow similarity exists between the cytokines in the sap of the minor hosts as well as non minor ones (Hall et al., 1987).

In general, *Loranthaceae* mime the hosts on which they push, very evidently by the shape of their leaves, but this variation also spreads to the peel and to the colour. The *Mistletoes* have a weak chemical defence and are often tasty for herbivores, especially for those living in forest (Barlow and Wiens, 1977).

Specific relations hosts-parasites

The obtained results show that in the *Loranthaceae* family, some species are ubiquities and parasitize a large range of hosts. In fact, *P. capitata* parasitizes most the fruit trees studied. *M. indica* doesn't escape to its infestation but, remains less sensitive than other hosts. In this case, *M. indica* synthesizes abundantly and quickly polyphenolic compounds rich in tannins and flavonoïdes (Hariri et al., 1991). The parasite is then unable to cross this barrier and dies due to the lack of nutritional exchanges with the host tissues (Hariri et al., 1990).

Some interrelationships have already been established between the abundance of the *Loranthaceae* and particular topographic situations (surroundings of the rivers, slopes, lispers) (Gibson and Watkinson, 1989). So, some

Loranthaceae show a high degree of specificity on the small plateau of Douala in relation to the infested host. Here, *T. ogowensis* parasitizes only *D. edulis* to a precise place of the site, the summit of the tray.

Within of a population, the parasites could infest a high number of hosts, but by using some species only commonly. *T. ogowensis* infests a wide range of hosts such as *Citrus* spp. (*Rutaceae*), *P. americana* (*Lauraceae*), *T. cocoa* (*Sterculiaceae*) and *C. nitida* (*Sterculiaceae*), but no more *D. edulis* which becomes resistant to the parasitism of *Loranthaceae*. Therefore appears therefore that when the number of available hosts increases, the specificity of the parasite in relation to a host becomes uncertain. Another *Loranthaceae*, *G. opaca* is at the same time specific of the site and the host. That species parasitizes only the *Citrus*, in particular *C. sinensis*. The only plant on which it has been met was also infested by *P. capitata*.

The host specificity must be seen in a dynamic way, variable in time and space (Norton and Carpenter, 1998). It ensues that the host species vary from a site to the other and inside the same site. However, in spite of the local differences of the host supports, we predict that the general features of the tree species would determine what available trees would be like hosts in every site.

Conclusion

The proliferation of the *Loranthaceae* is probably owed to a disruption of the host-parasitic balance, but also to changes in the land use and other ecological factors. The rate of *Loranthaceae* is higher in the parcelled forests. *P. capitata* is the most abundant and most frequent species, but also the most dreaded by the populations for theirs morphogenetical, technological, ecological and socio-economic consequences. These numerous and damageing effects make some parasitic angiosperms true agronomic threats, especially in developing countries.

The leakage by manual destruction of the tufts appears like an efficient method of fighting even though it asks for some complements of information, notably the cutting point for completely eradication of the parasite from the trees.

However, *Loranthaceae* have higher rate of therapeutic properties. Moreover, the objective pursued at the present time by the researchers is not more the eradication of the parasites in general, but to maintain them to a compatible level with their environment. This explains the necessity of integrated struggle proposed and important training of smallholders in developing countries.

REFERENCES

Alexander ME, Hawksworth FG (1975). Wildland fires and dwarf *Mistletoes*: a literature review of ecology prescribed burning. General technical report RM-14. U. S. Department of Agriculture Forest Service, Fort Collins, Colorado.

Amougou A (1989). La notion de stratification type de référence en milieu forestier tropical. Candollea 44: 192 – 198.

Aukema J, Martinez Del Rio C (2002). Where does a fruit-eating bird deposit *Mistletoe* seeds? Seed deposition patterns and an experiment. Ecol. 83: 3489- 3496.

Balle S, Hallé N (1961). Les *Loranthaceae* de la Côte d'Ivoire. Adansonia 1 : 209-265.

Balle S (1982). Loranthacées, Flore du Cameroun, vol. 23, Satabié B., Leroy J.F., Yaoundé, Cameroun, p.82.

Barlow BA, Wiens D (1977). Host- parasite resemblance in Australian *Mistletoes*: the case cryptic mimicry. Evolution 31: 69 – 84.

Barlow BA (1983). Biogeography of *Loranthaceae* and *Viscaceae*. The Biology of Mistletoes (Calder M, Bernhardt P), Academic Press, Sydney. pp. 68-131.

Boussim IJ, Sallé G, Guinko S (1993a). *Tapinanthus* parasite du karité au Burkina Faso, 1. Identification et distribution. Bois et Forêts des Tropiques 238 : 45-52.

Boussim IJ, Sallé G, Guinko S (1993b). *Tapinanthus* parasite du karité au Burkina Faso, 2. Phénologie, biologie et dégâts. Bois et Forêts des Tropiques 238 : 53-65.

Boussim IJ, Guinko S, Tuquet C, Sallé G (2004). Mistletoes of the agroforestry parklands of Burkina Faso. Agroforestry Syst. 60: 39-49.

Brooks DR, Mc Lennan DA (1993). Parascript : Parasites and the Language of Evolution. Smithsonian Institution Press, Washington and London.

Clerk GC (1978). *Tapinanthus bangwensis* in a *Cola* plantation in Ghana. PANS 24: 57 – 62.

Din N, Saenger P, Priso JR, Dibong SD, Amougou A (2008). Logging activities in mangrove forests: A case study of Douala Cameroon. Afr. J. Environ. Sci. Technol. 2 (2): 22-30.

Ehleringer JR, Schulze H, Ziegler CL, Lange GD, Farquhar, Cowan IR (1985). Xylem-tapping *Mistletoes* partially heterotrophic? Oecologia 84: 244- 248.

Engone Obiang NL, Sallé G (2006). Faut-il éradiquer *Phragmanthera capitata*, parasite des hévéas en Afrique ? C. R. Biologies 329: 185-195.

Frochot H, Sallé G (1980). Modalité d'implantation et de dissémination du gui. Rev. For. Fr. 32 (6): 505 – 518.

Gibson CC, Watkinson AR (1989). The host range and selectivity of a parasitic plant: *Rhinanthus minor* L. Oecologia 78: 401 – 406.

Hall PJ, Badeboch-Jones J, Parker CW, Letham DS, Barlow BA (1987). Identification of quantification of cytokines in the xylem sap of *Mistletoes* and their hosts in relation leaf mimicry. Austr. J. Plant Physiol. 14: 429 – 438.

Hariri EB (1989). Polyphénols et résistance au gui. Etude histochimique et analytique. Thèse d'Université Pierre et Marie Curie, Paris, p.179.

Hariri EB, Sallé G, Andary C (1990). Mécanismes de résistance de quatre cultivars de peuplier en réponse à l'attaque du gui (*Viscum album* L.). C. R. Acad. Sci. Paris, 311 (3) : 439-444.

Hariri EB, Sallé G, Andary C (1991). Involvement of flavonoids in the resistance of two poplar cultivars to mistletoe (*Viscum album* L.). Protoplasma 162: 20-26.

Hariri EB, Jeune B, Baudino S, Urech K, Salle G (1992). Elaboration d'un coefficient de résistance au gui chez la chène. Can. J. Bot. 70: 1239-1246.

Hawksworth FG, Wiens D (1996). Dwarf Mistletoes: Biology, Pathology, and Systematics. Agricultural Handbook 709. US Department of Agriculture, Washington, DC.

Hoffmann AJ, Fuentes ER, Cortès I, Liberona F, Costa V (1986). *Tristerix tetrandrus* (*Loranthaceae*) and its host-plants in the Chilean mattoral: patterns and mechanisms. Oecologia 69: 202-206.

Kelly P (1993). Effect of spring burning and defoliation on survival and resprouting of box Mistletoe *Amyema miquelii* and drooping *Mistletoe Amyema pendulum*. Thesis, University of New England, Armidale, Australia.

Laurance WF, Ferreira LV, Rankin de Merona JM, Laurance SG (1998). Rain forest fragmentation and the dynamics of Amazonian tree communities. Ecol. 69: 2032 – 2040.

Letouzey R (1985). Notice de la carte phytogéographique du Cameroun au 1/500000: domaine de la forêt dense humide toujours verte, IRA/ICIV, Toulouse, France.

Monteiro R, Martins R, Yamamoto K (1992). Host specificity and dispersal of *Psittacanthus robustus* (*Loranthaceae*) in South East

Brazil. J. Trop. Ecol. 8: 307 – 314.

Norton DA, Carpenter M (1998). *Mistletoes* as parasits: host specificity and speciation, Trends in trends. Ecol. Evolution 13: 101-105.

Norton DA, Hobbs J, Atkins (1995). Fragmentation, disturbance, and plant distribution: *Mistletoes* in woodland remnants in the Western Australian Wheatbelt. Conserv. Biol. 9: 426 – 438.

Overton J (1994). Dispersal and infection in *Mistletoe* metapopulations. J. Ecol. 82: 711 – 723.

Restrepo C, Vargas A (1999). Seeds and seedlings of two neotropical montane understory shrubs respond differently to anthropogenic edges and treefall gaps. Oecologia 119: 419 – 426.

Roxburgh L, Nicolson SW (2005). Patterns of host use in two African *Mistletoes*: the importance of *Mistletoe*-host compatibility and avian disperser behaviour, Functional Ecol. 19: 865 – 873.

Sallé G, Aber M (1986). Les phanérogames parasites : Biologie et stratégies de lutte. Bull. Soc. Bot. France, Lett. Bot. 3 : 235-263.

Sallé G, Frochot H, Andary C (1993). Le gui. La recherche 24: 1334 – 1342.

Shaw MR (1994). Parasitoid host ranges. Parasitoid Community Ecology (eds BA Hawkins, W Sheehan), Oxford University Press, New York. p. 111-114.

Saunders DA, Hobbs RJ, Arnold GW (1993). The kellerberrin project on fragmented landscapes: a review of current in formation, Biol. Conserv. 64: 185 – 192.

Sonké B, Kenfack D, Tindo M (2000). Parasitisme de l'avocatier (*Persea americana*, *Lauraceae*) par les Loranthacées dans la région de Yaoundé (Cameroun). Fruits 55 : 325 – 331.

Thorne RF (1992). Classification and geography of flowering plants. Bot. Rev. 58: 225 – 348.

Turner RJ (1991). *Mistletoe* in eucalypt forest- a resource for birds. Australian Forestry 54: 226 – 235.

Wellman F (1964). Parasitism among neotropical phanerogams. Ann. Rev. Phyt. 2: 43-56.