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INFESTATION AND PREVALENCE OF THE MISTLETOE, *Tapinanthus bangwensis* ON HOST PLANTS IN MOOR PLANTATION, IBADAN, NIGERIA

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ABSTRACT

An assessment of the host-parasite relationship of the Mistletoe, Tapinanthus bangwensis was undertaken in a field with wide array of susceptible host plants cover. The focus of the investigation was to identify the incidence of the parasite on host plants, the susceptible hosts and distribution of the parasite among hosts population. The field assessment revealed a sizable sum of 55 species belonging to 24 families out of which 19 species in the domain of 14 families were susceptible to infestation. It was evident that the parasite was less discriminatory and able to infest a range of different host species which made it a generalist in its mode of infestation. The incidence of the Mistletoe on susceptible hosts rose with increased population of the hosts when other factors of influence were minimal.

Key words: Incidence, haustorium, loranthaceae, population, spatial distribution

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INTRODUCTION

Mistletoes are angiosperm and parasitic plants in the order Santalales. They characteristically coexist and adhere to their host plant's stems through a bulb-like rooting structure known as the haustorium (Mathiasen *et al*., 2008). Mistletoes generally share an obligate hemi-parasitic lifestyle as they obtain water and minerals from other plants being partially autotrophic (Ileana *et al*., 2016; Leimu, 2010).

Tapinanthus species are a group of the African mistletoes which constitute the bulk of the Loranthaceae family comprising about 250 species in East and West Africa. They are acknowledged to have wide spread in Nigeria. The host plants of mistletoes span several families including ranges of trees and shrubs (see fig. 2 – 4, some host-mistletoe association) with aesthetic, economic and medicinal importance (Ibrahim *et al*., 2014; *Kwon-Ndung et al*., 2009; Zaroug, *et al*., 2014).

The growth and spread of Mistletoe on host plants can be influenced by a number of factors which include suitable host species distribution, splintered habitat state, feeding habits of dispersers and herbivory. Some other features such as topography of the ensuing environment like elevation and steepness of slope are a subtle and perennial contributor to the perpetuation of the parasite on host stands (Aukema, 2004; Ileana *et al*., 2016; Kumbasli *et al*., 2011; Roxburgh and Nicolson, 2005).

Mistletoes inarguably constitute a vast majority of the plant parasites' niche and by extension serve pivotal roles in many ecosystems as the resource from which several intrinsic interactions gain a foothold. They ostensibly affect their host population biology. Infestation of hosts by the mistletoe parasite is deprivative; thus, growth and nutrition of infested plant could be impacted negatively leading to premature

death when the population density of the parasite is allowed to increase beyond the tolerable capacity of host species (Pennings and Callaway, 2002; Arruda *et al*., 2012; Maruyama *et al*., 2012; Mathiasen *et al*., 2008).

Hence, the primary focus of this research was to determine the host range and spatial distribution of mistletoes while also assessing the degree of infestation by the parasite on susceptible host species in Moor Plantation within the locale of the National Cereals Research Institute (NCRI).

MATERIALS AND METHODS

Study Area:

The study was carried out on the expanse of land area of 40 km^2 which is of the derived Savannah vegetation belt covering the National Cereals Research Institute (NCRI) landscape of Moor Plantation in Ibadan, Oyo State, Nigeria. The survey was conducted in 2021-2023**.**

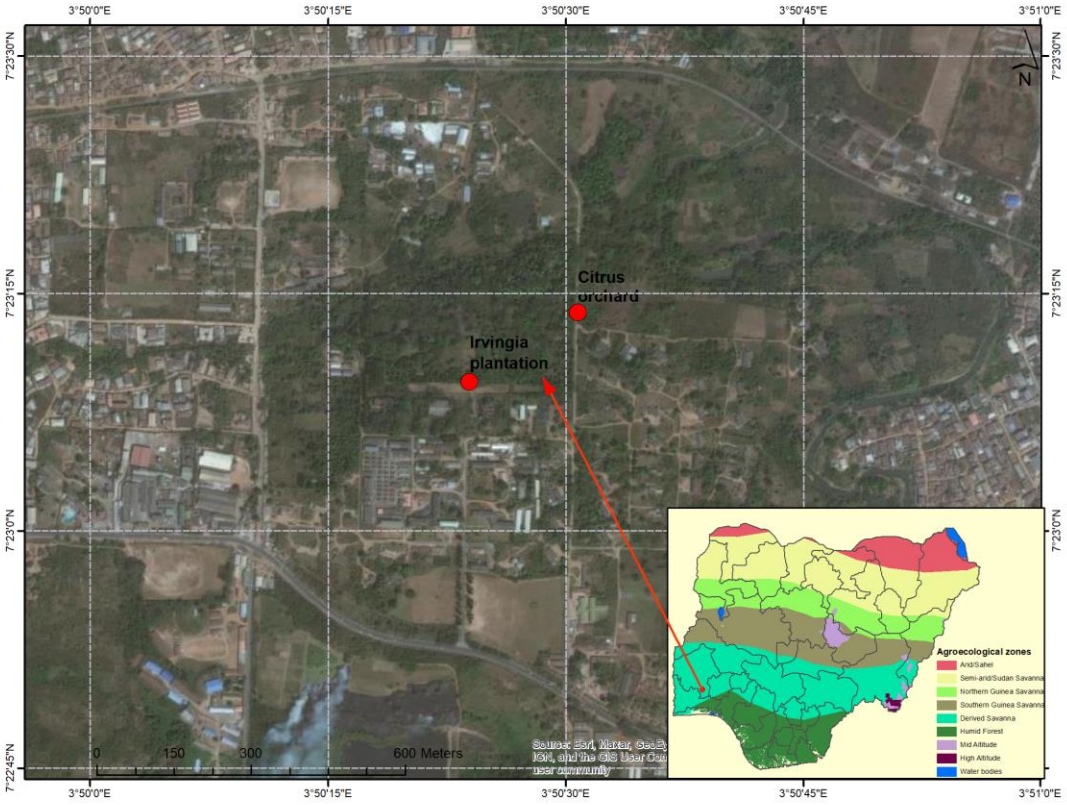

Fig. 1: Map of the image view of the study area pointing at the *Irvingia* plantation and *Citrus* orchard at the centre of the NCRI landscape, Moor Plantation, Ibadan

Host Trees Field Survey:

The total species population was obtained as a field survey was undertaken to assess host plants susceptible to mistletoe infestation. The infested hosts were distinguished by the presence of bulbiferous outgrowth known as the haustorium seen on infested branches.

Susceptibility to Infestation and Host Range

All host trees assessed for the presence of mistletoe were duly identified and those parasitized were verified and noted.

Spatial Distribution

The total population of host trees and the number of infested stands observed were noted. Percentage infestation of the mistletoe was then calculated relative to the susceptible hosts.

Degree of Infestation

Evaluation of the prevalence of mistletoe on the various hosts was conducted through counting of the number of haustorium per host plant. The scale outlined below as used by Zaroug *et al*., 2014 was adopted and modified to denote the degree of infestation:

+ = low infestation (1-5 haustoria of the parasite/tree)

++ = moderate infestation (6-10 haustoria/tree)

+++ = high infestation (more than 10 haustoria/tree)

RESULTS

Field survey for the evaluation of host tree species susceptible to mistletoe infestation was carried out as shown in Table 1. The total population of plants assessed were 24 families and 55 species. The families of Fabaceae and Moraceae each having five (5) species domain count were the ones with the most in different species unit in the whole group. Next in the ranking, were four (4) species observed for Combretaceae, Rutaceae and Sterculiaceae. There were few three (3) and two (2) species representations among the assessed population but majority were of one (1) species count. The vegetative belt of the field survey location being derived savannah favoured a fair mixture of trees and shrubs and the diverse tree types are captured in the outlined list of plant species assessed.

Table 1: Host tree species evaluated for susceptibility to mistletoe infestation in Moor Plantation

S/No	Plant family	Species
1.	Anacardiaceae	*Mangifera indica, Anacardium occidentale, Spondias mombin*
2.	Annonaceae	*Annona muricata, Annona squamosa, Monodora myristica*
3.	Apocynaceae	*Holarrhena floribunda*
4.	Bombacaceae	*Ceiba pentandra*
5.	Buseraceae	*Dacryodes edulis*
6.	Ceasalpinaceae	*Afzelia africana, Erythrophleum suaveolens, Senna fistula*
7.	Clusiaceae/Guttiferea	*Garcinia kola*
8.	Combretaceae	*Terminalia catappa, Terminalia ivorensis, Terminalia mantaly, Terminalia superba*
9.	Fabaceae	*Pentaclethra macrophlla, Albizia lebbeck, Albizia odoratissima, Leucaena leucocephala,*
10.	Irvingiaceae	*Tamarindus indica*
11.	Luretaceae	*Irvingia gabonensis, Irvingia wombulu*
12.	Lythraceae	*Persea americana*
13.	Malvaceae	*Lagerstroemia indica*
14.	Meliaceae	*Bombax glabrum, Theobroma cacao, Adansonia digitata*
15.	Moraceae	*Cedrela odorata, Khaya grandifoliola, Khaya senegalensis*
16.	Moringaceae	*Artocarpus altilis, Artocarpus heterophyllus Ficus exasperata, Milicia excelsa,Treculia africana*
17.	Myrtaceae	*Moringa oleifera*
18.	Papillionaceae	*Psidium guajava, Eucalyptus camaldulensis*
19.	Rubiaceae	*Parkia biglobosa*
20.	Rutaceae	*Ixora chinensis, Morinda lucida*

21. Sapindaceae	*Citrus limon, Citrus paradisi, Citrus reticulata, Citrus sinensis*
22. Sapotaceae	*Bligha sapida*
23. Sterculiaceae	*Gambeya albida*
24. Verbanaceae	*Cola acuminata, Cola millenii, Cola nitida, Triplochyton scleroxylon*
	Gmelina arborea, Tectona grandis

The assessment of the stands of trees and shrubs on the field for their susceptibility to mistletoe infestation reveal the presence of mistletoe on some host species as depicted in Table 2. It was observed that 19 species belonging to 14 families were susceptible to the parasitic mistletoe infestation. Majority of the host tree families have a species representation each except for the Anacardiaceae, Irvingiaceae, Rubiaceae, Rutaceae and Sterculiaceae which have two species representation each.

Table 2: Host tree species susceptible to mistletoe infestation in Moor Plantation

Plant family	Species
Anacardiaceae	*Mangifera indica, Anacardium occidentale*
Apocynaceae	*Holarrhena floribunda*
Fabaceae	*Leucaena leucocephala*
Irvingiaceae	*Irvingia gabonensis, Irvingia wombulu*
Lythraceae	*Lagerstroemia indica*
Meliaceae	*Cedrela odorata*
Moraceae	*Ficus exasperata*
Moringaceae	*Moringa oleifera*
Myrtaceae	*Psidium guajava*
Rubiaceae	*Ixora chinensis, Morinda lucida*
Rutaceae	*Citrus limon, Citrus sinensis*
Sapindaceae	*Bligha sapida*
Sapotaceae	*Gambeya albida*
Sterculiaceae	*Cola acuminata, Cola nitida*

The spatial distribution of mistletoe on susceptible hosts was presented in Table 3. There were 19 different species of host trees with the presence of mistletoe. *Cola nitida* and *Ixora chinensis* each has one stand of tree at 100% infestation while the other stands of tree species majorly have below average percentage rate of infestation. Among the host trees with the more spatially distributed mistletoe on its stands include *Cola acuminata* (71.4%), *Cedrela odorata* (40%), *Irvingia gabonensis* (31.8%), and *Citrus sinensis* (29.6%). The comparative distribution of mistletoe among the different susceptible hosts group across the vegetation and land mass assessed; showed spatial distribution for the hosts with the higher domicile base (resident parasite) as *Irvingia gabonensis* (35.0%), *Citrus sinensis* (17.9%) and *Leucaena leucocephala* (10.3%). The susceptible hosts with the least spatial distribution at 0.9% included *Cola nitida*, *Ficus exasperata*, *Holarrhena floribunda* and *Ixora chinensis*.

Table 3: Spatial Distribution of Mistletoe on Susceptible Host Plants in Moor Plantation

Host tree species	Total population assessed	Infested stands of tree species	Percentage infestation of susceptible hosts	Percentage infestation of each species relative to the total susceptible hosts
Anacardium occidentale	14	3	21.4	2.6
Bligha sapida	8	2	25.0	1.7
Cedrela odorata	5	2	40.0	1.7
Citrus limon	7	2	28.6	1.7
Citrus sinensis	72	21	29.6	17.9
Cola acuminata	7	5	71.4	4.3
Cola nitida	1	1	100.0	0.9
Ficus exasperata	4	1	25.0	0.9
Gambeya albida	33	3	9.1	2.6
Holarrhena floribunda	4	1	25.0	0.9
Irvingia gabonensis	129	41	31.8	35.0
Irvingia wombulu	88	6	6.8	5.1
Ixora chinensis	1	1	100.0	0.9
Lagerstroemia indica	7	2	28.6	1.7
Leucaena leucocephala	57	12	21.1	10.3
Mangifera indica	43	5	11.6	4.6
Morinda lucida	12	2	16.7	1.7
Moringa oleifera	21	3	14.3	2.6
Psidium guajava	15	4	26.7	3.4

Presented in Table 4 is the degree of mistletoe infestation on the various host species. Severity of infestation on the susceptible hosts ranged from low to moderate and high in few others. Majority of the susceptible host species were at low degree of infestation. Among the nineteen (19) susceptible hosts, fourteen (14) were at low degree of infestation, three (3) at moderate infestation while two (2) were at high degree of infestation. The two species (*Cola acuminata* and *Cola nitida*) with high degree of infestation both belong to the Sterculiaceae family. The three families of Fabaceae (*Leucaena leucocephala*), Irvingiaceae (*Irvingia gabonensis*) and Lythraceae (*Lagerstroemia indica*) were the origin of the other species which exhibited moderate infestation. The remaining fourteen (14) species at low infestation were scattered among ten (10) families.

Table 4: Degree of infestation on host tree species susceptible to mistletoe

Family	Species	Severity
Anacardiaceae	*Mangifera indica*	+
	Anacardium occidentale	+
Apocynaceae	*Holarrhena floribunda*	+
Fabaceae	*Leucaena leucocephala*	++
Irvingiaceae	*Irvingia gabonensis*	++
	Irvingia wombulu	+
Lythraceae	*Lagerstroemia indica*	++
Meliaceae	*Cedrela odorata*	+
Moraceae	*Ficus exasperata*	+
Moringaceae	*Moringa oleifera*	+
Myrtaceae	*Psidium guajava*	+
Rubiaceae	*Ixora chinensis*	+
	Morinda lucida	+
Rutaceae	*Citrus limon*	+
	Citrus sinensis	+
Sapindaceae	*Bligha sapida*	+
Sapotaceae	*Gambeya albida*	+
Sterculiaceae	*Cola acuminata*	+++
	Cola nitida	+++

+ = low infestation (1-5 haustoria of the parasite/tree)
++ = moderate infestation (6-10 haustoria/tree)
+++ = high infestation (more than 10 haustoria/tree)

DISCUSSION

Mistletoes, especially the Lorantaceae family, are known to possess the capacity to infest a wide range of host plant species (Pennings and Callaway, 2002; Odeyemi *et al*., 2022). Reflected in Table 1 is thus the diversity among the host plants at the field location earmarked for the assessment of host plants susceptible to mistletoe infestation. The list in Table 1 highlighted plants belonging to 24 families and 55 species, many of which have been found to be host to mistletoes at several other locations (Zaroug, *et al*., 2014; Odeyemi *et al*., 2022). However, each location oftentimes showcases its peculiarity relative to the biotic and abiotic interactions of its domain (Ileana *et al*., 2016).

The representation in Table 2 is the outcome of the field assessment for susceptibility to mistletoe infestation across different host plants. It was observed that 19 species belonging to 14 families were susceptible to infestation out of the 55 species of 24 families. This outcome supported the wide range of host species habitation attributed to many mistletoe species (Pennings and Callaway, 2002). *Tapinanthus bangwensis* was the only mistletoe species type identified with the susceptible hosts at the location assessed unlike other places where the outcome were incidences of two or more distinct mistletoe species flourishing and evolving in same thriving environment (Yirgu, 2014; Odeyemi *et al*., 2022). The growth and adaptation of many of the potential host plants relative to the environment could have made some of them not to support mistletoe habitation. Hence, many potential host species which hitherto were susceptible in other climes could be seen to be resistant and non-receptive to the parasitic growth and vice versa (Lopez de Buen and Ornelas 2002; Roxburgh and Nicolson 2005).

Spatial distribution of *Tapinanthus bangwensis* among the susceptible hosts on the field was presented in Table 3. Outlook of individual host-parasite species co-habitation revealed that *Cola nitida*, *Ixora chinensis*, *Cola acuminata* have

above average percentage incidences while *Cedrela odorata*, *Irvingia gabonensis*, and *Citrus sinensis* had much lower incidence encounter of the parasite. The comparative expression for spatial distribution of the parasite relative to the susceptible host group showed that *Irvingia gabonensis*, *Citrus sinensis* and *Leucaena leucocephala* were the ones with greater incidences of the parasite. And the hosts with the least spatially distributed parasite included *Cola nitida*, *Ficus exasperata, Holarrhena floribunda* and *Ixora chinensis*. The spatial distribution of the parasite on the basis of each host species showcased distinct relationship pattern different from what the comparative outlook at the susceptible hosts group interaction revealed. In practical terms, this could be explained using extract of data from Table 3. *Lagerstroemia indica* (7 stands) had 28.6% as its host-parasite species habitation and 1.7% at the susceptible hosts group and then, *Citrus sinensis* (72 stands) 29.6% and 17.9%. It could be seen that while the two host plants had similar spatial distribution of the parasite within their species domain, *C. sinensis* exerted more impact at the susceptible hosts group level. So that with other variables being negligible, it can be safe to presuppose that the more densely populated host attracted higher spatial distribution of the parasite in susceptible hosts group than that of a sparsely populated host (Dlama *et al*., 2016). Hence, the relative distribution of the parasite among the hosts seemed thus to correlate with the preponderance or otherwise scarcity of the species unit of each susceptible host population.

The assessment regarding degree of infestation by *T. bangwensis* on the susceptible hosts showed varying levels of impact among the various host species. Several factors account for the variability observed in the severity of infestation. One of such include that the host plants were at different locations, spread across the expanse of field covered for the assessment with their peculiar ecophysiological feature (Edagbo *et al*., 2013). Also, the host plants had different levels of exposure to the natural processes of growth and development, the sustenance process of evolution and other intrinsic and extraneous factors. Essentially, some of the biological activities that could bring about sustained impact of the parasitic infestation as deducted from related works done in the past, comprise among others, host-parasite compatibility, access to nutrients, activities of dispersal agents (perching preference determining deposition of seeds of the parasite), crown cover of host and duration of host-parasite co-existence (Ileana *et al*., 2016; Kumbasli *et al*., 2011; Roxburgh and Nicolson, 2005).

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CONCLUSION AND RECOMMENDATION

The mistletoe, *Tapinanthus bangwensis* like some other plant parasites in the Loranthaceae family has proved to be a generalist in its infestation of host species. When other eco-physiological factors are negligible, the host-parasite interactions indicate prevalence of the mistletoe on the more densely populated hosts susceptible to infestation.

It is important to study the economic impact of mistletoe in plantation of trees severely infested by the parasite such as was the case with the family of Sterculiaceae especially as it adds up to the cost of production, in view of the agronomic practices of its removal.

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a). Host plant b). Section of the mistletoe infestation showing its leaves and flowers

Figure 2: Mistletoe on *Ixora chinensis*

a). Host plant b). Section of the mistletoe infestation showing the leaves, flowers and haustorium

Figure 3: Mistletoe on *Lagerstroemia indica*

a). Host plant b). Section of the mistletoe infestation showing its leaves and flowers

Figure 4: Mistletoe on *Irvingia gabonensis*