



## Preliminary Survey of African Mistletoe (Loranthaceae) on Host Trees Species in Sokoto Metropolis, North Western Nigeria

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### ABSTRACT

The study assessed occurrence and distribution of African Mistletoe (Loranthaceae) in Sokoto Metropolis, northwestern Nigeria between February and July, 2015. Seven (7) different study locations with occurrence of the mistletoe-bearing trees were studied. Host trees and Loranthus were identified and examined accordingly using standard methods. Results have indicated highest occurrence of the mistletoe in *Azadirachta indica* with 45.99% and its lowest occurrence in *Ceiba pentandra* with 2.08%. Overall, eleven (11) tree species had mistletoes on them with different levels of infestation among the species. Similarly, different locations have shown different levels of the mistletoe occurrence with variations in the number of infested trees. UDUS Main Campus with seven (7) tree species infected had the highest infestation of 21.66% but Runjin Sambo with no fewer than eight (8) infected tree species had the second highest infestation of 20.18%. The least infected of all the study locations is Gagi with an infestation level of 6.53% and five (5) tree species infected. This is lower than Farfaru with 9.20% infestation and only four (4) species infected. Vegetative crowns of all the mistletoes observed were apparently, ball-shaped (54.70%), irregular-shaped (28.60%) or triangular-shaped (16.60%). The feeding preference of bird mutualists to the host tree species and/or the associated mistletoe could be responsible for the higher mistletoe's infestations in some tree species than others. Moreover, tree populations having closer proximity to water bodies probably attracted more pollinator birds, responsible for the transfer of mistletoe seeds and causing higher infestations on tree populations in the affected areas.

**Keywords:** Survey, Mistletoe, Infestation, Host tree species, Sokoto metropolis, Northwestern Nigeria

### INTRODUCTION

Mistletoes are common aerial-stem hemi-parasites that frequently depend on frugivores for seed dispersal and their host plant for water and nutrients (Reid *et al.*, 1995). These woody hemi-parasitic perennial plants are found usually in hard wood trees and shrubs which have ethno botanical and economic importance including shea butter, neem, citrus, cocoa, rubber, cola nuts, coffee, mango etc (Bako *et al.*, 2001). Mistletoes make part of their nutritional requirements (carbohydrates) through photosynthesis but develop haustorial systems which penetrate host tissue (s) to obtain water, mineral nutrients and other metabolites (Bako *et al.*, 2003).

The two major families of mistletoe are Loranthaceae and Viscaceae. Most genera of African mistletoe belong to the family Loranthaceae (Dambele *et al.*, 1994). It is the largest family of mistletoe having up to 73 genera and over 900 species (Judd *et al.*, 2002). The six major genera of the Loranthaceae found in Nigeria are Tapinanthus, Agelanthus, Loranthus, Globometula, Phragmenthera and Englerina, with Tapinanthus being far more widespread in the Nigerian savanna (Bako *et al.*, 2001). The most

commonly encountered species are *T. dodoneifolius*, *T. globiferus*, *T. belbisii*, *T. pentagonia*, *I. butigii* and *I. sessifolus*. They infest many wild and domesticated tree and shrub species causing ecological and economic damage of varying proportions (Omolaja and Famaye, 1998).

Recent studies have reported widespread distribution of mistletoes in habitats ranging from tropical rainforest and mangroves to arid shrub lands (Shaw *et al.*, 2004). Habitat diversity and structure have been identified as being the major factors influencing the distribution pattern of mistletoes (Kelly *et al.*, 2004). Very few studies, to date, have linked seed dispersal and seedling establishment for understanding of mistletoe distribution and plant demography together with different anthropogenic disturbance at local scale (Didier *et al.*, 2009). We therefore need a broader understanding of mistletoe dispersal and establishment patterns across habitat types in different plant communities at small scales.

The present study was carried out to investigate the pattern of mistletoe distribution among tree populations in Sokoto Metropolis. This became necessary considering the relatively low tree populations and high risk of

desertification due to anthropogenic interferences occasioned by fast growing human population and increasing demands for energy in the relatively semiarid environment. The findings of this study are envisaged to provide a baseline data for effective management of the existing woody flora and to help forestall excessive reoccurrences of the undesirable species of parasitic mistletoes and effective utilization as well as management of the desirable ones in future. This could provide a suitable platform for effective replacement of some mistletoe prone tree species with mistletoe resistant ones, hence reducing its devastation on the susceptible tree populations in the area.

## MATERIALS AND METHODS

Data collection was carried out using the method in Methiasen *et al.* (2007). Tree species were examined at various study locations (units) in Sokoto metropolis on latitudes 11°30' to 14°00'N, longitudes 4°00' to 6°56'E and altitude 351.0m above sea level, in the Sudan savanna ecological zone of Nigeria (SERC, 2015). Exactly 50 m<sup>2</sup> area covered with standing tree species was measured in each unit and tree stems with diameter at breast height (DBH) of  $\geq 7$  cm were sampled and tagged. The tagged stems were identified to species level and their DBH was measured using a diameter tape. Loranthus plants on each measured stems were counted often using binoculars to enhance visibility particularly on trees with high stems and/or dense crowns. The loranthus species found on all the host trees was identified as *Agelanthus heteromorphus* (syn. *Tapinanthus heteromorphus*), probably being the principal species associated with most tree populations in the study area. The mean DBH of individual host tree species were obtained in all study locations and finally, the distance of each tree to the nearest infected tree stem was calculated. Numbers of mistletoe found per host tree species per study locations were examined and percentage infestations determined accordingly. Other features of the mistletoe investigated include the vegetative crowns of the Loranthus species as they were closely examined in the herbarium.

## RESULTS

Results in Table 1 indicated that *A. indica* had the highest mistletoe infestation of 45.99 percent followed by *B. aegyptiaca* with 11.57 percent, then *F. albida* with 7.42 percent, *P. thoningii* with 6.82 percent, *F. thoningii* with 6.53 percent, *A. nilotica* with 6.23 percent, *Z. spinachristii* with 5.05 percent, *Z. mauritiana* and *T. catapa* both had 2.97 percent, *A. squamosa* followed with 2.37 percent and

the least being *C. pentandra* with 2.08 percent. The results in Table 2 indicate the percentage distribution of mistletoe according to study location. UDUS Main Campus had the highest mistletoe distribution of 21.66 percent with 7 tree species infested. The second highest infestation of the mistletoe (i.e. 20.18 percent) was obtained in Runjin Sambo with 8 tree species infested. The third highest infestation obtained at Old Airport is 17.80 percent with 6 tree species infested. Arkilla had 12.46 percent infestation with 6 species affected. Kwannawa had 12.17 percent with 7 species affected. Farfaru had 9.20 percent infestation with only 4 species affected. Gagi had the least infestation of 6.53 percent with 5 tree species infested.

Table 3 shows percentage distribution of three different vegetative crowns of the mistletoe at each study location in the study area. UDUS main campus had 12.00% ball-shaped, 25.00% irregular-shaped and 14.30% triangular-shaped mistletoe. Runjin Sambo had 17.00% ball-shaped, 8.00% star-shaped and 28.50% triangular-shaped mistletoe. Arkilla had 17.30% ball-shaped, 18.00% irregular-shaped and 14.30% triangular-shaped mistletoe. Old Airport had 17.30% ball-shaped, 8.00% irregular-shaped and 14.30% triangular-shaped mistletoe. Kwannawa had 17.30% ball-shaped, 17.00% irregular-shaped and 14.30% triangular-shaped mistletoe. Farfaru had 8.90% ball-shaped and 17.00% irregular-shaped no triangular-shaped mistletoe crown was found here. Gagi had 8.90% ball-shaped mistletoe, 17.00% irregular-shaped mistletoe and 14.30% triangular-shaped mistletoe.

Table 4 shows percentage distribution of the different mistletoe crowns by host tree species in Sokoto metropolis. The species, *A. indica* harbours 35% of all the ball-shaped mistletoes in the area and no other type. *B. aegyptiaca* harbours 50% of the star-shaped and 14.30% of the triangular-shaped mistletoe crowns in the area. The mistletoes on *P. thoningii* are 10% of the ball-shaped, 8.33% of the star-shaped and 14.30% of the triangular-shaped. Mistletoes on *C. pentandra* are 16.68% of the star-shaped while those of *A. nilotica* are 8.33% of the star-shaped crown types. *F. albida* harbours 25% of the ball-shaped and 8.33% of the star-shaped types. While *A. squamosa* harbours 14.30% of the triangular-shaped mistletoe type only, *T. catapa* bears 5% of the ball-shaped type in addition to 14.30% of the triangular-shaped. On *F. thoningii*, 10% of the ball-shaped, 8.33% of the star-shaped and 14.30% of the triangular-shaped mistletoe crowns were found. Both *Z. spinachristii* and *Z. mauritiana* had 5% of the ball-shaped mistletoe each but while *Z. mauritiana* had 14.50% of the triangular-shaped type, *Z. spinachristii* had 14.00% triangular-shaped type and 8.33% star-shaped.

**Table 1:** Percentage occurrence of the Loranthus on host tree species in Sokoto metropolis

S/N	Host Tree Species	UDUS Main Campus	Runjin Sambo	Arkilla	Old Airport	Kwan nawa	Farfaru	Gagi	Total	Perce ntage
1	<i>Azadirachta indica</i> A. Juss	40	20	25	25	15	20	10	155	45.99
2	<i>Balanites aegyptiaca</i> (L.) Delile	10	8	2	7	5	4	3	39	11.57
3	<i>Piliostigma thoningii</i> Schum	5	6	3	2	3	-	4	23	6.82
4	<i>Ceiba pentandra</i> (L.) Gaertn	3	4	-	-	-	-	-	7	2.08
5	<i>Acacia nilotica</i> L.	7	-	2	10	-	-	2	21	6.23
6	<i>Faidherbia albida</i> (Delile) A. Chev	5	5	5	4	4	2	-	25	7.42
7	<i>Annona squamosa</i> L.	-	3	5	-	-	-	-	8	2.37
8	<i>Terminalia catapa</i> L.	-	7	-	-	3	-	-	10	2.97
9	<i>Ficus thoningii</i> Blume	-	15	-	7	-	-	-	22	6.53
10	<i>Zizyphus spina-christii</i> ((L.) Desf.	-	-	-	5	7	5	-	17	5.05
11	<i>Zizyphus mauritiana</i> Lam.	3	-	-	-	4	3	-	10	2.97

**Table 2:** Percentage distribution of the Loranthus on tree species by study location in Sokoto Metropolis

S/N.	Study Location	No. of Tree Species	No. of Mistletoe	Percentage Mistletoe
1.	UDUS Main Campus	7	73	21.66
2.	Runjin Sambo	8	68	20.18
3.	Arkilla	6	42	12.46
4.	Old Airport	6	60	17.80
5.	Kwannawa	7	41	12.17
6.	Farfaru	4	31	9.20
7.	Gagi	5	22	6.20

**Table 3:** Percentage distribution by location of Loranthus based on the shape of their vegetative crowns in Sokoto metropolis

S/N.	Study Location	Ball--shaped	Irregular-shaped	Triangular
1.	UDUS Main Campus	13.00	25.00	14.30
2.	Runjin Sambo	17.30	8.00	28.50
3.	Arkilla	17.30	8.00	14.30
4.	Old Airport	17.30	8.00	14.30
5.	Kwannawa	17.30	17.00	14.30
6.	Farfaru	8.90	17.00	-
7.	Gagi	8.90	17.00	14.30
Percentage Totals		100	100	100

**Table 4: Percentage distribution of host trees bearing *Loranthus* with different vegetative crown types in Sokoto metropolis**

S/N	Tree Species	Ball Shaped	Irregular Shaped	Triangular Shaped
1	<i>Azadirachta indica</i> A Juss.	35.00	-	-
2	<i>Balanites aegyptiaca</i> (L.) Delile	-	50.00	14.30
3	<i>Piliostigma thoningii</i> Schum	10.00	8.33	14.30
4	<i>Ceiba pentandra</i> (L.) Gaertn	-	16.68	-
5	<i>Acacia nilotica</i> L.	5.00	8.33	-
6	<i>Faidherbia albida</i> (Delile) A. Chev	25.00	8.3	-
7	<i>Annona squamosa</i> L.	-	-	14.30
8	<i>Terminalia catapa</i> L.	5.00	-	14.30
9	<i>Ficus thoningii</i> Blume	10.00	-	14.30
10	<i>Zizyphus spina-christii</i> (L.) Desf	5.00	8.33	14.00
11	<i>Zizyphus mauritiana</i> Lam.	5.00	-	14.50
	Percentage Totals	100	100	100

## DISCUSSION

The highest infestation of the African mistletoe in *Azadirachta indica* than in the other host tree species could be due to feeding preference of the pollinator birds visiting the area in search of nectar and nesting place. Aukema and Martinez del Rio (2002) reported that, seed dispersing birds favored larger infected trees as perching and feeding sites and deposited seeds disproportionately on them, which contributed to the mistletoe distribution being significantly aggregated within its host population. Aukema and Martinez del Rio (2002) reported that almost all species of Loranthaceae have fleshy animal-dispersed single seeded fruits, which are well known for their close relationship with birds both for pollination and seed dispersal. Hussaini and Musa (1987) reported earlier that availability of large variety of tree plants provided by the flora has contributed immensely to the large host range of the tropical mistletoe. According to Aukema (2004), mistletoe are found on many tree crops of economic importance in West Africa, among them are *Vitellaria paradoxa*, *Citrus sinensis*, *Citrus paradisia*, *Azadirachta indica*, *Havea brasiliensis* and *Theobroma cacao*.

The highest percentage occurrence of the mistletoe at UDUS Main Campus and its corresponding least occurrence at Gagi may not be unconnected with distribution patterns of the host tree species, which in turn affected the behaviour of the pollinating birds. Amico and

Aizen (2000) indicated that the establishment of Mistletoes in host branches depends not only on seed and host characteristics but also on foraging behavior of the birds feeding on the mistletoes. Similarly, Aukema (2004) reported that host distribution, size and sex may influence mistletoe distribution and abundance. He explained that, when hosts are widely scattered, their mistletoe parasites may be less common and widely distributed as well. Furthermore, Ismaila (2000) sited nearness to water source as an important factor influencing mistletoe distribution locally. In this study, the UDUS main campus, having closer proximity to both River Sokoto and River Rima, showed the highest percentage mistletoe compared to Gagi, which is located far away from rivers or similar water bodies had the least mistletoe infestation.

The results also show different vegetative types of the mistletoe growing on the infested tree populations. This indicated structural diversity of the mistletoe occurring in the study area. The highest percentage of the ball-shaped vegetative type mistletoe more than the others in the study area is supported by the findings of Horneber *et al.* (2008), which states that the parasitic mistletoes appear mostly bulbous in shape while others are either irregular or triangular. Further evidence on the diversity of mistletoe structure in the area is supported by Calvin and Wilson (1998), who reported that all mistletoes produce a morphologically diverse structure. Many mistletoe species have large leaves several centimeters in length and width

particularly the tropical loranth, such as *Psittacanthus cucularis*. Some other species are squamate, having leaves which are reduced to small scales as in *Phoradendron juniperinum*. In contrast to the large colorful flowers of many loranthacean mistletoes, viscacean mistletoes such as *Arceuthobium sp.* have small flowers, which are insect or wind rather than bird pollinated.

## CONCLUSION

Occurrence of Loranthus in the study area is influenced by the host species type, size and distribution of the host tree species. Seed dispersal appears to be the principal determinant of the mistletoe distribution. The feeding preference of the disperser birds coupled with nearness to water source at the vicinity of the host tree species have been found to influence local distribution of the hemiparasitic plants in this study. Diverse nature of the mistletoe vegetative crown in the area seems to arise from the diversity of the host tree species. Apparently varied host plants bore mistletoes having one or more specified vegetative crown (s), which in turn influenced the local distribution of mistletoe species types in the study area.

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