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Influence of Seasons on Honeybee Wooden Hives Attack by Termites in Port Harcourt, Nigeria

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Abstract**—**Termites have been observed as major pre-colonisation and post-colonisation pest insect of honeybees' wooden hives in Nigeria. However, pest situation studies in modern beekeeping have been largely directed towards those pests that affect honeybees rather than the biological structure (wood) which houses the honeybees and the influence of seasons on the pests' activities against the hives. This study, therefore, investigated the influence of seasons on the intensity of hives attacks by termites for 2 years in University of Port Harcourt, Rivers State using visual inspection. The Experimental Apiary was established with 15 Kenyan's top bar hives made of *Triplochiton scleroxylon* wood that were strategically placed and observed within the Department of Forestry and Wildlife Management arboretum. The colonies hives consistently showed comparatively lower termite's infestation levels in the dry season and, consequently, also lower attacks on the colonized hives. The result indicated raining season as a distinct period for more destructive activities of termites on the hives and strongly associated with dryness of the hives. Since previous study and observations have linked colonization with dry season coupled with minimal attacked on colonized hives; the non-colonised hives should be removed from the field at the onset of raining season and returned two weeks prior to dry season to reduce hives degradation by pests.

Keywords**—**Attack, hives degradation, Nigeria, seasons, termites.

I. Introduction

WOODS remain the principal nest service provider to *Apis mellifera* Scutellata in Nigeria [1] and its utilizations for modern beekeeping are not without attacks by degradation agents such as termites, powder-post beetles, rats and *Monomorium minimum*. Termites are major problem of woods globally but with devastating proportion in the tropics. This is perhaps as a result of the great diversity of the termites in the region. Over 2,600 different species of termites have been identified and lumped into four distinct groups: damp woods, dry woods, subterranean, and arboreal/mound builders [2]; some of them are found in Nigeria though characterization of termite species have not been fully explored and reported. Seasons have been observed to have greater effect on activities of termites.

Like other living creatures, termites have optimal temperature range and a preferred food (woods) moisture level for feeding activities. Termites exhibit a wide range of dietary, foraging and nesting habits, with many species showing high degree of resource specialization [3]. Their influence therefore on degradation processes can be dictated to a large extent by the moisture content of the species and functional composition of the local termites. Thus the dampwood feeders or drywood feeders play different roles in the degradation processes and are considered as major wood destroyers in different seasons.

Literature is replete of the impact studies of temperature and precipitation on foraging activities of termites in North and South America [4]-[16]. Both air and soil temperature have been reported to have strong influences on termites foraging and seasonal activities [17], [12], even though termites could, to a point, regulate temperature and moisture within their nests [18]. According to [19], rainfall, temperature and relative humidity are the climatic variables that had the most significant effect on termites. Reference [20] argued that dryer conditions with low temperature and low relative humidity increased termites' attacks but isolating these variables resulted in conflicting relationships.

Most termites are polyphagous, feeding on wide varieties of wood species and have been observed as major pre-colonisation and post-colonisation pest insects of honeybees' wooden hives in Nigeria. However, pest situation studies in modern beekeeping have been largely directed towards those pests that affect the honeybee itself with little or no attention given to pests that attack the biological structure (wood) which houses the honeybees and the influence of seasons on the pests' activities against the wooden hives. Previous studies and observations have recognized and reported small hive beetles, termites, wax moths, ants, rats etc including man as distinct pests of honeybees in Ogun and Rivers States, Nigeria [21],while similar checklists of minor pests such as wasps, spiders etc have previously been reported in Central Uganda and Western Nigeria [22]-[26]. Of all these pests, termites are the most destructive, followed by *Monomorium minimum* while others often compete with honeybees and cause disorders, diseases, low productivity and absconding without any interference with the hives.

Despite the observed influences of seasons on activities of termites against woods under service in external environmental conditions in Nigeria, information on the influence of seasons on activities of termites against woods under service for beekeeping is inadequate. This gap prompted the investigation of the influence of seasons on activities of termites against hives in University of Port Harcourt, Nigeria.

II. Methods and Materials

A. Study Area and Mounting of Hives

Influence of seasons on honeybees' hives (made of *Triplochiton scleroxylon* wood) attack by termites was

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investigated between April, 2012 and March, 2014 in the Department of Forestry and Wildlife Management Arboretum, University of Port Harcourt, Rivers State. The University is located on a land area of about 400 hectares in Obio/Akpor Local Government Area of Rivers State. The hives were strategically mounted on iron stands between Latitude 4.90794 and 4.90809 N and longitude 6.92413 and 6.92432 E within the Department of Forestry and Wildlife Management Arboretum. The area is within the swamp freshwater forest zone characterised with two seasons, the dry season (November to March) and wet season (April to October). The rainfall distribution is nearly all year round though its intensity is seasonal and variable. The monthly mean maximum temperature ranges from 28^0C to 33^0C while the monthly minimum temperature ranges from 17^0C to 24^0C [27].

The vegetation is a mixture of disturbed fallow land and secondary forest growth with planted *Gmelina arborea, Tectonagrandis and Naucleadiderrichii* trees dominating. The area is termites prone with many termites' mounds, and nests on dead woods and heartwoods of live trees. The Experimental Apiary was established at the beginning of raining season in April, 2012 with 15 Kenyan's top bar hives made of *Triplochiton scleroxylon* wood.

B. Assessment of Termites' Activities

The mounted hives were reinforced with used corrugated roofing sheets to reduce the effect of weathering and ultra-violet rays. The hives environments were kept at most sanitary conditions. The hives were monitored periodically from April, 2012 to March, 2014 using visual inspection. Activities of termites like tunneling from the iron stand base, nesting and feeding on the hive frames and top bars were observed in some of the colonized and non-colonized hives.

III. Results

A. Influence of seasons on termites activities

Three activities: tunneling, eating and nesting were observed. These characteristics are peculiar to a wood feeder termite "*Amitermes evuncifer* Silvestri". There were pathways suggesting links to the primary colony. Small nesting of termites on top bars assemblage was an indication of secondary colony. Nuptial flight of termites from the matured colony(ies) occurred in April and May which concise with the raining season. This is an indication that seasons influence breeding of the termites. Evidences abound to suggest wood feeders as dominant trophic group in Port Harcourt. Three hives were colonized in October, 2012 and the remaining twelve in October, 2013. Two non-colonized hives were attacked in the first year of study, and three other non-colonized and two colonized hives in the second year of the study as shown in Table I. The infestations started near the base and extended to the upper part of the top bars where termites nested as shown in Fig. 1.

Observations of termites' characteristics showed a sharp decrease in activities from raining season to dry season. Termites encountered in the affected colonized and non-colonized hives showed a consistent pattern in density as well. The presences of wood-feeding termite species vary distinctly between the two climatic seasons and between colonized and non-colonized hives in Port Harcourt. Termites remarkably attacked both colonized and non-colonized hives more in the raining season than dry season though colonized hives were relatively less attacked than non-colonized hives. Termites' activities such as tunneling from the iron stand base, nesting and feeding on the hive frames and top bars were observed from two of the colonized and five non-colonized hives.

Higher relative humidity in the raining season has been observed to reduce the diversity of dry wood species for drywood termites nesting and nutrition. The reinforcement of the hives against weathering made the wood to become more suitable for termites nesting and feeding in the raining season than dry season when varieties of dry wood are available. Seasonality played a major role in regulating the feeding and nesting activities of *Amitermes evuncifer* Silvestri in Port Harcourt. It created more room for competition among the cavity nesting animals such as *Monomorium minimum*, small rats, wasps, small ants which prefer dry shelters before colonization by honeybees. Termites, apart from sharing the same hives can complete their entire life cycle within the wood tissue until the woods are completely degraded.

TABLE I
TERMITES INFESTATIONS ON HIVES

Year	Colonized hives	Colonized hives
1	-	2
2	2	3
Total	**2**	**5**

Authors' Fieldwork, 2012

Fig. 1 Honeybee colony infested with termites

B. Economic Loss Aspect

Termites live in large/moderate colonies in a variety of nests ranging from soil, damp dead woods, dry dead woods, exposed heartwood in living trees and dead wood parts in living trees in Nigeria. They are serious pest of woods and wooden structures in Rivers State, Nigeria. *Amitermes evuncifer* Silvestri has been identified as the termite species attacking the hives and its infestations if not promptly controlled may bring zero economic returns on initial

investment capital (in this case ₦ 150,000;00), weaken the wood, exert stress on honeybees, reduce honeybee's productivity and may eventually cause absconding. Economic loss of woods and wooden structures to this species of termite in Rivers State has not been fully explored.

Absconding of honeybees' colonies may be a huge economic loss to the keeper directly and indirectly to the nation as a whole because of unquantifiable pollination services for many agricultural and forest crops which may cease. The value of pollination attributable to honeybees is higher in thousand folds than value accruing from sale of honey annually in America and UK [28]-[31]. Most Nigerian agricultural soils need no fertilizers; the missing input is probably "honeybees' visitations". *Monomorium minimum* is another serious insect pest of hives but its attack was only found in one hive and strictly pre-colonisation pest.

The termites attacked nearly half of the total number of the experimental hives (46.67%) at periphery as indicated in Table II during the two years of study. The quantification of wood loss in monetary term was not explored because the hives have all been colonized but future study can quantify the economic loss in term of weight loss percentage to determine the real economic loss value. Keeping the hives environments in most sanitary conditions and removal of non-colonized hives from the field in raining season are good preventive measures to curbing infestations.

TABLE II
RELATIVE FREQUENCY OF TERMITES' INFESTATIONS ON HIVES

Status	Frequency	Relative frequency %
Infested	7	46.67
Non-infested	8	55.33

Authors' Fieldwork, 2012

IV. DISCUSSION

The influence of seasons on termite activities against *Triplochiton scleroxylon* wood made hives was explored by visual assessment. Development of resistant plant varieties has been possible technique of controlling crop insect pests including termites in crop production. However, the production of resistant lumbers from the growth of resistant forest hybrids against termites in Nigeria is rare except those trees that are inherently resistant. The species of wood native honeybees preferred in the wild are not in the category of trees with high natural durability. Because of honeybees preferences for certain wood species colours, the selection of wood for hives construction must not be based on durability alone without considering the safety of the honeybees and the consumers of their products. The hives colonies consistently showed comparatively lower termites infestation levels in the dry season. This is strong indication that seasons influence the attacking pattern of the hives which is believed to be strongly associated with the dryness of the hives. This is probably because of ample availability of dry woods in the dry season from which termites selectively foraged and since such woods had direct contact with soil which often reduced their drudgery of climbing hives stands.

Practically, high relative humidity in the raining season restricts air movement needed to keep the area and existing dead woods dry for active foraging, hence protected hives become more susceptible to attack in the raining season. The result was in consonance with [32] that *Microtermes* sp. and *Coptotermes* sp. have strong foraging activity with high peak in the wet season in India. Reference [12] noted that *Coptotermes lacteus* subterranean wood feeding termites are more active during colder months (winter) in Autralia.

The result was however in contrast to [32] that *Odontotermes* sp. and *Macrotermes* sp. have strong foraging activity with high peak in the dry season in India, [33] that *Coptotermes formosanus* termites consumed woods significantly less during the winter in New Orleans US, and [18] argued that *Reticulitermes flavipes* and *Reticulitermes virginis* consumed lowest cellulose during winter. Because of the dryness of the ground and underground to some appreciable depth, it is assumed that termites are more active on the underground and ground during dry seasons if such species are dry wood feeders and there were ample of dry woods from which to select. Consequently, low attacks on the colonized hives were observed. This is expected because of the activities of the honeybees. The termites attacked the colonized hives only through the back while the non-colonized hives were attacked in all directions. The activities of termites in colonized hives were restricted to back and top bars where honeybees could not accessed. This is because of relative smaller body sizes of termites.

It was observed that tunnels and tunneling activity of termites is a protective mechanism being cryptic insect and it was strongly observed that tunneling was usually done at night when honeybees are less active. The movement of the termites in day time through the tunnels may not be noticed by honeybees. Termites can degrade woods both day and night because their pathway provides darkness for their movement and feeding.

To reduce the economic loss of woods under service by termites, hives should not be mounted within the vicinity of big/moderate dead woods infested with termites.

V. CONCLUSION AND RECOMMENDATIONS

Result revealed that woods under service for beekeeping are more susceptible to attack by termites in the raining season than dry season with lower attacks on the colonized hives.

Despite the use of iron stands, termites still used the soil and iron stands as easy pathways to reach the hives. In view of serious damage that termites could cause to hives in Port Harcourt, it is imperative to remove termites infested woods or potential woods far from hives' stands.

Keeping the hives environments in most sanitary conditions and withdrawal of non-colonized hives from the field in raining season are also good preventive measures to curbing infestations.

Future study should focus on the quantification of the hives economic loss in term of weight loss percentage to determine the real economic loss value

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