

Honeybees: The Year's Most Prominent Guests: An Examination of Contemporary Apiaries in Sokoto State, Nigeria

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ABSTRACT

Honey is one of the products with huge benefits to mankind for medication and, a source of income and also serves as a food in many parts of the world, however, they had been affected by many pests. Therefore, the present research aimed to identify the honeybees' visitors to modern apiaries in Sokoto State, Nigeria. A mixed design methodology involving experimental and ethnographic research methods was employed for the study, samples were collected using snowball purposive sampling techniques were employed, meanwhile 30 hives were used as a sample size from Madorawa, Kware and Duhuwa Locations. The hives were divided into two to detect the level of occurrences of the visitors to the colony. Both the hives were given proper inspection every two weeks to detect the condition of the colonies. The data obtained were analyzed using descriptive statistics, and Chi-Square was used to identify significant association at $P \leq 0.05$. The results indicate that, the total pest frequency in the study area is 574, Duhuwa had the highest percentage (39.89%), significant associations of 0.002 and 0.000 were observed between the frequency of the pest at Madorawa and More sites respectively. In conclusion, it was observed that three (3) different classes of pests namely insects, mammals, and reptiles were the visitors of honeybees in modern apiaries of Sokoto State, therefore, it was recommended that, appropriate control and preventive measures should be considered for better production of honey in the study area.

Keywords: Apiaries, Honeybees, Modern, Pests, Sokoto

1.0 INTRODUCTION

Colonization is an artificial means of catching a colony or a swarm of bees in hives while colonies are those bees that form colonization (Nekoei *et al.*, 2023) and Honey bees are social insects that live together as a colony in well-organized developed families, having different styles of living, that involve communication, nest construction, environmental control, defence, division of labour and other behaviours that make the colony live a successful life (Ramsey *et al.*, 2019). Bees are social insects that live in a system of colonies; and they possess three characteristics which include integration, division of labour and overlap of generation (Noel *et al.*, 2020). More examples of social insects include termites (*Isoptera*), ants (*Formicidae*) and wasps (*Hymenoptera*) (Begna, 2020). Most of the Zoologists argue about what exactly is said to be social insects. E. O. Wilson stated that they are those insects in which the generations overlap, live together and cooperate in their lives and work (Christian *et al.*, 2016). For example, in the life of honey bees, they divide themselves into three types: Drones, Queen and Workers. Drones are male, while queens and Workers are female, with different divisions of labour (Lawal *et al.*, 2020).

An apiary is defined as a place where bees are kept in the hive to forage nectar and pollen grains for honey and other bee products (Begna, 2020). Mostly Bees are kept in a conducive place outside, or away from the residential areas, where vegetation and water are very much available for bees to thrive on (Paxton *et al.*, 2022).

Normally, hives colonization is not supposed to face challenges in some parts of Nigeria, because the regions possess many factors that can enhance the development and reproduction of the bees and production of honey, and in most cases, if an apiary is sited on a virgin land where there is no competition and appropriate baits are used and also colonization can begin within the first-day installation of hives. However, there have been reported cases of colonization problems in Nigeria due formation of symbiotic relationships with other organisms which serve as pests, diseases or predators to the colonies (Herrero *et al.*, 2019).

Pest refers to any harmful and annoying organism that causes damage or destruction of other organisms, part of the organism or their properties), they are the most common factors that cause problems to honeybees (Avalos *et al.*, 2019).

Seasonal variation is one of the most important factors that influence symbiosis between bee colonies and other organisms, it may be less hazardous or favourable to the symbionts, as dampness influences productivity in beekeeping. It has great greater danger than cold. Based on these observations, influences on the bee flora as well as the bee itself. Locke et al. (2019), favored the research for a low temperature. Beekeeping includes understanding the seasonal colony bee, but this also means that such a bee cannot perform cycles and manage the colonies in such a way as to during high temperatures or in regions with obtain a large adult colony population to coincide with temperature (AGDR, 2018).

Beekeeping is one of the cultural farming practice that provide more opportunity to Sokoto people, however, there is decrease in production of the honey product which may likely due to huge damage that bees encounter from the visitors. Additionally, dearth information had been documented on the visitors of the modern apiaries in the study area. Therefore, this research work aim to identify and assess the frequency of the pests of honeybees in Modern Apiaries of Sokoto, State Nigeria

1.1 Study Area

The study was conducted in some selected Apiaries around Sokoto Metropolis, Sokoto State, Nigeria, in three (3) Local Government Areas namely:

- i- Modorawa area, Bodinga Local Government, lies between latitude N 11^o38'14.6222 and longitude E 5^o 32'48.4502.
- ii- More area, Kware Local Government, lies between latitude N 12^o 56'32.7552 and longitude E 5^o 8'45.5136.
- iii- Duhuwa village, Dange-Shuni Local Government lies between latitude N 13^o 1'2.828 and longitude E 5^o 16'11.942.

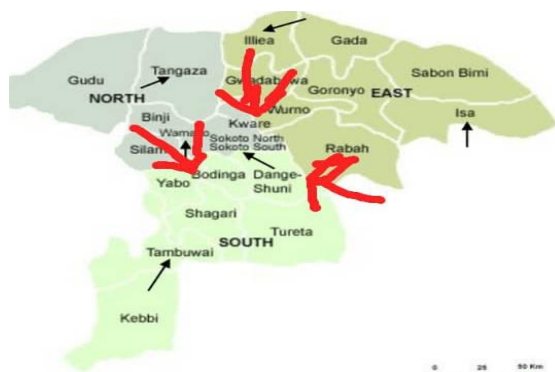


Plate 1: Map of Sokoto State, showing the three location areas of the research project

1.2 Research Design

A mixed design methodology involving experimental and ethnographic research methods was employed for the

study. Ethnographic design was employed because the study explores the pests of honeybees in the environment, and how traditional beekeepers handle the issues. The design facilitates Ethnographic researchers and participants to engage and interact closely in their normal and natural context for data collection purposes (FAO, 2019).

1.3 Sample Population

Sokoto State is the study area of the research. According to the Nigerian Population and Development Fact Sheet, the population of Sokoto State was estimated to be 6,391,000 heads (Fact Sheet, 2022). However, not every area of Sokoto has the technology of using modern beekeeping. Many of the areas are practicing local beekeeping, and are still in that system of beekeeping. Modern beekeeping is more suitable since it involves the use of modern technology which allows beekeepers to observe the dangers that affect Bees' colonization and colonies in their hives. Among the twenty-three (23) local governments, three (3) were selected, because it's the only place where modern Beekeeping is been practiced for some years.

1.4 Sampling Size and Sampling Technique

The study used thirty (30) hives as its sampling size. This was based on the recommendation of Buchler *et al.* (2020) that a sample size of thirty is considered by many researchers as an ideal sample size. In this view, Snowball Purposive Sampling Techniques were employed to sample thirty (30) hives from three (3) Local government Areas dealing with modern Beekeeping in the State. This technique was chosen because it allows for the identification of a small number of organisms in the study and has information on the study of interest.

1.5 Instrumentations

Field research was conducted with regular inspection at least twice a month. This allowed proper observation of any strange things attached to the hive at earlier stages before they caused damage to the colony. The reason why two weeks were selected is that bees don't want more disturbances, especially during cold and wet seasons, which they use to block their entrances and any space they find with propolis to protect themselves from enemies and to maintain normal temperature within the hive (Giacomelli *et al.*, 2016).

1.6 Data Collection

The research started in the dry season in November 2022 and ended in October 2023. The hives were divided into two, those under control and the other ones without control to detect the level of occurrences of the visitors to the colony. After the colonization of hives, the hives with control took measures and applied freeze oil frequently

and were set far from the other hives. Both hives were given proper inspection every two weeks to detect the condition of the colonies. Four (4) Research Assistants were assigned to collect the data from the selected areas of research. One (1) research assistant to cover one (1) Local government area (Anderson *et al.*, 2023).

1.7 Statistical Analyses

Data collected from the field in the course of conducting the research project was analyzed by using Descriptive Statistics in the form of frequency and percentages in response to the five research questions based on the objectives of the study. Chi square statistic was used to identify significant association using IBM SPSS Version 26.0, association was considered to be significant at $P < 0.05$

2.0 RESULTS AND DISCUSSION

2.1 Results

The present research detected various visitors of honey bees the majority are reptiles and insects. In terms of reptiles, the research found Lizard, Squirrel etc. In insects, there are flying insects such as large hive Beetles, Small hive beetles, Wax moths, Wasps, Crawling insects like Ants, spiders, and Termites etc. Among the diseases of the honey colony, none was observed for now. Also, the research cannot conclude that they are not present, but proper monitoring and inspection will reveal what comes

In addition, it was presented that, in More site, Reptiles had the highest percentage of 52.66%, followed by mammals at 28.40%, while insects had the lowest frequency of 32 (18.93%) with statistically significant association ($P=0.000$)



Plate 1: Wasp/Wasp nest

across and may testify to the existence of the other organism.

The results of some types of pests and their frequency on the hives colonization during the period of the dry season (November 2022 to April 2023) and the wet season (May to October 2023) from the three selected Apiaries in Sokoto State are presented in plates 1 to 10 and summarized in Table 1 and 2.

Results from the present research indicate that the total frequency of pests in the study area during the dry season was 574, it was observed that Duhuwa had the highest percentage of 39.89%, followed by Madorawa (30.66%), while More had the lowest percentage of 29.44%. Statistically, there was no significant association for the percentage of the pest in the study areas ($P=0.142$).

It reported that, from the Duhuwa area, insects had the highest impact of 85 (37.12%), followed by mammals at 72 (31.44%), then Reptiles at 69 (30.13%). However, there was no significant association ($P=0.241$).

Similarly, it was observed that, from the Madorawa site, Insects had the highest distribution impact of 91 (51.71%), followed by Reptiles at 62 (35.22%), while Mammals had the lowest percentage frequency of 23 (13.07%), statistically, there was a significant association ($P=0.002$)



Plate 2: Wasp infestation



Plate 3: Adult Wax Moth



Plate 4: Wax moth infestation



Plate 5: Large hive beetle



Plate 6: Earwig



Figure 7: Spider



Figure 8: Wall gecko



Figure 9: American Foulbrood



Figure 10: Small hive Beetle

Table 1: Types and Distribution of Pests infesting Hives and Colonies in the selected Apiaries during the Dry and Wet Session

DRY SESSION			
Location	Types of Pests Identified	Frequency	Percentage (%)
Duhuwa	Insects	85	37.12
	Mammals	72	31.44
	Reptiles	69	30.13
Sub-Total		229	39.89
Madorawa	Insects	91	51.71
	Reptiles	62	35.22
	Mammals	23	13.07
Sub-Total		176	30.66
More	Reptiles	89	52.66
	Mammals	48	28.40
	Insects	32	18.93
Sub-Total		169	29.44
Grand Total		574	100
WET SESSION			
Duhuwa	Insects	62	18.73
	Mammals	21	6.34
	Reptiles	38	11.48
Sub-Total		121	36.56
Madorawa	Insects	46	13.89
	Reptiles	35	10.57
	Mammals	15	4.53
Sub-Total		96	29.00
More	Reptiles	62	18.73
	Mammals	25	7.56
	Insects	27	8.16
Sub-Total		114	34.44
Grand Total		331	100

There was an indication that pest colonization was significantly decreased in the study areas during the wet season as the recorded frequency of the pest was 311. However, it was observed that the Duhuwa area recorded the highest frequency of the pest [36.56% (121/331)], followed by the More area [34.44% (114/331)], while Madorawa recorded the least frequency of pest [29.56% (114/331)].

From the Duhuwa area, the non-significantly associated ($P=0.156$) frequency of the insects was highest [18.73% (62/331)] followed by reptiles [11.48% (38/331)], then Mammals [6.36% (21/331)]. Similarly, Madorawa showed that Insect pests had the highest frequency of 13.89% (46/331), followed by reptiles [10.57% (35/331)], while mammals recorded the lowest frequency

of 4.53% (15/331) and there was significant association ($P=0.003$).

Finally, reptiles recorded the highest frequency (18.73% (62/331)) in More areas, followed by insects [8.16% (27/331)] then mammals [7.56% (25/331)], a significant association was also reported ($P=0.000$)

3.0 DISCUSSION

Present research discovered a different group of organisms such as reptiles, insects and mammals that visit modern apiaries in the study area, these visitors cause a huge amount of damage to bees and their products, our findings were by the several research conducted in a different part of Nigeria, Jack *et al.* (2023), observed that honeybees experience several

things throughout their lifetime that are part of their fight, in their research, mentioned that many pests such as insect (beetle, ants, wasps and hornets), Wax, moths, Lepidoptera and Vertebrates (amphibians, reptiles, birds, mammals) affect honeybee colonies. They added that many microbial diseases like *Bacterial diseases* (American foulbrood disease AFB, and European foulbrood diseases EFB), *Fungi diseases (chalkbrood)*, *viral diseases (sacbrood diseases)* and *Protozoa* (Nosema diseases) affect the colonies of bees and their product.

The present survey observed that the visitors were highly populated during the dry season, this could be attributed to the fact that the visitors had adequate sources of food, shelter and other means of surviving, therefore, they attempted to form predation associations with the bees which serve as preys to them. A similar observation was reported by Gray et al. (2019) who reported that, the problem of man and his activities that consist of honey hunting, bush burning, bee burning, and poisoning bees, among others; the natural pests that are ants, wax moths, lizards, toads, snakes, praying mantises, spiders, bee pirates, alpine swifts, and bee friends that are creatures living near the bees like wall geckos and green lizards were mostly found during the dry season and that was the reason why the honeybees encountered many problems during dry season than the wet season. In another research also Gray et al. (2020) recorded that there are thirteen species representing (17.1%) in the wet season and 23 species (82.9%) in the dry season. While not all were discovered during the wet season, all of the pests and parasites found in all of the research regions were discovered during the dry season. Among the pests are *Aethina tumida* (adult) 437, 133; wax moth larvae 121, 22; *Aethina tumida* (larvae) 118, 18; and *Crematogaster lineolata* 117, 19 are the species with the highest frequency of occurrence at both dry and wet seasons. Additionally, they mentioned that in either season, mites were not discovered.

In another research, Osterman et al. (2021), detailed the prevalence of insect pests that affect honeybees in the forest vegetation zones, including small hive beetles (*Aethina tumida* Murray), ants, greater wax moths (*Galleria mellonella* Fab.), spiders, large bee beetles (*Oplostomus haroldi* and *Oplostomus fuliginus*), lesser wax moths (*Achroia grisella* Fab.), (5%), and the wasp (5%), whereas the pests found in the savanna vegetation zones are the small hive beetle (21%), ants (17%), bigger wax moth has (16%), spider (5%), large hive beetle (21%), lesser wax moth (4%) and wasp. They concluded that the dry season had more individual species encountered than the wet season overall. Despite *Aethina tumida* (adult) having the largest number in both the dry

and wet seasons, *Macrotermis nigeriense* had the highest mean value in both the dry and wet seasons.

This study looked into various pests and diseases of honeybees in seasonal variations in Sokoto Metropolis. In this research, some chosen apiaries in three local governments in were selected to conduct the research. These areas are Madorawa in Bodinga Local Government, More in Kware Local Government, and Duhuwa in Dange Shuni Local Government. A lot of measures were used in terms of selecting the method of research, where modern manufactured hives (Kenyan Top Bar Hives) were dispersed. To conduct the research, ten (10) beehives were hung beneath the sheds of trees in each region that was depicted.

The research started in the dry season in November and will last for a year. The hives were divided into two, those under control and the other ones without control to detect the level of occurrences of the visitors to the colony. After the colonization of hives, the hives with control took measures and applied grease oil frequently and were set far from the other hives. Both hives were given proper inspection every two weeks to detect the condition of the colonies. Diseases of the honeybees were not detected yet, but many predators were found visiting the colony at various times. Both the controlled and uncontrolled hives recorded visitors in every season but uncontrolled have more pests than the controlled ones. The research will continue to manage till the end of the wet season which will be the end of the research.

4.0 CONCLUSION AND RECOMMENDATIONS

Present research identified three classes of pests affecting the honeybees in Sokoto State modern apiaries, the pests include insects, mammals, and reptiles. The total frequency of the pest was 574, a pest from the Duhuwa location, showed the highest percentage frequency of 39.89% followed by Madorawa (30.66%), while the more location had the lowest percentage frequency of 29.44%

It was recommended that beekeepers should provide with some local measures to prevent the effect of the identified pest on the honey bees, also government and nongovernmental organizations should provide some new technologies that may prevent the pest from visiting the apiaries of the honeybees.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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