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Multiplication of Honeybee (*Apis mellifera* Adansonii L.) Colonies using Three Different Low-Cost Model Nucleus Hives Design in Two Main Vegetation Zones of Nigeria

Ayoade Alabi Akande[1]; Akeem Abolade Oyerinde[2]; Toba Samuel Anjorin[3]; Liadi Muideen Tella[4]; Ismail Adeniran Aderolu[5]
Department of Crop Protection, Faculty of Agriculture, University of Abuja, Nigeria
Federal University of Agriculture Abeokuta

Abstract:- There is a growing need for additional honeybee colonies to satisfy the demand for pollination services and compensate for high colony mortality through bush burning, vandalization and pesticide poisoning. This study evaluates the preference of different nucleus hive to the establishment of colony and how to mitigate the associated pests and diseases in the practice. This was carried out in the forest (7.50ºN, 4.52 ºE) and savanna (8.98 º N, 7.19 º E) agroecological zones of Nigeria. The experiment at the two locations was layout using Randomized Complete Design (RCBD), data collected were analyzed using SPSS Version 22. The data collected in both AEZ include the rate of colony establishment which clearly shows that wooden hive have 63% followed by bamboo with 62% and the least was carton with 37% savannah AEZ in the same vein the colony establishment at rain forest AEZ shows that wooden hive gave 53% followed by bamboo with 49% and carton with 32%. Number of incoming bees that clearly show the strength of the colony was higher in wooden hive with 36.31/min, bamboo 33.40/min and 27.29/min in carton, followed by wooden and the least was in carton colony weight, brood length, incidence of pest and infestation of diseases as well as colony abscondment rate at week intervals. A total number of 24 nucleus hives made from different low-cost model of materials were deployed in the two agroecological zones. The result shows that the bamboo and the wooden hives gave similar result while carton were significantly different from the two hives model earlier mentioned. The findings from this study portrayed that bee farmers in Nigeria can adopt the use of low-cost materials of bamboo and carton to raise nucleus hives for establishment of colony in modern beekeeping practice.

Keywords:- *Colony Establishment, Bamboo Carton and Wooden nuc Hives, Pests, Diseases.*

I. INTRODUCTION

Apis mellifera L., is an insect of crucial economic, agricultural, and environmental importance. *Apis mellifera* adansonii is about the most common species that has been given due attention in Nigeria probably because of its beneficial attributes as the most important of all insect pollinators (Akunne, 2015). In Nigeria, due to increase in government focus on agriculture, which includes beekeeping, to tackle unemployment and increase food security, there has been a surge in the number of beekeepers, and this keeps growing (Oyerinde and Ande, 2009).

Multiplying colonies is achieved by creating a new colony with a young, mated queen, drone and worker (Ambrose, 2008). Despite the efforts of beekeepers, the available bee colonies in Nigeria still do not meet the demand for honey production at the local level (Ojeleye, 2009; Bekele *et al*., 2017).

Like other living organisms, the life and products of honeybees are affected by harmful diseases, pests and toxic materials. Successful beekeeping requires regular and on time monitoring of any factor that endangers honeybee life and threaten their products (Desalegn and Begna, 2015). Honeybee pests have been identified as one of the major biotic factors affecting the successful beekeeping practice in Nigeria (Oyerinde and Ande, 2009).

Honeybee colonies existing in the wild produce small quantity of honey above their requirements, but modern beekeeping is much more productive and profitable if managed properly (Chala *et al*., 2012). To this reality, protecting them from disease and pests have been recognized many centuries back and the goal of beekeepers is to make the beekeeping more profitable by protecting colonies from pest, pathogen, and bee diseases. (Desalegn and Begna, 2015).

To meet the increasing demand for honeybee colonies for new beekeepers and to combat the increasing rate of colony abscondment, there is the urgent need to develop strategies and tools to enhance colony multiplication. This study examines the use of waste materials to produce nucleus hives for colony establishment in the forest and savana agroecological zones of Nigeria.

Not many new beekeepers can afford to buy established nucleus colony at price of ₦ 15,000- ₦ 25,000 per one. But if we can make one that is acceptable by bees at affordable price it will help to move the sector forward. Also, the wandering wild colonies or swarm looking for new

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abode can easily find one around them and colonise it before the farmer will transfer it into the production hive. The need to increase the number of bee colonies as a wide number of beekeepers are coming into the sector and the major challenge for this new beekeeper is how to attract bees into their hives for the cost of buying one is expensive and not sustainable for honey production and for crop pollination. In addition, the influence of climate change, use of pesticides and the rate at which the bees are dying in different climes calls for research on how we can increase the colonies naturally in a sustainable way without tampering with the genetic makeups of our bees.

The aim of this study is to multiply bee colonies using different models of nucleus hives (*Apis mellifera* A.) and to scale up honeybee colony multiplication technology in Nigeria in other to build beekeepers capacity in applying sustainable beekeeping methods for maximum honey production and pollination. This research work attempts to compare the productivity and bee preference to different nucleus hive types and the efficiency of various baits with a view of improving bee farmer's productivity and economic benefits.

II. MATERIALS AND METHODS

➢ *Experimental Field*

This study was conducted at the Teaching and Research Farms of Faculty of Agriculture, University of Abuja (8 °58'N, 7 °10'E) and the Obafemi Awolowo University (7° 31'N, 4° 31'E). The two sites were carefully selected before siting the apiary research there. The features of the two sites in terms of forage were the presence of banana plants, citrus plants, mango trees and some wild growing trees. There were small streams that pass through the two project sites which does not dry all the year round.

Fig 1 Map of Nigeria Showing the States Visited in Forest and Guinea Savannah Zones.

➢ *Experimental Design*

The study was set up in a Randomized Complete Block Design RCBD with four replicates. Three types of nucleus hives namely: wooden, bamboo and carton hives were assessed for colony establishment, pest and disease incidence in two agroecological zones (rainforest and derived savannah) of Nigeria. The nucleus hives were randomly sited at four different locations per site. Data were collected on weekly and fortnightly, depending on the measurement taken.

➢ *Statistical Analysis:*

Data obtained was tested to assess the differences in colony strength, acceptability of the nucleus hive designs, and the durability of the materials used for the making of the nucleus hives and in-between variables using SPSS Software Version 21. Means were separated using Duncan Multiple Range Test ($p<0.05$).

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III. RESULTS AND DISCUSSION

➢ *Weekly Variations in Colony Performance in Three Different Nucleus Hives in Abuja*

Table1 shows weekly variations in colony performance in three different nucleus hives in Abuja. There was significant difference in colonization rate of bees in three different nucleus at $p<0.05$. Wooden had 0.86% colonization rate; Bamboo had 0.70% while carton had 0.38%. In terms of colony weight, wooden hive had 9.5kg, bamboo had 7.29kg while carton hive had 3.56kg. There was significant difference in the rate of bee colony flight for wooden and bamboo hives. Wooden hive had 36.31/min while bamboo recorded 33.40/min, the values recorded for wooden and bamboo hives were both significantly different from carton 27.39/min. Brood length of hives significantly differed between carton, wooden and bamboo hives. Wooden hives had 27.58cm, bamboo had 28.46cm while carton recorded 16.5cm. There was no significant difference in comb count between the wooden and bamboo hive: which recorded 6.29 and 6.17 respectively($p>0.05$) while Carton hive recorded 3.70 which significantly lower compared to the wooden and bamboo hive.

Table 1 Mean Variations in Colony Performance in Three Different Nucleus Hives in Abuja

Bee character	Wooden Hive	Bamboo Hive	Carton Hive
Colonization rate (%)	0.63^{b}	0.62^{b}	0.37^{a}
Colony weight (kg)	9.56^{a}	7.29^{b}	3.56^{c}
Number of incoming bee/min	36.31^{b}	33.40^{b}	27.29^{a}
Brood length (cm)	27.58^{b}	28.46^{b}	16.50^{a}
Comb count	6.29^{b}	6.17^{b}	3.70^{a}

Means in the same row with different alphabets are significantly different ($P<0.05$)

➢ *Weekly Variations in Colony Performance in Three Different Nucleus Hives in Ile – Ife*

Table 2 shows the colony performance of three different hives in Ile-Ife. There was a significant difference in bee colonization rate in different hives at $P<0.05$. Wooden hive had colonization ratio of 0.53% bamboo recorded 0.49% while carton hive had 0.32%. The colony weight of different hives also varied. Bamboo and carton hives recorded 4.78 kg and 4.12 kg respectively and are both significantly difference in bee entry flight in different hives. Wooden hive had 43.17/min, bamboo had 37.63/min while carton hive recorded 37.61/min. Brood length recorded for the different hives had no significant difference at $P<0.05$. Wooden hive recorded 13.41 cm; bamboo hive recorded 16.29 cm while carton hive had 9.67 cm. There was no significant in comb count in the different hives. Wooden hive had 3.40; bamboo had 3.73, while carton hive had 2.81.

Table 2 Mean Variations in Colony Performance in Three Different Nucleus Hives in Ile-Ife

Bee character	Wooden Hive	Bamboo Hive	Carton Hive
Colonization rate	0.53b	0.49b	0.32a
Colony weight	6.03b	4.78a	4.12a
Bee entering flight	43.17a	37.63a	37.61a
Brood length	13.41ab	16.29b	9.67a
Comb count	3.40a	3.73a	2.81a

Means in the same row with different alphabets are significantly different ($P<0.05$)

Figure 2 shows the seasonal variation across the first 8 weeks (dearth season), second 8 weeks (swarming season) and the third 8 weeks (nectar flow season). The graph shows that colony weight of the honeybees is highest in wooden hives at the dearth, swarming and nectar flow season. The carton gave the least colony weight at the three seasons. Though the colony weight of the bamboo hives is higher than that of carton. It slopes down towards the swarming season and later picked up steadily as we approach the nectar flow season. Carton hives almost maintained its weight from swarming season to nectar flow season.

➢ *Effect of Seasonal Variation on Colony Weight of Honeybees in Three Types of Hives in Abuja.*

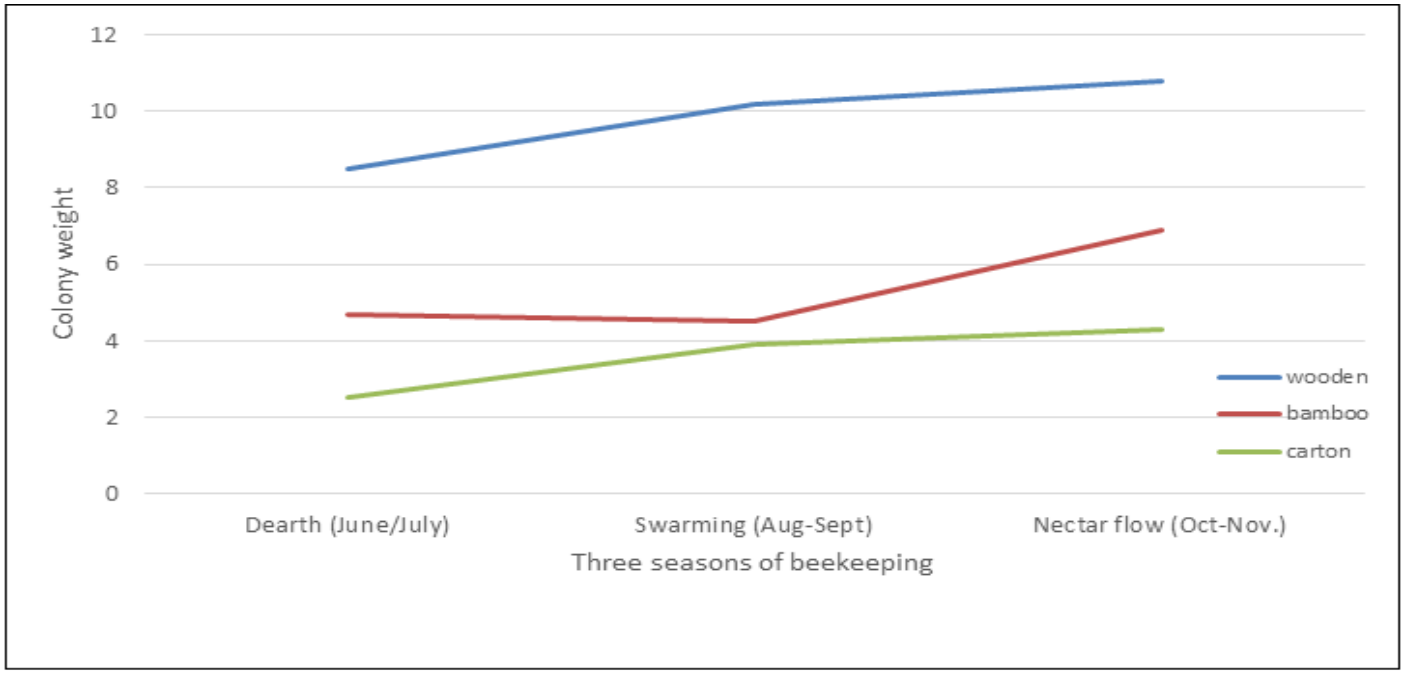

Fig 2 Effect of Seasonal Variation on Colony Weight of Honeybees in Three Types of Hives in Abuja

Figure 3 shows the seasonal variations across the first 8 weeks (dearth season), second 8 weeks (swarming season) and the third 8 weeks (nectar season). The graph shows that the colony weight of the wooden hives at Ile-ife was the highest at all the seasons following by bamboo and the carton was the least during the dearth season. But the colony weight was consistently increasing towards the swarming season and the nectar flow season. Carton hives shows that there is steady increment along all the seasons.

There is a sharp increase in the colony weight of that of bamboo from swarming season to that of nectar flow season compared to the wooden and the carton.

➢ *Effect of Seasonal Variation on Colony Weight of Honeybees in Three Types of Hives in Ile-Ife, Nigeria.*

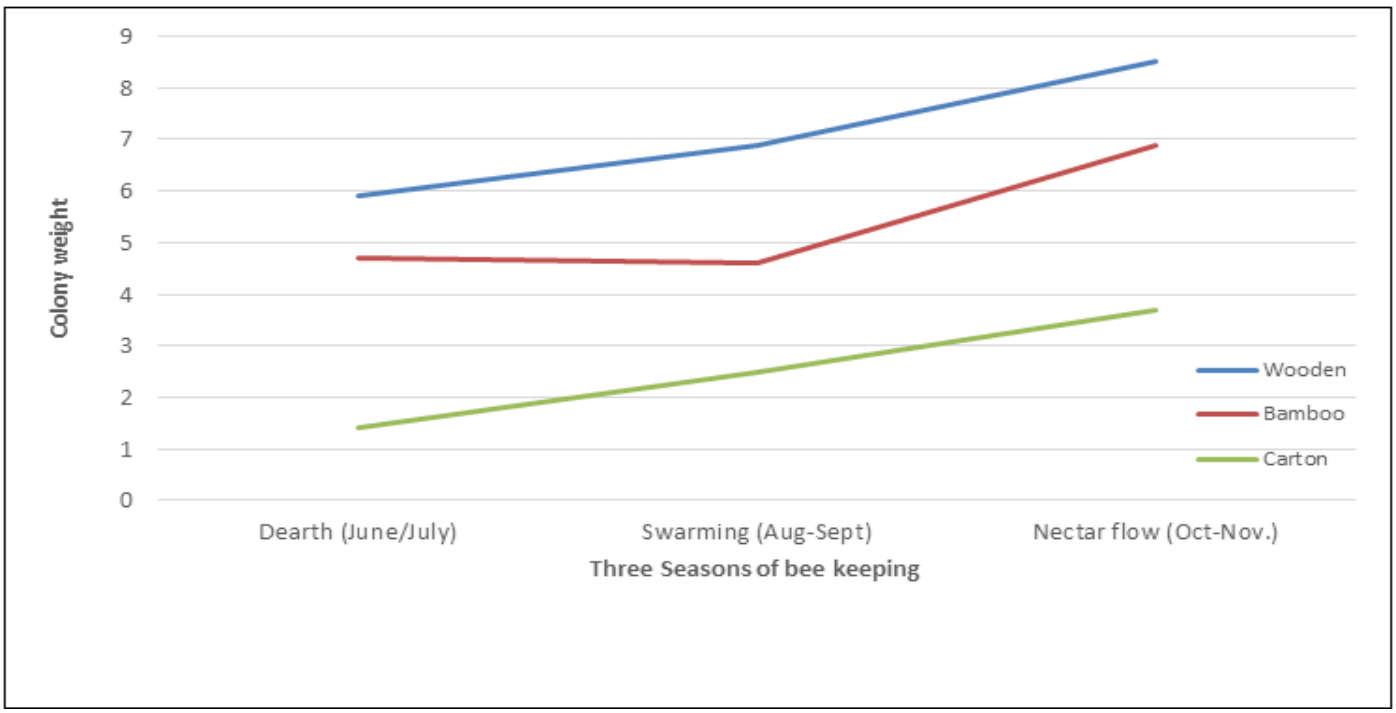

Fig 3 Effect of Seasonal Variation on Colony Weight of Honeybees in Three Types of Hives in Ile-Ife, Nigeria

IV. DISCUSSION

Three hive types designed using different materials such as wood, bamboo and carton were used in the study and were all shown to have variations in the preference of honeybee colonization.

Comparison of the rate of colonization of honeybees in the two different agroecological zones showed a faster rate of colonization in wooden hives located in guinea savannah at 2week after installation compared to the rain forest zone which colonized at 6weeks after installation. This observation agrees with the findings of Wasiam *et al*., (2018) (Using within-day hive weight changes to measure environmental effects on honeybee colonies). The difference in the rate of colonization in the two ecological zones could be because of honeybee preference for the hive material, rainfall duration, pollen availability and density.

The honeybee preference for hive colonization is more related to some factors which are dearth, swarming and nectar seasons, the weather condition, the height of the hives from the ground, the prevalence of the insect pest or ants and the type of the materials used in construction of the hive Akinbi, O.J, 2021. Colonization of the honeybees was a little bit delayed during the June to July which led to few hives' colonization, this was the dearth season when nectar and pollens were scarce. This could be largely affected by the intense rain at 230mm/annum, cold weather condition, inadequate pollen, and nectars around this period of the year at Abuja agro-ecological zone. The same type of observation was established by Alexander *et al*., 2017). At initial period, only wooden hive was able to attract swarm while the bamboo and the carton have no colony in them. From August to September when pollen and nectar begin to come, bees' population begins to increase and the colonization were also affected positively as the bamboo and the carton were colonized in ratio 2;1. The carton was not too strong to withstand the weather condition within this period leading to some of the carton being damaged due to high humidity and wind (Kugonza *et al*., 2008), hive types (Ande *et al*., 2008), shade tree species types (Babarinde *et al*., 2011) and hive wood colours.

V. CONCLUSION

This study provides information on honeybee preference for three nucleus hives in colony multiplication in two agroecological zones of Nigeria. It is of note that there was a serious problem in colony establishment after setting up an apiary with so many farmers in the industry. The finding recorded show that the colony multiplication using nucleus hive of this size quoted in this research was of great help as one nucleus hive can be splitted into two mother hive within 10 weeks of establishment provided there are forage (nectar and pollen) around the apiary. It was established that the colonisation in both agroecological zones were positively increased as the weeks goes by. This implies that as from September and October the colonization keeps increasing and all the nucleus hives that were not colonized began to attract bees swarm and were colonised. The natural splitting does occur before splitting the colonies into two. It shows that four top bar combs with equal distribution of the arrangement in the hives gives a better stability and adaptation to the splitted colony.

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