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Comparative Study of the Influence of Hive Types on Bee Colony Establishment

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ABSTRACT

The influence of hive types on bee colony establishment was monitored for pest infestation as well as abscondment between June and December 2006. Bee colony establishment was generally poor, but Kenyan top bar (KTB) and Clay-pot (PTH) hives performed significantly well by establishing bee colony earlier than others and achieving 50% success of bee colony establishment. The infestation of four bee pests *Campanotus pennsylvanicus, Gelloria mellonella, Lactrodectus mactans* and Rana spp. was generally low but it was observed that established bee colony in hives infested by *C. pennsylvanicus* and *G. mellonella* later absconded, while the infestation by *L. mactans* and *Rana sp.* did not pose threat to the established colonies in their infested hives.

Key Words: Hive type; Bee colony establishment; Abscondment; Bee pest

INTRODUCTION

Honey bees are insects of the super family Apoidea in the order Hymenoptera (Parker, 1981). Economically important species of honey bees include the *Apis cerana, Apis dorsata* and *Apis mellifera* (Roubik, 1989; Howpage, 1991). But, the most widely spread economic species of the honey bees is the *Apis mellifera,* which is native to Europe, Middle East and Africa with about 25 distinctive races (ERLS, 1995; Segeren, 1997).

Bee colonies are usually initiated by swarming with a prospective queen leading the way in most developing bee management settings, while on the advanced note colonies can be obtained from a queen rearing program. A colony consists of three castes i.e., infertile female (workers), male (drones) and a fertile female (queen) (Johansson, 1980).

The basic principles of beekeeping are simulation of what is evident in the bee colony in the wild (Karlsson, 1990) with the ultimate goal of sustaining the bee colony and easing harvesting process. However, the improved interest in beekeeping as a result of the growing demand for bee products and services made the few natural wild colonies inadequate. Hence, the advent of special artificial hollows in the form of bee hives (Adejare, 1990) presently engaged in the practice world over.

Bee hive construction varies from one area to the other (Olagunju, 2000). The traditional bee hives was initiated in an attempt to utilize the cheap and plentiful local materials for hive construction. In Nigeria, the common traditional hive includes: gourds, clay pot, raffia basket, rolled up straw and hollow trunks (ERLS, 1995).

Modern bee hives on the other hand adopt the principle of having a box-like enclosure with removable top or frames, which facilitate routing inspection of the established colonies. The common modern beehives in Nigeria includes: Kenyan top bar, Langstroth and East African long transitional top bar hives (Olagunju, 2000).

The increasing awareness about honey consumption viz a viz other hive products in the world have called for a concerted effort on boosting honey production (Olagunju, 2000). The ability to increase the supply of the bee hive products is rested upon several factors among, which hive that houses honey bee and its products require a top most attention. This research work therefore attempts to compare bee preference to different traditional and modern hive types with a view to improving bee farmer's colony establishment rates in the different hive types engaged on their bee farms.

MATERIALS AND METHODS

Study site. The research work was carried out at the University of Ilorin Apiary site. The bee farm was located close to the University Sugar Research Farm, about 3 km off the major road linking the University campus to the town. The farm had a dense vegetation of cashew and neem trees that shaded the experimental hives.

Hive types. Five beehive types (3 traditional & 2 modern), namely: Bucket (BKT), Grass woven (GWH), Pot (PTH),

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Kenyan Top Bar (KTB) and Langstroth (LAN) hives were engaged in the study.

Construction of hives. BKT: 18 light blue plastic 10 L buckets were procured from an open market in Ilorin. Three large holes of 10 mm diameter were made on the lid for bee entrance. The lid firmly covered the bucket and a twine rope was used to further fasten it and hold it in place.

GWH: 18 grass woven hives were manually constructed using grasses, ropes and sticks. These were woven into a conical shape with one open end whose diameter ranged from 45 cm - 50 cm. A lid was separately woven to cover the open end. Two pegs with pointed tips were used to support the lid when the hive was covered.

PTH: 18 brown oval clay pots of about 30 L capacity with an opening of about 40 cm diameter were purchased from an open market in Ilorin. The pots were burnt to reduce permeability to liquids. Ceiling boards were cut into sizes of pot openings to serve as lid. Three holes of about 10 mm diameter were made on each lid to serve as bee entrance. String was used to hold the pots and lids together.

KTB: 18 units of KTB were sourced from the University of Ilorin Apicultural Unit. The KTB is a modern hive, it has the hive body, top bars and iron stand as its basic component. The bee entrance measured 1 cm was constructed at the base of the hive body.

LAN: 18 units of LAN were obtained from University of Ilorin Apicultural Unit. The LAN is another modern hive type. It consists of the bottom board, brood chamber, queen excluder, honey super, inner and outer covers and iron stand. An entrance of 1 cm was constructed at the bottom board of the hive.

Bait application. Beeswax sourced from the University of Ilorin Apicultural Unit was used in baiting all the experimental hive types in molten forms.

Installation. The KTB and LAN hive types were installed on their conventional stands, which were about 0.6 m and 0.7 m from ground, respectively. The BKT, GWH and PTH were either placed on the sturdy branch or on the fork of cashew or neem tree at irregular heights. However, the height of the hive base to the ground was noted as the installation height in meters.

Duration and surveillance. The inspection accessibility and sturdiness of each hive type were assessed subjectively. Hives whose interior could easily be inspected were assigned + designation and those that were not accessible were assigned–sign. The hive sturdiness was assessed to most fragile and easily dismantled ones (x), more sturdy ones (xx) and the highly sturdy ones (xxx).

Daily surveillance was mounted on all the hives for 180 days between June and December 2006. Colony establishment was monitored by the occurrence of dancing scout bees around the hive entrance, as well as, humming sound within the hive. The total numbers of days between installation and colony establishment was recorded as the colony initiation time (t). Each of the established colonies was subsequently monitored for possible abscondment, incidence, types and number of pests and diseases. The average colony initiation time (days) per hive were calculated and noted as Preference Indices i.e., PI (h):

$$PI(h) = \frac{\sum t_1 + \text{-------} t_n}{n}$$

The colony establishment rate was calculated as a ratio of a particular hive type colonized by bees from the total number set up in the experiment in percentage, while abscondment rate was the proportion of established colonies that absconded subsequently from those established initially in percentage.

The Pest Incidence Rate (%) was calculated as the frequency of occurrence of pest per hive.

i.e.,

$$\frac{\text{Total number of occurrence per hive}}{\text{Total number of established hives}} \times 100$$

While the frequency of occurrence of each pest type per hive was also in percentage as:

$$\frac{\text{Total number of hive with particular pest type}}{\text{Total number of the hive type with established bee colony}} \times 100$$

RESULTS

Installation and accessibility. The average hive installation height in all cases was not more than 2.4 m (Table I). All the hive types except GWH were within reach and did not require any support during inspection. The KTB and LAN with height below 1 m were the most conveniently reached hives and most stable as they were located on individual stands constructed for them.

BKT and PTH hive types though reachable were above eye level and relatively unstable as they had to be hung on tree branches to avoid dislodgement. PTH was particularly more difficult to hang due to their relatively heavier weight than the BKT and GWH which were quite lighter. Detailed assessment of the hive from interior was only possible in KTB and LAN hive types. Un-covering the lids in all the traditional hive types exposes the entire hive interior and made the bees uncontrollable.

Colony development. The mean colony initiation time recorded in the study showed that no colony was initiated in BKT hive type during the entire 180 days of surveillance. The least mean colony initiation time of 70 days was recorded in KTB hive type. The order of efficacy of attracting bee colony exhibited by the four hive types that support colony development was KTB>PTH>LAN>GWH.

Colony establishment rate per hive type showed that KTB and PTH had 50% colonization rates each. While lower percentages of 27.80% and 20.00% colonized hives were observed in LAN and GWH hives respectively. The abscondment rate was particularly high in LAN (100.00%) and GWH (100.00%) hive types. Whereas KTB and PTH hive types with high colonization rates had quite low

Table I. Comparative details of properties, bee colony initiation and performance of the various bee hive types

Characteristic	Hive types				
	BKT	GWH	PTH	KTB	LAN
Average Installation height (m)	1.6± 0.2	2.3 ± 1.0	1.4 ± 0.2	0.6 ± 0.1	0.7 ± 0.1
Inspection Accessibility	-	-	-	+	+
Sturdiness	xxx	xx	x	xxx	xxx
Colony Initiation time $PI_{(b)}$ (days)	-	112.0 ± 1	77.0 ± 1	70.0 ± 1	98.0 ± 1
Colony Establishment Rate (%)	0.0 ± 0.0	22.0±0.5	50.0±0.5	50.0±0.5	27.8±0.1
Abscondment Rate (%)	-	100.0±0.1	33.0±0.2	22.0 ± 0.2	100.0±0.1
Pest Incidence (%)	-	66.6±0.2	33.3±0.2	11.1±0.2	33.3±0.5

Table II. Frequency of occurrence of various pest types per hive type

Pest description	Frequency of occurrence %				
	BKT	GWH	PTH	KTB	LAN
Ants	0.00	66.60	33.33	0.00	0.00
Small bee beetle	0.00	0.00	0.00	0.00	0.00
Large bee beetle	0.00	0.00	0.00	0.00	0.00
Bee louse	0.00	0.00	0.00	0.00	0.00
Greater wax moth	0.00	50.00	33.33	11.11	100.00
Lesser wax moth	0.00	0.00	0.00	0.00	0.00
Mites	0.00	0.00	0.00	0.00	0.00
Spiders	0.00	55.50	0.00	11.11	11.11
Termites	0.00	0.00	0.00	0.00	0.00
Toad/Frog	0.00	5.60	0.00	0.00	0.00

abscondment rates of 22.00% and 33.00%, respectively.

Bee pests. The frequency of occurrence of various pest types per hive (Table II) revealed that the most frequently occurring pests were Ants (*Campanotus pennsylvanicus*) and Greater wax moth (*G. mellonella)*. These two were noted to have occurred in GWH and PTH hive types. The moth was in addition observed in the KTB hive type. GWH hive type had 66.68% infestation with *C. pennsylvanicus* indicating a high frequency of occurrence compared to the 33.33% infestation recorded in the PTH hive type. Moth infested LAN hive type, and mostly 100.00% frequency of occurrence was noted, while low degrees of occurrence (33.33% and 11.11%) were noticed in PTH and KTB, respectively. Occurrence of *G. mellonella* was traced to hives with established colonies (KTB, PTH, LAN & GWH).

Spider infestations were observed in many hive types but, the frequency of occurrence per hive was very low except in GWH hive type with 55.50%. The other hive types (KTB & LAN) recorded only 11.11% each as frequency of occurrence. Also Frog infestation was only noticed in GWH hive type, but, had a low frequency of occurrence of 6.67% infested hives.

All the colonized hives of GWH, PTH, KTB and LAN hive types were infested with one pest or the other. Hence, pest incidence rate followed the following order GWH>LAN>PTH>KTB.

DISCUSSION

The establishment of bee colonies in the site was generally poor. Two reasons were responsible for the low colonization rates recorded. Firstly, modern apicultural practices had been reported to reduce natural swarming rate of *Apis mellifera adansonii* (Olagunju, 2000), such that the natural swarming rate had been stretched from one year to once in two to three years.

Secondly, colony establishment based on natural swarming is seasonal (Clayton, 2001). For instance, Mutsaers (1993) observed that the swarming season in the forested region of western Nigeria is from July to October. The poor bee colony establishment recorded in this study is related to the experimental period (June to December) being off the swarming season for Ilorin and environs, since the climatic belt of Ilorin falls within the Guinea savannah region. Oyerinde and Ande (2006) also reported low bee colonization levels in the various Local Government Areas of Kwara State (Nigeria). However, the poor status was due to low age level of modern beekeeping practice in the State.

The first hive type to establish colony i.e., KTB also had the highest colonization rate. This result supports the observation of Taylor (1978) that the best hive for African honey bee is the KTB. In the same vein Aidoo and Paxton (1991) and Adejare (1989) rated KTB above other hive types and best in Ghana, respectively 50% of the PTH hives installed established bee colonies, therefore PTH though a traditional hive was comparable to KTB hive. The performance by the best was an indication that bees show preference for PTH and this may account for why it is widely used in Nigeria in particular (Olagunju, 2000) and Africa in general (Adejare, 1990).

The Grass woven hives also a traditional hive and the Langstroth hive, which is a modern hive performed very poorly in the experiment. Reasons for the poor performance

was attributed to non-availability of swarming bees, or bee's higher preference to the KTB and PTH hives in which case the ability of the GWH hives to perform may be in the absence of other hives. BKT is a traditional hive, however no report was seen to have used bucket as hives. It actually recorded 0% performance.

Great difficulty was encountered in the inspection of established traditional hives. The combs were not removable, because the built combs were firmly glued to hive body wall of such hives like PTH, and GWH. Attempt to remove the combs would lead to destruction of the combs. This observation supports the report made by Mutsaers (1993) and Ojeleye (1999). When the lid of a traditional hive was opened in the course of inspection, more bees are exposed to the surface than in the modern hives. This exposure thus contributes to the fierce and massive attack of bees on the beekeeper. Equally, if the honey was to be harvested, to reduce bee attack, it was done in the dark or after full moon (Mutsaers, 1993).

In terms of durability, only the GWH hive had short life span. It is more or less a seasonal hive type that cannot survive the forces of rain, bush fire and human or animal activities. The inability of traditional hives to withstand the stresses of such environmental factors requires that such hives must be replaced annually or seasonally (Adejare, 1990). The PTH hive was fragile and required much caution and care when preparing it for installation as beehive. However, if placed at hitch free and safe location, it was more durable than the traditional hives (Adejare, 1990).

The pests reported included *C. pennsylvanicus, G. mellonella L. mactans* and *Rana sp*. Although the pest infestation was generally low but it was observed that established bee colony in hives infested by *C. pennsylvanicus* and *G. mellonella* later absconded. The infestation by *L. mactans* and *Rana sp.* was insignificant as it does lead to abscondment of established colonies in their respective hives.

CONCLUSION

The ability of the KTB hives to establish bee colony earlier than others, easy accessibility for proper inspection and very low susceptibility to pest rate, it was best among others. In addition to these advantages, local carpenters can easily construct KTB hive type. Thus, KTB hive is best and should be used by bee farmers in Nigeria.

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