

**IMPACT OF HIVE DIMENSION AND FIGHT ENTRANCE ON
HIVE COLONIZATION, PEST INFESTATION AND HIVE
WEIGHT GAIN IN *APIS MELLIFERA ADANSONII*
(HYMENOPTERA: APIDAE)**

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ABSTRACT: Four hive types [Kenya top bars hive with flight entrance on the floor (KF), Kenya top bars hive with flight entrance on the wall (KW), Kenya top bars hive with flight entrance on the floor and the wall (KFW) and Tanzania top bars with flight entrance on the floor and the wall (TFW)] were constructed and baited by smearing 30 g bee wax on their flight entrance, top bars, inner surface of the wall and floor on 17th April 2008. Colonization, colony development and pest infestation were monitored over a period of 16 weeks. Hive type did not significantly ($P > 0.05$) affect colonization period. All hive types were colonized with 100% colonization in TFW and KF. KW and KFW had 66.67% colonization. The least mean colonization period was 3.67 days after hive installation and was observed in KF, while the longest colonization period of 7 days was observed in KFW. Hive type did not affect weight gain ranged from 0.3 kg (TFW at 2 weeks after colonization) to 2.5 kg (KF at 8 weeks after colonization). Bee population was significantly affected by hive type and was lowest in TFW which was the only hive type that was heavily (2/3 of the replicates) infested by *Galleria mellonella*, hence the reason for its lowest weight and bee population. *Aethina tumida* was encountered in KT and KF. Both pests were observed in colonized hives. The only intruder that was observed in uncolonized hive was *Gryllus bimaculatus* and was encountered in KFW. With 100% colonization and least mean colonization period of 3.67 days post installation of baited hives in Kenya top bar with flight entrance on the floor (KF), KF is recommended for areas where the risk of accidental rain water into hive is not paramount.

KEY WORDS: Top bar hive, hive type, hive colonization, fight entrance, hive dimension, honey bee pests, colony weight gain.

Colonization is artificial means of catching a colony or a swarm of bees into hives. Ordinarily, colonization does not suppose to be a problem in West Africa, a region which is full of wild bees colonies. In most cases if an apiary is sited on a virgin land where there is no competition and appropriate baits are used, colonization can begin within the first day installation of hives. However there have been reported cases of colonization problems in South western and South Eastern Nigeria (Babarinde pers. comm.; Ojating & Ojating, 2004).

Several baiting materials have been listed with performance based on different factors. Bee wax is considered to be the best bait to attract swarm and the started strips on the top bar may be enough to do this (Eaton, 2006). Alternatively, smearing bee wax on inner surface of the hive, the top bars and the flight entrance will attract the bee colony. The baited hive could then be installed on a stand and

covered with corrugated materials to provide shade. Though, there are several designs of hives, the top bar hives are comparatively predominant amongst tropical beekeepers (Sageren, 1997; Gregory, 2003; Romet, 2005; Eaton, 2006; Emery, 2006). Top bar hives have many of the advantages of movable frame hives and their use can lead to 3-fold increases in yields of honey and can be very profitable because of low input costs (Wilson, 2006). Okwee-Achai et al. (2010) reported that the top bar hives had significantly higher colonization rate than the log hives in the North-western agro-ecological zone of Uganda.

Although, several designs of top bar hives have been reported (Sakho, 1999; Magnum, 2001), the need for further research on their designs are paramount, since they form an intermediate technology which is an improvement over the traditional honey hunting. In south western Nigeria, the conventional top bar hive used for beekeeping is the Kenya top bar with flight entrances on the wall and floor. This is presented as sample hive type in most private and institution-based beekeeping trainings or workshops. Though the Tanzania top bar hive seems easier to construct due to its shape, it is not common amongst the beekeepers in the area of this study. The technical knowledge required to construct some of the modern hive types is a major discouragement to rural farmers who have interest in beekeeping (Caron, 2007). As a way to eliminate this discouragement, Kenya top bars and Tanzania bars hive were constructed and experimented for beekeeping, with the aim of investigating the effect of hive dimensions and flight entrance on hive colonization, pest infestation and colony weight gain.

MATERIALS AND METHODS

Experimental Site

The apiary site was located at Ayekale Village, Surulere Local Government, which is about 12 km from the Campus of Ladoko Akintola University of Technology, Ogbomosho, Nigeria. The apiary was about 4 m to the stream.

Hive specifications

The Kenya top bars hives used for the experiment were constructed using Sageren (1997) and Gregory (2003) models with little modifications. Each hives had 15 top bars of 3 cm width. Each entrance on the floor was 12 x 1 cm and positioned around the centre of the hive length. Entrances on the wall were 3, each having 12 mm diameter and were aligned towards an edge of the hive. Details of each hive type are presented in Figures 1 to 4.

Installation of the hives

Each hive was baited with 30 g bee wax and installed 56 x 31 cm surface area and 30 cm height metallic stand. A total of 12 hives were baited, three replicates each of Kenya top bars hive with flight entrance on the floor (KF), Kenya top bar hive with flight entrance on the wall (KW), Kenya top bars hive with flight entrance on the floor and the wall (KFW) and rectangular top bars hive with flight entrance on the floor and the wall (TFW). The experiment was set up on 17th April 2008. Corrugated roofing sheets were used as roofing material to prevent adverse weather conditions. The flight entrance of each hive faced the east. The baited hives were placed under cashew (*Anacardium occidentale*) trees which was the only available tree species grass (*Pennisetum purpureum*) and spear grass (*Imperata cylindrica*). During the experimental period, arable farmers around the apiary had maize (*Zea mays*) and cassava (*Manihot spp*) grown on their plots.

Data collection and analysis

Data were collected on colonization date, pest infestation, hive weight gain and bees population. Colonization date was recorded as number of days post installation of hives that bees colonized the hive. Pest type and date of its infestation were also recorded. This was determined by daily inspection of the hives. Pests encountered were collected and preserved for identification at Insect Collection Museum, Crop Protection and Environmental Biology Department, University of Ibadan, Ibadan, Nigeria. Hive weight was determined immediately after baiting before installation and on bi-weekly interval with the aid of a top loading weighing machine, Camry®. Hive weight gain was calculated as the difference between the previous weight and the weight at bi-weekly interval. Number of bees at flight entrance (s) was recorded on inspection of colonized hives at bi-weekly interval. The number of bees at flight entrance was determined by visual count and bees population was determined by ERLS formula. Data collected were subjected to one way analysis of variance (ANOVA). The experiment was set up in completely randomized design.

RESULTS

Effect of hive dimension and flight entrance on hive colonization

Hive type did not significantly affect colonization period. All hives were colonized but Kenya top bars with flight entrance on the floor (KF) and rectangular top bars with flight entrance on the floor and the wall (TFW) had 100% colonization. The other two types (Kenya top bars with flight entrance on the wall (KW) and Kenya top bars with flight entrance on the floor and the wall (KFW) had 66.67% colonization. Kenya top bars with flight entrance on the floor (KF) had the shortest mean colonization period (3.67 days after hive installation). The longest mean colonization period was 7 days after hive installation and was recorded in Kenya top bars with flight entrance on the floor and wall (KFW) (Fig. 5).

Effect of hive dimension and flight entrance on hive weight gain

Hive type did not affect weight gain throughout the experimental period and ranged from 0.3 kg-2.5 kg. Hive weight fluctuated but was consistently least (0.3-0.7 kg) in TFW and highest (1.5-2.5 kg) in KF. At 12 weeks after colonization (WAC), weight loss was recorded in TFW (Fig. 6).

Effect of hive dimension and flight entrance on bee population

Population of bee colony in KF was significantly higher than population of bee in other hive types. Population in TFW was throughout the experimental period. Bee population did not progressively increase with experimental duration but rather fluctuated (Fig. 7).

Occurrence of pests in different hive types

Two pests and one intruder were recorded in the different hive types. KF and KW had highest number of hive beetle, *Aethina tumida*, and a replicate each was affected by the pest on 1st June 2008 and 5th July 2008 respectively. An intruder, *Gryllus bimaculatus*, was recorded in KFW. Two replicates of TFW were infested by large wax moth, *G. mellonella*, on 19th July 2008 and 22nd August 2008 respectively. KFW was infested by the intruder before hive colonization while the pests attacked hives after the hive had been colonized (Table 1).

DISCUSSION

Top bar hives are almost becoming most popular among educated trainers who are interested in modern bee keeping in some developing countries. As simple as the technology of top bar hives is, construction details are not fully understood by local farmers who have no access to documented sketches. In South Western Nigeria, the common model has two flight entrances. The first set of entrances is on the wall, while the second is on the floor. The floor entrance is often presumed to be useful to drain off water from hives when there is accidental water drain into the hives practically in Nigeria variations of flight entrances have not been studied.

In this research, attempt was made to compare three types with the Gregory model (Gregory, 2003). A rectangular hive was included because its specification was simpler than the standard Kenya models. The result indicates that hive type did not affect hive colonization and weight gain. Primarily, choice of hive type by bees keeper should depend on a number of apicultural factors such as colonization, yield and vulnerability to pests. TFW and KF performed equally in terms of colonization periods. This results recommends a reduction of flight entrance to just one especially in areas where pests can utilize extra flight entrance to attack the colony. However this can only be adopted where there is no tendency of water draining into the hive.

The initial population of bees could not have been affected by hive types. This is because the scout worker bees look for a convenient accommodation and communicate to the colony. This would lead to colonization (Segeren, 1997). Also population of bee colony in KF was significantly higher than population of bees in other hive types and the reason for these could be as a result of pest infestation in the other hive types. Several authors (Adjare, 1990; Segeren, 1997, Ojating & Ojating, 2004, Ande et al., 2008; Babarinde et al., 2010) have reported that *G. mellonella* can cause absconding of established colony. Although *Aethina tumida* could be a nuisance to honey bees, it may not be associated with absconding (Adjare, 1990). So, in this study, TFW that had highest incidence of *G. mellonella* had the least bee population.

As simple as the specification of TFW was, a major deterrence that hinders its recommendation for practical use was its vulnerability to the wax moth, *G. mellonella*. Though, it had 100% colonization, yield was greatly affected by the pest infestation. It was not however certain whether pest incidence was catalyzed by the double flight entrance or not. It is therefore recommended that rectangular hive with single flight entrance be compared with those studied in this work, before final recommendation of rectangular hive can be made.

Since KF had 100% colonization and shortest mean colonization period which was 3.67 days after hive installation, it appears better than other two types of Kenya top bars hive. It has been observed in Ogbomoso, south western Nigeria that bees sometimes used the floor entrance for their foraging activities and abandoned the conventional wall flight entrance. Hence, single flight entrance on the floor will not have a negative impact on apicultural activities, especially when hives are placed securely to avoid water drain.

The result of this study will help bee keepers in solving the problem of getting standard hive sample for their apicultural activities. This study has shown that KF could be more preferable for it had least number of pests, higher number of bees population, and significant weight gain on bi-weekly basis. It is also important that baited hive installation should be done during the time of floral blossom. This

is because seasonal productivity of honey bee colonies depend on the seasonal availability of nectar and pollen of flowering plants (Ikedobi et al., 1985).

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Table 1. Occurrence of pests and intruders in different hive types.

Pest	Order	Category	Hive type	Date of occurrence
<i>Aethina tumida</i>	Coleoptera	Pest	KF	1 st June, 2008 & 5 th July, 2008
<i>Gryllus bimaculatus</i>	Orthoptera	Intruder	KFW	5 th July, 2008
<i>Galleria melonella</i>	Lepidoptera	Pest	TFW	19 th July, 2008 & 2 nd August, 2008

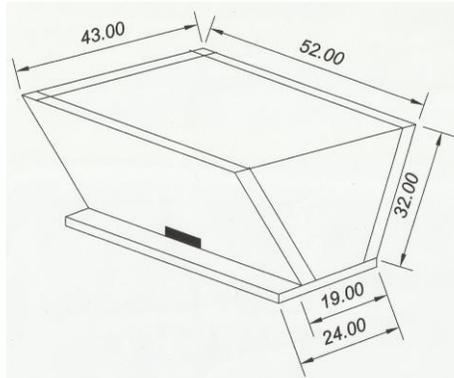


Figure 1. Kenya top bar hive with flight entrance on the floor (All dimensions are in centimeters).

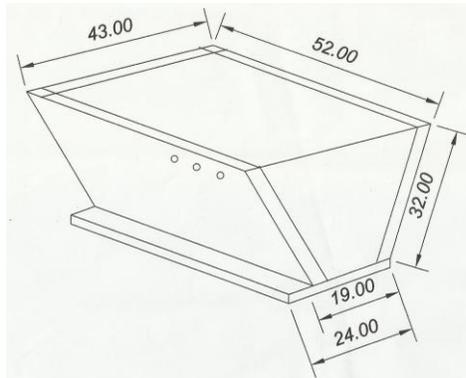


Figure 2. Kenya top bar hive with flight entrance on the wall (All dimensions are in centimeters).

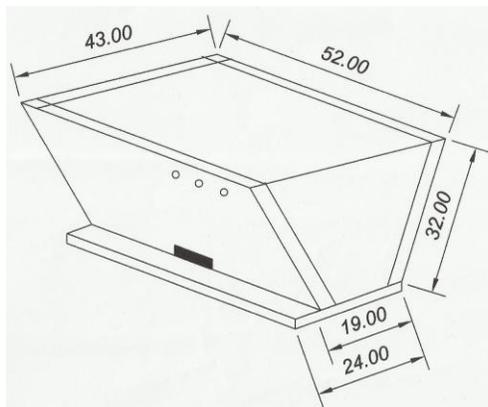


Figure 3. Kenya top bar hive with flight entrance on the floor and wall (All dimensions are in centimeters).

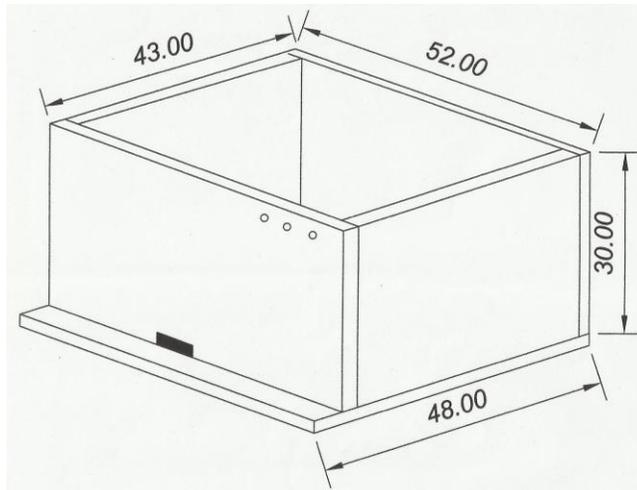


Figure 4. Tanzania top bar hive with flight entrance on the floor and wall (All dimensions are in centimeters).

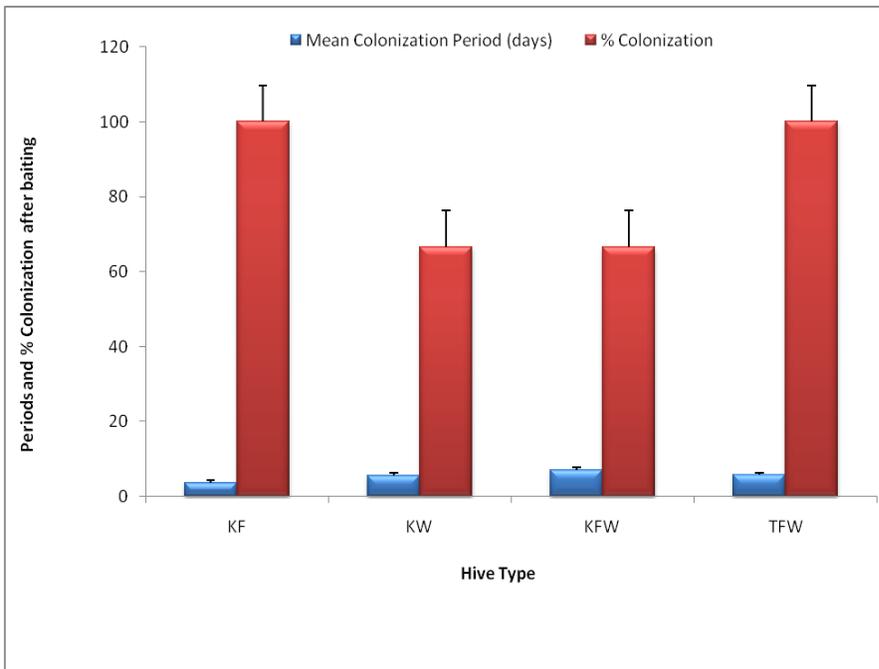


Fig. 5. Effect of hive dimension and flight entrance on colonization
 KF: Kenya top bar hive with flight entrance on the floor
 KW: Kenya top bar hive with flight entrance on the wall
 KFW: Kenya top bar hive with flight entrances on the floor and wall
 TFW: Tanzania top bar hive with flight entrances on the floor and wall

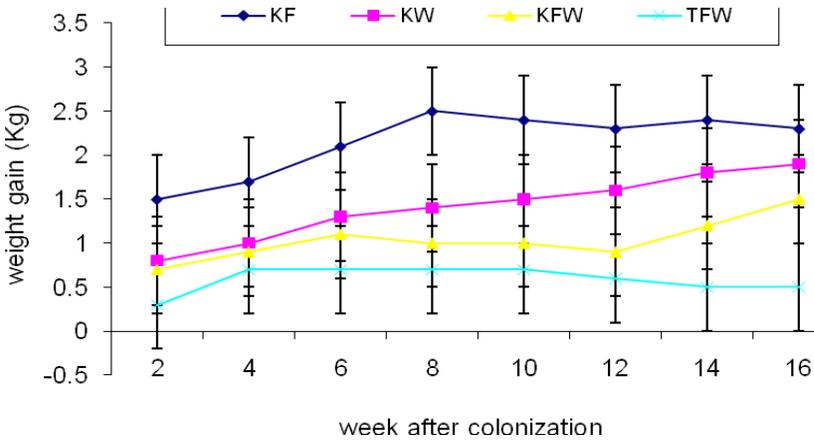


Fig. 6. Effect of hive dimension and flight entrance on hive weight gain.
 KF: Kenya top bar hive with flight entrance on the floor
 KW: Kenya top bar hive with flight entrance on the wall
 KFW: Kenya top bar hive with flight entrances on the floor and wall
 TFW: Tanzania top bar hive with flight entrances on the floor and wall

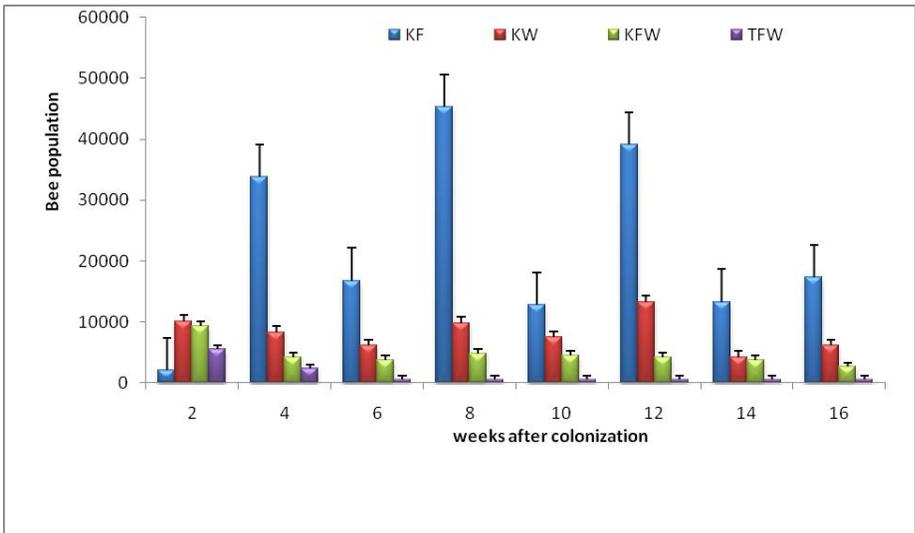


Fig. 7. Effect of hive dimension and flight entrance on bee population.
 KF: Kenya top bar hive with flight entrance on the floor
 KW: Kenya top bar hive with flight entrance on the wall
 KFW: Kenya top bar hive with flight entrances on the floor and wall
 TFW: Tanzania top bar hive with flight entrances on the floor and wall