ISSN - 2277 - 2755

Journal of Agricultural Science and Environment

THE PERIODICITY OF BUILDING HONEY COMBS BY HONEY BEES AND PEST INFESTATION IN TWO APIARIES IN OGUN STATE, SOUTH WESTERN NIGERIA

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ABSTRACT

The study examined the periodicity of comb building by Honey bee, *Apis mellifera* in some hives in Ogun State and pest of the honey bee in hives for twenty weeks. Four Kenya top bars hives were each placed in two apiaries located in University of Agriculture, Abeokuta (UNAAB), Ogun State, Nigeria and Olupakun village in Abeokuta North Local Government Area, Ogun State, Nigeria. Each of the 22 top bars and the flight entrances were smeared with honey as bait to attract bees to the hive. Data were collected weekly from two colonized hives in each apiary on: number of honey combs built, size of newly built honey combs along and across the bars and pest infestation. The results indicated that the bees initiated comb building as early as first week after colonization. In the first week, two combs built in hives at UNAAB had mean size of 8.61cm^2 and one and half combs built in hives at Olupakun measured 1.65 cm^2. As at the 20th week, seven and half combs measuring 662.71 cm^2 and eight combs measuring 352.28cm^2 were built at UNAAB and Olupakun respectively. Although, higher numbers of combs were built at Olupakun; they were of relatively smaller sizes than combs built in hives at UNAAB. The pests encountered in the hives were greater wax moth (*Galleria mellonella*), grass hopper (*Zonocerus variegatus*), termites (*Macrotermites nigeriense*), Cockroach (*Periplanata americana*), snakes, Lizard (*Agama agama*) and Praying mantis (*Stanomantis spp*.)

Keywords: *Apis mellifera*, Apiaries, Honey comb, Pest, Periodicity.

INTRODUCTION

Honey bee (*Apis mellifera* L.) (Hymenoptera: Apidae) is the most widely distributed economic species of bees which accounted for over 90% of the world honey production and majority of insects pollination in plants. They are social insects that live in colonies and differentiated into different castes namely the queen, the drone and the workers, which perform different functions in the colony (Michael, 1980). These functions include laying eggs, mating the queen, cleaning and defending the colony against external attack (Mackean, 2008). All castes of honey bees live in combs built by the workers and the size and shape of the honey comb determines the kinds of eggs the queen lays in the comb (Nelson and Gray, 1983; Ayoade, 1997).

The worker bees' produce combs by transforming scales removed from their wax pockets into comb or capping. Comb production requires abundance of honey; nectar or sugar syrup and the young workers are more efficient than the old ones in this activity (William and Roger, 1995). Bees always cluster in a curtain-like arrangement when they are constructing comb and the social system is put in place as some workers act as producers by applying wax to the cell walls, while others act as molders and do the final work. In the process of constructing combs, many bees hang quietly, while others are actively adding wax and shaping cell walls. The cell walls are extended gradually and edge is reworked until the wall thickness average 0.002 to 0.003 inch for worker cells and 0.0043 to 0.005 inch for drone cells. The temperature within a comb building cluster or curtain of bees is about 36^{o} C (William and Roger, 1995).

Honey comb is a mass of hexagonal cells of wax built by the bees in which they rear their young, store honey, and deposit pollens (Seegeren *et al.,* 1996). The layers of hexagonal chambers of honey comb are made of cells made from bee wax secreted from the abdominal glands of worker bees. It consists primarily of hydrocarbon and ester components and is commonly built by worker bees hanging down vertically from a rock, building, branch of trees and top bars. Comb is pliable, near white in colour and has thin and fragile walls when first built. However, combs used for storage of food such as pollens and honey take on yellowish hue over time due to the accumulation of pollens (Free and Williams, 1974). Also, as combs used for brood rearing age; they becomes darker, almost black and more brittle because of accumulated faecal materials, propolis, and pollens (Jay, 1963; Heppburn, 1998). The workers are reared in small-like worker cells. The drone cells are slightly large, while queen cells are enormous, triangular and cylindrical hanging down from the bottom (William and James, 1997). Honey bee colony can be attacked by a wide variety of pest and predators that could be devastating and cause a major constraint to profitable bee keeping. Some of the pests merely harbour themselves in the hives without any devastating result, while others attack the bees, honey, combs and hive structure (Ojeleye, 1999).

Since honey comb serves as store for honey, pollens, propolis and has the cells that accommodate the eggs, the brood, and the adult bees; its building is therefore essential for the survival and growth of honey bee colony. These studies therefore evaluate the periodicity of honey comb building in hives by honey bee *A. mellifera* and pest of bees associated with the colony.

MATERIALS AND METHODS

Four Kenya top bar hives were placed in each of two apiaries in University of Agriculture, Abeokuta (UNAAB), Ogun State and Olupakun Village, Abeokuta, Ogun State that were about 30km distance apart in February 2008. The first location, UNAAB, has floral sources such as *Anarcadium occidentalis* (cashew nuts), *Carica papaya* (Pawpaw) and *Elaeis guinensis* (Oil palm). The second location, Olupakun village is a thick virgin forest mainly dominated by forest trees, *Elais guineensis* (Oil palm), *Tetracarpidium conophorum* (Cherry) and *Citrus* spp. (Orange). The nearest pond to the hives was about 500m away. Each of the 22 top bars, side walls and the flight entrance were smeared with honey as bait to attract bees to the hives for colonization. Two hives from each apiary were colonized by honey bees one week after placement and were used for the study. The hives

were observed for comb initiation/building on the second day and the following data were taken weekly for 20weeks:

(i) Number of combs built
(ii) Comb length across and along the bars
(iii) Pest infestation

Statistical Analysis

Statistical analysis of data was based on SAS's general linear models procedure SAS Institute, 1998). Means of the hives comb length/breadth and number of combs built were subjected to analysis of variance (ANOVA). Significant means were separated using Student's Newman-Keuls Test (SNK) and Student t-test at P = 0.05

RESULTS

Number of combs built by A. mellifera

The number of combs built by the honey bees in colonized hives at the two locations is shown in Table 1. At UNAAB, mean number of two combs was built in the first week and it stabilized at three from week 2 to 4. The mean number of combs built between week 1- 4 were however, not significantly ($p>0.05$) different from each other. As from weeks 16 to 20, the mean number of combs built stabilized at 7.5 and they were not significantly ($p>0.05$) different from each other. The mean number of combs built as from weeks 9 to 13 ranged from 6.0 and 6.5 and they were not significantly ($p>0.05$) different from each other and from combs built between weeks 16 to 20.

At Olupakun village, the mean number of combs built between weeks 1 to 3 ranged from 1.5 – 2.0 and they were not significantly ($p>0.05$) different from each other. As at week 13th, mean numbers of seven combs were built and it stabilized at seven till week 17. Similarly, eight combs were built as at the 18th week and the number stabilized till the twentieth week. The number of combs built between weeks 9-17 were not significantly ($p>0.05$) different from each other. Also, the number of combs built between weeks 13-20 were not significantly ($p>0.05$) different from each other

Size of combs built by A. mellifera

As at the first week, the mean size of combs built by *A. mellifera* was 8.61cm^2 and 1.65cm^2 at UNAAB and Olupakun respectively. The comb size varied directly with numbers of days, as it increased from weeks 1-20 at the two locations. At UNAAB, the comb size in the first eight weeks were not significantly ($p>0.05$) different from each other. Likewise, the comb size in weeks 11-16 were not significantly ($p>0.05$) different from each other. The highest comb size was 662.71cm^2 in week 20, it was however, not significantly ($p>0.05$) different from 654.39cm^2, 652.46cm^2, 606.35cm^2, 553.19cm^2 and 521.70cm^2 comb sizes in weeks 19,18,17,16 and 15 respectively (Table 2). Similarly, at Olupakun village, the comb size was lowest in week one and increased along the weeks. The highest comb size was in week 20 and it was significantly ($p<0.05$) higher than comb sizes in other weeks. As at week one, the mean comb size at UNAAB was about 5 times bigger than the mean comb size at Olupakun village and by the 20th week, the comb size at UNAAB was (662.71cm^2) which almost double the comb size at Olupakun village (352.28cm^2)

Pest found in the hives

As shown in Table 3, the pests found in hives at the two locations were Rats - *Rattus rattus*, Lizard - *Agama agama,* snake, variegated grasshopper - *Zonocerus variegatus,* larger wax moth- *Galleria mellonella* (Caterpillars), Cockroach - *Periplanata americana*, termites-

Macrotermes nigeriense, praying mantis - *Stanomantis* spp. Sixty *G. mellonella* were seen in hives at Olupakun. These number were significantly ($p<0.05$) higher than twenty *G. mellonella* seen in hives at UNAAB. Likewise, the number of *A. agama* (32) seen in hives at Olupakun were significantly ($p<0.05$) higher than four *A. agama* seen in hives at UNAAB. The number of other pest found in hives at the two locations were not significantly ($p>0.05$) different from each other.

Table 1: Mean numbers of combs built by honey bees - *A. mellifera* in hives at two locations in Ogun State

Months	Weeks after colonisation	Mean number of comb	
		Locations	
		UNAAB*	OLUPAKUN
February	1	2.0±3.2g	1.5±4.2f
February	2	3.0±4.2gf	2.0±3.6fe
February	3	3.0±4.2gf	2.0±1.2fe
February	4	3.0±4.2gf	3.0±4.2e
March	5	4.0±3.2ef	3.0±4.2e
March	6	4.5±2.2ed	4.5±3.8d
March	7	5.0±4.1edc	4.5±3.8d
March	8	5.5±5.2bdc	5.5±3.7c
April	9	6.0±4.1bac	6.0±4.2bc
April	10	6.0±4.1bac	6.0±4.2bc
April	11	6.0±4.1bac	6.5±0.8bc
April	12	6.5±2.2bac	6.5±0.8bc
May	13	6.5±2.4bac	7.0±3.2ba
May	14	7.0±2.8ba	7.0±3.2ba
May	15	7.0±1.1ba	7.0±3.2ba
May	16	7.5±3.4a	7.0±3.2ba
June	17	7.5±3.4a	7.0±3.2ba
June	18	7.5±3.4a	8.0±5.3a
June	19	7.5±3.4a	8.0±5.3a
June	20	7.5±3.4a	8.0±5.3a

Mean with the same letters along the column are not significantly ($p<0.05$) different from each other using Student-Newman-Keuls Test.
UNAAB* - University of Agriculture, Abeokuta, Ogun State, Nigeria.

Table 2: Mean size of combs (cm^2) built by honey bees- *A. mellifera* in colonized hives at two Apiaries in Ogun State

Months	Weeks after colonisation	Mean size of comb (cm^2) Locations	
		UNAAB*	OLUPAKUN
February	1	8.61±2.2g	1.65±2.6L
February	2	10.31±3.1g	2.29±1.7L
February	3	15.74±2.4g	3.65±3.2L
February	4	28.10±3.1g	6.86±2.4L
March	5	39.41±1.4g	11.74±2.1L
March	6	58.10±0.7g	24.38±1.1L
March	7	68.13±2.9g	50.49±2.2k
March	8	130.76±4.1g	86.79±3.1j
April	9	212.35±2.3ef	124.02±4.1i
April	10	315.87±1.1ed	157.18±1.4h
April	11	387.33±2.3dc	176.29±2.3h
April	12	410.10±3.2dc	205.16±2.2g
May	13	449.78±4.2bdc	223.27±3.2fg
May	14	472.17±3.2bdc	244.03±6.2fe
May	15	521.70±2.4bac	265.17±2.4ed
May	16	553.19±6.2bac	279.72±3.6cd
June	17	606.35±4.1ba	292.91±4.6cb
June	18	652.46±5.2a	297.72±5.9cb
June	19	654.39±4.4a	317.64±4.8b
June	20	662.71±3.2a	352.28±2.4a

Mean with the same letters along the column are not significantly ($p<0.05$) different from each other using Student-Newman-Keuls Test.

UNAAB* - University of Agriculture, Abeokuta, Ogun State, Nigeria

Table 3: Mean number of pests found in hives at the locations

PEST			Mean number of Pests Locations			
Scientific name	Common name	Family	UNAAB*	OLUPAKUN	t-value	Significance level
Rattus rattus	Rat	Muridae	4.5	5.0	0.44	NS
Agama agama	Lizard	Agamidae	4.0	32.0	3.50	S
-	Snake	Ophicthidae	-	-	-	-
Periplanata Americana	Cockroach	Blattidae	5	7	0.63	NS
Macrotermes nigeriense	Termite	Termitidae	M	M	-	-
Zonocerus variegatus	Grasshopper	Pygomorphidae	32	30	0.15	NS
Galleria melonella	Larger wax moth	Pyralidae	20	60	3.71	S
Stanomantis Spp	Praying mantids	Mantidae	49	45	0.38	NS

Mean values across the locations were separated using student's t-test at P = 0.05
M = Many, NS = Non-significant, S = Significant
UNAAB* - University of Agriculture, Abeokuta, Ogun State, Nigeria.

DISCUSSION

The results of this study suggest that the first responsibility of honey bees after colonization of hives is to build combs. Comb building was initiated as at the second day after colonization and by seventh day two combs measuring 8.61cm^2 had been built. This may probably be the result of the importance of honey comb to the existence, survival and multiplication of bee colony. Farrar (1967) reported that honey bee colony include a series of parallel honey combs made up of six sides for rearing young bees (brood rearing) and for storage of food, pollens and honey. According to him, the bees of a colony cannot survive without combs for brood, and storage of honey and pollens. Similarly, Heppburn (1998) reported the importance of comb for brood rearing and hiding when attacked by enemies. The insect was also reported to use hollow structures and man-made hives for shelter, honey, nectar and pollen storage (Heppburn, 1998).

The combs' size and number progressively increased along the weeks and stabilized at some points. These increases may be due to increase in the population of the honey bee in the later weeks. The life cycle of a queen, worker and drone is completed in 15, 20 and 25 days respectively (Mackean, 2008). Therefore within the five months of the study, the bees would have undergone about

6 life cycles that will lead to increase in population of the bees and hence increase activities in terms of comb building. As at the twentieth week, maximum of eight combs (352.28^2) and seven and half combs (662.71cm^2) were built at UNAAB and Olupakun respectively. Osipitan *et al.* (2010) reported that there usually low ebb of field activities by honey bees in the period April to June when most of the flowers are dry and less nectar and pollens are available for the bees to visit. The period is usually a rest period for bee colonies and this may have affected the number and sizes of combs built during the five months period of these studies.

The study also indicated that bee hives and honey are prone to infestation and predation by vertebrate and invertebrate pests. Of the 22 top bars in each of the hives, only seven and half (7.5) and eight (8) were utilized for comb building by honey bees in UNAAB and Olupakun Village respectively. The large number of unoccupied frames in hives at the two locations might be responsible for infestation of the hives by *G. mellonella*. The insect is reputed to occur in weak colonies which cannot occupy all the frames in hives (Seegeren *et al.,* 1996). A significantly ($P< 0.05$) higher number of *G. mellonella* and *A. agama* in hives at Olupakun may be responsible for the comparable smaller comb sizes at the location. Seegeren *et al.* (1996) reported *G. mellonella* as one of the frequently encountered insect pests that easily gain entry to bee colony in hives. The caterpillar of *G. mellonella* was reported to eat pollens, brood and destroy the wax combs as it constructs its silken tunnel through the comb (Seegeren *et al.* 1996). Likewise, *A. agama* preys on bees and may substantially reduce the population in a colony.

The study revealed that honey bees build combs as early as the second day after colonization and bee colony is prone to infestation by pest such larger wax moth (*Galleria mellonella*), grass hopper (*Zonocerus variegatus*), termites (*Macrotermites nigeriense*), Cockroach (*Periplanata americana*), snakes, Lizard (*Agama agama*) and Praying mantis (*Stanomantis spp.*)

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(Manuscript received: 11th May, 2010; accepted: 22nd December, 2010).