

Annual Trends of Honeybee Activities and Their Correlation with Some Hive Characteristics in the Southern Guinea Savannah Vegetation Zone of Nigeria

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ABSTRACT:

The study was conducted between November 2009 and October 2010 on eight randomly selected hives from two different apiaries in Ilorin (Kwara State) and Ogbomosho (Oyo State). All selected hives were put under surveillance and inspected fortnightly to document hive weight, hive bee population, comb building, proportion of comb capped and propolis texture/feel as well as availability. The estimated mean monthly bee population per hive in OGB.FI and II ranged between $9,362.5 \pm 1.00$ and $10,675.0 \pm 0.42$ while those of ILR.FI and II ranged between $8,875.0 \pm 0.28$ and $10,787.3 \pm 1.33$. In addition, the annual trend of Capped comb proportion attains its peak i.e. slightly above 80% in April. Also, the overall weight gain in Ogbomosho farm (39.38 kg) was higher than the value (38.12 kg) recorded in Ilorin farm while the monthly trend of moisture and elasticity levels in the propolis at the two locations were similar. Propolis was dryer and less elastic between November 2009 and January 2010, more hydrated and elastic therefore, more sticky, between February and May 2010. The correlation analyses indicated that proportion of capped comb cells was positively correlated with weight gain in both Ilorin (0.94) and Ogbomosho (0.84). Beekeepers in this zone, particularly at Ilorin and Ogbomosho towns, should plan to harvest their hive between February and May as this is the honey production period.

Key Words: Annual, Trends, Honeybee, Hive, Characteristics

INTRODUCTION:

Beekeeping is worthy of in-depth study due to its economic and ecological importance in Nigeria and the fact that it is a low impact

Land use and Non Tree Forest Products (NTFP). Honeybees are important pollinators and are known to be useful in the regeneration of fallow plots and optimizing ANDE, A.T. *et al*, Annual trends of honeybee activity.....

Benefits of Urban and Peri-urban Agriculture

The benefits of UPA are manifold and include:

- creation of jobs and enhancement of income,
- enhancement of market opportunities as food crops from UPA attract higher prices in developed economies because they are termed organic foods and assumed to be tastier and healthier,
- alleviation of poverty at individual and community levels,
- promotion of confidence in the children of the poor who often feel inferior amongst their peers,
- provision of some measure of confidence to the urban poor,
- multiple cropping of a variety of vegetables, fruits and tubers regulates pest populations on limited land size through diverse food choices for the pest, thus reducing much use of chemical pesticides,
- utilization of waste water from domestic activities provides irrigation for crops in UPA,
- reduction in eutrophication in water bodies,
- proceeds from UPA stabilizes the home and engender some measure of domestic peace a poor man is usually disrespected by the family and community.

Insect Pest Challenges in Urban and Peri-urban Agriculture (UPA)

Insect pest challenges are usually ignored or taken for granted in UPA because of the small size of the farmland, the part-time nature of the activities, the increasingly rising cost of pesticides and the general lack of pesticide education.

Despite these, insect pests could be damaging, and more so in peri-urban agriculture where farmland is larger. Insect pest damage in UPA is classified in this keynote address according to the group of crops they attack as follows:

- **Insect Pest Damage to Vegetables:** The most commonly grown vegetables in UPA are okra, amaranthus, corchorus, tomato, peppers,
- **Leaf Damage by Insect Pests:** The leaves are damaged mostly by biting and chewing insects e.g. larvae and adults of flea beetles, larvae of the cotton leaf worm and of the leaf roller, adults and nymphs of grasshopper. Damage to leaves is also caused by sap-feeders including adult and nymph of the whitefly and thrips. *Nezara viridula* (Green Stink bug) nymph on legume leaf, *Podagrica uniformis* (Flea beetle) adults and typical feeding damage (on kenaf leaf).
- **Insect Damage to Vegetable Fruits:** Damage to okra fruits, eggplant, sesame, egusi melon and tomato is mostly by sap-feeders, e.g. adults and nymphs of the cotton stainer, coreid bug, bollworm, aphid, thrips.

Yields of various food crops. Honey is one of the major NTFP that provides additional economic gains for families and communities since it is a very important commodity of trade to both national and regional economies. Other valuable products such as beeswax, bee bread, propolis, royal jelly and bee venom are derivable from the same practice that generates valuable honey (Ojeleye, 1999). Bee colony activities vary with seasons and localities. In Nigeria, the records of bee activity cycles remain confusing especially the period of honey flow (Chinaka, 1995; Ojeleye, 1999). Whereas September to December is generally regarded as the beginning of a beekeeping year and the condition of a colony at this time informs its prosperity in the year (Fukuda and Segiguchi, 1966); the most important season, i.e. the cropping season remain elusive and unduly long. Fasasi and Malaka (2005) reported that the cropping season is between February to May as against an earlier report of between February to April (Malaka and Fasasi, 2004), the lack of precision and uncertainty have informed and necessitated frequent disturbance of the bee hive system, thus marring the inspection and monitoring advantages proffered by modern beekeeping method and calling for frequent disturbance of the bee hive system, crushing of bees including the much coveted queens, swarming and abscondment as well as exposure of beekeepers to unnecessary bee stings; all of which are counterproductive.

Accurate timing no doubt remains a major guide to apicultural activities and management, but unfortunately this varies with ecological zones. The need to

precisely determine the cropping season of honeybees in the Southern Guinea savannah zone of Nigeria was therefore identified.

This study of the timing of honeybee colony activities within the Southern Guinea Savannah zone was to identify hive characteristics that can serve as precise index for hive productivity, as substitutes for frequent perturbing hive inspection, and enhancing honeybee management practices.

MATERIALS AND METHODS

Study site:

The study was carried out in Ilorin, Kwara State Nigeria (Latitude 4° and Longitude 8°) and Ogbomoso Oyo State, Nigeria (Latitude 8° and Longitude 5°). Ilorin has an annual rainfall of 1000 to 1500 mm and a temperature range of 19°C to 35°C, while Ogbomoso presents an annual rainfall of 1200-1550 mm, with a temperature range of 19°C 33°C. The weather of the two locations is within the recommended climate range suitable for beekeeping by FAO (Adejare, 1990). Two farms each were selected from each of the locations. In Ilorin, the University of Ilorin Agriculture Teaching and Research apiary (Longitude 8°29'N; Latitude 4° 35'E) and the NYSC CDS group apiary (Longitude 8° 18'N and Latitude 4° 26'E) tagged I and II, respectively were sampled, the distance Between farm I and II was approximately 3.5 km. Each of these farms had not less than 50 thriving

and at least 4- year old Kenyan Top Bar hives. Hive history from each of the farms, indicated that the hives were colonized by honeybees after baiting with beeswax. The predominant vegetation cover that forms the major nectar/pollen sources for the honeybees were cashew (*Anacardium occidentale*), mango (*Mangifera indica*), locust bean tree (*Parkia biglobosa*), citrus (*Citrus* spp.). The arable crops available were maize, melon, groundnut and cowpea.

In Ogbomoso, Oladele apiary, Imaji village (Longitude 5° 20'N; Latitude 8° 24' E) was selected as farm I while the Greater Height apiary (Longitude 5° 30'N, Latitude 8° 35'E), was selected as farm II. The distance between farm I and II was approximately 6 km. Each of these farms had not less than 50 thriving and at least 4-year old Kenyan Top Bar hives. Historically the hives from each of the farms were mainly baited with beeswax. The predominant vegetation covers were mango (*Mangifera indica*), cashew (*Anacardium occidentale*) and citrus (*Citrus* spp.). The arable crops available were maize, cassava, yam and cowpea.

Sampling: The bee productive activities were studied between November 2009 and October 2010. Each farm was inspected and eight thriving hives selected per farm. The history, type and situation of each hives were noted. The selected hives were

coded as ILR.FI: 01-08 and OGB.FI: 01-08 for Ilorin farms I and II samples respectively and OGB.FI: 01-08 and OGB.FI: 01-08 for Ogbomoso farms I and II samples respectively. All selected hives were subsequently put under surveillance and regularly inspected forthrightly and records kept. Parameters monitored included, hive weight, hive bee population, comb building, proportion of comb capped and propolis texture feel as well as availability.

Hive Bee Population Estimate: The bee population number was estimated indirectly by counting the number of scout bees observed over a period of 2 minutes and using the formula: Bee population number = number of scout bee at hive entrance x 80/100 x 1000 (Oyerinde and Ande, 2006).

Comb Area Estimate (cm²): Comb area was estimated by determining the area of comb cell, which was equal to 27.7 cm². The numbers of cells per comb were then counted each time and the total comb area was estimated as a product of unit cell area (27.7 cm²) and number of cell in the comb.

Proportion of Capped Comb Cell (%):

The number of capped comb cells found on one honey- filled top bar frame picked at the middle of each hive was expressed as a percentage of the total number of comb cells encountered.

Hive Weight Gain (kg): Total weight of the hive was measured on each occasion with the aid of a weighing scale CAMRY-MODEL-BR-9012 of 120 kg capacity. A fortnight difference in weight was calculated as weight gain, the overall weight gain during the entire season was calculated as a difference from the final and initial weight.

Propolis Feel: Propolis was extracted and hand felt. It was rated on a scale of hydration and elasticity to reflect level of stickiness in three broad categories, namely: Dry/Inelastic (D/e), Hydrated/Elastic (d/E) and <Hydrated/<elastic (d/e).

Data Analysis: The respective values were pooled and their means as well as standard error of means were calculated to reflect monthly values in each farm, location, year and zone. The farms, locational and yearly means were compared using the student T test at 0.05 level of significance. In addition, the annual trend of each factor were then analyzed by using the student T test to determine the probability of a factor influencing the

RESULTS:

The estimated monthly mean population of honeybee per hive in OGB.FI and II ranged between $9,362.5 \pm 1.00$ and $10,675.0 \pm 0.42$ while those of ILR.FI and II ranged between $8,875.0 \pm 0.28$ and $10,787.3 \pm 1.33$ honeybees. The seeming difference was, however, not significantly different ($P > 0.05$) except in June and July. The means recorded in the 2009/2010 beekeeping season were not significantly different ($P > 0.05$) at the two locations. The annual trend of monthly bee population in the season investigated therefore followed the same regular pattern (Table 1). The annual trend of bee population numbers maintained a consistently close range of values at the two locations although these were seemingly lower from June to November. **Comb areas were least developed generally in November: at this period the general average recorded was $239.2 \pm 0.11 \text{ cm}^2$ (Fig. 1).** This subsequently increased at an average rate of about 25 cm^2 over the next 7 months, bringing the comb area to a high slightly above 400 cm^2 in all the farms in June. This height was then maintained to the end of the season in October, 2009. OGB.FI had the highest comb areas consistently between June and October with the highest value of 457.7 cm^2 in October.

Fig. 2 shows the mean percentage of capped honey combs from two apiary farms in Ilorin and Ogbomoso in the 2009/2010 cropping season. The annual trend of capped comb proportion was such that showed least proportion of about 32% in November, increased slowly to about 40% in January. The rate of capping subsequently improved drastically to a peak slightly above 80% in April. Capping was particularly high between February and March with a record of about 30% percent in the month as against the 5% per month between November and January. Subsequently the capping rate went lower. There was no significant difference ($P>0.05$) in the values contained for the two sites.

The mean hive weight was least in November with an average value of about 18 kg. A trend in hive weight similar to that of honey comb capping was observed (Fig. 3). Between November and January a rate of about 2 kg per month was the case. This improved to about 5 kg per month between January and March and the highest rate of about 7 kg per month was recorded between March and May. Subsequently the weight of the hive declined by 2 kg to 5 kg per month with a low of about 27 kg recorded at the end of the 2009 cropping season in August. The overall weight gain (39.38 kg) observed in

Ogbomoso farm was higher than the value (38.12 kg) recorded in Ilorin farm. These were however not significant difference ($P>0.05$).

The monthly trend of moisture and elasticity level in the propolis at Ogbomoso and Ilorin, followed the same pattern. Table 2 showed that it was dryer and less elastic between November 2009 and January 2010, more hydrated and elastic therefore, more sticky between February and May 2010 (Table 2). The level of propolis hydration and elasticity dropped progressively subsequently as from June 2010.

Correlation analyses indicated that proportion of capped comb cells was positively correlated with weight gain in both Ilorin ($r = 0.94$) and Ogbomoso ($r = 0.84$) (Table 3). Same was the case with hive weight in Ilorin ($r = 0.94$) and Ogbomoso ($r = 0.84$). This revealed that capped comb cells had a greater influence on hive weight in Ilorin than in Ogbomoso. As expected the percentage capped comb cells were positively correlated with comb area in $r = 0.99$ for Ilorin and $r = 0.98$ for Ogbomoso.

Table 1: Estimated Monthly population of bees on each farm in the 2009/2010 beekeeping season

Month	Ogbomoso		Ilorin	
	FI Mean	FII Mean	FI Mean ^a	FII Mean ^a
November	10025.0±1.11	10387.5±0.44	8875.0±0.28	9518.8±0.35
December	10050.0±0.21	9818.75±0.69	9700.0±0.11	10244.8±1.27
January	9762.5±0.82	10462.5±1.88	9787.5±1.31	10075.0±1.02
February	9850.5±1.02	10027.0±1.78	10312.5±0.31	9825.0±0.76
March	10475.0±1.21	10325.0±2.10	10387.5±0.75	10325.0±0.32
April	10675.0±0.42	10550.0±0.58	10500.0±0.99	10112.5±0.94
May	9962.5±0.77	9775.2±0.92	10562.5±1.18	9850.2±0.62
June	9892.3±0.41	9737.0±1.13	10375.5±1.09	9625.5±1.48
July	9600.0±1.01	9662.3±0.55	9812.6±0.83	9550.0±0.76
August	9362.5±1.00	9656.6±1.72	9789.5±0.92	9512.2±0.49
September	9700.3±0.84	9925.0±0.15	10000.0±2.13	10775.0±0.58
October	9789.2±0.52	9835.0±0.65	10687.5±1.26	10787.3±1.33

^a = mean ± standard deviation

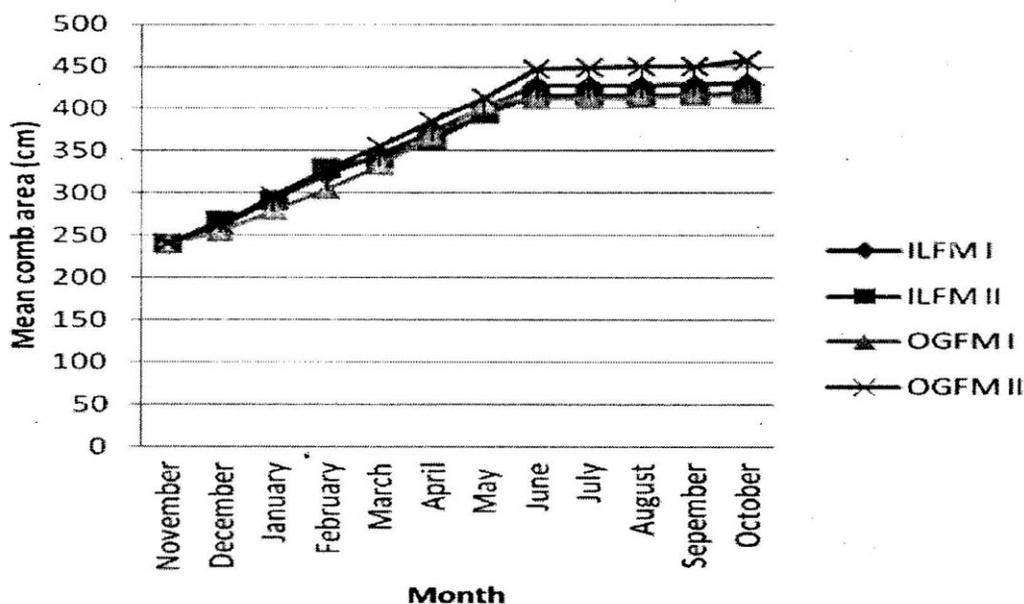


Figure1: Mean comb area development pattern of honeybee colonies from two apiaries in Ilorin and gbmoso in the Southern Guinea savannah zone of Nigeria in 2009/2010 cropping season

Table 2: Texture of propolis collected from Ilorin and Ogbomoso apiaries

Months	Location	
	Ilorin	Ogbomoso
November	D/e	D/e
December	D/e	D/e
January	D/e	D/e
February	d/E	d/E
March	d/E	d/E
April	d/E	d/E
May	d/E	<u>d/e</u>
June	<u>d/e</u>	<u>d/e</u>
July	<u>d/e</u>	<u>d/e</u>
August	D/e	D/e
September	D/e	D/e
October	D/e	D/e

Dry/Inelastic (D/e) Hydrated/Elastic(d/E)<Hydrated/<elastic (d/e)

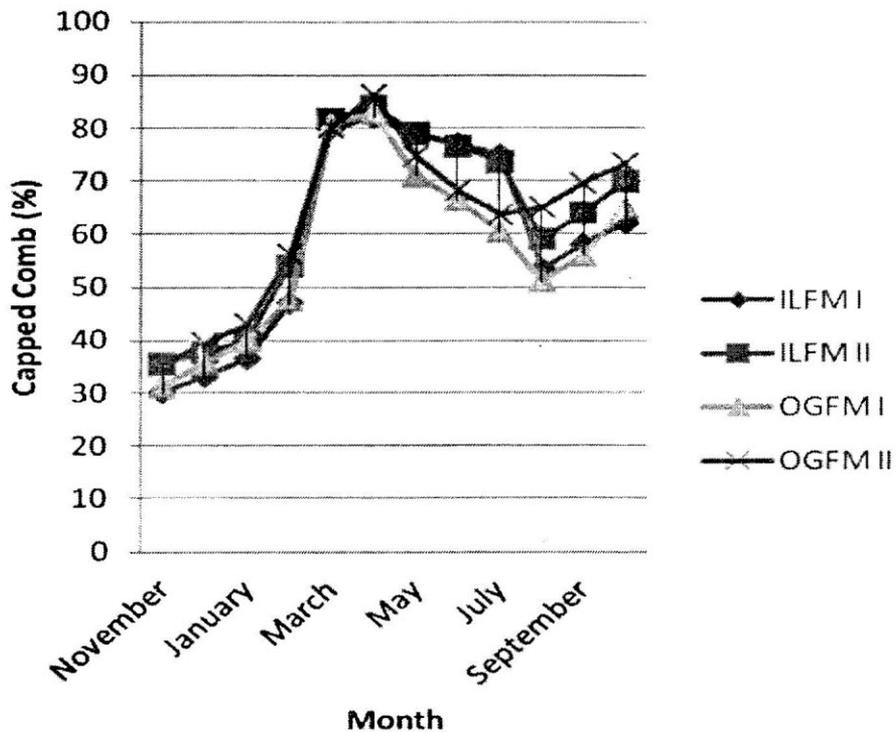


Figure 2: Mean Percentage capped honey combs from two apiaries in Ilorin and Ogbomoso in the Southern Guinea savannah zone of Nigeria in the 2009/2010 cropping season

Table 3: Correlation analyses of studied parameters in the two locations (i.e. Ilorin/Ogbomosho) within the Southern Guinea savannah zone of Nigeria

Parameter	Capped comb cell	Bee popn. estimate	Hive weight gain	Comb area
Capped comb cell	1/1	0.12/0.3	0.94**/0.84**	0.94**/0.83**
Bee popn. estimate		1/1	0.02/0.16	0.00/0.20
Hive weight gain			1/1	0.99**/0.98**
Comb area				1/1

**Correlation significant at the 0.01 level

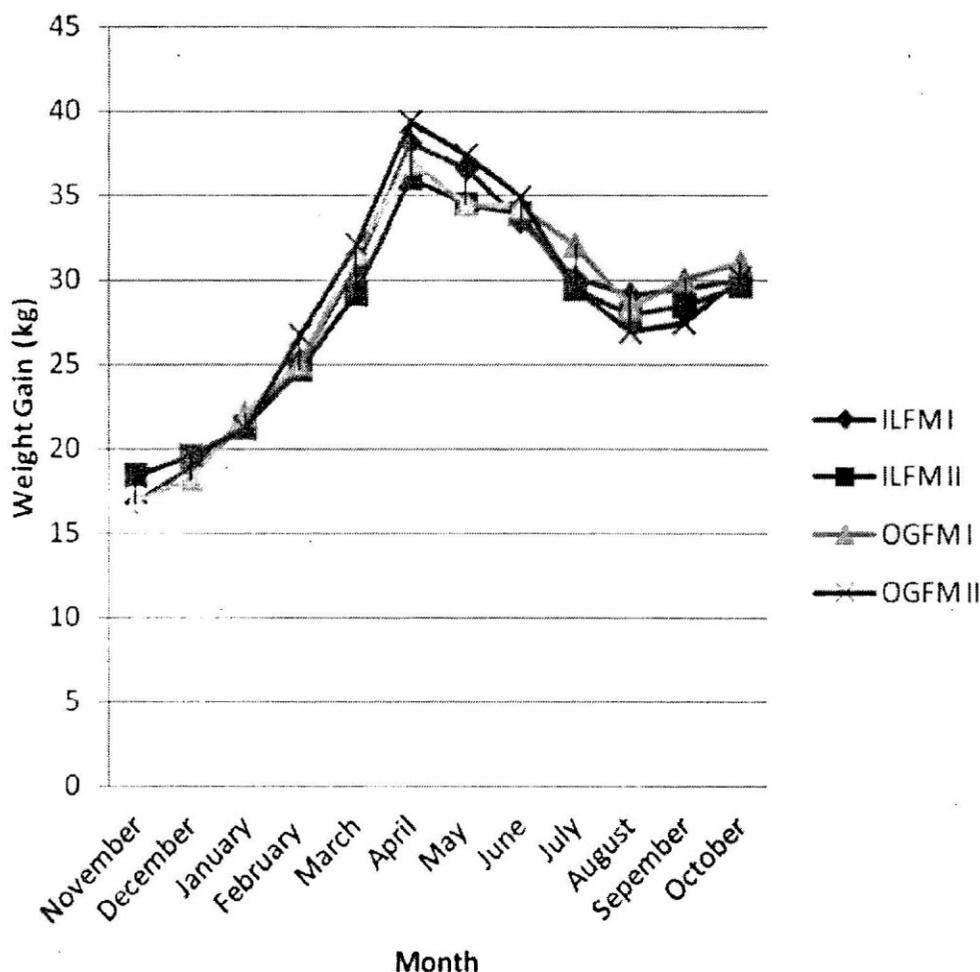


Figure 3: Mean monthly weights of bee hives from two apiaries in Ilorin and Ogbomosho in the Southern Guinea savannah zone of Nigeria in the 2009/2010 cropping season

DISCUSSION:

Honeybee productivity can be affected by a number of factors especially the agro-ecological zone. Nectar flow was identified as an important factor in Nigeria by Fasasi and Malaka (2005) and was higher between November and May.

The progressive increase in percentage capped cells, hive weight and comb area from November to June affirm this assertion. If indeed comb cell capping rate was an indication of hive maturity for honey (Ojeleye, 1999; Fasasi and Malaka, 2005) then April is the best month to harvest. In April, the mean capping rate stood slightly above 80%. Adopting Segeren's (1997) suggestion of a minimum of 70% capped comb cell for harvest, honey in the Southern Guinea Savannah zone can be harvested between late February and April. This conforms with Malaka and Fasasi's (2004) proposal of harvest between February to April.

The period of the year that had highest percentage capped cells corresponded with the period of nectar flow in the Southern Guinea Savannah. Adebayo (2000) had earlier confirmed *A. occidentalis*, *M. indica* and *P. biglobosa* as the three major flowering plants around Ogbomoso. *A. occidentalis* flower around December to January, while *M. indica* and

P. biglobosa flower as from February. The reduction in the percentage of capped cells after April indicates that the honeybees must have started utilizing the stored honey, due to paucity of nectar. In Nigeria honey flow seem to be once in a year contrary to the two honey flow periods in a year reported in Bermuda, USA, (Hillburn, 2006) and Angola, (Emery, 2006). Results obtained from different farms within the towns and zone was not significantly different, thus suggesting that the slight differences in agro-ecological environment did not matter.

Bee population pattern did not follow any regular trend in the zones. This could be due to ecological peculiarities or reproductive performance of the queen bee. The study, however, showed that bee population (number per hive) fluctuate around 10,000 in the year and confirms the earlier observation of Oyerinde and Ande (2006). The erratic pattern of bee population numbers renders it ineffective as a predictive tool in productive activity in the studied areas.

Hive weight gain increased steadily during the experimental period. This must have been due to increased percentage capped comb cells which actually reflected honey yield. Fasasi and Malaka, (2005) had earlier observed that honey yield was a product of hive weight. Comb development pattern followed the same trend as the hive weight. This is because comb used for honey storage was a major content of the hive, hence had a significant bearing on hive weight and larger comb in turn reflects beeswax availability

Directly. The result of correlation analysis, i.e. a positive correlation coefficient of percentage capped cell with hive weight and comb area, confirmed that hive weight was a function of comb area and percentage capped cells.

Thus both hive weight and comb development pattern can adequately serve as a predictive tool in the determination of bee productivity in a hive while an elastic and gummy propolis was an indication of ripe honey and hence informs harvest (Kaal, 1990). Propolis in this study was most elastic and gummy between February and May when it was reported to be Hydrated/Elastic (d/E). Thus confirming Fasasi and Malaka, (2005) view that harvest of honey and propolis can be carried out in the zone between February and May. An index built around the elasticity and hydration rate of propolis as well as hive weight will no doubt solve the problem of frequent hive inspection, as it provides a dependable indirect mode of assessing the hives readiness for harvest without opening the hive.

CONCLUSION:

Beekeepers in the Southern Guinea savannah zone particularly in Ilorin and Ogbomoso towns should plan to harvest their hive between February and May as this is the honey production period. To maximize harvest however April is advisable. The timing for maximum

harvest can however be improved upon through the use of reliable indirect predictive tools such as hive weight monitoring and propolis situation. Harvest is best when hive weight is maximum and propolis is most elastic and gummy. An adoption of these predictive tools will reduce frequent hive inspection and disturbance by beekeepers and improve bee hive management practice.

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