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Research Article

Comparative Seasonal Yield of Colonies of *Apis mellifera adansonii* (Hymenoptera: Apidea) in Response to some Environmental Variables

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Abstract

Comparative seasonal yield of colonies of *Apis mellifera adansonii* (Hymenoptera: Apidea) in response to environmental variables such as ambient temperature and relative humidity in relation to colony productivity was studied for two years. Ambient and hives temperatures, relative humidity and colony biomass were monitored using digital thermometer, thermo-hygrometer and weighing balance, respectively. The correlation trends of ambient temperatures and relative humidity in both seasons (Dry and wet seasons) influenced the productivity of *A. mellifera adansonii*. From this study, the ambient temperatures and relative humidity of the beekeeping environment affected the activities of the bee colonies seasonally. The beehives tend to be more productive in dry season than in wet season. The mean monthly fluctuation of hive temperatures between November, 2011 and October, 2013 followed the pattern of fluctuation of ambient temperatures. This showed that the ambient temperature and relative humidity dictate the level of bee activities in hives and their environment of which if monitored regularly could be used to determine harvest period in the zone. However, there is need for further study to determine other factors which may probably contribute to colony productivity of *A. mellifera adansonii* in the studied zone.

Key words: Colony productivity, honeybees, ambient and hive temperatures, relative humidity

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Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Honeybee colony in beehive is active year round, but their level of activities and population size varies with different seasons (Kovac and Stabentheiner, 2011; Tirado *et al*., 2013). Abou-Shaara *et al*. (2012) and Contreras *et al*. (2013) explained that the intensity of daily activities and foraging patterns of insects are determined by their environmental weather conditions. During the winter months or wet seasons, the bee population and activity level is low and the bees survive by feeding on their honey stores (Sudarsan *et al*., 2012) or sugar syrup/candy provided by the beekeepers (Fasasi *et al*., 2007). The most important factors in the environment which influence the physiology of insects are temperature and relative humidity whose effects are constantly reacting upon one another and determine the extent of their activities including their feeding behaviour. This was buttressed by Tripath (2011) and Contreras *et al*. (2013), who noted that insects generally alter their food preferences depending on environmental conditions. Honeybees maintain temperature and humidity inside their hive within narrow limits such as the maintenance of brood on the combs at a steady temperature range of 33-36°C (Kleinhenz *et al*., 2003). Constant temperature range is essential for the growth and development of broods in the colony and any deviations from this range can occur when the ambient air temperature changes (Tautz *et al*., 2003). This may be detrimental to the development of the broods of which the worker bees may probably engage in behavioral and physiological activities to either warm up or cool the broods as situation demands (Sudarsan *et al*., 2012). Most social insects such as ants, termites including honeybees use metabolic heat to regulate the temperature of their immediate environment when the need arises. Kovac *et al*. (2009) and Kovac and Stabentheiner (2011) explained that during honeybees' foraging activities of nectar and pollen and water foraging wasps (*Vespula vulgaris*, *Polistes dominulus*) in temperate climate region, they are exposed to a broad range of ambient temperatures, challenging their thermoregulatory ability. Kovac and Stabentheiner (2011) explained further that the body temperature which honeybees exhibit results from endothermic heat production, exogenous heat gain from solar radiation and heat loss. Periodic season was suggested to have a considerable influence on thermoregulation which sometimes favour foraging activities of honeybees. The broods are the most affected by changes in the hive temperature; hence, worker bees take great care to maintain the temperature in the brood chamber where the brood cells are nurtured (Kleinhenz *et al*., 2003). Gebremedhn *et al*. (2014) observed that temperature and relative humidity had significant influence on whether honeybees collected pollen and/or nectar and the number of pollen loads increased as relative humidity rose, while high temperatures had a strong negative influence on the number of honeybees that collected pollen. Air temperature was also observed to be positively correlated with the number of honeybees collecting nectar, while relative humidity was negatively correlated with nectar collection. However, this study focused on the influence of environmental variables (ambient temperatures and relative humidity) on the seasonal yield of colonies of *Apis mellifera adansonii*.

MATERIALS AND METHODS

Study site: The study was carried out between November, 2011 to October, 2013 at the Honeybees' Research Farm Centre, Department of Biological Sciences, Faculty of Basic and Applied Sciences, Osun State University, Osogbo Main Campus, Osun State, Nigeria. The dry season is from November-April while wet season starts from May-October in the study area.

Data collection: Honeybees were reared and cultured in four Kenya Top Bar (KTB) hives constructed with hardwood (*Terminalia macroptera*-black afara). The bee hives were naturally colonized by the honeybees from the wild using modified baits. In this study, each existing queens whose age ranged between 3-5 years old were replaced with 24 days old queens, while the 5th KTB was set-up and monitored as control without bee colony within the duration of the study, hence 5 replicates (Hive-A, Hive-B, Hive-C, Hive-D and Hive-E). Each replicate hive was placed 4 m away from each other in the farm. Data on ambient temperatures and relative humidity were taken using thermo-hygrometer (HT-800) while hive temperatures were also taken using hand held Digital thermometer with probe twice (10 am and 5 pm) per day over a period of 24 months (November, 2011 to October, 2013). Each digital thermometer was inserted through a small sealed channel and fixed into the brood section of each hive with the monitor displayed outside each hive for easy reading. Colony productivity in each replicated hive was monitored by weighing using adapted bathroom weighing scale (T11DW1) (120 kg capacity, Readability: 0.1 kg) and recorded weekly at about 18.00 h for 24 months (2 dry seasons (November, 2011 to April, 2012 and November, 2012 to April, 2013) and 2 wet seasons (May-October, 2012 and May-October, 2013). The data on temperature, relative humidity and hive's weight were subjected to correlation and regression analysis.

Procedures for estimating colony productivity in each colonized hive

General procedures: Before colonization, each hive together with its entire 22 frame bars was weighed as a unit (Y). After colonization, initial colony weight was estimated by using a net mesh (2 mm) to screen off the entrance of the hive at sunset (7.00 pm), when most of the bees were always inside the hives, before reweighing the hive plus bee colony (K). Also, after experimental set up, the weight of each hive was monitored weekly to determine each hive's productivity (P) for two consecutive dry and wet seasons (two years).

Colony biomass per hive:

Weight of colony biomass = K-Y

Colony (hive's) productivity
(honeycombs and honey only) = P-(K-Y)

RESULTS

The results obtained showed negative correlation between the ambient temperatures and the Relative Humidity (RH) in dry season (November, 2011 to April, 2012). The correlation coefficient (r) is 0.87 and the regression equation is y = 43.73-0.20x. The linear relationship between ambient temperatures and hives weight was positively correlated in dry season. From Table 1, hives A, B, C and D have correlation coefficients of 0.80, 0.75, 0.85 and 0.83, respectively which showed that moderate ambient temperatures have positive influence on hive's weight in relation to bee's activities.

Table 2 showed the monthly fluctuation of mean relative humidity (%), ambient temperatures and hive temperatures in dry season. Between November, 2011 and January, 2012, the mean relative humidity ranged between 65.3 and 66.7%, while the mean ambient temperature between 30.3 and 32.4°C favoured bee activities in relation to weight gained (WTGD) by individual hives (Table 3).

As the monthly mean RH decreases from 66.7-56.0% between January, 2012 and March, 2012, the monthly mean ambient temperature increased from 30.8-32.4°C which encouraged intensive activities of bees on the field and in the hives as depicted by Table 3. It was observed in 3rd week of January, 2012, that as the ambient temperature rose from 31.7-33.3°C which influenced the bee's activities, the weight of hives A, B, C and D increased by 0.5-1.0 kg weekly. By April, 2012, the RH began to rise gradually, while the temperature was relatively constant. This marked the peak period of bee's activities as indicated by the weight gained by each hives. In this season, the productivity of *A. mellifera adansonii* colonies ranged from 5.0-14.0 kg (Table 4), when the ambient temperature ranged between 28.0-33.3°C and RH of 53.3-69.7%.

In wet season (May, 2012 to October, 2012), there was a negative correlation between the ambient temperatures and the relative humidity. The correlation coefficient (r) is -0.53 and the regression equation is y = 43.13-0.22x. The linear relationship between ambient temperatures and hive weight were negatively correlated. Table 5 showed that hives A and D had negative correlation of -0.68 and -0.88, while hives B and C had partial positive correlations 0.62 and 0.12, respectively. Hives B and C's correlation coefficients reduced from +0.75 to +0.60 and +0.85 to +0.12, respectively (Table 1 and 5).

These negative correlations were attributed to wet season. Table 6 showed the monthly mean fluctuation of

Table 1: Correlation coefficients, regression equations and hives temperatures in dry season (November, 2011 to April, 2012)

Bee hives	Hives temperatures (H±SD) (°C)	Correlation coefficients	Regression equations
A	33.40±1.75	+0.80	-56.1+1.87x
B	32.48±1.54	+0.75	-55.9+1.85x
C	34.59±1.66	+0.85	119.6+4.00x
D	34.21±2.01	+0.83	-71.9+2.38x
E	29.00±1.60	0.0	17

Table 2: Monthly fluctuation of mean relative humidity, ambient and hive temperatures in dry season (November, 2011-April, 2012)

Months	Monthly mean relative humidity (%)	Monthly mean ambient temp. (°C)	Monthly mean of hive-A temp. (°C)	Monthly mean of hive-B temp. (°C)	Monthly mean of hive-C temp. (°C)	Monthly mean of hive-D temp. (°C)	Monthly mean of hive-E temp. (°C)
November, 2011	66.3	30.5	33.6	31.0	34.7	34.6	29.7
December 2011	65.3	30.3	33.5	31.7	34.5	34.5	30.3
January, 2012	66.7	30.8	33.1	33.4	36.0	35.8	29.9
February, 2012	62.2	31.9	34.1	33.4	36.5	35.9	29.2
March, 2012	56.0	32.4	34.5	38.8	35.9	34.9	30.3
April, 2012	61.9	32.1	35.0	32.4	35.1	34.9	30.0

Table 3: Monthly mean of hives productivity in dry season (November, 2011 to April, 2012)

Months	Hive-A WTGD (kg)	Hive-B WTGD (kg)	Hive-C WTGD (kg)	Hive-D WTGD (kg)	Hive-E WTGD (kg)
November, 2011	0.9	0.3	1.5	0.4	0.0
December, 2011	1.4	1.2	2.2	0.9	0.0
January, 2012	0.5	0.0	3.6	1.1	0.0
February, 2012	1.5	1.0	4.8	2.4	0.0
March, 2012	4.8	4.0	8.9	4.5	0.0
April, 2012	5.5	5.0	14.0	7.5	0.0

WTGD: Weight gained

Table 4: Seasonal yield and hives temperatures (Mean±SD) (°C) in dry season (November, 2011 to April, 2012)

Bee hives	Weight of empty hive before experiment (kg)	Weight of colonized hive before experiment (kg)	Weight of hive before harvest (kg)	Date of harvest	Gross weight of honey and combs (kg)
A	17.0	20.0	25.5	06-05-2012	05.5
B	17.0	19.0	24.0	06-05-2012	05.0
C	17.0	21.0	35.0	29-04-2012	14.0
D	19.0	22.5	30.0	29-04-2012	07.5
E	17.0	17.0	17.0	Nil	Nil

Table 5: Correlation coefficients, regression equations and hives temperatures in wet season (May, 2012 to October, 2012)

Bee hives	Hives temperatures (H±SD) (°C)	Correlation coefficients	Regression equations
A	30.3±0.9	-0.68	5.55-0.17x
B	29.8±0.7	0.60	-5.82+0.19x
C	31.7±0.8	0.12	-0.35+0.02x
D	30.9±0.9	-0.88	6.11-0.17x
E	26.4±0.5	0.00	17

Table 6: Monthly fluctuation of mean relative humidity, ambient and hive temperatures in wet season (May, 2012 to October, 2012)

Months	Monthly mean relative humidity (%)	Monthly mean ambient temp. (°C)	Monthly mean of hive-A temp. (°C)	Monthly mean of hive-B temp. (°C)	Monthly mean of hive-C temp. (°C)	Monthly mean of hive-D temp. (°C)	Monthly mean of hive-E temp. (°C)
May, 2012	62.2	30.5	34.0	31.8	34.2	33.6	28.4
June, 2012	66.5	29.0	30.7	30.3	32.1	31.5	26.8
July, 2012	64.1	27.3	30.5	29.8	30.8	31.3	25.9
August, 2012	69.1	27.3	30.4	29.8	32.1	30.5	26.3
September., 2012	69.9	28.3	29.6	29.2	31.8	30.0	26.6
October, 2012	66.8	29.0	31.8	29.3	33.3	32.6	28.1

WTGD: Weight gained

relative humidity, ambient temperatures and hives temperatures in the wet season. When the average relative humidity increased from 62.2-69.9%, the mean ambient temperature decreased from 30.5-27.3°C between May, 2012 to August, 2012 except slight increase in September, 2012 and October to 2012. This did not favour bees' activities in relation to weight gained by individual hives. In wet season (May, 2012 to October, 2012), the productivity of bee colonies of *A. mellifera* adansonii in hives was comparatively low (-0.1-1.5 kg) (Table 7), when ambient temperatures ranged between 26.0 and 31.5°C and the RH of 59.7-74.7%.

The ambient temperatures (26.0-31.5°C) were lower than those of the dry season (28.0-33.3°C). By the first week of May, 2012, the ambient temperatures reduced from 31.5-26.0°C gradually which had a negative impact on the activities of the bee colonies up to October, 2012. The weight of hives A, B, C and D remained relatively constant at 20.5, 19.0, 22.0 and 22.5 kg, respectively in August, 2012. In October, 2012, hives A, B, C and D at 21.5, 20.0, 23 and 28.0 kg, respectively were harvested on 30 and 31 October, 2012 but low yield of 1.0-5.5 kg of honey and bees wax were harvested compared to the high yield realized in dry season (Table 4 and 8).

Between November, 2012 and April, 2013, hives A and D exhibit partial positive correlations while hives B and C showed negative correlation (Table 9). During this period, the monthly mean relative humidity fluctuates between 58.2 and 64.0% with monthly mean ambient temperature range of 31.4 and 33.2°C (Table 10) which encouragedbees' activities within and outside the hives in relation to weight gained (WTGD) by individual hives (Table 11).

Within the season under review, the cumulative productivity of the honeybees' colonies (Hives A, B, C and D) ranged from 10.6-19.4 kg (Table 11 and 12) when the monthly mean ambient temperature ranged between 31.4 and 33.2°C and relative humidity of 58.2-64.0%, respectively. In wet season (May, 2013 to October, 2013), Table 13 showed that hives A, C and D had negative correlations of -0.47, -0.12 and -0.44, respectively, while hives A had partial positive

Table 7: Monthly mean of hives productivity in wet season (May, 2012 to October, 2012)

Months	Hive-A WTGD (kg)	Hive-B WTGD (kg)	Hive-C WTGD (kg)	Hive-D WTGD (kg)	Hive-E WTGD (kg)
May, 2012	0.3	0.0	0.4	0.8	0.0
June. 2012	1.1	0.0	0.6	1.2	0.0
July, 2012	0.9	-0.5	0.4	1.3	0.0
August, 2012	0.9	-0.7	0.4	1.5	0.0
September, 2012	1.0	-0.8	-0.1	1.3	0.0
October, 2012	1.5	1.0	2.0	5.5	0.0

WTGD: Weight gained

Table 8: Seasonal output and mean of hives temperatures (H±SD) (°C) in wet season (May, 2012 to October, 2012)

Bee hives	Weight of empty hive before experiment (kg)	Weight of colonized hive before experiment (kg)	Weight of hive before harvest (kg)	Date of harvest	Gross weight of honey and combs (kg)
A	17.0	20.0	21.5	30-10-2012	1.5
B	17.0	19.0	20.0	30-10-2012	1.0
C	17.0	21.0	23.0	31-10-2012	2.0
D	19.0	22.5	28.0	31-10-2012	5.5
E	17.0	17.0	17.0	Nil	Nil

Table 9: Correlation coefficients, regression equations and hives temperatures in dry season (November, 2012 to April, 2013)

Bee hives	Hives temperatures (H±SD) (°C)	Correlation coefficients	Regression equations
A	33.5±1.2	0.11	16.96+0.27x
B	34.0±1.0	-0.01	24-0.002x
C	34.9±0.9	-0.06	38.4-0.01x
D	34.1±1.1	0.09	21.5+0.01x
E	29.7±1.2	0.00	17

Table 10: Monthly fluctuation of mean relative humidity, ambient and hive temperatures in dry season (November, 2012 to April, 2013)

Months	Monthly mean relative humidity (%)	Monthly mean ambient temp. (°C)	Monthly mean of hive-A temp. (°C)	Monthly mean of hive-B temp. (°C)	Monthly mean of hive-C temp. (°C)	Monthly mean of hive-D temp. (°C)	Monthly mean of hive-E temp. (°C)
November, 2012	58.2	31.4	32.6	32.8	34.8	33.1	29.8
December, 2012	62.0	32.3	33.7	34.0	35.4	34.0	29.8
January, 2013	64.0	33.2	34.4	34.7	36.0	35.1	30.5
February, 2013	59.8	33.0	34.3	34.5	35.2	34.5	29.3
March, 2013	61.2	32.6	33.8	34.5	34.7	34.5	30.0
April, 2013	60.8	31.5	32.6	33.3	33.9	33.2	28.1

WTGD: Weight gained

Table 11: Monthly mean of hives productivity in dry season (November, 2012 to April, 2013)

Months	Hive-A WTGD (kg)	Hive-B WTGD (kg)	Hive-C WTGD (kg)	Hive-D WTGD (kg)	Hive-E WTGD (kg)
November, 2012	4.3	2.1	6.2	4.3	0.0
December, 2012	5.6	3.0	6.5	5.8	0.0
January, 2013	7.6	4.3	7.9	7.3	0.0
February, 2013	9.8	6.6	11.5	9.3	0.0
March, 2013	11.4	9.3	15.6	10.4	0.0
April, 2013	12.1	10.6	19.4	11.8	0.0

WTGD: Weight gained

correlation of 0.47. Most of the hives experienced reduction incorrelation coefficients from 0.11, -0.01, -0.06 and -0.09 to -0.47, 0.47, -0.12 and -0.44, respectively (Table 9 and 13).

These negative correlations were attributed to wet season with increase in relative humidity and decrease in ambient temperature. During the wet season (May, 2013 to October, 2013), the monthly mean ambient temperatures ranged between 26.6.0 and 30.2°C while monthly meanrelative humidity ranged between 67.5 and 76.3% (Table 14) which rendered the bees less active in relation to weight gained by individual bee hives (Table 15). Within the period, the colony productivity of *A. mellifera adansonii* in the hives was comparatively low (2.1-4.1 kg) (Table 1 and 16).

The first cumulative productivity peak was between February and April, 2012 (Fig. 1). When the mean ambient temperature rises from 30.5-32.4°C between November, 2011 and April, 2012 with decreasing mean relative humidity from 66.7-56%, the seasonal cumulative productivity (honey and honeycomb) of hives A, B, C and D was 32.5 kg as at April, 2012. But when the mean ambient temperature decreases between April, 2012 and October, 2012 from 32.4-27.3°C with increasing mean humidity from 61.9-69.9%, the seasonal

Table 12: Seasonal yield and hives temperatures (mean±SD) (°C) in dry season (November, 2012 to April, 2013)

Bee hives	Weight of empty hive before experiment (kg)	Weight of colonized hive before experiment (kg)	Weight of hive before harvest (kg)	Date of harvest	Gross weight of honey and combs (kg)
A	17.0	22.5	34.6	27-04-2013	12.1
B	17.0	23.0	33.6	27-04-2013	10.6
C	17.0	22.5	41.9	28-04-2013	19.4
D	19.0	24.0	35.8	28-04-2013	11.8
E	17.0	17.0	17.0	Nil	Nil

Table 13: Correlation coefficients, regression equations and hives temperatures in wet season (May, 2013 to October, 2013)

Bee hives	Hives temperatures (H±SD) (°C)	Correlation coefficients	Regression equations
A	31.0±2.1	-0.47	27.6-0.01x
B	30.0±1.1	0.47	7.68+0.04x
C	32.3±1.5	-0.12	23.4-0.003x
D	31.5±2.2	-0.44	29.9-0.01x
E	27.0±1.1	0.00	17

Table 14: Monthly fluctuation of mean relative humidity, ambient and hive temperatures in wet season (May, 2013 to October, 2013)

Months	Monthly mean relative humidity (%)	Monthly mean ambient temp. (°C)	Monthly mean of hive-A temp. (°C)	Monthly mean of hive-B temp. (°C)	Monthly mean of hive-C temp. (°C)	Monthly mean of hive-D temp. (°C)	Monthly mean of hive-E temp. (°C)
May, 2013	68.8	30.2	33.6	32.0	33.8	33.4	28.4
June. 2013	70.0	28.8	30.8	30.2	32.0	31.3	26.8
July, 2013	72.6	27.9	30.4	29.8	30.6	31.5	26.3
August, 2013	76.3	26.6	30.6	29.7	32.0	30.8	26.0
September, 2013	67.5	28.1	30.2	29.6	32.2	30.1	26.5
October, 2013	67.5	28.2	30.0	29.3	31.8	30.4	27.2

WTGD: Weight gained

Table 15: Monthly mean of hives productivity in wet season (May, 2013 to October, 2013)

Months	Hive-A WTGD (kg)	Hive-B WTGD (kg)	Hive-C WTGD (kg)	Hive-D WTGD (kg)	Hive-E WTGD (kg)
May, 2013	3.3	7.4	4.9	3.8	0.0
June. 2013	4.1	5.1	5.1	4.1	0.0
July, 2013	3.8	2.9	4.8	4.0	0.0
August, 2013	4.3	2.8	5.3	4.6	0.0
September, 2013	4.0	2.8	4.6	4.8	0.0
October, 2013	3.4	2.1	4.1	3.6	0.0

WTGD: Weight gained

Table 16: Seasonal yield and hives temperatures (Mean±SD) (°C) in wet season (May, 2013 to October, 2013)

Bee hives	Weight of empty hive before experiment (kg)	Weight of colonized hive before experiment (kg)	Weight of hive before harvest (kg)	Date of harvest	Gross weight of honey and combs (kg)
A	17.0	22.5	34.6	27-04-2013	12.1
B	17.0	23.0	33.6	27-04-2013	10.6
C	17.0	22.5	41.9	28-04-2013	19.4
D	19.0	24.0	35.8	28-04-2013	11.8
E	17.0	17.0	17.0	Nil	Nil

cumulative productivity of the experimental hives was 10 kg as at October, 2012. Between December, 2012 and April, 2013 was the second peak of cumulative productivity when the mean ambient temperature rises from 29.0-33.2°C with decreasing mean relative humidity from 69.9-58.2%.

The seasonal cumulative productivity was 53.9 kg as at April, 2013. But when the mean ambient temperature decreases between May, 2013 and October, 2013 from 30.2-26.6°C with increasing mean relative humidity from 60.8 -76.3%, the seasonal cumulative productivity was 13.2 kg as October, 2013.

DISCUSSION

The activities and developmental rate of many insects including honeybees is influenced by temperature (Milum, 1930; Jay, 1959; Spivak *et al.,* 1992; Ofuya and Lale, 2001). Honeybees influence the developmental rate of their broods through adult worker thermoregulation of the brood nest (Milum, 1930; Free and Spencer-Booth, 1959; Harrison, 1987; Levin and Collison, 1990). In this study, the hive temperatures in both wet and dry seasons are relatively higher than the ambient temperatures. This may probably be as a result of

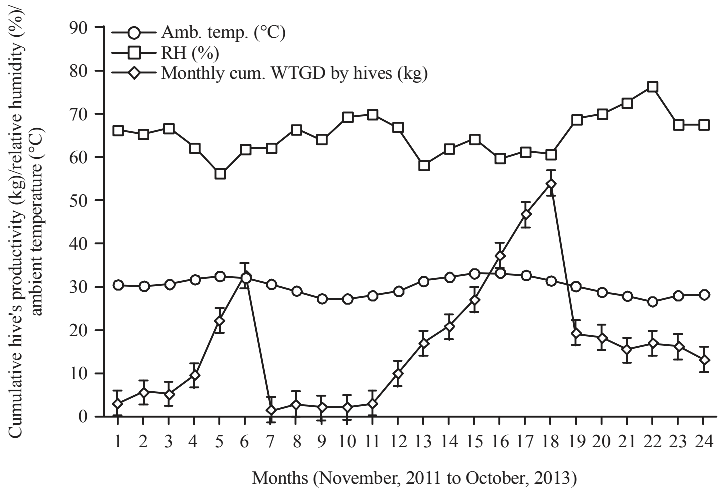

Fig. 1: Seasonal fluctuation of ambient temperature and relative humidity in relation to productivity of honeybee's colonies

bee's activities such as brood nursing and conversion of pollens and nectars into honey and storing of honey in comb cells in the hive by worker bees as described by Free and Spencer-Booth (1959) and Levin and Collison (1990). This showed that environmental temperature among other factors play a vital role in bees activities being ectotherms individuals but ectothermic homeotherms as social insects in colony to regulate hive internal temperatures. When the monthly mean ambient temperatures and relative humidity were 28.0-33.3°C and 53.3-69.7%, respectively in 1st dry season (November, 2011 to April, 2012), cumulative hive production was 5.0-14 kg which was higher than the hive production (0-1.5 kg) in 1st wet season (May, 2012 to October, 2012) at 26.4-29.1°C and 76.9-84.2% RH. The same pattern of hive production was also observed in the following seasons (2nd dry season: November 2012 to April, 2013; 2nd wet season: May-October, 2013) with slight variations in weather conditions, except that there was increase in productivity by 3.1 kg. This indicated that bees were more active in dry season than in wet season when more bees were restricted within the hives forming clusters to generate more heat to survive the wet season, hence high yield output in dry season than in wet season. Free and Spencer-Booth (1959) and Jay (1963) explained that in bee colonies, brood survival depend on the maintenance of hive temperatures between 32 and 37°C. While, Spivak *et al.* (1992) and Degrandi-Hoffman *et al.* (1993) reported that, bee colonies with broods maintained hive temperature range of 25-41.2°C, but it was observed that the bee colonies maintained their broods and bee population at hive temperature range of 30.13-36.14°C within the studied period. Kronenberg and Heller (1982) are of the view that honeybees maintained hive temperatures by forming a cluster within the colony to increase the efficiency of thermoregulatory heat production. From this study, bee colonies in south western Nigeria attained their peak production between November and April within the dry seasons (58.2-66.3%, 30.5-32.1°C) while they are docile in wet seasons (62.2-76.3%, 26.6-30.2°C). The results of this study conformed to the observation of Nascimento and Nascimento (2012) who studied the extreme effects of Season on the Foraging Activities and Colony Productivity of a Stingless Bee (*Melipona asilvai*; Moure, 1971) in Northeast Brazil and concluded that the dry-rainy seasonal variation strongly affects external and internal biological parameters of *Melipona asilvai*. They also observed that Foraging activities of *Melipona asilvai* decrease by almost 90% from the dry to the rainy seasons, although they emphasized that temperature and humidity were not the main factors responsible for such seasonal variations. Hence, there is need for further studies on weather conditions, light intensity, humidity, food availability, competition, colony state and physiological conditions of individuals which are likely factors that can influence foraging activities *of Apis mellifera adansonii* in the studied area. Also from this study, it is recommended that beekeepers can determine harvest period of beehives if the environmental variables specifically temperature and humidity are monitored in the beekeeping environment and plotted on a chart to take decision.

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