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EFFECTS OF TEMPERATURE AND RELATIVE HUMIDITY ON COLONIZATION OF BEES HIVES WITHIN FUTA COMMUNITY

Oluwaseyi F.O., Mustapha M.A. and Oluwaseyi I.G.

Department of Ecotourism and Wildlife Management Federal University of Technology Akure
***Corresponding Author:** *oluwaseyifo@futa.edu.ng; oluwaseyifranklin1992@gmail.com;*
+234 7031662462

ABSTRACT

The objective of this study was to determine the effects of temperature and relative humidity on colonization of honey bee hives within FUTA community. An initial reconnaissance survey was carried out prior to the commencement of the study; the coordinates of all the locations were taken and recorded with a GPS. Three different locations were used for this study, and three artificial beehives were constructed and placed at these three locations within the FUTA community. The study lasted for fifteen weeks. The climatic conditions of these three locations were measured each week, i.e. temperatures and relative humidity. Variations in these climatic factors were observed throughout the fifteen weeks of this study. The beehive located behind the Quarantine section of Prof. T.A Afolayan Wildlife Park) had the maximum temperature of 31.4 ^{0}c and low relative humidity of 76.9%, while the beehive located at Animal Production and Health Teaching and Research Farm had a minimum temperature of 28.0 ^{0}c and maximum relative humidity of 80.5% after fifteen weeks. At the 6th week, 8th and 9th week respectively the beehives were all noticed to have been colonized respectively. There was significant difference between the the mean of temperature of the three different locations. This study shows that the modern/artificial beehive under a good climatic condition and management is a sustainable way of high honey production, bees tends to thrive under relatively high temperature and relatively low humidity.

Keywords: Honey, temperature, relative humidity, colonization

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INTRODUCTION

Apiculture is one of the most widespread agricultural activities that is practiced all over the world. Turkey, with its rich flora, suitable ecology and with the existence of colonies, has a great potential in apiculture (Tzob, 2006). Today, 56 million bee hives exists in the world and 1.2 million tons of honey is produced from these hives. One quarter of produced honey is subject to trade and 90% of the exports come from nearly 20 honey producing countries (FAO, 2010). World honey production per bee hive is around 20 kg and this amount is 33 in China, 40 in Argentina, 27 in Mexico, 64 in Canada, 55 in Australia, 40 in Hungary and approximately 16 kg in Turkey. Although the other countries have neared their full capacity in terms of colony number and honey production (Tolera, 2014).

The use of honeybees in agriculture (apiculture) is a well-known technique to improve crop production. Farmers also grow significant quantities of apricots and figs. Pollination is critical for crops such as almonds which require cross-pollination. Natural pollinators exist but successful apiculture can result in a 40% increase in almond yield. Apiculture also significantly increases yields for pomegranates, apricots, and

figs. Grapes are self-pollinating and do not benefit from apiculture (Wilson, 2006). In addition to increased yield, the quality of the product will improve as a result of fully pollinating the flower. An apple requires up to five trips before becoming fully fertilized. Bees are efficient pollinators because of their behavior, known as *foraging consistency*, in only working one plant species per trip. A bee will visit hundreds of flowers each trip, each bee makes about 10 trips a day. If placed near an orchard the bees will consistently pollinate the orchard during its specific bloom (Tolera, 2014). In nearly all countries of the world bees and their products are not only well known and have wide consumer preference, but provide sustainable livelihoods to many small-scale farmers and other rural and non-rural people. Bees offer a large potential with minimal investments. As an agricultural enterprise beekeeping does not require land ownership or rental, it can be started with equipment and tools that can be sourced locally and in many instances skills and knowledge required for such an enterprise are found within local traditions. As a business enterprise it offers not only diverse products, for example honey and wax among others, which can be sold in local markets and become an important source of regular income for farm families, but can also provide complementary services, such as crop pollination (Lietaer, 2009).

The livelihoods of the majority of the country's citizens living in rural areas are closely tied to natural resource uses. Beekeeping is an environmentaly friendly and income generated activity that can improve the livelihood of rural beekeepers. Beekeepers have tendency of detaching their homes and established temporary sites in the forest during hive siting and harvesting periods. These temporary sites are termed as beekeeping camps. The management of these camps is informal depending on the number of beekeepers who organized themselves in a particular site. These areas are potential for collection of natural honey and beeswax that are free from pollution and have natural flavours of the flowers in bloom.

The utilization of traditional beehives enables a large number of honey bees to establish their habitat in close proximity to the living environment of humans, which would stabilize the honey production commensurate with expectation to a certain extent. The beekeeping using traditional beehives also continues to be practiced even at the present time, and diverse types of beehives exist not only in Africa but also throughout the world. Since traditional types of beekeeping concentrate honey bees in the areas close to human living environment, we may be able to suppose that they possess also the effect to promote the utilization of honey bees for the purpose of pollinating agricultural crops on arable lands. However, the significance in this sense is rarely appreciated, and honey bees are essentially deemed as the means of producing honey.The structure of beehives allowing the inspection and management of multiple frames of honeycomb individually has enabled beekeepers to carry out various management tasks including division of a colony, addition of empty frames for harvesting honey or inversely thinning out surplus frames to build a more compact colony. Beekeepers tends to travel far from their homes in order to keep bees in designated areas with plenty resources for bees and free from other land use activities and pesticides application. Most of these areas have been gazetted as protected areas for the purpose of maintaining ecosystem stability, conservation of wild animal and catchment for water (Munthali, 1992).

The problem underlying beekeepers in protected areas are associated with seasonality, timing harvesting period and permits to use resources in specific administered protected area. In these areas, production of honey is based on raw products that no mechanism for adding value such as packaging and packing. The beekeepers do not have adequate capital to process themselves honey that meet market requirements. Most of them sell bee products individually by relying on who come as the right buyers and the earning is subsistence to solve immediately necessities. Do not have strong legal instrument (registered association) that can stand on their behalf and negotiate with nearby authorities regarding the use of resources in the area (Masuku, 2013).

They encountered also series of challenges in the sense that there are other actors (i.e. tourist hunting blocks, forest dealers, professionals and "poachers") in same areas who sometime become more important or influential. The hives are subjected to forest/wild fires, pests and vandalism. The beekeepers have adequate indigenous knowledge of keeping bees in the area with dangerous animals and snakes. There are little or no records that show appreciations of efforts of beekeepers linking management approaches for conservation and development (Masuku, 2013).

MATERIALS AND METHODS

Study Area

The study was conducted at the Federal University of Technology, Akure (FUTA) community, located on Latitude 7°N and Longitude 5°N on an elevation of 1200ft above sea level. The entire area is underlain by the crystalline basement rocks which impose a partly rugged topographic relief on the area. The lower elevation is about 95m above sea level and rises in places to a maximum elevation of about 140m above sea level.

The drainage of the area is by narrow channel streams which are dendritic in pattern. The stream flows in almost Northeast – Southwest and Northwest - Southeast directions. The courses of the major stream are well defined V-shaped valleys which characterize the area. The vegetation is largely rainforest but it has been altered briefly by human activities such as farming, construction of building and land clearing. The climate of the area is typical of what prevails in South-West Nigeria. Rainfall is about 1,000m to 1,500m and an average temperature of about 31°C.

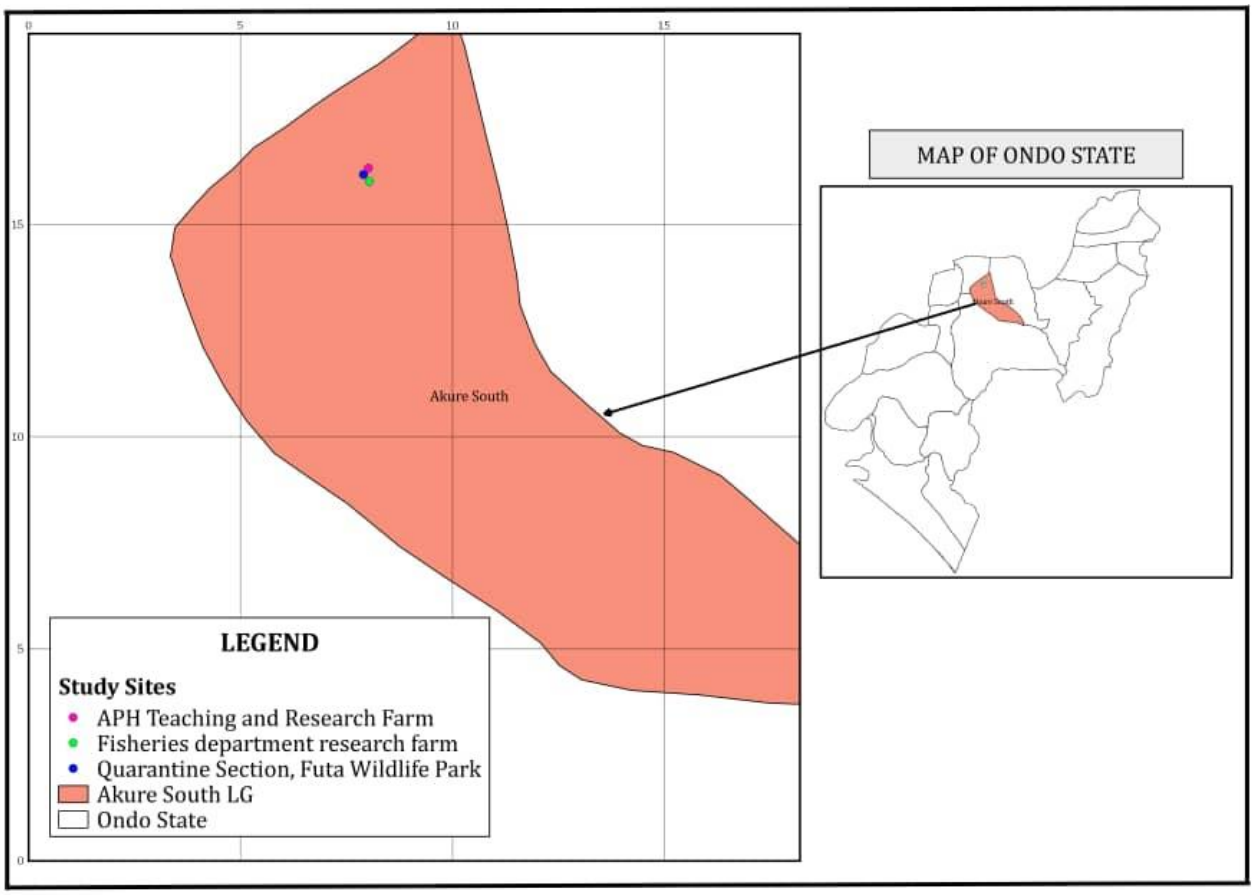

Figure 1: Map of the study area

Data Collection and Analysis

Reconnaissance survey

An initial reconnaissance survey was carried out prior to the commencement of the study. This is to establish the presence of the beehive locations within FUTA campus. After the initial reconnaissance survey had been carried out the actual research took place, the coordinates of all the locations that were to be used for study were taken and recorded. Three artificial beehives were constructed and baited with honey to attract bees and placed at the three locations chose for this study.The data obtained through these various observations was analysed using descriptive statistical tool such as percentages, frequencies and graphs and charts.

RESULTS

Effect of Temperature of the Beehive Locations on Honey Production

Table 1 presents the data collected on the different temperature of the three selected beehive locations within the FUTA community. The data was collected for fifteen (15) weeks respectively. The first beehive location (behind the Quarantine section of Prof. T.A Afolayan Wildlife Park) had the maximum temperature over the period of fifteen (15) weeks, while a minimum temperature of 27^0C was recorded at the third location of the beehive inside FUTA community. It was observed at the first location of the beehive (behind the Quarantine section of Prof. T.A Afolayan Wildlife Park) the temperature was relatively high. The temperature ranges from 28.4^0C to 31.9^0C. The average temperature of this location over the period of fifteen (15) weeks was 30.6^0C. However, at the second beehive location (FUTA Fish Farm) (the temperature ranges from 28.0^0C to 31.0^0C over the period of fifteen (15) weeks, while the average temperature over the period of fifteen (15) was 29.3^0C. The third beehive location Animal Production and Health Teaching and Research Farm) had a minimum temperature of 27^0C and a maximum temperature of 29^0C, while the average temperature over the period of fifteen (15) was 27.9^0C.

Effect of Relative Humidity of the Beehive Locations on Honey Production

Table 2 presents the data collected on the relative humidity of the three selected beehive locations within the FUTA community. The data was collected for fifteen (15) weeks respectively. The third beehive location Animal Production and Health Teaching and Research Farm) had the maximum relative humidity of 82.2% over the period of fifteen (15) weeks, while a minimum relative humidity of 76.1% was recorded at the first location (behind the Quarantine section of Prof. T.A Afolayan Wildlife Park) of the beehive inside FUTA community. It was observed at the first location of the beehive (behind the Quarantine section of Prof. T.A Afolayan Wildlife Park) the relative humidity was relatively low, while the relative humidity of both the second and third beehive locations i.e. FUTA Fish Farm and APH Teaching and Research Farm were relatively high over the period of fifteen (15) weeks. The relative humidity of the first beehive location (behind the Quarantine section of Prof. T.A Afolayan Wildlife Park) ranges from 76.1% to 78.1%, while its average relative humidity over the period of fifteen (15) weeks was 76.9%.

Furthermore, at the second beehive location (FUTA Fish Farm) the relative humidity ranges from 79% to 82.1% over the period of fifteen (15) weeks, while the average relative humidity over the period of fifteen (15) weeks was 81.16%. The third beehive location (Animal Production and Health Teaching and Research Farm) had a minimum relative humidity of 79.8% and a maximum relative humidity of 82.2% while its average relative humidity over the period of twelve weeks was 80.5%.

After the period of fifteen (15) weeks, it was observed that the three beehives located at different places had been colonised. After a period of 6 weeks, the beehive located at behind the Quarantine section of Prof. T. A Afolayan Wildlife Park), was observed to have been colonized. Also, after the 8^{th} and 9^{th} week respectively the beehive located at the FUTA Fish Farm and APH teaching and Research Farm were observed to have been colonized respectively. Also, Table 3 shows the different flora species found at the locations of the beehives.

Table 1: The Temperature of the Three Locations of the Beehives from Week 1 to Week 15

Weeks	Site 1	Site 2	Site 3
	Temperature (^{0}C)	Temperature (^{0}C)	Temperature (^{0}C)
Week 1	28.4	28.5	28.6
Week 2	31.0	30.5	27.0
Week 3	30.6	29.0	29.0
Week 4	30.1	28.0	29.0
Week 5	29.8	28.4	27.0
Week 6	30.0	30.0	28.0
Week 7	29.7	28.0	27.5
Week 8	31.0	30.0	28.0
Week 9	31.5	31.0	28.0
Week 10	30.7	29.1	27.4
Week 11	30.2	28.6	27.3
Week 12	31.9	29.5	27.0
Week 13	30.9	28.5	27.9
Week 14	31.2	30.0	28.1
Week 15	31.4	29.7	28.0
Ave. Temp	31.4	29.7	28.0

Table 2: The Relative Humidity of the Three Locations of the Beehives from Week 1 to Week 15

Weeks	Site 1	Site 2	Site 3
	Rel. Humidity (%)	Rel. Humidity (%)	Rel. Humidity (%)
Week 1	76.2	82.0	82.2
Week 2	76.1	80.0	79.8
Week 3	76.5	81.0	80.7
Week 4	77.1	79.0	80.0
Week 5	77.3	81.0	80.4
Week 6	76.5	80.0	80.0
Week 7	77.8	81.0	80.0
Week 8	76.4	82.0	80.5
Week 9	76.9	80.9	81.1
Week 10	78.1	81.5	82.0
Week 11	77.8	81.9	80.0
Week 12	76.8	82.1	80.3
Week 13	76.7	81.2	80.1
Week 14	76.8	82.0	80.2
Week 15	76.8	81.8	80.7
Ave. Humidity	76.9	81.2	80.5

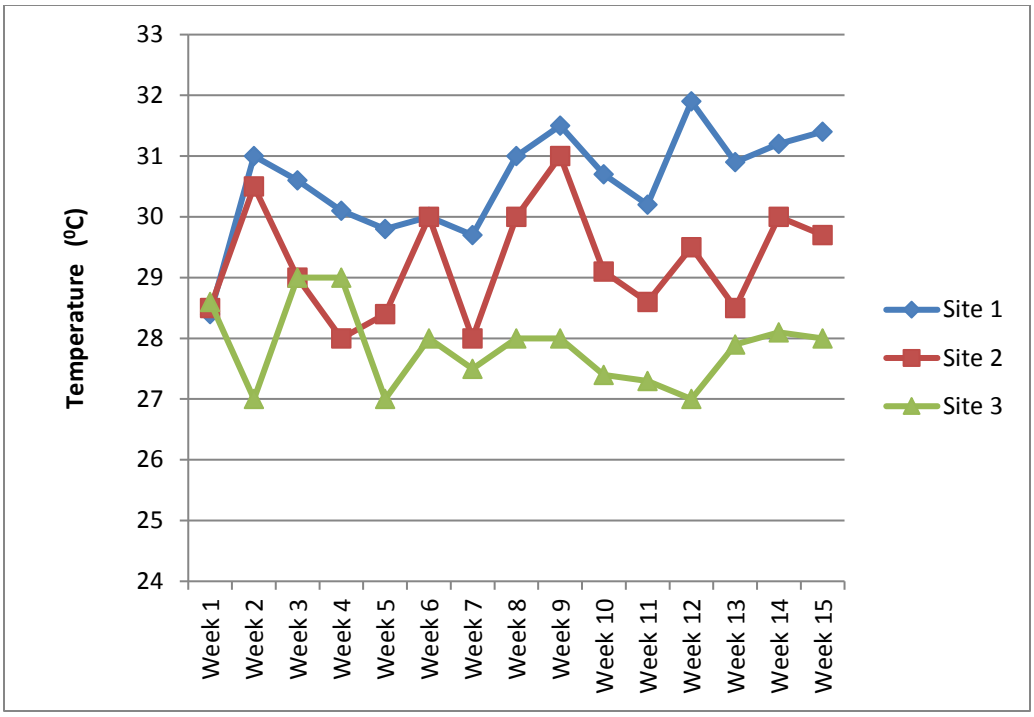

Figure 2: Temperature of the beehive locations within FUTA community

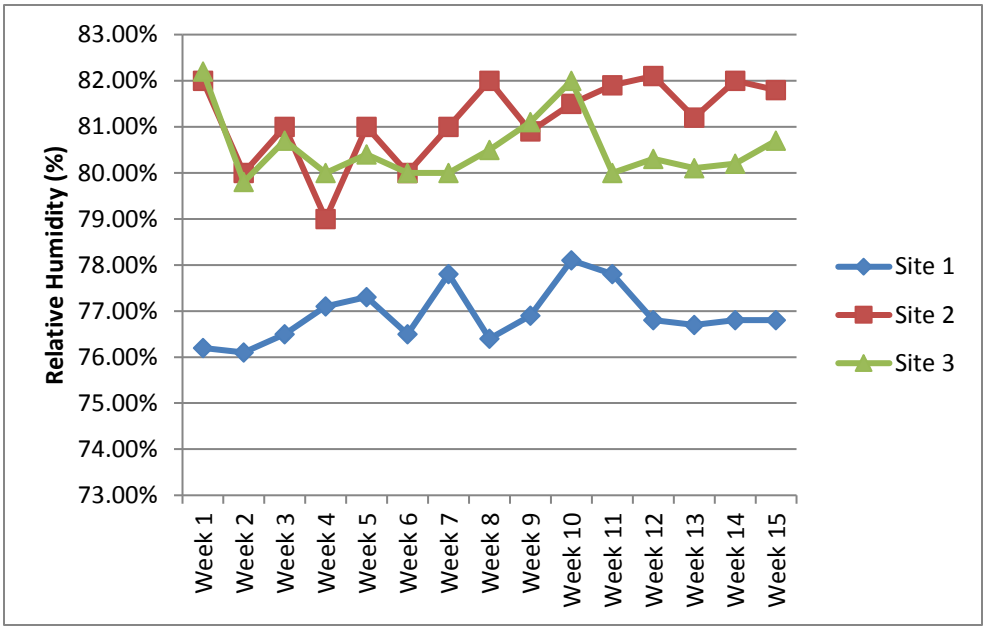

Figure 3: Relative Humidity of the beehive locations within FUTA community

Table 3: Trees species present at location of the beehive

Beehive Locations	Tree species
Behind the Quarantine section of Prof. T.A Afolayan Wildlife Park	*Carica papaya* *Piliostigma thonningii* *Detarium microcarpum* *Aspillia Africana* *Kahaya senegalensis*
FUTA Fish Farm	Oil palm tree Mango tree (*Mangifera indica*) *Carica papaya* *Combretum nigericans* Oil palm tree
Animal Production and Health Teaching and Research Farm	*Mangifera indica* *Ficus spp* *Gardenia aqualla* *Daniela oliveri*

Analysis of Variance of Temperature and Relative Humidity of the Beehive Location on Honey Production

Table 4 presents the analysis of variance of temperature and relative humidity of the Beehive location on honey production. The first location had the maximum mean temperature of 30.6^0C while the third location had the minimum mean temperature of 27.9^0C over the period of fifteen (15) weeks. There was significant difference between the mean of temperature of the three different locations as shown in Table 4 below. The second beehive location had the maximum mean of relative humidity while the beehive located at the first location had the minimum mean of relative humidity. There was significant difference between the mean relative humidity of first location and the other two locations, while there was no significant difference between the mean relative humidity of the second and third beehive locations.

Table 4: Analysis of Variance of Temperature and Relative Humidity of the Location of the Beehive on Honey Production

Parameters	Site 1	Site 2	Site 3
Temperature	30.60^a	29.21^b	27.85^c
Relative Humidity	76.96^a	81.03^{bc}	80.58^{bc}

Discussion

The results from this study show that temperature, relative humidity affects honey production in the modern beehive. Thus, it was observed that beehives location at the end of the research had an effect on honey location as the beehive located where the environmental conditions were favorable was observed to colonized quickly when compared to other locations. This implies that in setting up a modern beehive for optimum honey production the environmental conditions must be put into consideration, as bees tends to thrive under high temperature and low relative humidity Most native bees thrive in sun and dry soils (Dauber *et al.* 2003).

In this study modern hive showed relatively great potential of honey yield which might be ascribed to the variations in the climatic zone of the experimental sites. According to CSA, (2013) the regional average honey yield from modern and traditional hives was about 16.2kg/hive/year and 6kg/hive/year respectively On the other hand community response from Enderta woreda of Tigray region indicated that 33kg/hive and 16kg/hive honey yield was found from modern and traditional hives respectively (Teferi *et al.* 2011). As survey result from Atsgede Tsembla

district of Tigray region reported that the maximum honey production potential of modern hive was within the range of 45- 50 kg/hive while 20-25kg/hive from traditional hives (Gidey *et al*., 2012). Even in Kafa zone in the Southern Ethiopia where bee forage is not a limitation traditional hives produced within the range of 10.53- 16.06 kg/hive (Awraris *et al.*, 2012). Such variations indicate that local environmental factors particularly of climate and bee flora availability have impact on honey yield of the different hives (Chagwiza *et al*., 2011, Teferi *et al*., 2011, Haftom and Awet, 2013).

CONCLUSION

This study shows that the modern/artificial beehive under a good climatic condition and management is a sustainable way of high honey production, bees tends to thrive under relatively high temperature and relatively low humidity (Dauber *et al.* 2003). Also, anthropogenic factors can also affect the Colonisation of beehives as this was observed by the beehive located at the FUTA Fish farm and at the APH research farm.

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