

## Effect of Artificial Modification of the Feeding Activity of Non-foraging and Foraging Worker Bees (*Apis Mellifera Adansoni* L.) (Hymenoptera :Apidae) on Honey and Comb Production.

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**Abstract:** This study was carried out to determine the effect on honey production and population growth of foraging worker bees when the non-foraging and foraging worker bees *Apis mellifera adansoni* L were fed with banana paste and when foraging bees were converted to non-foragers by inducing undertaker and nursing care behaviour in apiaries set up in the Teaching and Research Farm of Obafemi Awolowo University, Ile-Ife from December 2006 to February, 2008. Four apiaries were set up and three colonized hives were selected from each apiary and labelled A<sub>1</sub>, A<sub>2</sub>, A<sub>3</sub>, B<sub>1</sub>, B<sub>2</sub>, B<sub>3</sub>, C<sub>1</sub>, C<sub>2</sub> and C<sub>3</sub> and D<sub>1</sub>, D<sub>2</sub> and D<sub>3</sub> constituted as control hives. Bee colonies in hives A<sub>1</sub>, A<sub>2</sub> and A<sub>3</sub> were fed with banana paste, nursing care function was induced in hives B<sub>1</sub>, B<sub>2</sub> and B<sub>3</sub> and undertaker duty was induced in hives C<sub>1</sub>, C<sub>2</sub> and C<sub>3</sub>. The census of the foraging worker bees in all hives were carried out at intervals of 70 ± 5 days using the Capture-mark and recapture method (Lincoln's index). In colonies A<sub>1</sub>, A<sub>2</sub> and A<sub>3</sub>, the mean foragers population was 9,324 ± 256 and the honey yield was 16.24 ± 0.54 kg, in B<sub>1</sub>, B<sub>2</sub> and B<sub>3</sub> the mean foragers population was 6,714 ± 256 and honey yield was 6.03 ± 0.29 kg while in C<sub>1</sub>, C<sub>2</sub> and C<sub>3</sub>, the foragers population was 5,466 ± 256 and the honey yield was 7.02 ± 0.29 kg. In the control hives the mean population of foraging workers was 8,670 ± 256 and honey yield was 13.13 ± 0.14 kg. There were significant differences between the means of population of foraging worker bees (F = 1028.50, df = 11, P < 0.005) and honey produced (F = 238.82, df = 11, P < 0.005). There is no significant correlation between the weights of combs produced and foragers population.

**Key words:** Apiary, foragers, undertakers, nursing workers.

### INTRODUCTION

Honey bees (*Apis mellifera Adansoni* L. (1758) (Hymenoptera:Apidae) are known for their honey production and pollinating activities<sup>[2,8]</sup>. In Nigeria among the Tivs and Oyo people beekeeping has been part of the normal agricultural enterprise<sup>[1,9]</sup>, the beekeepers used fixed comb hives such as gourds, baskets, logs of wood and drums<sup>[9]</sup>. There is no record of income generated from honey production in Nigeria, as it has no positive impact on the economy. Honey productivity has been at a subsistence level<sup>[1,9,12]</sup>.

Honey bees are social insects known with unique features of division of labour<sup>[3]</sup>. In a complete bee colony there is one queen, several hundred drones that are males and 30,000 to 75,000 workers, which are sterile females<sup>[6,10]</sup>.

The number of honey bees in a colony is regulated by a multitude of variable factors, which includes meteorological conditions such as light, wind, temperature, and other factors like foraging activities, pests and diseases and the queen reproductive potential<sup>[11]</sup>.

There is a high influence of colony population on honey production and colonies with appreciable population of bees produce high yield than colonies with a sparing population<sup>[2,5]</sup>. Worker bees population is usually large in bloom season provided there is a suitable temperature and food supply while in the time of low pollen season, there is limitation to egg production and worker population size is small<sup>[2]</sup>. The ability of a colony to maintain a high population of foraging worker bees for high honey yield depends on genetical and physiological attributes of the colony as well as response threshold to chemicals and social inhibition encountered by the bees.

Research work had shown that juvenile hormone which consists of dopamine is linked to task performance; it has been the driving factor, pushing workers to become foragers<sup>[7]</sup>. Banana contains this substance dopamine<sup>[4]</sup>. There is a need for a local research to boost honey productivity in Nigeria and other Sub-Tropical countries<sup>[5,8]</sup>.

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## MATERIALS AND METHODS

The research was set up in the Teaching and Research Farm of the Faculty of Agriculture, Obafemi Awolowo University, Ile – Ife. Four apiaries were set up on the 6<sup>th</sup> of December 2006 in different locations on the Farm about 1,500metres from each other. Each apiary contains four hives arranged irregularly within a distance of 5 to 20 metres from each other depending on shade and other physiognomic conditions. Each of the bee colonies in all the apiaries was baited with 50ml of honey. Some of the hives in each apiary were colonized within 57 days (December 6 to February 21, 2007) and twelve colonized hives were selected, three from each apiaries. The hives were labelled A<sub>1</sub>, A<sub>2</sub>, A<sub>3</sub>, B<sub>1</sub>, B<sub>2</sub>, B<sub>3</sub>, C<sub>1</sub>, C<sub>2</sub>, C<sub>3</sub>, D<sub>1</sub>, D<sub>2</sub> and D<sub>3</sub>. Hives D<sub>1</sub>, D<sub>2</sub>, D<sub>3</sub> were constituted as control hives. The colonies in Apiary No.1 Hives A<sub>1</sub>, A<sub>2</sub> and A<sub>3</sub> were fed with 25ml of banana paste weekly. In Apiary No.2 Hives B<sub>1</sub>, B<sub>2</sub> and B<sub>3</sub>, nursing care function was induced in the foragers by occasionally removing some of the developing young nursing care workers in the brood comb with forceps. In Apiary No.3 Hives C<sub>1</sub>, C<sub>2</sub> and C<sub>3</sub> undertaker behaviour was induced by dropping dead insect parts regularly in the hives and in Apiary No.4 Hives D<sub>1</sub>, D<sub>2</sub> and D<sub>3</sub> were allowed to grow naturally.

The census of the foraging workers in the hive was carried out during the wet and dry season March 2007 to October, 2007 and November 2007 to January 2008 respectively using the Capture marked -Recapture method. Capturing of bees was done between the hours of 1500 to 1800 starting from 70±5 days after hive colonization. Recapturing was carried out at intervals of 70±5 days. This makes it possible for the population of new generation of foraging workers in each hive to be estimated.

All the hives including the bees were weighed and cropped on the 1<sup>st</sup> of February 2008. Honey extracted from all the combs in each hive was weighed. The remnant honey was extracted from the comb by using a warm solution of 60g/15litres of detergent (e.g.omo) for 24 hours to dissolve it and weighed.

The data obtained were analyzed using Multiple Variance Analysis and Pearson Correlation Coefficient.

## RESULTS AND DISCUSSION

Population of foraging workers of *Apis mellifera* was 9321 ± 256 (Mean ± s.e) and the mean honey yield was 16.24±0.71 kg (Mean ± s.e) in hives A<sub>1</sub>, A<sub>2</sub> and A<sub>3</sub> (Fig. 1 and Table 1). Where the bees were fed with banana paste .

Similarly, the mean population of foraging worker bees in the control Hives D<sub>1</sub>, D<sub>2</sub> and D<sub>3</sub> was also high 8670 ± 256 (Mean ± s.e) and the mean honey yield was 16.24±0.71 kg (Mean ± s.e). (Fig. 1 and Table 1) against the mean population of foraging workers in Hives B<sub>1</sub>, B<sub>2</sub> and B<sub>3</sub> and Hives C<sub>1</sub>,C<sub>2</sub> and C<sub>3</sub> where

foraging worker bees were converted to non-foragers, these were as low as 6714 ± 256 (Mean ± s.e) and 5467 ± 256 (Mean ± s.e) respectively (Table. 1). The mean honey yield in hives B<sub>1</sub>, B<sub>2</sub> and B<sub>3</sub> was 6.03 ± 0.71 kg (Mean ± s.e) while in Hives C<sub>1</sub>, C<sub>2</sub> and C<sub>3</sub>, the mean honey yield was 7.02 ± 0.71 kg (Mean ± s.e) (Fig. 1).There were significant differences between the mean foraging workers population at significant level of 5%, Df = 11, F<sub>c</sub> = 1028.50 at P = 0.000 < 0.005 and the mean honey yield at 5% significant level Df = 11, F<sub>c</sub> = 238.82 and P = 0.000 < 0.005.

The mean weights of combs in Hives A replicates was 15.61 ± 1.19 kg (mean ± s.e.), in B replicates the comb weight was 14.29 ± 0.68 kg (mean ± s.e.) while in Hives C and D replicates the mean weights of combs were 15.42 ± 0.17 kg and 15.06 ± 0.08 kg (mean ± s.e) respectively (Fig. 2).

There was a direct relationship between the honey produced and the foragers' population (Fig.3)

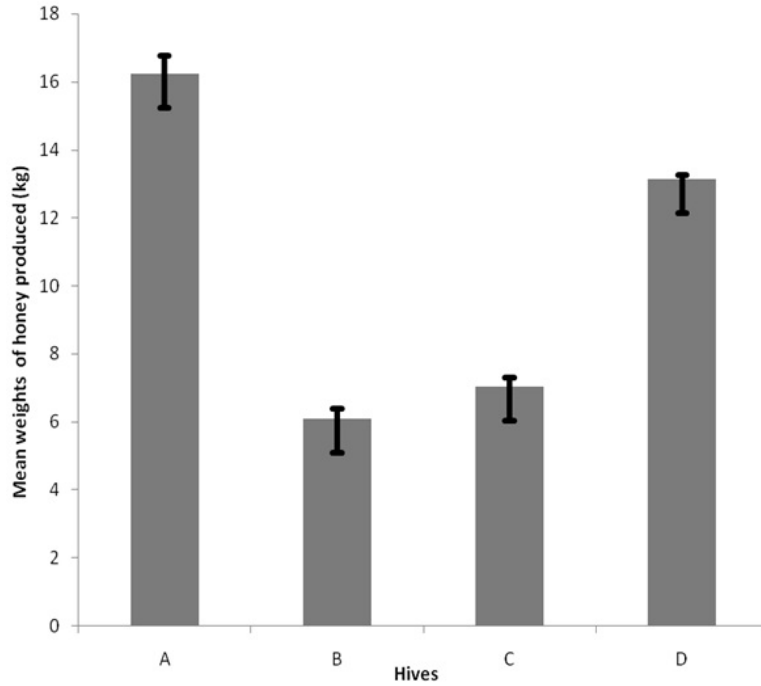
The response of the bee colonies in Hives A<sub>1</sub>, A<sub>2</sub> and A<sub>3</sub> to administration of banana paste syrup from March 2007 to January 2008 was responsible for the high population density of foraging worker bees. Research work had shown juvenile hormone are linked to task performance and they had proposed it to be the driving factor, pushing workers to become foragers<sup>[7]</sup>. This juvenile hormone contains octamine dopamine and banana paste have been found to be a rich source of the amines<sup>[4]</sup>. The fed colonies were able to sustain a continuous and rapid growth during the period of low pollen and the records showed a significant difference compared to population growths in other hives. The significant difference between the fed colonies and the natural control groups suggested that feeding amines to bees might have a role in inducing foraging behaviour.

There was a very low population of foraging worker bees recorded in hives C<sub>1</sub>,C<sub>2</sub> and C<sub>3</sub> This was in response to reversion of foraging worker bees to undertakers when dead bodies of small arthropods like ants and termites and tiny pieces of plant materials were introduced into the hives, the old foraging workers returned to the hives and partook in the cleaning duty. This observation hinted that the bee colony has workers that cleans and removes dirt in the hives sometimes seal the dirt or dead bodies to the hive especially when too big to be removed. The colony is always maintaining a balance such that all forms of workers are available.

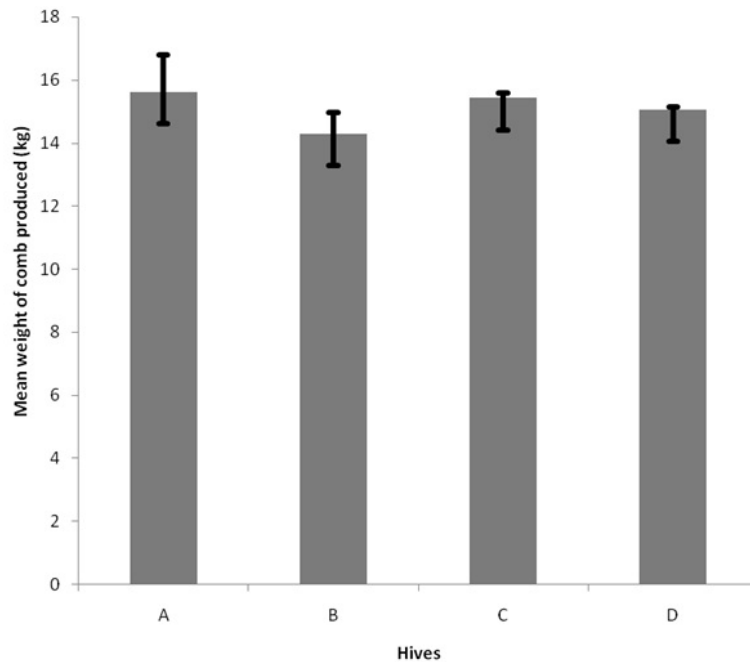
Similarly,there was a very low population of foraging worker bees recorded in hives B<sub>1</sub>, B<sub>2</sub> and B<sub>3</sub> This was a response to reversion of foraging to nursing care duty, when some of the young worker bees 'nurses' that clustered around the brood combs in the hives were removed some of the old foraging workers returned to the hives and assumed the nursing care duty. This observation hinted that a colony is always

**Table 1:** Mean of foraging worker bees population prior to harvesting using Capture and Recapture method (Lincoln's index)

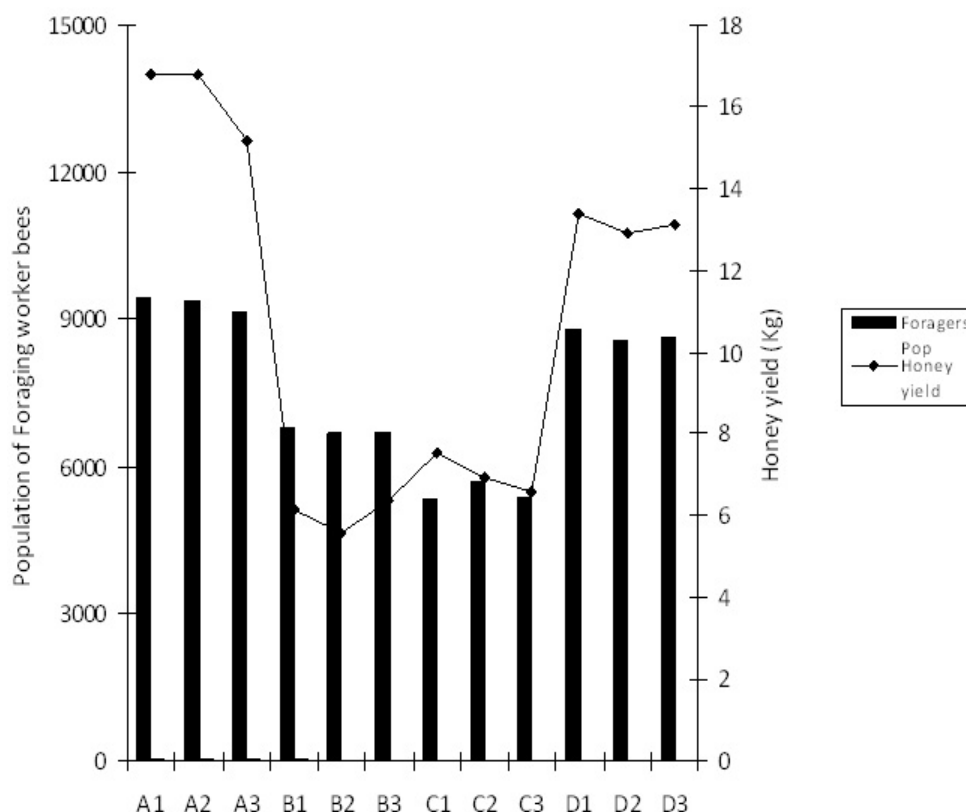
Hives	Experimental hives		Control hives	
	Apiary No 1 (A)	Apiary No.2 (B)	Apiary No.3 (C)	Apiary No. 4 (D)
1	9450	6789	5336	8794
2	9362	6675	5693	8586
3	9151	6680	5371	8631
Mean Pop.	9321	6714	5467	8670



**Fig. 1:** Mean weights of honey produced with the standard error



**Fig. 2:** Mean weights of comb produced with the standard error



**Fig. 3:** Relationship between foraging workers population and honey production

maintaining a balance such that all forms of workers are available in the colony and the co-operative brood care duty is not neglected while at the same time the foraging duty did not suffer.

There was no significant relationship between the foraging workers population and comb produced as all the colonies maintain the potentiality to produce combs for honey storage and brood. However, the population of the foraging worker bees has direct relationship with the honey produced, the higher the population, the higher the yield.

In order to manage and sustain a large population of foraging workers for maximum honey yield during blossom season to the period of dearth, there is a need to feed the bees with substances containing amine. Similarly, there are some factors that can revert the foraging activities such as presence of dirt in the hives, which need to be removed. Modification in feeding activities and cleanliness in the hives in a little way will help to improve honey production.

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