

SOME FACTORS AFFECTING ON THE CONSTRUCTION RATE OF WAX FOUNDATION AND WAX PRODUCTION OF HONEY BEE COLONIES UNDER QENA GOVERNORATE CONDITIONS, EGYPT.

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ABSTRACT

This study was carried out in Qena governorate, Egypt and aimed to effect of both age of colony s queen, wax foundation thickness and site of comb foundation inside the hive on the construction rate of wax foundation and estimating of wax production.

Results obtained indicated that, the colonies having 12 months old queens built the largest areas of the comb through the active season, this areas arranged between 150.33 to 366.22 inch², when used thin sheets of wax foundations, while its 208.33 - 771.72 inch² when used thick sheets.

In addition, the differences were highly significant between all the foundations inserted at different location inside the colonies.

The colonies having queens less than six months 6 old , built the areas lesser than the colonies having 12 months old queens , the total areas of constructed combs arranged between 129.64 to 246.33 and 187.97 to 581.63 square inch when used thin and thick sheets, respectively, followed by the colonies having 24 months old queens , came the latest, they arranged between 95.94 to 267.63 and 157.98 to 403.63 square inch when used thin and thick sheets of wax foundation, respectively.

Placing a comb foundation in the hive center encouraged the bee workers to rapidly structure.

On the other side, the colonies having 12 months old queens produced the highest amount of wax, followed by the colonies of young queens(6 mouths old), while the colonies having 24 months old queens came the latest, the average amount of wax production was 100.6 , 84.6 and 72.1 grams per colony respectively.

INTRODUCTION

Bee wax combs is a product of wonderful and hard worker bees, which serve as secure incubator for immature stages and a proper container for rearing the brood and storing food. Beside its usefulness, the marvelous structure of the comb complex the admiration, although the combs play an essential role in honeybees activities, their long use may turn them to potential reservoirs for organisms that cause both adult and larval disease (Jaycox, 1979). In addition, it is well known that wax comb is a principle constitution of honeybee home and gives the bees and the beekeepers a guides on which to work.(Omar,2002)

Foundation provides the hives with these advantages: It encourages bees to build straight combs within wooden frames. This allows easy and rapid manipulation of honeybee colonies; it saves bees resources and labour in the construction of combs there by allowing increased honey production and it facilitates honey extraction since combs in frames can be strengthened by reinforcement with wire (Aidoo and Paxton 2007), also colonies provided with foundation are therefore able to develop their nest and commence brood rearing quickly, and can store more surplus honey than colonies given either no foundation or just starter strips of wax .

Normally, honey bee colony build their combs, but that work will be on the cost of honey production, therefore, providing the colonies with comb foundations is one of the important beekeeping practices for helping the colony to grow faster and to increase honey production (Mangum 1998).

In fact, comb construction one of the bee's behavior controlled by many factors such as quality or state of the queen (Hepburn, 1986), the presence of the brood (Killion and Carl, 1981), the need for extra space (Butler, 1974), population of the young bees (Goltz, 1977) and honey flow (Root, 1983).

The present study aimed to answer the questions:

- 1- Does the comb site in the hive has an effect on its construction?
- 2- What is the effect of colony queen age on rate of construction for the wax foundation?
- 3- What is the effect of wax foundation thickness sheet on constituent for the wax comb?

MATERIAL AND METHODS

In 15th March, 2006, ninety colonies of the first hybrids carniolan honeybee (*Apis mellifera carnica*) were selected amongst the colonies of the apiary in Qena Governorate having an equal strength, either for worker population, each colony housed

in Langstroth hive and its bees covered with about six combs, these colonies were fed with sugar syrup 1:1 (sugar: water) weekly with 500 grams sugar per colony in order to encourage the workers to build and instruct of comb. (Alien and Jeffree, 1956 and Townsend and Smith, 1969). The experimental colonies were divided into three groups thirty colonies each, the first colonies group having young queens less than six months old, the second group having 12 months old queens, while the third group contained queens aging 24 months old. Each group was further divided into five sub-groups (A, B, C, D and E), having six colonies, and each sub-groups was divided into two sub sub-group (thin sheet 13 / inch thick sheet 117 inch) having three colonies each. Colonies of sub-group A received any comb foundation as the first at the right side faced the wall hive (the first comb from right). Sub-group B received always a provided comb foundation at the place of the second comb from the right side (the second comb from right) Subgroup C received a comb foundation at the middle. sub-group D received a comb foundation at the place of the second comb from the left side (the second comb from left) while the last sub-group (E) received a comb foundation at the left side faced the empty area of hive (the first comb from left) each of sub sub-group colonies provided with comb foundation thickness 13 sheet/inch and 11 sheet /inch.

The colonies of sub group (having six colonies) and sub sub-group (having three colonies) were provide with a next comb foundation after finishing construction of the former one till the last of experiment

To investigate the effect of age of colonies queens, wax foundation thickness (13 and 11 sheet/inch) and site of comb foundation inside the hive on the construction rate of wax foundation, the following criteria were measured.

1- Construction rate of the comb foundation

Area of the construction comb was measured weekly using an empty frame divided into square inches. This measurement continued for twelve weeks from 23 / 3 till 15/6/2006.

2- Estimating of wax production

Ten colonies of the first hybrid carniolan honeybees were used to done this experiment, these colonies having an equal strength and its bees covered ten combs. At the end of experimental, and after honey extraction and uncapping honey comb and filtration, then the total amount of wax produced by every queen age colonies determined through calculation the amount of wax in grams which produced from uncapping honey combs. Place a comb on each uncapping tray. A comb should always be manipulated vertically, to prevent it from breaking off the top-bar and to avoid loss of

honey. When placing it horizontally on the tray for uncapping, it should therefore be supported with the rack, a: uncap one side, turn the comb carefully, and place it on the tray, with the second side up while supporting it b: uncap the other side: now lift it up with the comb hanging vertically, turn the bar carefully and place it in the centrifuge.

3- Statistical analysis

Analysis of variance was conducted and the critical differences between different treatments were calculated by using least significant differences (L.S.D). Snedecor (1959)

RESULTS AND DISCUSSION

A- Construction rate of comb foundation

1- Effect of the comb site in the hive on construction rate

1.1 The colonies having queens six months old

Data presented in Table (1a & b) revealed that, in most experimental colonies provided with comb foundation had started construction of these foundations at the first week and reached to the peak between the third and fifth week, and then decreased until reached to became rarely of the sixth, seventh and eighth weeks. Also, it was increased gradually until the peak of construction at the period of 22/5 to 7/6 then, this period was nectar flow of Egyptian clover, while in the period from 30/4 till 15/5 and in the last week of the experiment, there was no comb foundation. In addition, it was clear from the results that, in most sites of the comb foundation inserted in the colonies having queen's 6 months built the areas lesser than the colonies having 12 months old queens.

Looking to the results of Table (1a & b), it was clear that, there were no significant differences in all sites of the comb foundation, when the colonies headed by the young queens (6 months old) when used comb foundation thickness (13 sheet / inch), while the differences were highly significant in different sites when used comb foundation thickness (11 sheet / inch), in most of experiment periods expect with fifth and ninth weeks (this periods were active in nectar flow).

The average areas of comb foundation construction rate were the largest area, when the colonies received a comb foundation at the center of the hive (site C) putting a comb foundation in this site encourage the young workers to construction a large of the comb than the other sites , maybe due to existence the young workers. Ohtani, (1985) found that young workers tended to stay in the middle of the brood nest , older workers were on the edges of combs and those of the intermediate age were distributed through out. The obtained results are in the agreement with Morse (1977), who reported that the best place to draw foundation is immediately over the brood nest.

The mean construction area of the colonies provided with queens 6 months old were 25.33, 37.33, 54.66, 44.66 and 43.66 square inches for site: A, B, C, D and E (Table 1a) while they were 43.33, 41.00, 153.66, 66.66 and 52.00 square inches (Table 1b), when used comb foundation thickness 13 and 11 sheets /inch, respectively in the tenth week of experiment.

1.2 The colonies headed by queens 12 months old

At the same time, the construction rate of the comb foundation submitted to the colonies having queens of 12 months old, were presented in Table 2 a and b, the average of constructed area were 26.33, 18.00, 71.00, 63.33 and 48.00 square inches, while they were 43.33, 17.66, 165.00, 169.66 and 54.33 for the site A, B, C, D and E when used comb foundation thickness 13 and 11 sheets per inch, respectively.

On other hand, there were highly significant differences between all, the foundation inserted at different location inside the hives.

Results of (Table 4), showed that the colonies having queens 12 months old have a highest area for building the combs than other colonies contained young queen (6 months) or old queen (24 months). These results may due to interpreted through productivity rate of the queen which increased with time to reach to the peak productivity during the first year and then decline by the time again. This perhaps due to increasing in the population density of workers of the colonies having 12 months old queen, which perform with wax secretion and constructing a large area of the comb than the colonies having other queen ages, these results are corresponding with those documented by Root (1983), who mentioned that, the queen at the young age, as a rule will keep a colony more population than the old one and it is seldom, profitable after the second year.

The total areas of comb constructed through the periods of experimental were 150.33, 104.33, 366.22, 167.97 and 212.70 square inches when used the thin of wax foundation (13 sheet per inch), while they were 237.31, 208.33, and 771.72, 467.63 and 427.96, for the sites A, B, C, D and E, respectively., when used the thick of wax foundation (11 sheet /inch) of the colonies having 12 months old queens, and a large area of constructed comb was in comb putting in the center of the hive (site C), they were 366.22 and 771.72 with 13 and 11 sheets using, respectively comparing with 246.33, 267.63 and 581.63, 403.63 square inches with using 13 and 11 wax sheets, when the colonies headed by young queen (6 months) and the colonies headed by old queen (24 months), respectively. the obtained data agreement with (Ohtani 1985) found that the queen prefers the center of the hive *than the other sides* as a result of availability of the young workers in that side, also (Aidoo and Paxton 2007) observed that a preference by the bees to use thin non-embossed wax sheets to make

new combs rather than the thick non-embossed wax sheets or embossed foundation, also he mentioned that the amount of wax added to a unit area of foundation indicated highest fresh wax production using the thin non-embossed wax sheets. The starter strip, the thick non-embossed wax sheets and the embossed foundations followed in descending order, in terms of amount of wax added to the resultant combs.

1.3 -The colonies headed by the old queens (24 months)

Results of tables 3 a and b showed that the same trend could be achieved when used 13 and 11 sheets / inch in the all sites , the data declared that the average area of constructed comb inserted in the middle hiving (site C) gave the highest level followed by the site D,E, B and A Respectively (Morse 1977)

In generally, the resulted data of Table 1, 2, 3 and 4 are in agreement with opinion of (Visscher, 1986) who reported that when the queen lay the eggs in cells near the center they are reared more frequently than those of the edges.

B. Estimating of wax production

Data presented in the table 5 revealed that the colonies headed by the 12 months old queens produced the highest an amount of wax production compared with the colonies headed by other queens.

The average amount of wax production per hive were 100.6 grams for the colonies headed by 12 months old queens followed by the colonies having young queens , it was 84.6 grams ,while the colonies headed by the old queens was the latest , it was 72.1 grams per hive .The largest amount of wax produced by the colonies having 12 months old queens may be due to a continuous production of more young workers have ability to produce the wax , this interpretation in coincide with (Goltz (1977), who referred that the highest level of bee wax production in the colony usually corresponds with the maximum population level of young bees. Finally, we can answer the above questions 8.

In view of the present data, we can easily arrived to the conclusion that the colonies having 12 months old queens were; the best colonies for construction the comb foundation, for the wax secretion and for the wax production.

In addition, putting the comb foundation near or at the middle of the hive was suitable place for acceleration its construction and for wax production. Also using the thickness sheets was one of the important factor of comb construction, then the workers can be building the comb with using a little of wax secretion. (Omar, 2002) mentioned that the increasing percentage of comb construction between wax

foundation before construction and comb foundation after construction ranged from 29.04 to 36, 72% with an average of 33.33% the observation made during the study indicated a preference by the bees for constructed the comb in the first of construction when used thin sheets, but after that it prefer the thick wax sheets.

TABLE (Ia)

Effect of using young queens (6 months old), thin wax foundation sheet and site of comb foundation inside the hive on construction rate of the comb foundation

The site of comb foundation	Wax construction area per inch ² through the period experiment											
	22/3	30/3	7/4	15/4	22/4	30/4	7/5	15/5	22/5	30/5	7/6	15/6
The 1 st R.	1.33	6.33	25.33	20.33	24.33				13.66	25.33	13.00	
The 2 nd R.	0.66	6.00	11.33	22.00	23.00				24.00	37.33	32.33	
The middle	2.33	13.33	31.33	35.33	25.66	-	-	-	33.00	54.66	50.66	-
The 2 nd L.	1.00	9.33	18.33	21.66	18.00				40.00	44.66	66.66	
The 1 st L.	66.00	9.00	25.33	32.00	18.33				29.33	43.66	6.33	
L.S.D. 0.05	N.S	5.154	13.75	N.S	N.S	-	-	-	N.S	N.S	44.64	-

The 1st R.: the first comb form right. The 2nd R.: the second comb form right. The 2nd L.: the second comb form lift. The 1st L.: the first comb form lift.

TABLE (I b)

Effect of using young queens (6 months old), thick wax foundation sheet and site of comb foundation inside the hive on construction rate of the comb foundation

The site of comb foundation	Wax construction area per inch ² through the period experiment											
	22/3	30/3	7/4	15/4	22/4	30/4	7/5	15/5	22/5	30/5	7/6	15/6
The 1 st R.	0.33	6.66	21.33	29.33	41.33				22.66	43.33	23.00	
The 2 nd R.	1.66	9.00	9.00	40.00	43.00				56.33	41.00	68.33	
The middle	4.66	47.66	60.66	64.32	68.33	-	-	-	64.66	153.6	113.0	-
The 2 nd L.	1.66	13.33	21.66	30.33	45.66				52.33	66.66	138.0	
The 1 st L.	2.00	16.33	34.33	46.66	32.33				41.00	52.00	13.33	
L.S.D. 0.05	2.20	13.50	10.39	15.94	N.S	-	-	-	N.S	27.14	32.81	-

TABLE (II a)

Effect of using queens (12 months old), thin wax foundation sheet and site of comb foundation inside the hive on construction rate of the comb foundation

The site of comb foundation	Wax construction area per inch ² through the period experiment.											
	22/3	30/3	7/4	15/4	22/4	30/4	7/5	15/5	22/5	30/5	7/6	15/6
The 1 st R.	0.66	5.66	25.66	36.00	5.66				4.33	26.33	47.00	0.0
The 2 nd R.	0.66	4.33	14.33	14.66	13.33				13.33	18.00	24.66	1.0
The middle	4.66	22.66	35.00	46.33	54.24	-	-	-	73.33	71.00	55.00	4.0
The 2 nd L.	0.00	6.66	11.66	22.00	8.33				22.66	63.33	32.33	0.0
The 1 st L.	3.66	17.00	35.66	16.00	6.66				28.66	48.00	57.00	0.0
L.S.D. 0.05	N.S	9.180	14.40	16.13	12.15	-	-	-	N.S	22.67	N.S	2.30

TABLE (II b)

Effect of using queens (12 months old), thick wax foundation sheet and site of comb foundation inside the hive on construction rate of the comb foundation

The site of comb foundation	Wax construction area per inch ² through the period experiment											
	22/3	30/3	7/4	15/4	22/4	30/4	7/5	15/5	22/5	30/5	7/6	15/6
The 1 st R.	4.00	11.66	34.33	49.00	32.66				11.33	43.33	47.00	0.0
The 2 nd R.	4.66	10.66	26.00	60.66	26.66				33.00	17.66	24.66	3.0
The middle	16.0	37.00	74.00	84.33	130.0	-	-	-	166.6	165.0	55.00	10.0
The 2 nd L.	2.33	17.66	21.33	54.33	30.00				35.33	169.6	32.33	0.0
The 1 st L.	10.3	27.33	51.33	60.33	21.33				36.66	54.33	57.00	0.0
L.S.D.0.05	7.90	10.14	16.42	N.S	25.54	-	-	-	24.26	43.62	N.S	5.58

TABLE (III a)

Effect of using old queens (24 months old), thin wax foundation sheet and site of comb foundation inside the hive on construction rate of the comb foundation.

The site of comb foundation	Wax construction area per inch ² through the period experiment											
	22/3	30/3	7/4	15/4	22/4	30/4	7/5	15/5	22/5	30/5	7/6	
The 1 st R.	0.66	22.66	22.66	9.00	21.00				17.33	22.33	0.00	
The 2 nd R.	0.00	3.66	9.66	19.66	13.33				15.33	24.66	2.00	
The middle	3.66	19.00	22.66	36.66	25.00	-	-	-	51.33	54.66	54.66	
The 2 nd L.	1.33	16.66	20.66	36.33	17.33				16.66	78.00	60.33	
The 1 st L.	2.00	18.66	28.66	28.66	19.33				11.66	33.66	30.33	
L.S.D.0.05	N.S.	8.48	N.S.	18.10	N.S.	-	-	-	19.53	N.S.	38.85	

TABLE (III b)

Effect of using old queens (24 months old), thick wax foundation sheet and site of comb foundation inside the hive on construction rate of the comb foundation.

The site of comb foundation	Wax construction area per inch ² through the period experiment											
	22/3	30/3	7/4	15/4	22/4	30/4	7/5	15/5	22/5	30/5	7/6	15/6
The 1 st R.	6.00	11.00	3.66	37.00	43.66				25.66	43.33	5.00	
The 2 nd R.	1.66	16.33	19.00	41.00	29.33				29.00	16.33	5.33	
The middle	8.33	9.33	53.66	40.33	57.66	-	-	-	24.66	116.0	93.66	-
The 2 nd L.	5.66	27.33	28.33	47.00	64.00				37.00	61.66	67.66	
The 1 st L.	8.66	23.33	73.66	64.33	37.33				22.00	45.33	42.00	
L.S.D.0.05	N.S.	N.S.	25.56	18.25	N.S.	-	-	-	N.S.	25.93	35.80	-

TABLE (IV)

Total areas of wax foundation construction through the periods of experiment.

Comb site	Thickness wax foundation	6 months old queen	12 months old queen	24 months old queen
The 1 st R.	Thin(13/inch)	129.64	150.33	95.94
The 2 nd R.		156.65	104.33	88.33
The middle		246.33	366.22	267.63
The 2 nd L.		219.94	167.97	241.33
The 1 st L.		164.64	212.7	172.96
The 1 st R.	Thick (11/inch)	187.97	237.31	203.31
The 2 nd R.		268.98	208.33	157.98
The middle		581.63	771.72	403.63
The 2 nd L.		369.93	476.63	339.3
The 1 st L.		237.98	427.96	316.64

TABLE (V)

Effect of the colony queen age on the amount of produced wax.

No. of colony	Queen age		
	6 month	12 month	24 month
1	80	98	56
2	79	115	87
3	100	89	89
4	68	98	67
5	86	99	67
6	77	96	59
7	87	100	87
8	78	88	77
9	76	97	65
10	97	129	67
Total	846	1006	721
Average	84.6	100.6	72.1

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