



EFFECT OF BROOD AREA ON HONEY YIELD UNDER LUXOR GOVERNORATE CONDITION, UPPER EGYPT.

*Hosafy M. Eshbah⁽¹⁾, Adel R. Hassan⁽¹⁾, Mohamed A. Atalla⁽¹⁾,
El sayed E. Hagag⁽²⁾, and Sayed M. Amer⁽²⁾*

⁽¹⁾Plant Protection Dept., Faculty of Agriculture, Minia Univ.

⁽²⁾Honey Bee Res. Dept., Plant Protection Inst., Agric. Res. Center.

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ABSTRACT

Thirty-six of first hybrid carniolian bee colonies (*Apis mellifera* L.) with four ,six ,seven and nine brood combs covered with bee workers were prepared before honey flow in early spring. Colony parameters pollen and honey areas, were the same for all the groups. Results obtained in the first season (2012) showed that Esna district recorded the highest yield of honey. About 4.4, 7.6, 10.9 and 16. 5 kg/colony were extracted during the first season when the number of brood combs were 4, 6, 7 and 9/colony, respectively. While Elqurna location recorded the lowest honey yields were 3.1, 5.5, 8.1 and 12.9 kg/colony when the number of brood combs was 4, 6, 7 and 9/colony, respectively, with significant differences among them. When the number of brood combs was 9 combs/colony the highest yield of honey was recorded (12.9, 14.8 and 16.5 kg/colony) for Elqurna, Armant and Esna districts, respectively, with significant differences among all of the them.

In the second season results revealed that the highest yield of honey was recorded in Esna district. About 4.9, 7.7, 11.6 and 17.1 kg/colony were recorded when number of brood combs were 4, 6, 7 and 9/colony, respectively. While Elqurna district recorded the lowest honey yield which were 3.5, 5.9, 9.3 and 13.6 Kg/colony when the numbers of brood combs were 4, 6, 7 and 9/colony, respectively, with significant differences among them. When the number of brood combs was 9 combs the highest yield of honey was recorded 13. 60, 15.40

and 17.10Kg/colony) for Elqurna, Armant, and Esna districts, respectively, with highly significant differences

The same trend was observed at Armant location, where colonies of 9 brood combs produced more than three times that amount of honey produced by those colonies of 4 brood combs and double the amount of those colonies having 6 brood combs. Esna was the best district for floral sources followed by Armant and El qurna district. There was a positive correlation between brood rearing activity of honey bee colonies and their productivity.

Keywords: Brood area, Honey yield, Nectar collection.

INTRODUCTION

Honey is natural complex food product produced by bees from nectar of plants. pollen collection, brood production and honey yield is affected by many factors such as nectar and pollen flora (Taha et al.,2009), and colony strength (Georgijev et al.,2003). The amount of pollen and brood in the colony reflects its status and can be used to expect the honey yield produced at the end of the season. Several investigators have proved positive correlation between brood production and honey yield (Jevtic et al., 2009). The weakness of honey bee colonies has become a dominant feature for the colonies not only in governorates of Upper Egypt but also in most of the other governorates in Egypt which reflect low productivity of the honey bee colonies comparing with the mean of international production, Therefore, the present study aimed to investigate the relationship between brood rearing activity and honey yield of honey bee colonies under Luxor governorate conditions.

MATERIALS AND METHODS

The present study was carried out in three private apiaries located in three

different districts (Elqurna, Armant and Esna) in Luxor governorate (Upper Egypt). Different trials were carried out during two successive seasons started in early spring from the beginning of February till the end of October during 2012-2013 seasons.

Preparation of experimental honey bee colonies:

Thirty-six of first hybrid carniolian bee colonies (*Apis mellifera* L.) were provided with four ,six ,seven and nine sealed brood combs, The stored areas of pollen, honey were the same for all groups, which were used for conducting the trials of the present work. The experimental colonies were headed with sister mated queens in the same age.

Sealed brood areas measurement:

The sealed brood areas of the tested colonies were measured after two weeks from preparation by using a langstroth wire grid frame divided into 1 sq. inch as described by Jeffree, (1958) every 12 days intervals, during the experimental period and monthly means of sealed brood area were calculated.

Honey yield detremination:

At the end every honey flow during the active season, the sealed

honey combs were got out from tested hives and weighted. The honey combs were subjected to the extraction procedures and reweighed again. The honey yield was calculated as the difference between the weight of honey

combs before and after extraction. Mean production of the honey yield per colony was calculated (Hassan, 2007). Honey was extracted three times year as described in Table (1).

Table (1): Description of honey extraction.

District	Number of honey extraction	Type of honey source	Date of honey extraction
El qurna	3	Clover1 (<i>Trifolium alexandrinum</i>)	22 May 2012, 2013
		Clover2 (<i>Trifolium alexandrinum</i>)	25 June 2012, 2013
		Sesame (<i>sesamum indicum</i>)	10 September 2012, 2013
Armant	3	Clover1 (<i>Trifolium alexandrinum</i>)	22 May 2012, 2013
		Clover2 (<i>Trifolium alexandrinum</i>)	25 June 2012, 2013
		Sesame (<i>sesamum indicum</i>)	10 September 2012, 2013
Esna	3	Citrus (<i>Citrus sp</i>)	28 April 2012, 2013
		Alfalfa (<i>Medicago sativa</i>)	15 July 2012, 2013
		Banana (<i>Musa sp</i>)	15 September 2012, 2013.

Statistical Analysis.

The obtained data were subjected to analysis of variance and the difference among treatment means were compared according to least significant difference test(LSD) .Also, simple correlation was estimated according to the method of Mead et al. (1993) .

RESULTS AND DISCUSSION

Flactuation of brood areas:

Data presented in Table (2) and Figure (1a,b,c) showed the various areas of brood of honey bee colonies for different districts during the first season (2012) In the beginning of the experiment in February, at Esna district the honey bee colonies having 9 combs reared the highest area of brood(31.16 sq. inch/colony), in comparison to 15.56 sq. inch/colony for those having 4 combs.

Areas of brood reared by the other colonies which have different number of brood combs came in between the two levels mentioned above (Table 2), followed by the colonies located at Armant district which produced 17.22, 25.47, 27.32 and 29.01 sq. inch/colony by the colonies having 4, 6, 7 and 9 brood combs, respectively, while the lowest brood area was recorded in the colonies located at El qurna district .The peak of brood rearing activity of the honeybee colonies was recorded in May. The highest brood areas were noticed in Esna district.The honey bee colonies reared 421.22, 404.93, 370.16 and 212.02 sq. inch/colony by the colonies having 9, 7, 6 and 4 brood combs, respectively, The same observation was recorded with Elqurna district, the colonies which started by 4, 6, 7 and 9 brood combs, reared 233.33, 296.37, 299.16 and 308.55 sq. inch/colony, respectively.

On the other hand, the lowest values of brood areas were measured in October in the three districts with same sequence mentioned before.

while the colonies located at El qurna district yielded the lowest area. The brood areas produced by the honey bee colonies belong to the last tested district came in between the two level mentioned above. In general, the honey bee colonies located at Esna district produced the highest annual total of brood area (1660.98, 1459.53, 1368.14 and 860.30 sq. inch/colony) by the colonies started with 9, 7, 6 and 4 brood combs, respectively, followed by the colonies located at Armant district, while the lowest annual total brood area was recorded by the colonies located at El qurna district

Table (3) and Figure (2a,b,c) showed the same trend of the annual total brood area in 2013 season where brood areas were 1913.55, 1703.56, 1606.46 and 1070.08 sq. inch/colony for the colonies started with 9, 7, 6 and 4 brood combs at Esna district with significant differences among values, followed by the colonies located at Armant district produced by the colonies started with 9, 7, 6 and 4 brood combs, respectively, while the lowest annual total brood area was recorded by the colonies located at El qurna district which produced 1211.33, 1098.47, 1050.91 and 837.05 sq. inch/colony by the colonies having 9, 7, 6 and 4 brood combs, respectively with significant differences between all of them.

Also the lowest value was recorded in October with the same

sequence. It was noticed that activity of the of honey bee colonies increased in the period extended from April till September with fluctuation according to the activity of nectar and pollen store, from different districts of honey bee colonies.

Data in Table (4) and Fig. (3a) of the first season (2012) revealed that, the production of the honey produced by the colonies of different strength level at Elqurna district could be arranged in the following descending order 3.07, 5.32, 8.23 and 13.11 (kg/colony) for the colonies which had 4, 6, 7 and 9 combs, respectively, Significant differences were recorded among all of them .

In the second season, (2013), data of the same Table (4) and Fig. (3b) showed that the total production of the honey yield could be arranged in the following ascending order 3.52, 6.05, 9.40 and 13.87 (kg/colony) for the colonies which started with 4, 6, 7 and 9 brood combs, respectively .

On view of the obtained results in Table (5) and Fig. (4a) of the first season (2012) at the Armant district the colonies of highest strength a level occupied the first rank of the honey production (14.60 kg/colony) however, the lowest rank of the honey production was recorded by the lowest strength level 4 combs. The production rate of the other tested colonies came in between the two levels mentioned above. In the second season (2013) data in same Table (5) and Fig. (4b) showed the same trend.

Table (2): Monthly means of brood area (sq. inch/colony) produced by honey bee colonies located at three districts in Luxor during 2012 season.

Dist.	Colony strength (combs)	Monthly means of brood area(sq. inch/colony)										Duncan's range
		Feb.	Mar.	Apr.	May.	June	July	Aug.	Sep.	Oct.	total	
El qurna	4	12.12	13.71	112.25	233.33	106.23	15.48	175.49	75.86	15.89	760.36	19.6
	6	18.32	13.85	182.11	296.37	138.19	22.19	225.31	118.86	29.89	1045.09	
	7	19.96	15.71	189.33	299.16	141.98	25.22	231.67	121.67	35.71	1080.41	
	9	25.44	17.58	216.89	308.55	164.40	31.46	241.21	130.48	43.39	1179.40	
Armant	4	17.22	10.85	145.28	224.56	112.56	14.64	195.25	126.22	24.35	866.05	18.82
	6	25.47	15.59	220.63	348.15	159.33	27.98	264.25	169.19	43.27	1273.86	
	7	27.32	16.15	229.41	366.22	165.71	29.29	271.67	172.16	47.35	1325.28	
	9	29.01	19.89	242.58	384.29	175.96	40.74	278.96	190.64	51.47	1413.55	
Esna	4	15.56	7.65	185.58	212.02	95.56	22.52	179.25	109.23	32.93	860.30	93.61
	6	29.01	13.65	232.58	370.16	177.51	38.68	289.22	170.92	46.41	1368.14	
	7	29.56	18.29	239.38	404.93	178.75	40.52	308.08	186.35	53.67	1459.53	
	9	31.16	22.93	252.41	421.22	211.37	69.39	339.15	237.42	75.93	1660.98	

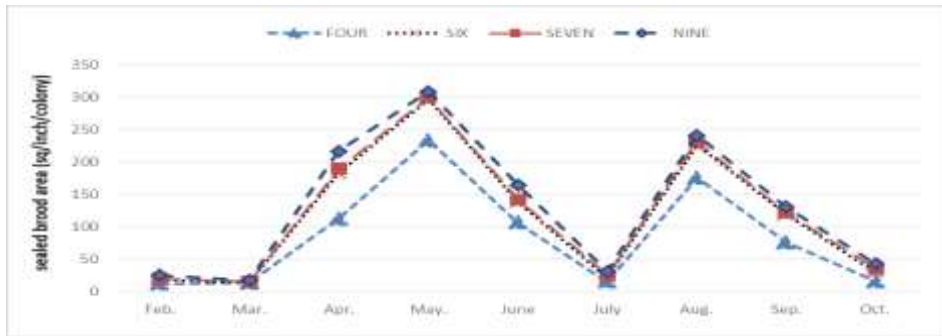


Fig. (1a): Monthly means of brood area (sq. inch/colony) produced by bee colonies located at Elqurna district in Luxor, 2012 season.

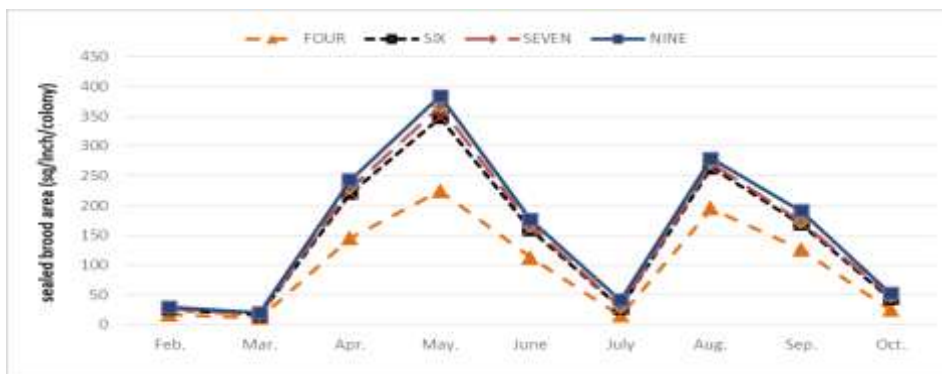


Fig. (1b): Monthly means of brood area (sq. inch/colony) produced by bee colonies located at Armant district in Luxor, 2012 season.



Fig. (1c): Monthly means of brood area (sq. inch/colony) produced by bee colonies located at Esna district in Luxor, 2012 season.

Table (3) Monthly means of brood area (sq. inch/colony) produced by first hybride honey bee colonies located at three districts in Luxor during 2013 season.

Dist.	Colony strength (combs)	Monthly means of brood area(sq. inch/colony)										Duncan's range
		Feb.	Mar.	Apr.	May.	June	July	Aug.	Sep.	Oct.	Total	
El qurna	4	5.72	7.32	198.25	211.59	89.82	12.45	148.11	86.56	77.23	837.05	44.7
	6	7.78	9.02	288.72	301.22	117.97	16.45	186.11	104.56	19.08	1050.91	
	7	10.56	10.53	292.12	310.44	122.82	17.33	197.20	115.41	22.06	1098.47	
	9	11.24	12.04	311.42	337.33	139.97	24.57	208.68	138.71	27.37	1211.33	
Armant	4	9.01	11.98	232.15	269.40	97.32	17.26	129.33	106.22	22.29	894.96	49.26
	6	12.33	15.98	302.15	383.65	165.21	25.26	203.33	144.65	31.15	1283.71	
	7	14.67	19.21	344.19	393.40	180.32	30.27	229.67	161.22	37.43	1410.38	
	9	17.01	22.44	380.11	397.96	198.43	38.28	265.01	180.79	44.74	1544.77	
Esna	4	14.22	19.75	257.23	286.12	135.22	22.44	177.26	128.61	29.23	1070.08	223.5
	6	19.17	27.71	393.79	428.65	216.68	36.41	256.79	188.48	38.78	1606.46	
	7	20.51	30.57	408.93	444.22	225.56	42.33	278.99	203.16	49.29	1703.56	
	9	23.83	39.43	436.07	495.79	246.44	66.25	304.19	232.84	68.71	1913.55	

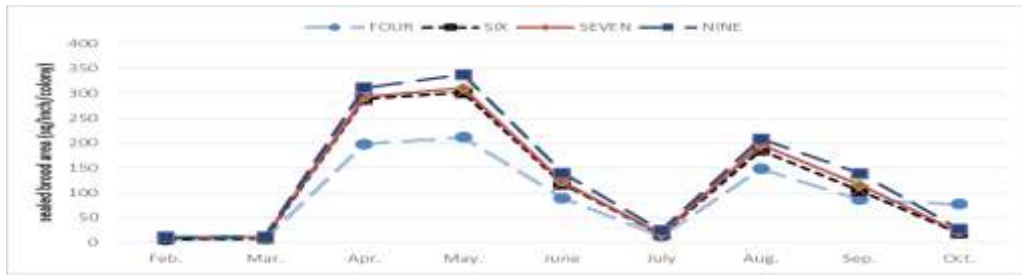


Fig. (2a): Monthly means of brood area (sq. inch/colony) produced by bee colonies located at Elqurna district in Luxor, 2013 season.

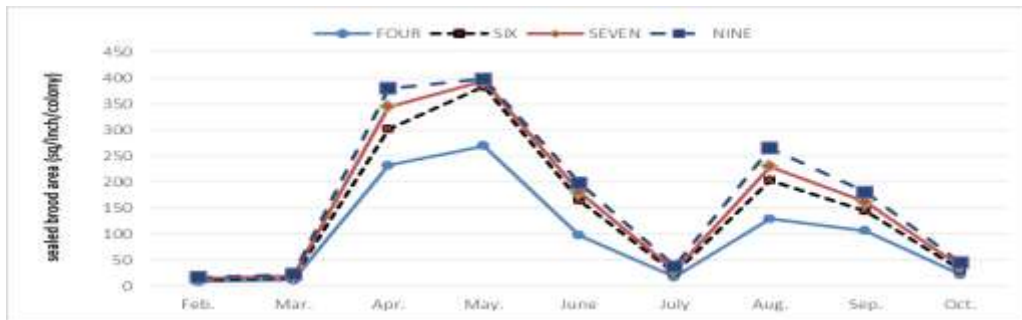


Fig. (2b): Monthly means of brood area (sq. inch/colony) produced by bee colonies located at Armant district in Luxor, 2013 season.

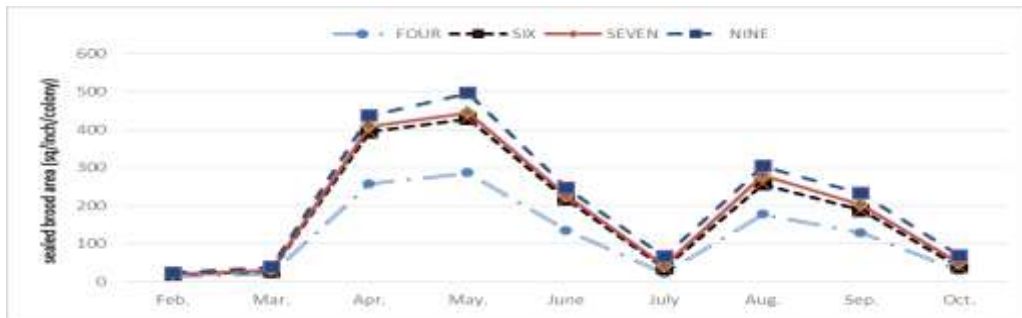


Fig. (2c): Monthly means of brood area (sq. inch/colony) produced by bee colonies located at Esna district in Luxor, 2013 season.

Table (4): Means of honey yield (kg/colony) produced by four levels of colony strength at El qurna district in the 2012-2013 season.

Number of brood combs	Mean of honey production (kg/colony) of 2012 season				Mean of honey production (kg/colony) of 2013 season				
	Clover1	Clover2	Sesame	Total	Clover1	Clover2	Sesame	Total	
Four	0.35	1.69	1.02	3.07	0.42	1.89	1.20	3.52	
Six	0.73	2.72	1.86	5.32	0.84	2.75	2.46	6.05	
Seven	1.57	3.55	3.12	8.23	1.33	3.99	4.09	9.40	
Nine	2.33	5.97	4.81	13.11	2.26	6.95	4.66	13.87	
L.S.D	0.05	0.163	0.217	0.309	1.126	0.259	0.236	0.363	1.509

Table (5): The mean of honey yield (kg/colony) produced by four levels of unsealed brood area of bee colonies located at Armant district in the 2012seasons.

Number of brood combs	Means of honey production (kg/colony)								
	2012				2013				
	Clover1	Clover2	Sesame	Total	Clover1	Clover2	Sesame	Total	
Four	0.45	1.93	1.59	3.97	0.52	2.14	1.51	4.17	
Six	0.95	3.12	2.76	6.83	0.95	3.56	2.63	7.13	
Seven	1.84	4.01	3.60	9.45	1.52	5.32	3.52	10.36	
Nine	2.89	6.48	5.23	14.60	2.44	7.42	5.00	14.86	
L.S.D	0.05	0.29	0.36	0.49	1.15	0.29	0.32	0.23	1.16

Data in Table (6) and Fig.(5a) of the first season (2012) revealed that, the honey produced by the colonies with different brood level at Esna district could be arranged in the following Ascending order 4.58, 7.82, 10.97 and 16.48 (kg/ colony) for the colonies having 4, 6, 7 and 9 brood combs, respectively, with significant differences among all of them. In the second season (2013), data in the same Table (6) and Fig.(5b) showed that the total honey production could be arranged in the following Ascending order 4.90, 7.83, 11.83 and 17.25 (kg/ colony) for the colonies having 4, 6, 7 and 9 brood combs, respectively .

In the first season (2012) data presented in Table (7) and Fig.(6) referred to the importance of brood area for encouraging bees to collect honey at different locations of the study. At Esna district, the colonies having 9 combs collected the highest amount of honey (16.5 Kg/colony), in comparison to 4.4 Kg/colony for those colonies which started with 4 brood combs before honey flow .Yields of honey collected by the other colonies having different number of brood combs came in between the two levels mentioned above .

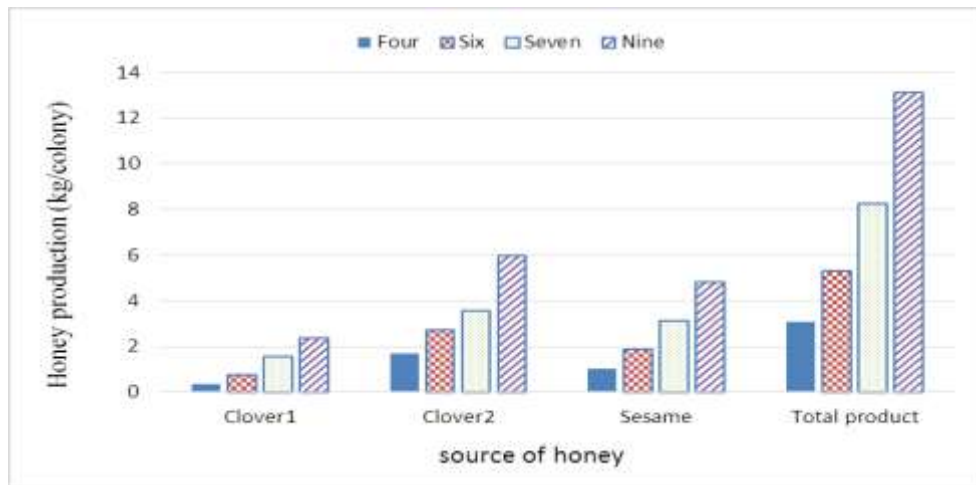


Fig.(3a): Means of honey yield (kg/colony) produced by four levels of colony strength at El qurna district in the 2012season.

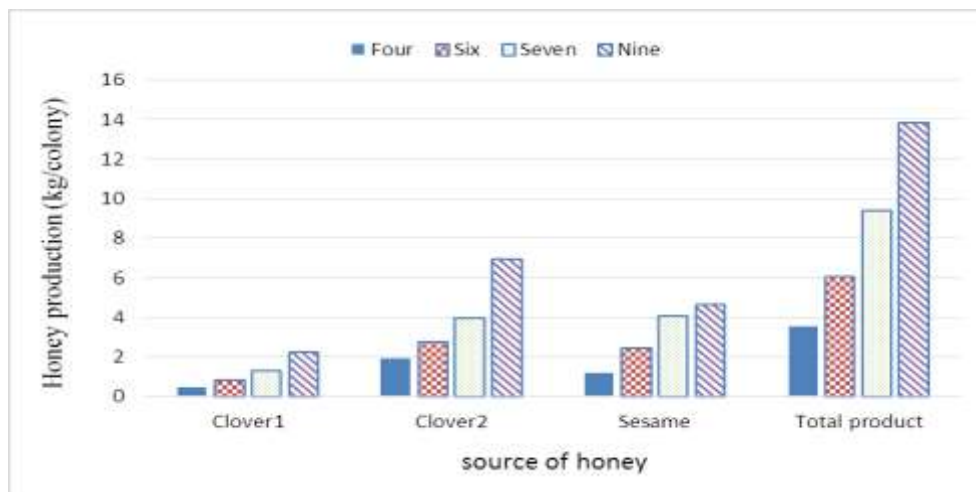


Fig. (3b): Means of honey yield (kg/colony) produced by four levels of colony strength at El qurna district in the 2013season.

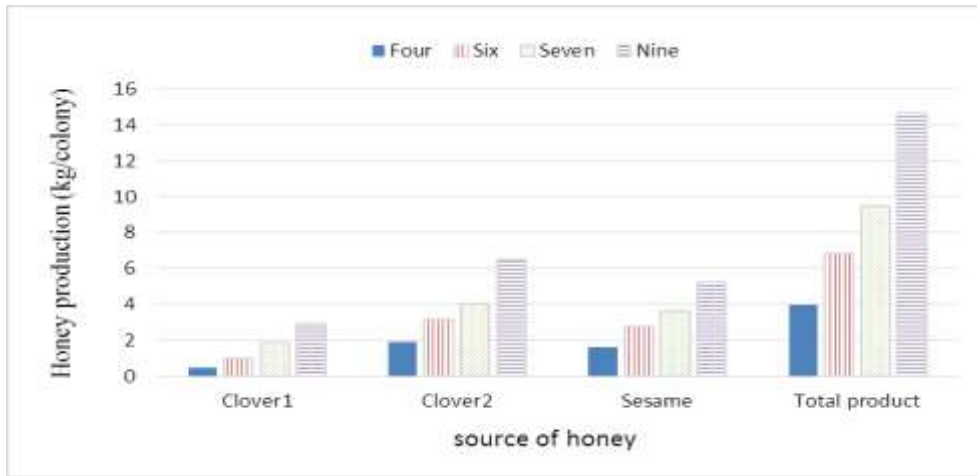


Fig.(4a): Means of honey yield (kg/colony) produced by four levels of colony strength at Armant district in the 2012season.

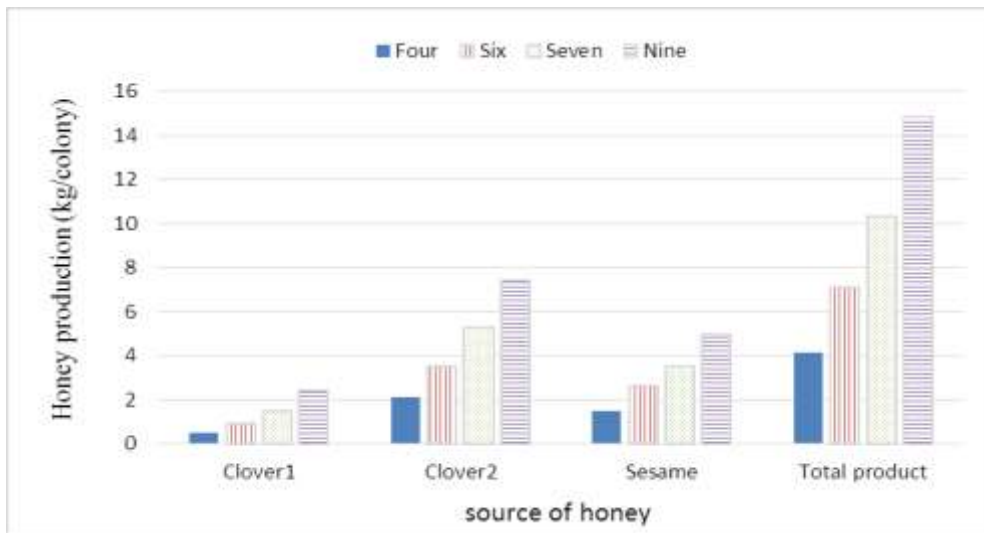


Fig.(4b): Means of honey yield (kg/colony) produced by four levels of colony strength at Armant district in the 2013 season.

Table (6): Means of honey yield (kg/colony) produced by four levels of colony strength at Esna district in the 2012-2013 seasons.

Number of brood combs	Mean of honey production (kg/colony)							
	2012				2013			
	Citrus	Alfalfa	Banana	Total	Citrus	Alfalfa	Banana	Total
Four	0.86	1.99	1.72	4.58	0.98	2.41	1.51	4.90
Six	1.72	3.70	2.40	7.82	1.86	3.73	2.24	7.83
Seven	2.17	4.98	3.82	10.97	2.96	5.25	3.62	11.83
Nine	3.72	7.52	5.24	16.48	4.03	7.99	5.23	17.25
L.S.D	0.05	0.37	0.19	0.45	2.07	0.61	1.07	0.43

Table (7): Effect of colony strength level on honey yield (kg / colony) during 2012 season.

COMB	El qurna	Armant	Esna	MEAN	LSD*
4	3.10	3.90	4.40	3.80	1.01
6	5.50	6.80	7.60	6.63	2.24
7	8.10	9.30	10.90	9.43	1.61
9	12.90	14.80	16.50	14.73	2.06
MEAN	7.40	8.70	9.85		
LSD*	1.67	1.24	1.94		

* L.S.D least significant difference.

Table (8): Effect of colony strength level on honey yield (kg / colony) during 2013 season.

COMB	El qurna	Armant	Esna	MEAN	LSD*
FOUR	3.50	4.20	4.90	4.20	1.16
SIX	5.90	7.10	7.70	6.90	0.72
SEVEN	9.30	10.50	11.60	10.47	NS
NINE	13.60	15.40	17.10	15.37	1.24
MEAN	8.08	9.30	10.33		
LSD*	1.46	0.96	1.28		

*L.S.D least significant difference.

At the same time, the colonies of different brood areas at Elqurna district showed the same trend, where increasing of honey collection was always related with increasing of brood rearing activity. The amounts of collected honey of the colonies having 4, 6, 7 and 9 combs were, 3.10, 5.50, 8.10 and 12.90 Kg/colony, respectively.

In the second season (2013), the total amount of honey harvested by the experimental bee colonies was (in general) more than those amounts that were collected in the first season. Results of Table(7) and Fig. (6) revealed that in general, the bee colonies located at Esna district collected more amount of honey than the other two locations, also the colonies having more brood combs collected more amount of honey.

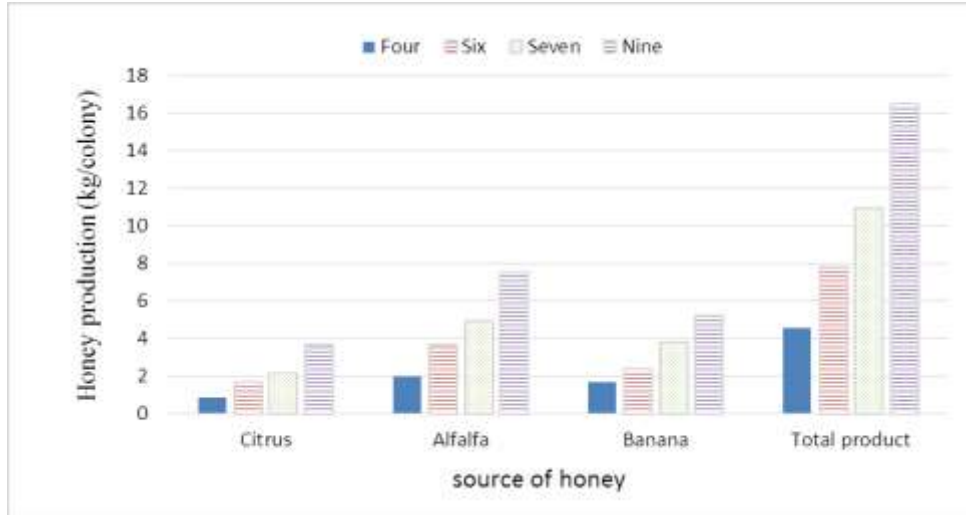


Fig. (5a): Means of honey yield (kg/colony) produced by four levels of colony strength at Esna district in the 2012season.

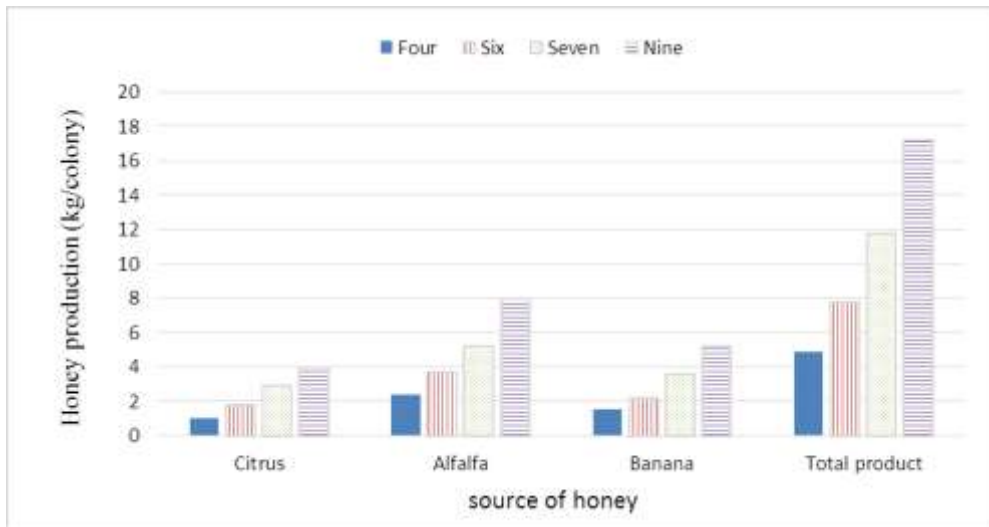


Fig. (5b): Means of honey yield (kg/colony) produced by four levels of colony strength at Esna district in Luxor region in the 2013season.

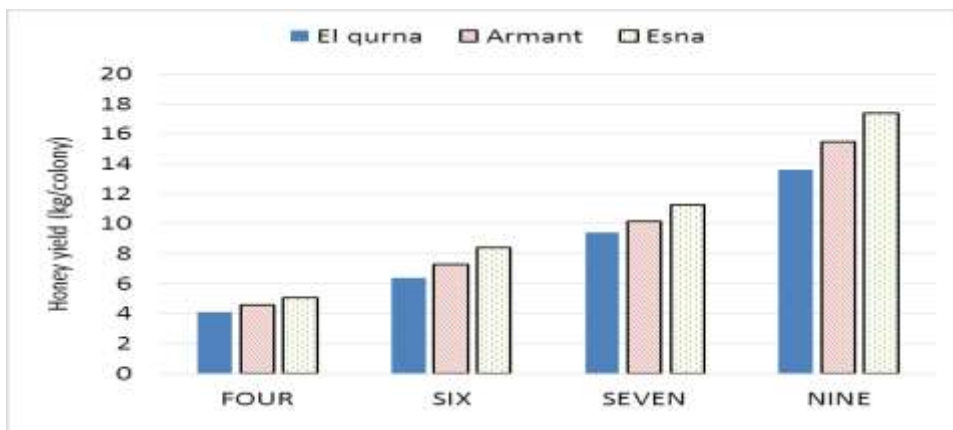


Fig. (6): Effect of colony strength level on honey yield (kg / colony) during 2012 season.

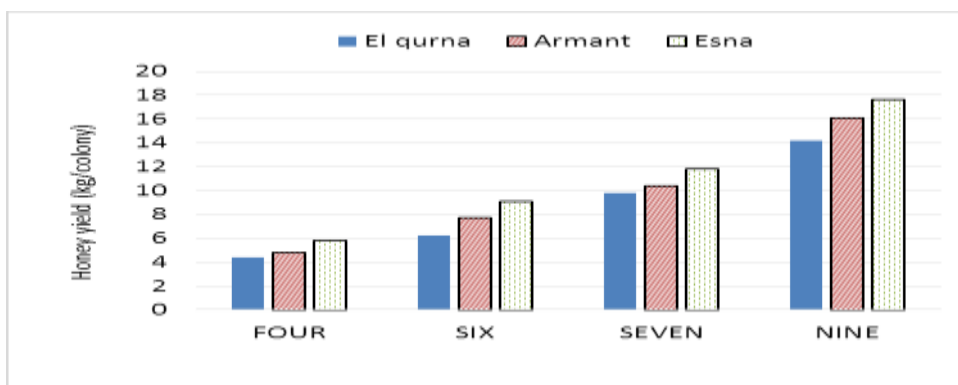


Fig. (7): Effect of colony strength level on honey yield (kg / colony) during season 2013.

In Esna district colonies at first strength level (9 combs) collected 17.10 kg honey/colony, followed by those colonies of second level of strength (7 brood combs) 11.60 kg honey/colony, then those colonies having 6 combs (7.70 kg/colony), while colonies having 4 combs came in the last rank (4.90 Kg/colony). The same observation was recorded with other two districts (Armant and Elqurna).

Viewing the obtained data from the statistical view point revealed that in both first and second seasons, there was a highly significant positive correlation (0.858 and 0.866, respectively) between activity of the brood areas and honey production.

It is clear from the obtained data that colony strength level positively affects the activity of nectar collection which may be due to the increment of foragers number during honey flow,

These results are some how in agreement with Eckert *et al.* (1994) who studied the effect of colony size on the behavior of individual nectar and pollen foragers, and found that individuals from large colonies made

longer foraging trips than those from small collected larger loads. These results indicated that the number of forgers from large colonies tend to high which gain more nectar.

Table (9): Correlation coefficient values between honey bee colony strength and honey yield in three districts in Luxor at 2012- 2013 seasons.

Comparisons	(r) values	
	2012	2013
El qurna	+0.844**	+0.854**
Armant	+0.830**	+0.851**
Esna	+0.902**	+0.894**

** High Significant (p<0.01)

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الملخص العربي

تأثير مساحة الحضنة على محصول العسل تحت ظروف محافظة الأقصر- مصر العليا.

حصافي محمد كمال الدين عشبه(1)، عادل رشدي حسن(1)، محمد أبو زيد عطالله(1)، السيد ابراهيم حجاج(2)، سيد محمد عامر(2).

(1) قسم وقاية النباتات، كلية الزراعة، جامعة المنيا.

(2) قسم بحوث النحل، معهد وقاية النباتات، مركز البحوث الزراعية.

تناولت هذه الدراسة تقدير نشاط طوائف نحل العسل من حيث كمية العسل المنتجة من هذه الطوائف في ثلاث مناطق من محافظة الأقصر وهي القرنة وأرمنت واسنا وذلك باستخدام عدد 36 طائفة هجين الأول لنحل الكرنولي مقسمة الى ثلاث مجموعات على مدار العام. وقد استغرقت الدراسة موسمين متتاليين (2012 ، 2013 م) حيث تم قياس تأثير مساحة الحضنة على كمية العسل المنتجة من الطوائف وذلك باستخدام أربعة مستويات من الحضنة (4؛ 6؛ 7؛ 9 أقراص حضنة / الطائفة). وقد سجلت النتائج ان الطوائف ذات 9 اطارات قد جمعت اعلى معدل سنوي في منطقة اسنا بمتوسط 16,5 كجم / طائفة/سنه، تبعثها الطوائف المحتوية على سبعة اقراص من الحضنة 10,9 كجم / طائفة/سنه، وحلت الطوائف المحتوية على ستة اقراص من الحضنة في الموضوع قبل الاخير بين الطوائف المختبرة لكمية العسل المنتجة 7,6 كجم / طائفة/سنه، بينما اتت في المركز الاخير(4,4 كجم / طائفة/سنه) الطوائف التي زودت في البداية باربعة اقراص من الحضنة. واستمرار لنشاط الطوائف المحتوية على تسعة فقد حلت على راس الطوائف التي جمعت اعلى معدل سنوي في منطقة اسنا 16,5 كجم / طائفة/سنه تبعثها الطوائف الموجودة في ارمنت 14,8 كجم / طائفة/سنه ثم الموجودة في منطقة القرنة 12,9 كجم / طائفة/سنه. في الموسم الثاني وجد ان اكبر معدل سنوي من العسل قد تحقق أيضا في منطقة اسنا حيث سجلت الطوائف 17,1، 11,6، 7,8 ، 4,9 كجم / طائفة لكل من الطوائف المحتوية على تسعة ، سبعة ، ستة ، واربعة اقراص من الحضنة ، على الترتيب بينما حققت منطقة القرنة أيضا اقل معدل سنوي من العسل وكانت النتائج 13,6 ، 9,3 ، 5,9 ، 3,5 كجم / طائفة/سنه لكل من الطوائف المحتوية على تسعة ، سبعة ، ستة ، واربعة اقراص من الحضنة ، على الترتيب. وكذلك ايضا كانت نتائج الطوائف الموجوده في منطقة ارمنت حيث جمعت الطوائف المحتوية على 9 اقراص على اكثر من ثلاث اضعاف كمية العسل المنتجة من الطوائف المحتوية على 4 اقراص وعلى ضعف كمية العسل المنتجة من الطوائف المحتوية على 6 اقراص. وفي نفس الاتجاه الايجابي كانت الطوائف المحتوية على 9 اقراص حيث انتجت اعلى معدل سنوي من العسل و سجلت 13,6 ، 15,4 ، 17,1 كجم / طائفة في كل من القرنة وارمنت واسنا على الترتيب مع وجود فروق معنوية بينها. كذلك وجد ان منطقة اسنا هي الافضل بين المناطق الثلاث من حيث توافر مصادر الرحيق مع وجود ارتباط ايجابي بين النشاط في تربية الحضنة وبين كمية العسل الناتجة من الطوائف.

الكلمات الدالة : مساحة الحضنة ، انتاجية العسل ، جمع العسل .