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EFFECT OF SHADING ON HONEYBEE COLONIES BROOD REARING ACTIVITY AND HONEY PRODUCTION

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ABSTRACT

The present study was designed and performed to evaluate the effect of shading honeybee colonies on their brood rearing activity and honey production in a private apiary located at Zagazig district during 1999 / 2000. Results obtained could be summarized as follows:

*** Brood rearing activity**
- The highest brood rearing activity was recorded during spring, whereas the least was in autumn. In addition, test colonies manifested three annual peaks during the 1st week of April, late May and early June and around mid August.
- Honeybee colonies placed in unshaded (open) location with southern entrance showed the highest brood rearing activity, whereas the least activity was recorded for those placed in shade with southern entrance.
- A positive correlation was detected between air temperature inside the hive and brood rearing activity, whereas the correlation of this activity with RH% inside the hive was negative.

***Honey production**
- Bee colonies placed in unshaded (open) place produced significantly higher honey yield than those placed in shade. Moreover, the direction of hive entrance had its effect only on the colonies placed in the open.
- A significant positive correlation was detected between the total sealed worker brood area in the colonies during winter and spring, and the

clover honey yield. The same trend was also detected between the total sealed brood area during summer and cotton honey yield.

Key words: *Apis mellifera ,brood rearing activity, honeybee colonies, honey production.*

1.INTRODUCTION

One of the main aims of the ecological studies is to determine the most suitable habitat for an organism to survive and to reproduce to maintain its kind.

Honeybees are cold-blooded animals living outdoors. So, they are greatly affected by the changes in the climate because they are obligated to adapt their microclimate to be suitable for themselves and their brood (Southwick, 1991)

From this standpoint, the present work was designed to investigate the effect of placing honeybee colonies in open and shaded locations with southern and eastern entrances on year round brood rearing activity and on honey production.

2. MATERIALS AND METHODS

The present investigations were carried out in a private apiary located at Zagazig district, Sharkia Governorate during 1999/2000 season.

Test honeybee colonies

Sixteen honeybee (*Apis mellifera* L.) nuclei were founded during January 1999 by division of strong colonies. Sixteen mated localized Carniolan sister queens from El-Manzalah district were introduced into the established nuclei. After queens acceptance, the tested nuclei were divided into four groups of four colonies each and installed as follows:

Group A: Colonies placed in a sunny (unshade) location with hive entrance towards the south direction.

Group B: As group (A) but with eastern entrance.

Group C: Colonies were placed in shaded location with southern direction.

Group D: As group (C) but with eastern entrance.

All the experimental nuclei were equal in strength, number of combs covered with bees, brood, stored honey and bee bread as possible.

During autumn and winter seasons the test colonies were provided with pollen substitute patties when necessary to maintain colonies survival and to encourage brood rearing.

Measurements of relative humidity inside the hives inhoused by the test colonies and air temperature inside the brood nest and inside the hive in the empty space were recorded at 2-hour intervals a day weekly from 7 a.m. to 5 p.m. for the period of study. The temperature was measured by thermometers inserted into the hive in the brood nest through a 1 cm diameter holes in the back wall of the hive. RH% was measured by hygrometers left inside the hives.

2.1. Evaluation of brood rearing activity

The areas of workers sealed brood cells in the test colonies were measured separately at twelve-day intervals during spring, summer, autumn and winter seasons of 1999/2000. The measurements were taken by the aid of Hoffman frame divided into square inches. On measuring covering brood bees combs were firstly shaken off, then sealed brood areas on both sides of each comb were measured, thereafter, the comb was replaced in the hive before taking out another one (El-Shakaa, 1985).

2.2. Estimation of honey yield

Clover and cotton honey yields produced by the test colonies were harvested in the second week of June and in the last week of August 1999 for the two honey yields, respectively. Estimating honey yield for each colony was made individually (in kg/colony) by calculating the difference between the weight of honey combs before and after honey extraction. The extracted combs were then returned back to their respective colonies.

The different possible correlation coefficient values between the studied parameters and each of inside hive air temperature and relative humidity were calculated

Data obtained were statistically analyzed according to Snedecor (1957) methods.

3.RESULTS AND DISCUSSION

3.1.Brood rearing activity

Data presented in Table(1) indicated that the highest total brood area reared by the test colonies was recorded during spring followed

Table (1): Sealed brood area (inch^2 /colony) reared by honeybee colonies placed in open and shaded locations facing both south and east directions measured at 12-day intervals during the four seasons of 1999 / 2000.

Locations & Directions	Open & Southern	Open & Eastern	Shaded & Southern	Shaded & Eastern	Locations & Directions	Open & Southern	Open & Eastern	Shaded & Southern	Shaded & Eastern
Date					Date				
Spring season 1999					Autumn season 1999				
21/3/1999	174.76	151.25	120.99	124.45	29/9/1999	121.34	116.36	93.68	97.84
2/4	217.61	210.37	187.84	183.11	11/10	75.86	71.40	52.60	67.21
14/4	198.58	194.51	177.76	172.42	23/10	59.42	55.55	42.95	50.99
26/4	148.63	157.08	118.82	134.57	4/11	73.93	71.01	53.49	61.04
8/5	175.79	166.60	134.99	150.17	16/11	91.40	82.24	63.24	71.64
20/5	179.45	170.67	154.09	155.93	28/11	94.67	87.11	66.58	76.33
1/6	208.28	177.94	178.96	172.12	10/12	101.24	94.24	72.50	81.18
13/6	147.25	140.64	125.45	132.04					
Total	1450.35	1369.06	1198.90	1224.81	Total	617.86	577.91	445.04	506.23
Summer season 1999					Winter season 1999/2000				
25/6/1999	126.61	120.96	108.81	114.90	22/12/1999	77.44	66.68	55.36	64.58
7/7	149.27	134.90	120.44	132.47	3/1/2000	74.03	64.53	52.39	61.61
129/7	155.42	140.48	127.59	137.09	15/1	104.33	98.25	84.38	89.73
31/7	169.78	159.30	140.32	154.79	27/1	116.96	111.99	96.49	103.43
12/8	181.80	166.83	158.37	160.67	8/2	133.74	124.45	112.84	118.63
24/8	177.03	165.50	153.24	157.81	20/2	141.44	133.94	116.57	120.71
5/9	171.95	162.04	146.09	148.81	4/3	143.88	131.64	112.69	124.07
17/9	160.78	148.55	139.25	143.24	16/3	150.38	140.49	121.04	133.42
Total	1292.64	1198.56	1094.11	1149.78	Total	942.20	871.97	751.76	816.18

L.S.D 0.05 = 11.21 3.84 4.47 and 3.45 For spring, summer , autumn and winter seasons, respectively.
0.01 = 15.26' 5.22' 6.11 4.69

The r values between temp. inside hive and sealed brood area were 0.802, 0.808, 0.739 and 0.883 while it recorded –0.675, –0.964*, - 0.738 and –0.827 with R.H.% in the four respective seasons.

descendingly by summer, winter then autumn seasons. It seemed that abundance of food sources and the more suitable weather factors were the main factors affecting brood rearing activity. For instance, there were two main flows during spring, i.e. citrus during the second half of March and early April and Egyptian clover during May and the first half of June (El-Dakhakhni 1980). The two crops supply bees with both nectar and pollen in addition to the prevailing weather factors which are considered the more suitable to both bees foraging activity and nectar secretion by the plants of the two crops. Similarly, cotton and maize were the two sources of nectar and pollen available to bees, respectively during summer.

This finding is in agreement with Woyke (1977) and Hussein (1992) who agreed that brood rearing activity of bee colonies was considerably higher during main flows as compared to this activity during the dearth periods.

Two peaks of brood rearing activity were detected during spring season, the first was noticed during the first week of April while the second was recorded during late May and early June. This coincides with the citrus and Egyptian clover flows, respectively. Another but smaller peak was detected around mid August coinciding with availability of maize pollen.

These results were in partial accordance with those of Hassan (1997), El-Shakaa (1985), Darhoos (1990), and Abd-Alla (1997) who recorded the same peaks with little variation.

A serious reduction in brood rearing was noticed at the beginning of Autumn until recording the lowest activity during the last week of October. This remarkable drop could be attributed to many factors such as the shortening of day length (photoperiod). Avitabile(1987) and Hassan (1997) agreed that decreasing day length had an inhibitory effect on brood production while increasing day length was stimulating. In addition, the shortage of food sources in the field, and the food stores inside the hive had an adverse effect on brood rearing activity (Schneider and Mcnally, 1992). Moreover, the higher rates of Nosema, Amoeba and Varroa mites infection during season are reported to be another decreasing brood rearing activity (Ritter, 1994 and Mattar, 1996). Furthermore,the cold autumn weather as well as the reduced brood nest temperature seemed to markedly affect brood production. This conclusion is in agreement with that of El-Dakhakhni (1980), taken into consideration the occasionally cold spring season. Meanwhile, in winter the colonies are already

treated against Nosema and Varoa and there are many sources of food supply (winter crops; pea, raspberries, lentil broad bean, Brassica spp and winter herbs) which considered great sources of pollen, In addition to the longer day length.

In this connection, Darhoos (1990) found that brood rearing activity was the highest during summer and the lowest in winter. Moreover, he detected positive correlation between air temperature and brood rearing activity; whereas a negative correlation was detected between RH and brood rearing activity during spring and autumn.

The direction of hive entrance has its effect in this respect. For instance, bee colonies placed in shade facing south reared more brood than those in the same place facing east in all seasons of the year. The reverse was noticed in case of the colonies placed in open (unshade) location.

3.2. Honey production

Data in Table (2) clearly indicated that bee colonies placed in the open yielded significantly more clover and cotton honey than those placed in shaded location. Moreover, the direction of the hive entrance had its effect, especially for the colonies placed in the open

Data of the present work concerning clover and cotton honey yield are in partial accordance with those of Yousif-Khalil and Shalaby (1992), Mattar (1996), Abd-alla (1997), Hassan (1997) and Khater (1998).

It seems that placing bee colonies in a sunny location during winter (cold season) creates warm conditions so the colonies possessed more field bees during flow, which enables such colonies to produce higher honey yields. This finding is in parallel with that of Vesely (1976).

A significant positive correlation was detected between the total sealed brood area in the colonies during winter and spring and the clover honey yield of such colonies. The same trend also was detected between the total sealed brood area during summer and the cotton honey yield.

The significant positive correlation reported in the present work between honey yield and brood area was also reported by Szabo and Lefkovitch (1995) and Hassan (1997). On the other hand, Nelson and Gery (1983) stated that honey yield is not correlated with brood area and colony weight.

The same trend was also reported by Hassan (1997) who added that the stronger colonies, initiated early in the season survived the cold

Table (2): Clover and cotton honey yields produced by the tested honeybee colonies placed in different locations and directions during 1999 season.

Location & direction	Open & Southern		Open & Eastern		Shaded &Southern		Shaded & Eastern		L.S.D	
Honey yield	Range	Mean	Range	Mean	Range	Mean	Range	Mean	0.05	0.01
Clover honey	6.30-7.05	6.67	4.70-5.80	5.26	3.45-3.80	3.68	3.75-4.15	3.60	0.670	0.962
Cotton honey	3.25-3.70	3.45	2.85-3.15	3.00	2.60-3.00	2.76	2.10-3.15	2.50	0.357	0.720
Total honey yield	10.0-11.0	10.345	7.55-8.80	8.266	6.05-6.55	6.36	6.50-6.90	6.45	1.650	2.170

r-values between clover honey yield and total sealed brood area during spring and winter were 0.979* and .975*,respectively.
r-values between cotton honey yield and total sealed brood area during summer and spring were 0.947*and0.896,respectively.

season with low losses and produced higher brood than weaker colonies.

Bee colonies placed in the open location reared more brood than those placed in shade. In addition, the colonies with hive entrances directed east reared more brood than those with southern entrances for shaded colonies but not for colonies placed in open location in spring, summer and winter season. However, in autumn season the eastern entrance is the most suitable for both shaded and open colonies to rear more brood. In this connection, Khattab (1976) found that colonies in a semi-shaded place reared more brood than those placed in complete shade.

The correlation between air temperature inside the hive and brood rearing activity was positive insignificant, recording values of 0.802, 0.808, 0.739 and 0.883 during spring, summer, autumn and winter seasons, respectively. The respective r values with relative humidity were –0.675, -0.964*, -0.738 and 0.827.

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تأثير التظليل على طوائف نحل العسل
١- نشاط تربية الحضنه وانتاج العسل

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ملخص

تـم اجراء هذا البحث لدراسة تأثير وضع طوائف نحل العسل فى اماكن مظللة واخـرى مشمسـة موجهـة جهة الجنوب او الشرق على نشاط تربية الحضنة وانتاج العسـل . وقـد اجرى البحث فى منحل خاص بالزقازيق خلال المواسم الاربعة لعام ١٩٩٩/٢٠٠٠. ويمكن تلخيص النتائج كما يلى:

أ-نشاط تربية الحضنه

سـجل اعلى نشاط لتربية الحضنه اثناء موسم الربيع بينما كان الاقل فى موسم الخريف. وقد اظهرت طوائف التجربة ثلاث ذروات لهذا النشاط خلال العام وذلك فى الاسبوع الاول من شهر ابريل وفى اواخر شهر مايو واوائل يونيو وعند منتصف شهر اغسطس.

كـان نشـاط تربـية الحضنه اعلى ما يمكن فى الطوائف المعرضة للشمس وذات مداخـل جهة الجنوب بينما كان اقل نشاط للطوائف المظلله وذات مداخل جهة الجنوب. سجل ارتباط موجب بين درجة الحرارة داخل الخلية ونشاط تربية الحضنه فى حين كان الارتباط بين هذا النشاط والرطوبة النسبية داخل الخلية سالبا.

ب- انتاج العسل

كـان محصـول العسـل للطوائف المعرضة للشمس اعلى بصفة معنوية عن محصول الطوائف الموضوعة فى اماكن مظلله. وكان لاتجاه المدخل تأثيراً معنوياً فى حالة الطوائف الموضوعة فى العراء فقط.

لوحـظ وجـود ارتباط معنوى موجب بين مساحة الحضنه الكلية فى الطوائف خـلال الشـتاء والربـيع ومحصول عسل البرسيم وسجل نفس الارتباط بين مساحة الحضنة الكلية فى موسمى الربيع والصيف ومحصول عسل القطن.

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