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Effect of Different Honey Bee, *Apis mellifera* L. Colonies Strength on the Quantity of the Produced Royal Jelly

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ABSTRACT

The effect of honey bee colony strength on the quantity of the produced royal jelly was studied during spring season of 2015 using three categories (weak, medium and strong) of honey bee colonies at the apiary of Honey Bee Research Center, Faculty of Environmental Agricultural Sciences, Arish University., Al-Arish, North Sinai, Egypt.

The results showed that the strong colonies recorded the highest number and percentage of accepted queen cells that mean the highest amount of royal jelly (12.22 gm / colony), moreover good rebuilding in short time (after two brood cycles) which increased by 7 % for combs covered with bees (ccb) and 2.7 % for worker brood cells (wbc) than that of the initial state. The medium colony strength appear to be balanced either for royal jell production (9.86 gm / colony) or rebuilding which increased slightly by 3.4 % for ccb and 1.1 % for wbc than that of the initial state. On the other hand the weak colonies produced lowest quantities of royal jelly (6.1 gm / colony) moreover, it failed to reach the original status after two brood cycles (it decreased by – 5.5 % for ccb and – 15 % for wbc).

Keywords: honey bee , *Apis mellifera* L., royal jelly, colony strength

INTRODUCTION

Royal jelly is one of the most important products of honeybee colonies, and produced from hypopharyngeal and mandibular glands of small workers (6-12 days old) which called nurse bees (Deseyn and Billen, 2005 & Hassan and Khater, 2006).It is homogeneous, creamy, milky white coloured, with a slightly acid flavour and a strong and pungent odour and frequently used to boost growth of larvae in the colony(Munstedt and Georgi , 2003). It contains about 60% to 70% water, 12% to 15% proteins,10% to 16% sugar, 3% to 6% fats, and 2% to 3% vitamins, salts,and amino acids(Mohamed and Ghamdi, 2012). Dietary Fatty acids, such as 10-hydroxy-2-decanoic acid (10-HDA unique to Royal Jelly at 32% of fatty acids) and others, such as gluconic acid (24%) 10-hydroxydecanoic acid (22%) and 5% other dicarboxylic acids(Vucevic *et al*, 2007) .

Nowadays, royal jelly becomes one of the most hive-products in beekeeping and its production affected by such factors as secreting characteristics of the kinds of bee used, presence nectar and pollen, tolls like queen cell cup and transfer tool, the length of royal jelly collecting period(Jianke,2001),seasons within the year (Kumova *et al* 2005), colony strength (Rana *et al*, 1996) and age of workers (Trumbo *et al*, 1997). For mass production of the royal jelly, the number of queen cells succeeded depends on bee races (Elbassiouny, 2008), weather conditions ambient the hive (Kumova *et al,* 2005), colony status (Cengiz *et al*, 2009), larval age at grafting (Gilley *et al,* 2003). Therefore, the beekeepers tend to offered pollen supplement, (karem, 1999) or food substitute to their bees (Moraes and Nogueira, 2000).

So, the present work aimed to throw more light on the role of the colony strength on the mass production of royal jelly under Al-Arish, North Sinai, Egypt conditions.

MATERIALS AND METHODS

The present study was conducted at the apiary of Honey Bee Research Center, Environmental Agricultural Sciences Faculty, Arish University, North Sinai, Egypt, during spring season of 2015. Fifteen honey bee colonies headed with open mated local carnica queen, *Apis mellifera carnica* were divided into three categories (5 colonies for each) according to its strength which were weak, medium and strong. The weak colonies which have less than five combs covered with adult worker bees; The colonies which considered medium have about five to six combs covered with adult worker bees; In strong colonies which have more than eight combs covered with adult worker bees. The colonies were used as the nurse colony. The adult bees of the tested free flying colonies were shaken between two combs full of honey with a space between them for the grafting frame. The queens and the other combs were removed and kept in another hives. After nearly 3 hrs of preparing the bees in the nurse colony, rearing frames provided with 60 queen cups were grafted with about 36 hrs old worker larvae then inserted in the space between the two combs of the queen less nurse colonies. Sugar syrup (50%) was offered daily to each colony during the period of the experiment. On the third day from grafting, the queen cells removed from the colonies. The accepted queen cells were counted and their larvae removed, royal jelly was collected, weighed and stored in deep freezer.

After the end of the experiment, the same queen and the relatively same number of sealed brood combs were returned to the original colony. The number of the brood cells was monitored during the period of two rearing brood cycles from the time of reintroduction of the tested colonies.

RESULTS AND DISCUSSION

To indicate the effect of the honey bee colony status on the amount of produced royal jelly, three types of colony strength (weak, medium and strong) were used. The weak colonies which have less than five combs covered with adult worker bees (Table, 1), recorded an average of 3.6 ± 0.55 Combs Covered with adult Bees (ccb) and a mean of 3832 ± 517.9 worker brood cells (wbc) / colony for the initial colony strength. By grafting 60 queen cups, the number of accepted

queen cups averaged 33 ± 7 cups / colony, which represents 55 % of the introduced cups. The total amount of royal jelly gathered from the accepted queen cups averaged 6.1 ± 0.8 g. / colony (189 ± 30 mg/ cup). After collecting the royal jelly the mean number of ccb and add wbc were 3.2 ±0.4 combs and 3230 ± 559 cells / colony. These values were lower than those reported at the beginning. After two brood cycles, the colonies failed to rebuild themselves as the initial values which recorded 3.4 ± 0.9 ccb / colony and the mean number of wbc 3256 ± 699 cells / colony. This value was slightly higher than that add after gathering the royal jelly. (4064 ± 670 cells / colony).

Table 1. Royal jelly production from weak colonies after grafting 60 queen cups

Rep.	Initial Colony Strength		No. of Queen Cups		Royal Jelly (g)		Colony Status			
							Soon after RJ gathering		After rebuilding	
	CCB[1]	WBC[2]	Accepted	%	Total	R.J./ Cup	CCB	WBC (add)	CCB	WBC
1	4	4620	39	65	6.3	0.161	3	3246	3	3180
2	3	3264	32	53.3	5.5	0.172	3	2938	3	2808
3	4	4032	29	48.3	6.4	0.221	3	3200	3	3426
4	4	3648	41	68.3	7.1	0.173	4	4130	5	4344
5	3	3596	24	40	5.2	0.217	3	2636	3	2522
Mean	3.6	3832	33	55	6.1	0.189	3.2	3230	3.4	3256
±SD	0.55	517.9	7	11.7	0.8	0.03	0.4	559	0.9	699

CCB = combs covered with adult bees
WBC = worker brood cells

The colonies which considered medium have about five to six combs covered with adult worker bees. In this work the initial state for the medium colonies strength recorded an average of 5.6 ± 0.5 combs and 5148 ± 517 cells per colony. After grafting, the accepted queen cups recorded an average of 45.8 ±5.3 cells, representing a 76.34 ± 8.8 % acceptance / colony, in which the mean amount collected of royal jelly, was 9.86 ± 0.81 g. / colony (217 ± 20 mg / cup). Soon after gathering the royal jelly from the experimental colonies, the number of ccb decreased as compared with their initial values, it was 5.2 ± 0.84 combs per colony. By adding 4642 ± 699 wbc/ colony, the tested colonies rebuilt themselves after two brood cycles whereas the number of ccb was higher than that at the beginning of the experiment, i.e. 5.8 ±0.84 combs and 5206 ± 354 brood cells /colony, respectively, (Table 2).

Table 2. Royal jelly production from medium colonies after grafting 60 queen cups

Rep.	Initial Colony Strength		No. of Queen Cups		Royal Jelly (g)		Colony Status			
							Soon after RJ gathering		After rebuilding	
	CCB[1]	WBC[2]	Accepted	%	Total	R.J./ Cup	CCB	WBC (add)	CCB	WBC
1	6	5552	46	76.7	10.9	0.237	6	5432	6	5180
2	6	5590	52	86.7	10.4	0.200	5	4874	5	5032
3	5	4338	41	68.3	9.6	0.234	4	3960	5	4728
4	5	5294	40	66.7	8.8	0.22	5	3856	6	5464
5	6	4966	50	83.3	9.6	0.192	6	5088	7	5626
Mean	5.6	5148	45.8	76.34	9.86	0.217	5.2	4642	5.8	5206
±SD	0.5	517	5.3	8.8	0.81	0,02	0.84	699	0.84	354

CCB = combs covered with adult bees
WBC = worker brood cells

In strong colonies which have more than eight combs covered with adult worker bees**,** the initial number of ccb averaged 8.6 ±0.5 combs / colony and the mean number of wbc was 7906 ±850 cells /colony. At the end of the experiment, an average of 50 ± 3.8 queen cups was accepted; representing 83.3 % acceptance from which a mean of 12.22 ± 0.52 g. of royal jelly was collected / colony and subsequently 246 ± 23 mg. per one cup. Soon after collecting the royal jelly, the number of ccb as well as the number of wbc per colony was slightly decreased to 8.2 ±0.84 combs / colony. The bees rebuilt themselves after two brood cycles (6774 ± 793 wbc / colony were add), whereas the number of ccb was higher than that at the beginning of the experiment which reached an average of 9.2 ± 0.84 combs and 8118 ± 780 brood cells /colony, respectively (Table 3).

Table 3. Royal jelly production from strong colonies after grafting 60 queen cups

Rep.	Initial Colony Strength		No. of Queen Cups		Royal Jelly (g)		Colony Status			
							Soon after RJ gathering		After rebuilding	
	CCB[1]	WBC[2]	Accepted	%	Total	R.J./ Cup	CCB	WBC (add)	CCB	WBC
1	8	7852	52	86.7	12.1	0.233	8	6680	9	7906
2	9	8644	50	83.3	12.6	0.252	8	7322	9	8600
3	9	7896	55	91.7	11.7	0.213	9	7720	10	8474
4	8	6540	45	75	11.8	0.262	7	5666	8	6848
5	9	8598	48	80	12.9	0.269	9	6482	10	8762
Mean	8.6	7906	50	83.3	12.22	0.246	8.2	6774	9.2	8118
±SD	0.5	850	3.8	6.4	0.52	0.023	0.84	793	0.84	780

CCB = combs covered with adult bees
WBC = worker brood cells

Generally, the previous data clear that the colony status plays an important role for the colony production especially royal jelly. Therefore, in strong colonies recorded highest the number and percentage of accepted queen cells that mean highest the amount of royal jelly production, moreover good rebuilding in short time. As summarized in Table (4) and illustrated in Fig.(1) the number of combs covered with adult bee soon after gathering royal jelly in weak, medium and strong colonies decreased by -11.1 % , -7.1 % and – 4.6 %, respectively. Also, the weak colonies failed to reach the original status after two brood cycles (it decreased by – 5.5 % for ccb and – 15 % for wbc) than that of the initial state in spite of supporting them with nearly the same number of brood cells. The medium colony strength appear to be balanced for rebuilding which increased slightly (it increased by 3.4 % for ccb and 1.1 % for wbc) than that of the initial state. On the other hand the strong colonies considered as the more appropriate for royal jelly production, where it produced high quantities (12.22 gm / colony) and the colonies were successfully rebuilt which increased by 7 % for ccb and 2.7 % for wbc. These findings for the amounts of produced royal jelly which highly affected by the colony status and colony management are agreement with other searches for that purpose.

Table 4. Colony status after and before royal jelly production from different colony strength

Status	Initial Colony Strength		Royal Jelly (gm)	Colony Status after RJ gathering			Rebuilding (after 2 BC)			
	CCB	WBC		CCB		WBC (add)	CCB		WBC	
				No	+/- (%)		No	+/- (%)	No	+/- (%)
weak	3.6	3832	6.1	3.2	-11.1	3230	3.4	-5.5	3256	-15
medium	5.6	5148	9.86	5.2	-7.1	4642	5.8	3.4	5206	1.1
strong	8.6	7906	12.22	8.2	-4.6	6774	9.2	7	8118	2.7

CCB = combs covered with adult bees
WBC = worker brood cells

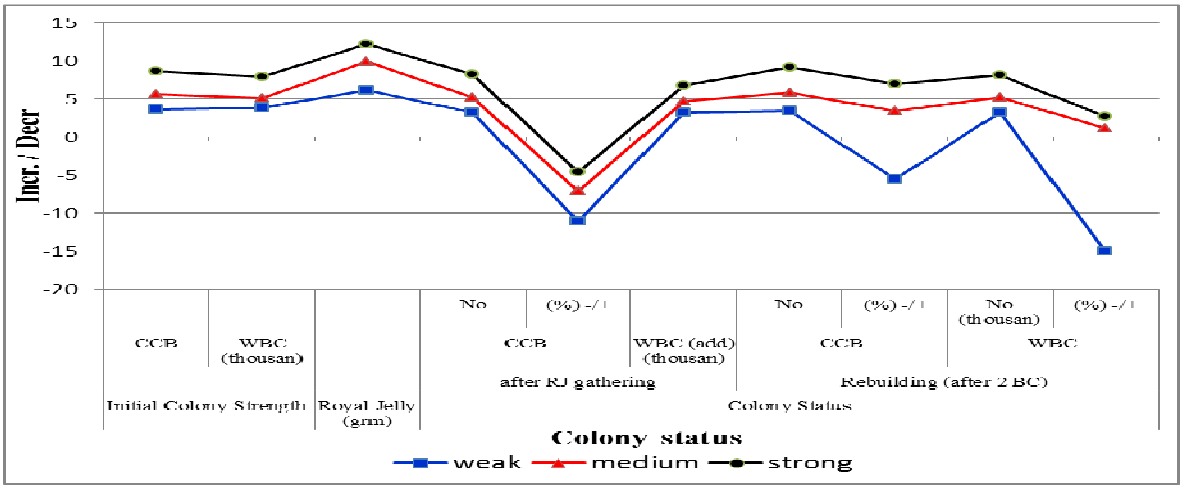

Fig. 1. Colony status after and before royal jelly production from different colony strength

The aforementioned results are in an agreement with those obtained by (Jianke,2001) who found that the ratio of population to brood (rpb) is an important factor that may affect its productivity. The correlations between rpb and royal jelly production were positive and highly significant.

A relative large value of rpb indicates that the adult bee population is predominant to that of brood, this means that more workers can engage in foraging for nectar rather than nursing brood. Since the worker bees outnumber the brood in the colony, which results in a better forging for nectar and a higher royal jelly output (Van-Toor and Littlejohn, 1994). On the other hand, a small rpb value means that more brood is present in the hive. Worker bees have a stronger inclination to tend the brood. In this term the worker bees have no swarming trend, so the desire of secreting royal jelly to queen cell has reduced sharply. This led to a decline on royal jelly production. This theory is feasible and applicable only under special conditions. The royal jelly secreted by a given amount of workers is not unlimited. Under specific conditions such as swarming, disease and mites which harm the colony, the RPB will not be positively correlated with royal jelly production even when there is a large percentage of larvae and young bees.

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تأثير اختلاف قوة طوائف نحل العسل على كمية الغذاء الملكى المنتج

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تم درسة تأثير اختلاف قوة طوائف نحل العسل (ضعيفة ومتوسطة وقوية) على كمية الغذاء الملكى المنتج خلال موسم الربيع ٢٠١٥ بالمنحل التابع لكلية العلوم الزراعية البيئية بالعريش - جامعة العريش – شمال سيناء- مصر . اظهرت النتائج ان الطوائف القوية تنتج كمية اكبر من الغذاء الملكى وصلت الى ١٢.٢٢ جرام / طائفة بمعدل ٢٤٦ ملجم / للكأس وايضا إستعادة بناء نفسها بقوة بزيادة مقدارها ٧% لعدد الاقراص المغطاة بالنحل و ٢.٧ % لاعداد الحضنة. بعد دورتى حضنة فقط. أظهرت الطوائف متوسطة القوة توازنا سواء على مستوى الغذاء الملكى المنتج (٩.٨٦جم / للطائفة بمعدل٢١٧ ملجم / للكأس) وايضا إستعادة بناء نفسها بزيادة طفيفة مقدارها ٣.٤ % لعدد الاقراص المغطاة بالنحل و ١.١ % لاعداد الحضنة. وعلى الجانب الآخر اظهرت الطوائف الضعيفة اقل انتاج من الغذاء الملكى بلغ ٦.١ جرام / طائفة بمعدل ١٨٩ ملجم / للكأس وايضا فشلت فى استعادة قوتها الاساسية حيث انخفضت قوتها بمعدل ٥.٥ % لعدد الاقراص المغطاة بالنحل و ١٥ % لاعداد الحضنة .