



EFFECT OF IMPROVING CERTAIN QUEEN CHARACTERS ON HONEY BEE PRODUCTIVITY IN THE NEW VALLEY IN EGYPT

Hosafy M. Eshbah, Abd El-Salam, A. Mohammed*, Adel R. Hassan*,
Mahmoud S. Omar** and Hamdy H. H. Mobarez***

**Plant Protection Department Faculty of Agriculture, Minia
University, Minia, Egypt*

***Honeybee Research Section, Plant Protection Research Institute,
Agriculture Res. Center, Giza, Egypt*

Received: 30 July (2017) Accepted: 14 August (2017)

ABSTRACT

Four sites in the New Valley Governorate i.e. Blat, El-Rashda, El-Mawhoup and West-Mawhoup were selected to study the effect of improvement on the productivity of honey bee colonies which include workers brood area, population density and honey production of Carniolan honeybee race during two successive seasons (2013 and 2014). Three Carniolan colonies in each site were used. The first single cousins program was carried out to help for collecting mother queen of desired characters mother (C.C.M.). Evaluation of C.C.M. was done through measurements. Thereafter, instrumental insemination program was applied to control mother mating between colonies of characters desire offspring of C.C.M. to improve collecting characters (P.C.C.M.). Results obtained in the tested colonies in the four sites were calculated, Data obtained from these studies will help for improving Carniolan honey bee race in New Valley region.

Key words: *Apis mellifera* L., Carniolan honeybee, workers brood area, population density, honey production.

INTRODUCTION

Queens of honeybee are the most important individuals in colonies. Maximum production of honey

depends on large population of bees and this in turn depends on good prolific queens, however good queens produce more offspring.

Certainly the most important aspect of successful beekeeping. Moreover, queen rearing process is a main factor in beekeeping; however Several authors investigated the effect of honeybee strains hybridization in different parts of the world (Mortize and Kauhausen, 1984; Nazzi, 1992; Maquelin *et al* 1995; Hepburn and Rodloff, 1996; Szabo, 1998 and Buchler, 2000).

During the last few years it could be seen that the production of carnica bees in the new valley was decreased due to some aspect according to inbreeding. So we are in need for increasing the productivity of bees in this region.

In Egypt, Carniolan honeybee, *Apis mellifera carnica* was the only race, which selected to be reared in the isolated zone, Dakhla Oasis for more than forty years to continuously provide Egyptian beekeepers with the pure Carniolan queens. The improvement was noticed in the productivity of carnica queens according to data obtained by Eshbah *et al.* (2003).

The aim of the present study is increasing the productivity of queen bees through using modern technique with breeding program. Results obtained will speed our ability to breed more colonies giving high yield.

MATERIALS AND METHODS

Four sites in Dakhla Oasis i. e. Blat, El-Rashda, El-Mawhoup and West-EL-Mawhoup were selected. The program of artificial insemination was

applied during two successive seasons (2013 and 2014).

The following two steps were carried out:-

1. Improvement of honey bee queens

1.1. collection of semen Drones:

Drones were collected from the hive entrances at 2-5 pm using the collecting tube for Collecting Characters Mothers (C. C. M.). Twenty drones were kept in wooden cages (10 X 7 X 2.5 cm) which provided with queen excluder from both sides Photo.(1). These cages were stored in the strong queenless colonies, for 17-23 days to ensure drone full maturity as described by (Kepena, 1997). These storage colonies were managed to contain numbers of broad combs covered with bee workers. The colonies were fed during storage periods on brewer's yeast + sugar syrup (3:1) + pollen grains.

Method of Koeniger *et al.* 1990 was used for collecting semen. The semen was taken by collecting tube of haemocytometer from completely everted indophallus and washed in a drop of physiological saline solution (0.9% NaCl) in a small glass watch. The later solution was also sucked inside the collecting tube to its bulb. The semen was thoroughly mixed with the saline solution and distilled water was then sucked inside the collecting tube up to 1.1 ml. All sperms became diluted in 1 ml of the tube bulb (1000 mm³), then save the semen in frozen at 4 °C until used it.



Photo (1): Drone collecting cages.

1.2. Using of instrumental artificial insemination of honey bee queens:

Every virgin queen of 8 days old was inseminated with 2 μ l of semen using the artificial insemination apparatus. The basic equipments such as Stereomicroscope, Cold light source, Co2 anesthetic apparatus, Insemination stand, Hooks and Micro syringe were used.

1.3. Collecting character mother program.

Twelve virgin queens were reared by grafting method (Doolittle, 1988) however, the first single cousin program with natural mating was used

for obtaining the collecting character mothers.

The best three colonies were selected in each apiary. twelve virgin queens were reared by grafting methods from each selected colony. Three virgin queens out of the twelve were introduced each into mating nucleus in the same region. The other three virgin queens were included in the first single cousin's program in four sites (Sinnott-Edmundw and Debzhansky, 1950). Data were statistically analyzed according to Fisher (1950).

Variation measurements percentages between before and after program were calculated by the following formula:

$$\text{Increasing \%} = \frac{\text{After program} - \text{before program}}{\text{Before program}} \times 100$$

2. Measurements of productive characters:

2.1. Workers brood area (sq. inches / colony/12 day):

The sealed brood area (inch²/colony) was measured and recorded using a typical langstroth frame divided into 17x8 inches at 12 days intervals according to (Al-Tikrity *et al.*, 1971). Measurements of the brood areas were done over the next active season (summer) and the mean of areas of sealed brood were estimated per 12 days according to (Eshbah *et al.*, 2011).

2.2. Population density of bees:

The wax combs covered with bees of the experimental colonies were recorded at 12 days intervals during the periods of active season and mean population strength per 12 days period was calculated (Hassan, 1998)

2.3. Honey production (kg./colony):

At the end of the tested season the sealed honey combs of every colony were weighted. The honey combs were subjected to extraction procedures and reweighted, the honey yield was estimated as the difference between the weights of the honey combs before and after extraction. Mean production of the honey yield per colony was determined (Hassan, 2007).

RESULTS AND DISCUSSION

1. Effect of improvement program on sealed brood area for Carniolan honey bee in four

locations at Dakhla Oasis, during 2013 and 2014 seasons.

Blat, El-Rashda, El-Mawhoup and West-Mawhoup sites were selected to study the effect of improvement on workers sealed brood areas. Tables (1 and 2) declared, workers sealed brood area/ colony/ 12 days during 2013 and 2014, and Table (3) also showed the increasing percentage of brood area. The results recorded the highest areas of worker sealed brood in tested colonies were measured in June during the flowering period of clover, in the four sites with average 498.75 in 2013 season, and 536.00 sq. inches/colony/12 days in 2014 season respectively, with increasing percentage (7.47%). While the lowest sealed brood areas in colonies were recorded in September month which showed 169.75 and 212.25 sq. inch/colony, in of 2013 and 2014 seasons respectively, with increasing percentage 25.04%.

The statistical analysis showed highly significant differences between sites and months. These results were in agreement with those obtained by El-Dakhakhni (1980) who found that the major peak of brood rearing activity during May then decreased during June and July in Chafer-El Sheikh governorate. Moreover, the second peak was during the cotton season.

On the other hand, the lowest activity of rearing occurred during November. The level of rearing gradually declined during September and October, but mid. of January was

the start of workers brood rearing activity. These results which showed the increasing of sealed brood area of the four sites after improvement agreed with Eshbah *et al.* (2003).

Table (1): Monthly mean of sealed brood area (sq/inch/colony) for Carniolan honey bee in four sites at Dakhla Oasis, before breeding program during 2013.

Months	Mean of sealed brood area (sq/inch/colony)				Mean	L.S.D (0.05)
	Locations					
	Blat	El-Rashda	El-Mawhoup	West- Mawhoup		
Mar.	441	428	443	415	431.75	**9.41
Apr.	380	388	396	355	379.75	**9.41
May	445	436	456	410	436.75	**9.41
Jun.	516	510	507	462	498.75	**13.45
Jul.	425	375	440	372	403.00	**9.41
Aug.	279	271	355	255	290.00	n.s
Sept.	159	170	198	152	169.75	**9.41
Oct.	301	314	349	283	311.75	**9.41
Nov.	373	363	383	334	363.25	n.s
Dec.	345	360	374	337	354.00	***
Mean	366.4	361.5	390.1	337.5		
L.S.R.	34.42**	9.56**	60.49**	8.61**		

L.S.D. (Least significant differences). L.S.R. (Least significant range).

Table (2): Monthly mean of sealed brood area (sq/inch/colony) for Carniolan honey bee in four sites at Dakhla Oasis, after breeding program during 2014.

Months	Mean of sealed brood area (sq/inch/colony)				Mean	L.S.D (0.05)
	Locations					
	Blat	El-Rashda	El-Mawhoup	West- Mawhoup		
Mar.	482	463	501	452	474.50	2.49**
Apr.	421	435	449	391	424.00	1.88**
May	492	471	498	454	478.75	1.88**
Jun.	551	554	577	462	536.00	1.88**
Jul.	424	411	478	408	430.25	1.88**
Aug.	312	325	337	291	316.25	1.88**
Sept.	197	217	238	197	212.25	1.88**
Oct.	342	321	390	324	344.25	53.56**
Nov.	381	406	422	378	396.75	1.72**
Dec.	382	407	417	380	396.50	1.88**
Mean	398.40	401.00	430.70	373.70		
L.S.R.	1.70**	1.89**	6.28**	1.70**		

L.S.D. (Least significant differences). L.S.R. (Least significant range).

Table (3): Increasing percentage of sealed brood area (sq/inch/colony) for Carniolan honeybee workers in the four sites before and after improvement program during 2013 and 2014 season.

Months	General mean		Increasing%
	Before program	After program	
Mar.	431.75	474.50	9.90
Apr.	379.75	424.00	11.65
May	436.75	478.75	9.6
Jun.	498.75	536.00	7.47
Jul.	403.00	430.25	6.76
Aug.	290.00	316.25	9.05
Sept.	169.75	212.25	25.04
Oct.	311.75	344.25	10.43
Nov.	363.25	396.75	9.22
Dec.	354.00	396.50	12.00

2. Effect of improvement on population density for Carniolan honey bee in the four locations at Dakhla Oasis, during 2013 and 2014.

The results presented in Tables (4 and 5) indicated that, the number of the combs covered with bees during 2013 and 2014 seasons, and Table (6) declare the increasing percentage. However, the highest number of combs with bees was recorded in June month and a second peak was during clover season, in the four sites average (8.75 and 9.25 the wax combs covered with bees) in 2013 and 2014 seasons, respectively with increasing percentage (10.47%).

While the lowest population density was recorded in September (5.75 and 6.71 wax combs covered with bees), in of 2013 and 2014 seasons respectively, with increasing percentage (17.13%). Moreover the statistical analysis showed highly

significant differences among months, but between sites there were no significant differences.

Data in the Tables show positive relationship between the areas of worker sealed brood, number of covered combs with bees and honey production.

3. Effect of improvement on honey production for Carniolan honey bee in four sites at Dakhla Oasis, during 2013 and 2014 seasons.

The results presented in Tables (7 and 8) showed that, the mean of first extracting for the four sites before improving was 3.75 kg/colony, but in the second extracting it was 5.05 kg/colony during 2013 season. While the first extracting for the four sites was 5.75, but in the Second extracting it was 7.30 kg/colony during 2014 season after applying improving program.

Table (4): Monthly mean of combs covered with bees for Carniolan honey bee in four sites at Dakhla Oasis, New Valley Governorate before breeding program during 2013 season.

Program during 2019 season						
Months	Mean of combs covered with bees				Mean	L.S.D (0.05)
	Locations					
	Blat	El-Rashda	El-Mawhoup	West- Mawhoup		
Jan.	5.67	5.16	6.5	5.50	5.71	0.768*
Feb.	6.17	6.17	7.00	6.33	6.42	n.s
Mar.	6.83	6.83	7.16	6.67	6.87	n.s
Apr.	7.33	7.50	7.83	7.33	7.49	n.s
May	7.33	8.17	8.17	7.83	7.88	n.s
Jun.	8.17	9.00	9.00	8.83	8.75	n.s
Jul.	8.16	8.50	8.83	8.17	8.42	n.s
Aug.	7.66	7.83	7.83	7.16	7.62	n.s
Sept.	6.20	5.47	6.21	5.13	5.75	n.s
Oct.	7.17	7.16	6.50	4.67	6.38	0.665**
Nov.	6.16	6.00	5.83	4.50	5.62	1.120*
Dec.	6.16	5.83	6.16	5.50	5.91	n.s
Mean	6.92	6.97	7.25	6.47		
L.S.R.	0.525**	0.889**	1.369**	1.240**		

L.S.D. (Least significant differences). L.S.R. (Least significant range).

Table (5): Monthly mean of combs covered with bees for Carniolan honey bee in four sites at Dakhla Oasis, after breeding program during 2014 season.

Months	Mean of combs covered with bees				Mean	L.S.D (0.05)
	Locations					
	Blat	El-Rashda	El-Mawhoup	West- Mawhoup		
Jan.	6.17	5.67	6.83	6.67	6.33	n.s
Feb.	6.83	7.00	7.50	7.16	7.12	n.s
Mar.	7.50	7.50	8.00	7.66	7.67	n.s
Apr.	8.17	8.16	8.50	8.16	8.24	n.s
May	7.83	7.50	8.40	7.50	8.11	n.s
Jun.	9.00	9.16	9.83	9.00	9.25	n.s
Jul.	9.00	8.83	9.16	8.50	8.87	n.s
Aug.	7.86	8.00	8.33	8.00	8.04	n.s
Sept.	7.17	6.40	7.16	6.21	7.08	n.s
Oct.	7.50	8.00	8.16	7.83	7.87	n.s
Nov.	6.67	6.83	7.00	6.66	6.79	n.s
Dec.	6.83	7.17	7.50	7.57	7.25	n.s
Mean	7.67	7.52	7.99	7.64		
L.S.R.	0.818**	0.879**	0.643**	1.060**		

L.S.D.(Least significant differences). L.S.R.(Least significant range).

Table (6): Increasing percentage of combs covered with bees for Carniolan honeybee workers in the four sites before and after program improvement during 2013 and 2014 seasons.

Months	General mean		Increasing%
	Before program	After program	
Jan.	5.71	6.33	10.86
Feb.	6.42	7.12	10.90
Mar.	6.87	7.67	11.65
Apr.	7.49	8.24	10.01
May	7.88	8.11	2.92
Jun.	8.75	9.25	10.47
Jul.	8.42	8.87	5.34
Aug.	7.62	8.04	5.51
Sept.	5.75	6.71	17.13
Oct.	6.38	7.87	23.35
Nov.	5.62	6.79	20.82
Dec.	5.91	7.25	22.67

Table (7): Mean of honey production (kg/colony) of Carniolan honey bee colonies in four sites at Dakhla Oasis, before breeding program during 2013 season.

Locations	Blat	El-Rashda	El-Mawhoup	West-Mawhoup	Mean	L.S.D (0.05)
Honey yield (kg/colony) of 1st extracting	3.80	3.30	4.10	3.50	3.75	0.32**
Honey yield (kg/colony) of 2nd extracting	4.90	4.50	6.50	4.30	5.05	0.34**
Mean	4.20	3.50	4.50	3.35		
L.S.D(0.05)	0.37**	0.51**	0.32**	0.45**		

L.S.D.(Least significant differences).

The increasing percentage was 53.33% in the first extraction but it was 44.55% in the second extracting (Table 9). These results agreed with Eshbah et al. (1994) who reported that, flight and quantitative parameters increased during the 1st season of the mating

program, when using queens of El-Rashda and drones of El-Ewena. Hence, mating between the original queens of El-Rashda and El-Ewena drones was highly recommended during the program of queen rearing in New-Valley.

Table (8): Mean of honey production (kg/colony) of Carniolan honey bee colonies in four sites at Dakhla Oasis, New Valley Governorate after breeding program during 2014 season.

Locations	Blat	El-Rashda	El-Mawhoup	West-Mawhoup	Mean	L.S.D (0.05)
Honey yield (kg/colony) of 1st extracting	5.50	3.60	6.50	5.90	5.75	0.37**
Honey yield (kg/colony) of 2nd extracting	7.20	6.80	8.50	6.70	7.30	0.37**
Mean	6.35	5.20	7.50	6.30		
L.S.D (0.05)	0.45**	0.45**	0.45**	0.45**		

L.S.D. (Least significant differences).

The results were in agreement with Fath-Allah (2004) who found that the average of honey production in Assuit region during clover honey

seasons (2002 and 2003) were 3.95 and 5.18 (kg)/colony for Carniolan race and Carniolan hybrid, respectively.

Table (9): Increasing percentage of honey production (kg/colony) for Carniolan honeybee workers in four sites before and after improvement program during 2013 and 2014 seasons.

Extracting sequences	General mean		Increasing%
	Before program	After program	
Honey yield (kg/colony) of 1 st extraction	3.75	5.75	53.33
Honey yield (kg/colony) of 2 nd extraction	5.05	7.30	44.55

CONCLUSION:

From the obtained results it could be concluded that using of this program (First single cousin's program) will increase the productivity of honeybee queens giving high yields in New valley Governorate, Egypt.

REFERENCES

Al-Tikrity, W.S.; Hillmann, R.C.; Benton A. W. and Clarke, W.W. (1971): A new instrument for

measurement in a honey bee colony. Amer. Bee, J., 111 (4): 143-145.

Buchler, R. (2000): Design and success of a German breeding program for *Varroa tolerance* Amer. Bee J., 140 (8): 662-665.

Doolittle, G.M. (1988): Scientific queen rearing published by Am. Bee J, Hamilton, Illinois. 26pp.

- El- Dakhakhni, N. M. (1980): Studies on the honeybee (*Apis mellifera* L.). Ph.D. Thesis, Fac. Agric. Alexandria Univ. 155pp.
- Eshbah, H.M.; Shoreit, M.N.; Mohamed, A.A. and Khattaby, A.M. (1994): Improvement of some characters of the pure local Carniolan honeybee *Apis mellifera carnica* L. in the isolated Dakhla Oasis, Egypt. Minia J. Agric. and Dev., 16(1): 119-128.
- Eshbah, H.M.; Atallah, M.A.; Mohamed, A.A.; Shoreit, M.N. and Omar, M.S. (2003): Improvement of carniolan honeybee race, *Apis mellifera carnica* in New Valley Governorate, Egypt. J. Agric. Sci., Ain Shams Univ., Cairo, 11(1):387-400.
- Eshbah, H. M.; Mohamed, A. A.; Hassan, A. R. and Hafez, Z. R. A. (2011). Effect of feeding with certain nectar and pollen substitutes on activity, productivity and health of honeybee colonies. M. Sc. Thesis, Fac. Agric., Minia Univ., Egypt. 142pp.
- Fath-Allah M. (2004): Comparative studies between the characters of some races and hybrids of honeybee in Assiut region, Upper Egypt. Ph.D Thesis, Fac. Agric., Assiut Univ., 200 pp.
- Fisher, R. A. (1950): Statistical Methods for Research Workers. 12th Ed., pp. 518. Oliver and Boyd Ltd.: Edinburg and London.
- Hassan, A.R. (1998). Role of some diets in increasing strength and hygienic behavior of honeybee (*Apis mellifera carnica*) colonies towards the *Varroa jacobsoni* parasite Indian. J. Entomol., 60(2):116-122.
- Hassan, A.R. (2007). An aggressive honeybee colony : Is it a productive and resistant colony ? The 40th Apimondia Int. Apic. Cong. Melbourne, Australia, September, 2007p.89.
- Hepburn, H. R. and Rodloff, S. E. (1996): Morphometric and pheromonal analysis of *Apis mellifera* L. along a transect from the Sahara to the Pyenees. Apidologie, 27 (1): 35-45.
- Kepena, L. (1997): Some biological observations on drone rearing. Vpd. Prac. Vyzkom. Vstav. Vcelar. Dol., 3: 65-76 in Slovak.
- Koeniger, G.; Koeniger, N.; Mordan, M.; Pueheheina, R. and Otis, G. (1990): Numbers of spermatozoa in queen and drones indicates multiple mating of queens in *Apis andreni formis* and *A. dorsata*. Apidologie, 21: 281-286.
- Maquelin, C.; Fluri, P.; Ruegg, H. and Zehnder, H. (1995): Testing of race purity at VDRB queen stations (Switzerland). Schweizerische Bienen-Zeitung, 118 (4): 195-199.
- Mortiz, R. F. K. and Kauhausen (1984): Hybridization between *Apis mellifera capensis* and adjacent races of *Apis mellifera*. Apidologie, 15: 21-222.

- Nazzi, F. (1992): Morphological analysis of honeybees from an area of racial hybridization in northeastern Italy. *Apidologie*, 23 (2): 89-96.
- Sinnott-Edmundw, L. C. D. and Debzhansky T. H. (1950): Principles of genetics. McGraw, Hill Book Company. Inc. New York. p. 505.
- Szabo, T. L. (1998): Progress report on selective breeding of honeybees for resistance to parasitic mites. *Amer. Bee. J.*, 138 (7): 646-466.

الملخص العربي

تأثير تحسين بعض صفات الملكات على إنتاجية طوائف نحل العسل في الوادي الجديد - مصر

حصافي محمد عشب* عبدالسلام أنور محمد* عادل رشدي حسن*

محمود سيد عمر** ، حمدي حامد عثمان مبارز**

* قسم وقاية النبات، كلية الزراعة، جامعة المنيا، المنيا، جمهورية مصر العربية
** وحدة بحوث نحل العسل، معهد بحوث وقاية النبات، مركز البحوث الزراعية، الجيزة،
جمهورية مصر العربية

أجريت هذه الدراسة في أربع مناطق بمحافظة الوادي الجديد وهي: بلاط والراشدة والموهوب وغرب الموهوب وذلك خلال عامين متتاليين (2013-2014) بهدف دراسة تأثير تحسين بعض صفات سلالة النحل الكرنولي على مساحة الحضنة المقلدة والكثافة النحلية وإنتاج العسل.

أولاً: برنامج التلقيح الصناعي:-

تم تجميع الحيوانات المنوية من الذكور الناضجة لكل من الأمهات في الأربع مناطق محل الدراسة لتحسين سلالة النحل الكرنولي بالوادي الجديد. تم عمل برنامج تلقيح طبيعي (cousin's program First single) لإنتاج أمهات جامعة حتى يتم التربية منها واستخدامها في التلقيح الصناعي لاستكمال برنامج التحسين ثم تربية ثلاث ملكات عذارى من كل منطقة وتم عمل برنامج التلقيح الصناعي بين ملكات المناطق الأربعة ثم اجراء القياسات السابق ذكرها لنسلها.

ثانياً: قياس الصفات الانتاجية:-

أ- قياس مساحة الحضنة المقلدة :- تم قياس مساحة الحضنة المقلدة كل 12 يوم قبل وبعد التحسين بواسطة برواز مقسم إلى بوصات مربعة ووضحت النتائج أن أكبر مساحة حضنة مقلدة كانت خلال شهر يونيو بقيمة

498,75 و 536,00 بوصة مربعة خلال موسمي 2013 و 2014 على التوالي بنسبة زيادة 7,47% بعد اجراء برنامج التحسين ، في حين أن أقل مساحة حضنة سجلت خلال شهر سبتمبر بمساحة 196,75 و 212,25 بوصة مربعة خلال الموسمين على التوالي بنسبة زيادة 25,04%.

2- الكثافة النحلية :- تم تقدير الكثافة النحلية بعدد الاقراص المغطاة بالنحل من الجهتين للطائفة الواحدة وأوضحت النتائج أن أعلى كثافة نحلية سجلت أيضا خلال شهر يونيو بمتوسط عدد أقراص 8,75 و 9,25 قرص مغطى بالنحل خلال موسمي 2013 و 2014 على التوالي بنسبة زيادة 10,47% بعد اجراء برنامج التحسين ، في حين أن أقل مساحة حضنة سجلت خلال شهر سبتمبر بمتوسط 5,75 و 6,71 قرص مغطى بالنحل خلال الموسمين على التوالي بنسبة زيادة 17,13%.

3- إنتاج العسل:- تم تقدير إنتاج العسل في الطوائف عن طريق وزن الأقراص قبل وبعد الفرز وحساب الفرق الذي يمثل إنتاج الطائفة من العسل وأوضحت النتائج أن الفرزة الأولى أعطت متوسط 3,75 كجم / للطائفة في الموسم الأول بينما كانت 5,75 كجم / للطائفة في الموسم الثاني بنسبة زيادة 53,33% بعد اجراء برنامج التحسين، في حين أن الفرزة الثانية سجلت 5,05 كجم / للطائفة في الموسم الأول بينما بلغت 7,30 كجم / للطائفة في الموسم الثاني بنسبة زيادة 44,55% بعد اجراء برنامج التحسين .

الخلاصة :- من النتائج المتحصل عليها يمكن القول أن استخدام هذا البرنامج ساعد في خصوبة الملكات الناتجة ذات الإنتاجية العالية . أيضا وجد أنه كانت هناك فروقا معنوية بين (مساحة الحضنة وإنتاج العسل) الصفات الإنتاجية ومناطق الدراسة، بينما كانت هذه الفروق غير معنوية مع كثافة النحل خلال عامي الدراسة.

الكلمات الدالة: نحل العسل الكرنيولي -تحسين صفات نحل العسل - قياس الحضنة - الكثافة النحلية - إنتاج العسل.