



MORPHOMETRIC CHARACTERS IMPROVEMENT OF PURE LOCAL CARNIOLAN HONEYBEE RACE, *APIS MELLIFERA CARNICA* IN NEW VALLEY GOVERNORATE, EGYPT.

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ABSTRACT

Four sites i.e. Blat, El-Rashda, El-Mawhoup and West-Mawhoup in New Valley Governorate were selected to study the morphological characters improvement of Carniolan honeybee race during two successive seasons (2013 and 2014). Morphological characters of the colonies were tested. Three colonies in each site were used. The first single cousins program was carried out to produce collecting characters mothers (C.C.M.). Evaluation of C.C.M. was done through morphological characters measurements. Significant improvement in some characters was recorded. Thereafter, instrumental insemination program was applied for the offspring of C.C.M. to produce pure collecting character mothers (P.C.C.M.). After evaluation increasing percentages in the most tested measurements in the two sites were calculated, while the morphological characters of the first hybrid Carniolan honeybee workers were measured in the two successive seasons. The data indicated that there were reduction percentages in the most tested measurements in the second season. Such information obtained from these studies may be used to improve Carniolan honey bee race in New Valley region.

Key words: *Apis mellifera* L., Carniolan honeybee, Morphological characters, First hybrid Carniolan honeybee.

INTRODUCTION

Queen rearing process is a main factor in beekeeping. 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).

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 provide Egyptian beekeepers continuously with the pure Carniolan queens instead of importing.

Morphological characters of honey bee workers of this race were noticeably decreased due to the continuous inbreeding (Atallah *et al.*, 1987). Many researches have been done by various scientists in Egypt to solve this problem (Eshbah *et al.*, 1994) and (Haggag and Mabrouk, 2006) but there is still much work to be done in this concern.

The aim of the present study is collecting some economic characters of Carniolan honeybee and first hybrid in four sites, in Dakhla Oasis using selection and breeding program under open and control mating schemes. Such method may help us for obtaining honeybee queens with good quality.

MATERIAL AND METHODS

Four sites in Dakhla Oasis were selected Blat, El-Rashda (for obtaining first hybrid Carniolan honeybee), El-Mawhoup and West-Mawhoup (for obtaining pure Carniolan honeybee) were selected. The program of artificial insemination was applied during two successive seasons (2013-2014). The following steps were carried out.

1. Morphological characters of honeybee workers measurements:

The first step of this study includes the morphometric measurements of some characters of Carniolan honeybee workers in the isolated region, (Dakhla Oasis, New Valley, Egypt). Four apiaries were chosen in the first of February 2013, in the sites of Blat, El-Mawhoup, El Rashda, and west-Mawhoup, with 8-13 Km. apart from each other to ensure pure open mating of queens.

Three colonies from each apiary were chosen after the examining of the all colonies during three months and the queens were marked. Measurements of 13 morphological characters were done. Samples of 12 honey bee workers per colony were killed in ethyl acetate to ensure the fully extension of the proboscis. Samples from each colony were preserved in a solution which consists of 1:1:1 of ethyl alcohol 95 %, glycerin and distilled water for further measurements as described Eshbah, *et al.* 2003.

The following parts of honey bee workers were subjected for measurements: length and width of fore wing, hind wing, corbicula, second wax mirror, and mandibles, number of hooks on the hind wing, proboscis length and cubital index a/b. The separated parts were placed on glass slides and measured by stereoscopic microscope with micrometer eye piece (1/10 mm). (Atallah, *et al.*, 1987 and Eshbah, *et al.*

1994). The data were statistically analyzed according to Fisher (1950).

Drones and semen collection:

Drones were collected from the hive entrances at 2-5 pm using collecting tube for Collecting Characters Mothers parogram(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 Fig.(1). These cages

were stored in the strong queenless colonies, for 17-23 days to ensure drone full maturity as dascribed 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.

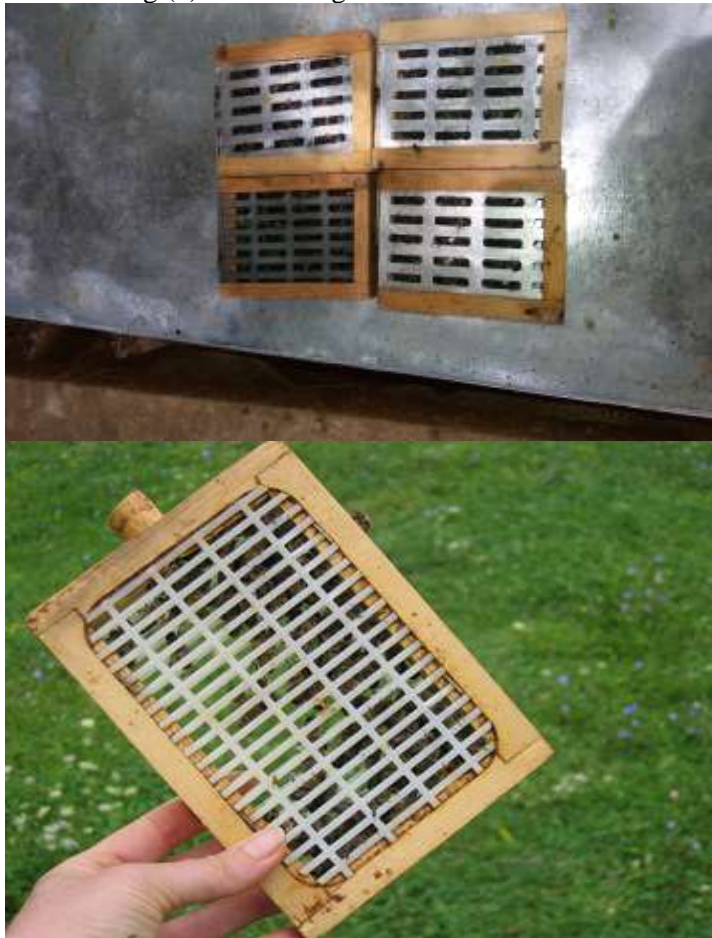


Fig. (1): Drone collecting cages.

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 watch glass. 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 4c.until used it.

Instrumental insemination of honey bee queens:

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

2. collecting character mother program.

Twelve virgin queens were reared by grafting method (Doolittle, 1988) and used first single cousin program with natural mating was used for obtain the collecting character mothers.

After morphological evaluation, the best three colonies were selected in each apiary. Six virgin queens were reared by grafting methods from each selected colony. Three virgin queens out of the six 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 two sites (Sinnott-Edmundw and Debzhansky, 1950). Data were statistically analyzed according to Fisher (1950).

3. Pure collecting characters mothers program.

From the collecting character mothers six queens were reared from each of the collecting character mothers A and B. Virgin queens of A colony were instrumentally inseminated using the method of Schley's apparatus (Schley, 1988) with 2 µl of fresh semen of B drones. Similarly, virgin queens of B were inseminated with semen of drones A. Comparisons of the morphological characters were measured before and after applying the improvement program. According to the results obtained from the morphological characters, the best three C.C.M. named A and B were chosen for the next trials. Variation in morphological characters measurements percentages between before and after program were calculated by the following formula:

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

4. Natural mating in first hybrid Carniolan honeybee workers:

Variation in the morphological measurements between two sites in the second season after natural mating were calculated. Reduction percentage of every morphological character

measurement between two sites in the first and second seasons was calculated were noticed.

RESULTS AND DISCUSSIONS

Morphological characters measurements of local Carniolan honeybee workers before breeding program during 2013 season.

Data in Table (1) indicated that there were significant differences between El-Mawhoup and West-Mawhoup sites in some morphological characters i. e. length and width of: fore wing, hind wing,

corbicula, second wax mirror, and mandibles, number of hooks on the hind wing, proboscis length and cubital index. These measurements were 8.74, 2.78, 5.81, 1.57, 3.01, 1.11, 1.36, 2.09, 1.15, 0.46, 21.10, 5.82 and 2.23 mm in El-Mawhoup site. While they were 8.69, 2.77, 5.68, 1.53, 3.04, 0.98, 1.38, 2.09, 1.17, 0.45, 21.00, 5.59 and 2.25 mm in West-Mawhoup site, respectively. These results were in agreement with the result of Atallah *et al.* (1987).

Table (1): Mean of morphological characters measurements of local Carniolan honeybee workers in the two sites before breeding program during 2013.

Variable	Mean of characters measurements (mm)		LSD 0.05
	El-Mawhoup	West-Mawhoup	
Number of hooks on the hind wing	21.10a	21.00a	0.66 n.s
Fore wing length	8.74a	8.69a	0.17 n.s
Fore wing width	2.78a	2.77a	0.12 n.s
Hind wing length	5.81a	5.68b	0.089 **
Hind wing width	1.57a	1.53a	0.11 n.s
Proboscis length	5.82a	5.59b	0.154 **
Cubital index a/b	2.23a	2.25a	0.11 n.s
Corbicula length	3.01a	3.04a	0.16 n.s
Corbicula width	1.11a	0.98b	0.064 **
Second wax mirror length	1.36a	1.38a	0.09 n.s
Second wax mirror width	2.09a	2.09a	0.12 n.s
Mandible length	1.15a	1.17a	0.09 n.s
Mandible width	0.46a	0.45a	0.10 n.s

L.S.D.= Least significant differences

Morphological characters measurements for Carniolan honeybee workers (mm) in the two sites after breeding program during 2014 season.

Data in Table (2) showed that measurements of morphological

characters for Carniolan honeybee workers in the two sites after applying the improving program of artificial insemination. Measurements of length and width of: fore wing, hind wing, corbicula, second wax mirror, mandibles, number of hooks on the hind wing, proboscis length and

cubital index were 9.17, 3.07, 5.95, 22.90, 5.93 and 2.29 (mm) in El-Mawhoup site.

Table (2): Means of morphological characters measurements for local Carniolan honeybee workers in the two sites after breeding program of artificial insemination during 2014.

Variable	Sites	Mean of characters measurements (mm)		LSD 0.05
		El-Mawhoup	West-Mawhoup	
Number of hooks on the hind wing		22.90a	22.00a	0.66 n.s
Fore wing length		9.17a	9.16a	0.13 n.s
Fore wing width		3.07a	3.07a	0.19 n.s
Hind wing length		5.95a	5.83b	0.078 **
Hind wing width		1.75a	1.71a	0.09 n.s
Proboscis length		5.93a	5.73b	0.089 **
Cubital index a/b		2.29a	2.34a	0.08 n.s
Corbicula length		3.11a	3.15a	0.11 n.s
Corbicula width		1.14a	1.03b	0.071 **
Second wax mirror length		1.45a	1.49a	0.09 n.s
Second wax mirror width		2.29a	2.28a	0.08 n.s
Mandible length		1.27a	1.27a	0.08 n.s
Mandible width		0.51a	0.49a	0.08 n.s

L.S.D.= Least significant differences

While they were 9.16, 3.07, 5.83, 1.71, 3.13, 1.03, 1.49, 2.28, 1.27, 0.49, 22.00, 5.83 and 2.34 (mm) in West-Mawhoup site, respectively. These results agreed with that obtained by Mazeed (1992) who found that reciprocal insemination improve all morphometrical and biometrical characters of honeybee workers.

Morphological characters measurements of the first hybrid Carniolan honeybee workers during season of 2013.

Table (3) presented the means of measurements of the first hybrid carniolan honeybee workers in the two

sites (Blat and El-Rashda) in Dakhla Oasis during 2013 season. The morphological characters i. e., length and width of: fore wing, hind wing, corbicula, second wax mirror, mandibles, number of hooks on the hind wing, proboscis length and cubital index. showed 9.14, 3.00, 5.97, 1.71, 3.11, 1.13, 1.46, 2.23, 1.27, 0.50, 23.10, 6.02 and 2.24 mm in Blat site. While they were 9.18, 3.01, 5.77, 1.73, 3.15, 1.01, 1.46, 2.25, 1.26, 0.48, 22.00, 5.81 and 2.28 mm in El-Rashda site, respectively. These results came in agreement with those of Mazeed 1992 results.

Table (3): Means of morphological characters measurements of the first hybrid Carniolan honeybee workers in the two sites during 2013 season.

Variable	Sites	Mean characters measurements (mm)		LSD 0.05
		Blat	El-Rashda	
Number of hooks on the hind wing		23.10a	22.00a	0.66 n.s
Fore wing length		9.14a	9.18a	0.18 n.s
Fore wing width		3.00a	3.01a	0.16 n.s
Hind wing length		5.97a	5.77b	0.089 **
Hind wing width		1.71a	1.73a	0.13 n.s
Proboscis length		6.02a	5.81b	0.078 **
Cubital index a/b		2.24a	2.28a	0.08 n.s
Corbicula length		3.11a	3.15a	0.09 n.s
Corbicula width		1.13a	1.01b	0.066**
Second wax mirror length		1.46a	1.46a	0.11 n.s
Second wax mirror width		2.23a	2.25a	0.11 n.s
Mandible length		1.27a	1.26a	0.08 n.s
Mandible width		0.50a	0.48a	0.07 n.s

L.S.D.= Least significant differences

Table (4): Morphological characters measurements of the first hybrid Carniolan honeybee workers in the two sites during season of 2014.

Variable	Sites	Mean of characters measurements (mm)		LSD 0.05
		Blat	El-Rashda	
Number of hooks on the hind wing		22.40a	21.00a	0.641 n.s
Fore wing length		9.21a	9.16a	0.15 n.s
Fore wing width		3.05a	3.06a	0.16 n.s
Hind wing length		5.76a	5.67b	0.071 *
Hind wing width		1.50a	1.52a	0.11 n.s
Proboscis length		5.75a	5.62b	0.063 **
Cubital index a/b		2.23a	2.25a	0.08 n.s
Corbicula length		2.98a	3.03a	0.11 n.s
Corbicula width		1.04a	0.95b	0.058 **
Second wax mirror length		1.35a	1.36a	0.09 n.s
Second wax mirror width		2.17a	2.18a	0.12 n.s
Mandible length		1.05a	1.08a	0.08 n.s
Mandible width		0.41a	0.40a	0.07 n.s

L.S.D.= Least significant differences

Morphological characters measurements for first hybrid Carniolan honeybee workers during 2014 season. Morphological measurements of the first hybrid Carniolan honeybee workers i. e. length and width of: fore wing, hind wing, corbicula, second wax mirror, mandibles, number of hooks on the hind wing, proboscis length and cubital index were 9.21, 3.05, 5.76, 1.50, 2.98, 1.04, 1.35, 2.17,

1.05, 0.41, 22.40, 5.75 mm and 2.23 in Blat site. While they were 9.16, 3.06, 5.67, 1.52, 3.03, 0.95, 1.36, 2.18, 1.08, 0.40, 21.00, 5.62 and 2.25 mm in El-Rashda sties Table (4) they were recorded significant differences among three characters length of hind wing, proboscis length and width of corbicula in the two sites. These

results agreed with those obtained by Eid *et al.* (2011) who found that Carniolan hybrid colonies reared significantly higher worker sealed brood and stored insignificantly more pollen than Local colonies, whereas Local colonies stored insignificantly more honey than Carniolans, during all period of experiment.

Table (5): General means of morphological characters measurements of the local Carniolan honeybee workers before improvement program.

Variable	General mean before program	General mean after program	Increasing%
Number of hooks on the hind wing	21.050	22.450	6.236
Fore wing length	8.715	9.165	4.909
Fore wing width	2.775	3.070	9.609
Hind wing length	5.745	5.890	2.546
Hind wing width	1.550	1.730	10.404
Proboscis length	5.705	5.830	0.934
Cubital index a/b	2.240	2.315	3.239
Corbicula length	3.025	3.150	3.968
Corbicula width	1.045	1.085	3.686
Second wax mirror length	1.370	1.470	6.802
Second wax mirror width	2.090	2.285	8.533
Mandible length	1.160	1.270	8.661
Mandible width	0.455	0.500	9.00

Evaluation of pure collecting character mothers

Morphological characters measurements of the progeny of P. C. C. M. showed increasing of all tested characters comparing with the general means of the worker bees of the two sites (Table 5) agreed with that obtained by Eshbah *et al.* (2003) and Haggag *et al.* (2006). While morphological characters

measurements of the first hybrid bee Carniolan showed reduction percentages in all tested characters of the worker bees of the two sites (Table 6). This result was in agreement with that obtained by Mortiz and Kauhausen (1984)

CONCLUSION:

From the obtained results it could be concluded to use this program to product queens of economic characters

to improve queen rearing in New Valley Governorate.

Table (6): General means of morphological characters measurements of the first hybrid Carniolan honeybee workers during season 2013 and 2014.

Variable	Season 2013	Season 2014	Reduction%
Number of hooks on the hind wing	22.550	21.700	3.769
Fore wing length	9.260	9.185	0.809
Fore wing width	3.065	3.055	0.326
Hind wing length	5.915	5.715	2.725
Hind wing width	1.720	1.510	12.209
Proboscis length	5.915	5.685	3.888
Cubital index a/b	2.260	2.240	0.884
Corbicula length	3.130	3.005	3.993
Corbicula width	1.070	0.995	1.929
Second wax mirror length	1.460	1.355	7.191
Second wax mirror width	2.240	2.175	2.901
Mandible length	1.265	1.065	15.810
Mandible width	0.490	0.405	17.346

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تحسين الصفات المورفولوجية لسلالة النحل الكرنولي المحلية في محافظة الوادي الجديد –
مصر

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**قسم بحوث النحل – معهد بحوث وقاية النباتات – مركز البحوث الزراعية – الدقي - مصر

أجريت هذه الدراسة في أربع مناطق بمحافظة الوادي الجديد وهي: الموهوب، وغرب الموهوب وبلاط والراشدة وذلك خلال عامين متتاليين (2013-2014) بهدف تحسين بعض صفات سلالة النحل الكرنولي المحلي في منطقتي الموهوب وغرب الموهوب عن طريق قياس 13 صفة مورفولوجية في شغالات العسل وخصصت منطقتين وهي بلاط والراشدة لحساب نسبة الخفض في الصفات المورفولوجية سلالات نحل العسل في الهجين أول كرنولي ويمكن تلخيص النتائج المتحصل عليها فيما يأتي:

أولاً: الصفات المورفولوجية لشغالات نحل العسل قبل تطبيق برنامج التحسين

تم قياس الصفات المورفولوجية التالية قبل التحسين: طول و عرض كلا من الجناح الأمامي والجناح الخلفي وسللة حبوب اللقاح ومرآة غدة الشمع الثانية والفك العلوي وبالإضافة إلى عدد الخطاطيف على الجناح الخلفي وطول الخرطوم وحساب الـ Cubital index a/b (العلاقة بين المسافة أ، ب في نظام تعريق الجناح الأمامي) وذلك لشغالات كل منطقة من مناطق الدراسة. وقد خلصت النتائج إلى وجود فروق معنوية في طول الجناح الخلفي وطول الخرطوم و عرض سللة حبوب اللقاح . ووفقاً لهذه النتائج تم اختيار ثلاث طوائف في كل منطقة سجلت أعلى مقاييس للصفات المورفولوجية لبدء عمليات التحسين من خلال عمليات التزاوج.

ثانياً: برنامج التلقيح الصناعي

تم تجميع الحيوانات المنوية من الذكور الناضجة لكل من الأمهات في المنطقتين محل الدراسة لتحسين السلالة الكرنولي ولقحت عذارى المنطقة الأولى صناعياً بذكور المنطقة الثانية، وعذارى المنطقة الثانية بالحيوانات المنوية لذكور المنطقة الأولى لإنتاج الأمهات المحسنة.

ثالثاً: تحسين الصفات في السلالة الكرنولي

تم عمل برنامج تلقيح طبيعي (First single cousin's program) لإنتاج أمهات جامعة حتى يتم التربية منها واستخدامها في التلقيح الصناعي لاستكمال برنامج التحسين ثم تربية ثلاث ملكات عذارى من كل منطقة من المنطقتين الخاصتين بتحسين السلالة الكرنولي (الموهوب وغرب الموهوب) وتم عمل برنامج التلقيح الصناعي بينهما ثم إجراء القياسات المورفولوجية السابق ذكرها لنسلها حيث ظهرت زيادة معنوية في بعض الصفات المورفولوجية لهذه القياسات.