

COMPARATIVE STUDIES ON SOME MORPHOMETRICAL AND PHYSIOLOGICAL CHARACTERS FOR VIRGIN QUEENS OF TWO STRAINS AND HYBRIDS OF HONEYBEE, *APIS MELLIFERA*

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ABSTRACT : *Comparative studies on four honeybee (Apis mellifera) strains and first hybrids of virgin queens of Italian and Carniolan were done on some morphometrical and physiological characters. Results indicated that Italian queen recorded the heaviest body weight (176.6mg) followed by F₁ Italian, then Carniolan, whereas, the F₁ Carniolan queen was the lightest body weight (159mg). Moreover, the Italian queen forewing was the longest one (10.274mm), followed by F₁ Italian, then F₁ Carniolan, while, the Carniolan queen forewing was the shortest (10.038mm). In addition, Italian queen forewing was the widest (3.456mm), followed by F₁ Italian, then F₁ Carniolan, whereas, the Carniolan queen forewing was the shortest (3.313mm). Also, the Carniolan queen recorded the heaviest right ovary followed by Italian, then F₁ Carniolan. While, the F₁ Italian was the lightest in right ovary weight, without significant differences among them. As for ovarioles number, the Italian queen gave the highest number (157.4), followed by F₁ Italian, then Carniolan while Carniolan F₁ had the lowest number of ovarioles (125.6). Positive correlation coefficients were recorded among length, width of forewing and queen weight, also between length and width of forewing, and between length of forewing and number of ovarioles.*

Key words: *honeybee, strains, hybrids, queen weight, forewing, ovary, ovarioles.*

INTRODUCTION

Many authors stated that, distinguish between different honeybee races was one of the most interested field used for a long time. For this purpose, the some morphological characters were mostly used. Most of these studies were concentrated in using morphometrical characters on honeybee workers (Schluens *et al.* (2003); Mazeed (2004); Tofilski (2008); Shaibi, *et al.* (2009); Souza, *et al.* (2009) and Rattanawanee, *et al.* (2010). In the last years, the morphometrical analysis is being incorporated into the honeybee genetic program as a tool for characterization of genetic materials. Moreover, morphometrics is the measurements and analysis of shape and is widely applied to problems in insect life, history, physiology and systematic (Daly, 1985). In addition, using of wing characteristics only has been proved as a useful tool for detecting the hybridization zone between two honeybee populations and are important in classifying different

races of bees and it could be measured precisely Kauhausen and Keller (1998).

The objective of this study is to use the morphometrical measurements and physiological characters of virgin queens for the differentiation between the phenotypic characterization of Carniolan, Italian strains and their first hybrids in Egypt.

MATERIALS AND METHODS

The experiments were carried out in Biology laboratory, Faculty of Agriculture, Menoufia University and Apiculture Research Department, Dokki, Giza. The used strains and hybrids were Carniolan queens (Manzala region), Italian queens (Suez region), First Carniolan hybrid and First Italian hybrid.

Biometrical characters of virgin queens:

Weight of virgin queen, length and width of right forewing, weight of right ovary and

number of ovarioles were measured. Thirty virgin queens from each strain and hybrid were weighted at the same day of emergence. The complete right forewing were pulled from the virgin queen and put on a slide with a drop of water and take its measure under stereo microscope (Savin, 1956). Dissection was carried out in 70% ethyl alcohol starting from the first tergum till the last one by cutting through the connections between the terga and sterna on both sides, then all the terga were removed. The right ovary was separated to measure the mean weight (mg) and numbers of ovarioles were accounted according to El-Banby and Abou-Korah (1976) and Abou El-Enin (1997).

Statistical analysis:

Descriptive, ANOVA and LSD test (at 0.05) analyses were calculated by SAS computer program (Samprit, *et al.*, 2000). The multiple Correlation and simple linear regression (Levesque, 2007). have been used to predict queen weight and number of ovarioles by using length and width of virgin queen forewing.

The statistical model was: $Y = \alpha + bX$

Where Y = dependent variables; α = the intercept; X = independent variable; and b= regression coefficient.

RESULTS AND DISCUSSION

The characters of virgin queens under this study were queen weight, length and width of right forewing, right ovary weight and number of ovarioles for strains and hybrids as follows:

1. Queen weight measurements:

Data presented in Table (1) showed that, the mean weights of virgin queens were 159.3mg, 159.0mg, 176.6mg and 161.2mg for the Carniolan, F₁ Carniolan, Italian and F₁ Italian, respectively. There was significant difference between Italian strain and each others. While, there were no significant differences among Carniolan, F₁ Carniolan and F₁ Italian. Generally, the Italian queen gave the heaviest weight followed by F₁ Italian, then Carniolan. Whereas, the F₁ Carniolan queen was the lightest one.

2. Forewing measurements:

• Length of forewing:

As shown in Table (1) the mean values of virgin queen forewing length were, 10.038mm, 10.042mm, 10.274mm and 10.184 mm. for the Carniolan, F₁ Carniolan, Italian and F₁ Italian, respectively. Statistical analysis of data showed that, there was no significant difference between F₁ Italian and each others. While, there was a significant difference between the Italian and each of Carniolan and F₁ Carniolan. These outcomes specified that, the Italian queen forewing gave the longest one followed by F₁ Italian, then F₁ Carniolan. While, the Carniolan queen forewing was shortest one.

• Width of forewing:

Data in Table (1) showed that, the mean values of virgin queen forewing width were, 3.313mm, 3.331 mm, 3.456 mm and 3.376mm for the Carniolan, F₁ Carniolan, Italian and F₁ Italian, respectively. In relation to statistical analysis, there was no significant difference between F₁ Italian and each others. While there were significant differences between the Italian and each of Carniolan and F₁ Carniolan. The results indicated that, the Italian queen forewing gave the widest one followed by F₁ Italian, then F₁ Carniolan. While, the Carniolan queen was the shortest forewing wide.

3. Weight of right ovary:

Data recorded in Table (1) confirmed that, the mean weights of right ovaries for virgin queens were 3.978mg, 3.808mg, 3.928mg and 3.733mg for the Carniolan, F₁ Carniolan, Italian and F₁ Italian, respectively. There were no significant differences among all of this strains and hybrids. Generally, the Carniolan queen gave the heaviest ovary followed by Italian, then F₁ Carniolan. While, the F₁ Italian was lightest one in ovary weight.

4. Number of right ovarioles:

Data presented in Table (1) showed that, the mean numbers of ovarioles were 142.3, 125.6, 157.4 and 146.6 for the Carniolan, F₁ Carniolan, Italian and F₁ Italian, respectively. Statistical analysis proved that,

Comparative studies on some morphometrical and physiological characters..

there were highly significant differences between Italian and each others. While, there was no significant difference between the F₁ Italian and Carniolan.

These results indicated that, the Italian queen had the highest number of right ovarioles followed by F₁ Italian, then Carniolan. Whereas, the F₁ Carniolan gave the lowest number of ovarioles.

The above mentioned results consent with Diab (1986) who mentioned that Prolific queens specialized and very simple guide lines produce specific offspring. Bee races in Egypt exposed to inbreeding process for long periods should negative effects on honeybee queen fertility. Abou El-Enin (1997) noticed that, the average weights of virgin queens of the ligustica queen bees were insignificantly more than those of the carnica. And also found that the ovarioles numbers of the ligustica queen bees were insignificantly more than those of the

carnica. El-Ghrib (2002) observed that, the mean weight of queen reared artificially was (163.95±3.2074mg.). Morini, *et al.* (1993) and Abd-Al-Fattah, *et al.* (2007) demonstrated that, the fertility of honeybee queens depends on many factors such as heredity genes available and environmental conditions. These factors can be associated with the physiological activities reflect on honeybee queens productivity. On the other hand, data disagreement with Yakoub (2002) showed that, the highest mean fresh body weight of queens was 173.26, 170.46 mg, in F₁ hybrid queen, Carniolan queen, respectively. El-Enany, *et al.* (2010) who observed that Carniolan hybrid followed by Italian hybrid were subjected with the highest characters of the queen quality (queens weight, total No. of ovarioles), whereas Carniolan indicated the lowest characters of queens.

Table (1): The mean of morphometrical and physiological virgin queen characters for Carniolan and Italian strains and their first hybrids.

Strain	Rep.	Queen weight (mg)	Forewing		Ovary weight (mg)	No. of Ovarioles
			length (mm)	width (mm)		
Carniolan	1	157.3	9.875	3.233	4.300	143.0
	2	159.0	10.083	3.275	3.933	145.0
	3	161.7	10.156	3.431	3.700	138.8
Mean		159.3 b	10.038 b	3.313 b	3.978 ns	142.3 b
F ₁ Carniolan	1	157.8	10.167	3.400	3.900	127.3
	2	157.6	10.083	3.317	3.700	131.0
	3	161.7	9.875	3.275	3.825	118.5
Mean		159.0 b	10.042 b	3.331 b	3.808 ns	125.6 c
Italian	1	180.5	10.375	3.525	4.433	158.3
	2	172.6	10.292	3.442	3.900	155.7
	3	176.8	10.156	3.400	3.450	158.3
Mean		176.6 a	10.274 a	3.456 a	3.928 ns	157.4 a
F ₁ Italian	1	159.2	10.375	3.400	3.733	157.0
	2	158.9	10.083	3.358	3.967	146.0
	3	165.6	10.094	3.369	3.500	136.8
Mean		161.2 b	10.184 ab	3.376 ab	3.733 ns	146.6 b
L.S.D. at 0.05		11.9	0.202	0.121	ns	9.6

Means in each row followed by the same letter (s) are not significantly different at 5%

Correlation and regression among morphometrical and physiological virgin queen characters:

Results in Table (2) revealed that there were positive correlation coefficients among length, width of forewing and queen weight, also between length and width of forewing, moreover between length of forewing and number of ovarioles.

As shown in Table (3) and Fig. (1) there was equation developed for predicting queen weight by measuring forewing length and forewing width, also another equation for predicting length of queen forewing by measuring forewing width, moreover, there was equation for predicting number of ovarioles by measuring forewing length. This study may help in determining the queen weight and number of ovarioles for

honeybee queens without need to kill and dissect them.

These results are in agreement with the findings of Taha (2005) who recorded a highly significant positive correlation between mean weight of newly emerged queen and each of mean measurements activity, and Mazeed and Tharwat (2004) indicated that, the relation between number of ovarioles and bristles covering the forewing was linear and negatively correlated with each other. The coefficient of regression was estimated at 0.52, 0.32 and 0.29 for Egyptian, Italian and hybrid bees, respectively. On the other hand, Szabo (1973) stated that the number of ovarioles was related to the weight of queens at emergence. Attili, *et al.* (1987) found that there was no significant correlation between number of ovarioles and the weight of the queens.

Table (2): Correlations coefficients among morphometrical and physiological virgin queen characters.

Character	Queen weight	Forewing length	Forewing width	Ovary weight	No. of ovarioles
Queen weight		0.447**	0.556**	0.286	0.300
Forewing length	**		0.710**	0.115	0.427**
Forewing width	**	**		0.083	0.129
Ovary weight					0.045
Ovarioles		**			

** Correlation is significant at the 0.01 level

Table (3): Regression models for morphometrical and physiological virgin queen characters.

Prediction equation	R ²
queen weight = -113.55 + 27.43* forewing length	0.20
queen weight = -31.14 + 58.01* forewing width	0.31
forewing length= 6.07+ 1.21* forewing width	0.50
No. of ovarioles= -144.73+ 28.36* forewing length	0.18

Comparative studies on some morphometrical and physiological characters..

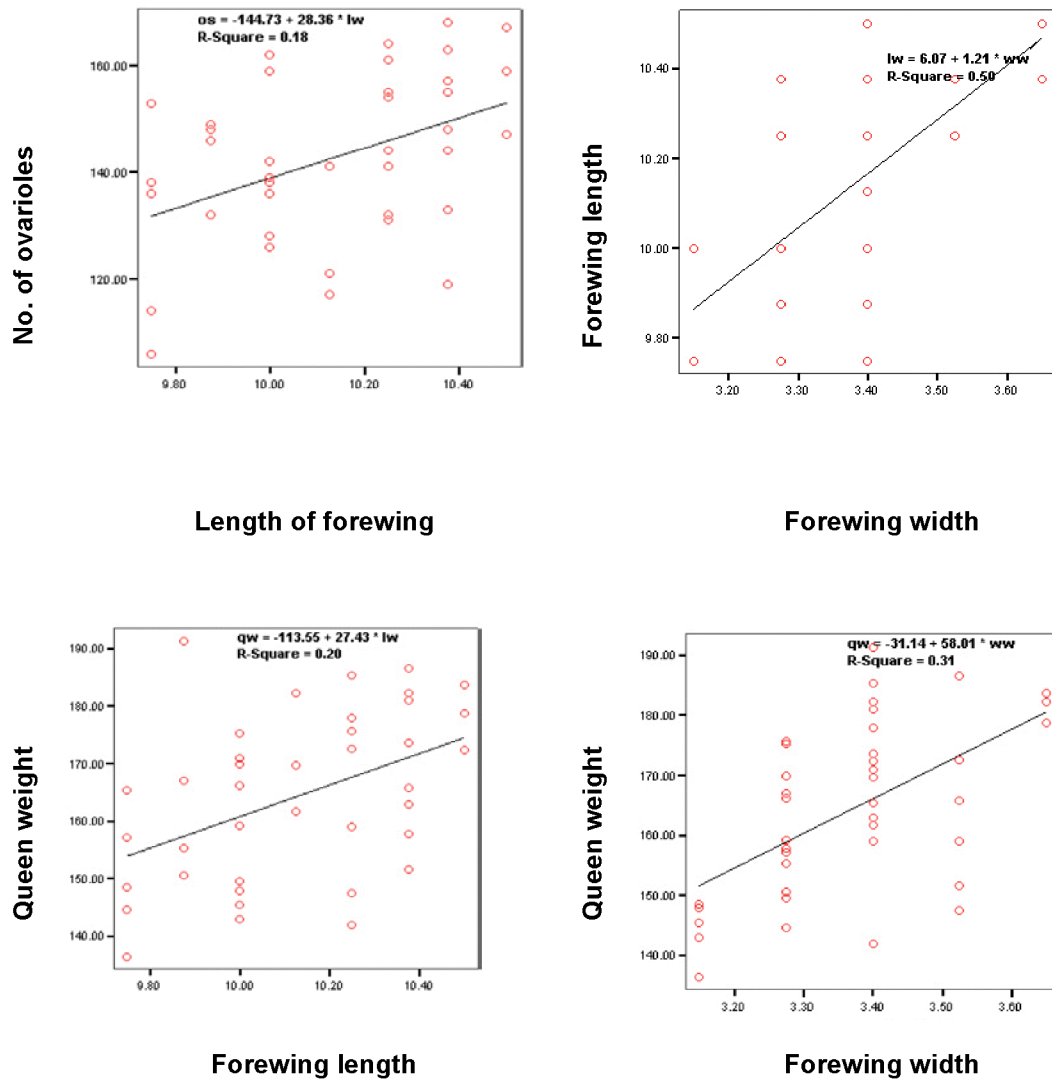


Fig (1): Linear regression for morphometrical and physiological virgin queen characters.

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دراسات مقارنة علي بعض الخصائص الفسيولوجية والقياسات المورفولوجية للملكات
العذارى على اثنان من سلالات وهجن نحل العسل أبيس ميليفيرا

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المخلص العربي

أجريت هذه الدراسة لقياس بعض صفات الملكات العذارى لسلالات نحل العسل الإيطالي (المعزولة بمنطقة السويس) والكرنيولي (المعزولة بمنطقة المنزلة) والهجين الأول لكل منهما من حيث وزن الملكات، طول وعرض الجناح الأمامي، وزن وعدد فروع المبيض الأيمن. وتهدف هذه الدراسة إلي تقييم الملكات العذارى لهذه السلالات والهجن، وأيضاً إيجاد طريقة للتنبؤ بكفاءة الملكات العذارى من دون قتلها أو تشريحها. وأوضحت النتائج مايلي:

- 1- الملكات الإيطالي هي الأثقل وزناً بمتوسط 176,6 ملليجرام يليه الهجين أول إيطالي 161,2 ملليجرام ثم الكرنولي 159,3 ملليجرام، بينما كانت الملكات الهجين أول كرنولي 159 ملليجرام والتي كانت أقلهم وزناً. حيث تبين وجود فروق معنوية بين السلالة الإيطالي والسلالات والهجن محل الدراسة ، بينما لم تكن هناك فروق معنوية بين السلالة الكرنولي وبين كل من الهجين أول كرنولي والهجين أول إيطالي.
- 2- الجناح الأمامي للملكات الإيطالي هو الأطول بمتوسط 10,274 مم يليه الهجين أول إيطالي 10,184 مم ثم الهجين أول كرنولي 10,042 مم، و كان الكرنولي أقصرهم بمتوسط 10,038 مم. حيث تبين وجود فروق معنوية بين السلالة الإيطالي وكل من الكرنولي والهجين أول كرنولي ، بينما لا توجد فروق معنوية بين الهجين أول إيطالي والسلالات والهجن محل الدراسة.
- 3- الجناح الأمامي للملكات الإيطالي هو الأعرض بمتوسط 3,456 مم يليه الهجين أول إيطالي 3,376 مم ثم الهجين أول كرنولي 3,331 مم ثم الكرنولي 3,313 مم حيث كان أقلهم عرضاً. حيث تبين وجود فروق معنوية بين السلالة الإيطالي وكل من الكرنولي والهجين أول كرنولي ، بينما لا توجد فروق معنوية بين الهجين أول إيطالي والسلالات والهجن محل الدراسة.
- 4- عدم وجود فروق معنوية بين السلالات والهجن محل الدراسة ، حيث كان وزن المبيض للسلالة الكرنولي 3,978 ملليجرام، بينما الإيطالي 3,928 ملليجرام، بينما الهجين أول كرنولي 3,808 ملليجرام، بينما الهجين أول إيطالي 3,733 ملليجرام .

5- الفروع المبيضية للسلالة الإيطالي كانت أكثرهم عددا بمتوسط 157,4 فرع مبيضي / مبيض يليه الهجين أول إيطالي 146,6 فرع يليه الكرنيلي 142,3 فرع ثم الهجين أول كرنيلي 125,6 فرع والذي كان أقلهم عددا. حيث تبين وجود فروق معنوية عالية بين السلالة الإيطالي و السلالات والهجن محل الدراسة, بينما لا توجد فروق معنوية بين الكرنيلي والهجين أول إيطالي.

6- أوضح التحليل الإحصائي وجود ارتباط موجب بين طول وعرض الجناح الأمامي للملكات محل الدراسة وبين وزن الملكات, وأيضا هناك ارتباط موجب بين طول وعرض الجناح الأمامي, وأيضا هناك ارتباط موجب بين طول الجناح الأمامي وعدد الفروع المبيضية مما يفتح الباب أمام توقع صفات الملكات دون اللجوء إلى تشريحها وإنما إلى الارتباط بين طول وعرض الأجنحة وعدد الفروع المبيضية لكل مبيض.

