

# MORPHOMETRIC STUDY OF ANDALUSIAN BEES

## ESTUDIO MORFOMETRICO DE LAS ABEJAS ANDALUZAS

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### Additional Keyword

*Apis mellifera iberica*. Morphometry.

### Palabras clave adicionales

*Apis mellifera*. Morfometría.

### SUMMARY

The biological and behavioral characteristics of the iberian bees are much less known than the other european races. This paper studies the morphological characteristics (Proboscis length; Forewing length; Forewing width; Cubital vein a; Cubital vein b; Cubital index a/b; Hindwing length; Hindwing width; Femur length; Tibia length; Metatarsus length; Metatarsus width; Width of tomentum at tergite 4; Pigmentation of tergite 3) of bees used in andalusian apiculture.

Our results coincide with those described for *Apis mellifera iberica*.

### RESUMEN

Las características biológicas y de comportamiento que presentan las abejas de la península ibérica son menos conocidas que las que presentan otras razas europeas. En el presente trabajo estudiamos las características morfológicas (longitud de la proboscis; longitud del ala delantera derecha; anchura del ala delantera derecha; vena cubital a; vena cubital b; índice cubital a/b; longitud del ala trasera derecha; anchura del ala trasera derecha; longitud del fémur; longitud de la tibia; longitud del metatarso; anchura del metatarso; longitud del tomentum

del terguito 4º y pigmentación del terguito 3º) que presentan las abejas empleadas en la apicultura andaluza.

Nuestros resultados coinciden con los descritos para *Apis mellifera iberica*.

### INTRODUCTION

The first beehives from Spain, containing the so-called castilian bees, reached America towards the beginning of the 19th century (Crane, 1990).

In the age of discovery, spanish beekeepers generally used beehives fashioned from cork bark or hollowed-out logs, in which bees built honey combs and brood combs.

Although bees from Spain were termed *castilian*, they probably came from Andalusia, since migratory beekeeping was poorly-developed at that time.

The biological and behavioral characteristics of the iberian bees (*Apis mellifera iberica*, Goetze 1964) are much less well known than the other

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**Table I.** Morphological measurements of 11 *A. mellifera iberica* colonies. (Medidas morfológicas de 11 colonias de *A. mellifera iberica*).

Beehive Character	1	7	31	37	39	47
PL	6.763± 0.017	6.865± 0.034	6.677± 0.041	6.519± 0.028	6.518± 0.032	6.665± 0.044
FL	9.446± 0.018	9.688± 0.029	9.573± 0.022	9.462± 0.031	9.785± 0.03	6.767± 0.025
FW	3.088± 0.006	3.168± 0.012	3.115± 0.01	3.039± 0.01	3.159± 0.01	3.176± 0.009
CVa	0.492± 0.004	0.47± 0.005	0.479± 0.006	0.485± 0.007	0.44± 0.004	0.467± 0.005
CVb	0.302± 0.002	0.314± 0.003	0.292± 0.004	0.293± 0.003	0.3± 0.003	0.274± 0.003
CI	1.648± 0.025	1.502± 0.021	1.656± 0.033	1.675± 0.041	1.478± 0.025	1.713± 0.03
HL	6.6± 0.015	6.81± 0.031	6.766± 0.018	6.725± 0.028	6.941± 0.03	6.851± 0.019
HW	1.742± 0.005	1.854± 0.009	1.777± 0.009	1.772± 0.01	1.811± 0.012	1.809± 0.008
FeL	2.679± 0.015	2.7± 0.015	2.697± 0.009	2.559± 0.015	2.709± 0.013	2.659± 0.013
TL	3.372± 0.009	3.421± 0.015	3.398± 0.011	3.165± 0.015	3.384± 0.018	3.341± 0.012
ML	2.198 0.007	2.231± 0.011	2.316± 0.014	2.138± 0.014	2.226± 0.016	2.211± 0.011
MW	1.224± 0.004	1.233± 0.006	1.223± 0.008	1.228± 0.006	1.24± 0.008	1.209± 0.006
LTT <sub>4</sub>	0.597± 0.01	0.588± 0.01	0.594± 0.01	0.56± 0.008	0.544± 0.008	0.541± 0.011
PT <sub>3</sub>	0.12± 0.014	0.224± 0.018	0.168± 0.018	0.141± 0.014	0.192± 0.013	0.146± 0.012

Values in mm (mean ± standard deviation) of all characteristics studied except CI (CI is a index between the characteristics 4 and 5).

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European breeds (Rutner, 1988). These bees have been defined as larger in size, with relatively short wings and with a cubital index

drastically reduced to values below 2.0 (5).

This paper studies the morphological characteristics of bees used in Andalusian apiculture.

*Table I. continuation.*

Beehive Character	49	57	58	98	99
PL	6.545± 0.031	6.592± 0.041	6.442± 0.038	6.72± 0.037	6.861± 0.024
FL	9.495± 0.026	9.448± 0.028	9.663± 0.023	9.735± 0.031	9.574± 0.024
FW	3.04± 0.009	3.094± 0.01	3.141± 0.009	3.18± 0.013	3.078± 0.01
CVa	0.44± 0.005	0.476± 0.005	0.485± 0.005	0.461± 0.008	0.548± 0.005
CVb	0.302± 0.005	0.292± 0.003	0.304± 0.003	0.316± 0.004	0.296± 0.003
CI	1.473± 0.029	1.641± 0.028	1.602± 0.026	1.469± 0.036	1.857± 0.027
HL	6.661± 0.027	6.805± 0.02	6.808± 0.029	6.851± 0.025	6.734± 0.025
HW	1.792± 0.008	1.783± 0.009	1.844± 0.009	1.838± 0.01	1.769± 0.009
FeL	2.618± 0.013	2.67± 0.011	2.598± 0.012	2.719± 0.022	2.653± 0.014
TL	3.339± 0.011	3.321± 0.014	3.236± 0.015	3.458± 0.02	3.431± 0.012
ML	2.174± 0.009	2.239± 0.012	2.191± 0.013	2.243± 0.017	2.229± 0.011
MW	1.185± 0.006	1.205± 0.006	1.263± 0.006	1.285± 0.007	1.235± 0.007
LTT <sub>4</sub>	0.451± 0.014	0.631± 0.015	0.539± 0.012	0.507± 0.019	0.464± 0.014
PT <sub>3</sub>	0.203± 0.013	0.185± 0.019	0.13± 0.014	0.12± 0.026	0.102± 0.016

**Table II.** Analysis of variance. (Análisis de la varianza).

Beehive	1	7	31	37	39	47	49	57	58	98	99
1		*		*	*	*	*		*	*	
7	*		*	*			*	*			*
31	*			*		*	*			*	
37		*			*	*		*	*	*	
39	*		*	*			*	*			*
47	*		*	*			*	*			*
49		*			*	*		*	*	*	
57		*	*		*	*			*	*	
58	*			*			*	*			*
98	*		*	*			*	*			*
99	*				*	*		*		*	

Tukey test result. In the horizontal the characteristic Forewing length (2) and in the vertical Forewing width (3). (\*) Indicate the existence of significative differences.

## MATERIALS AND METHODS

We collected 11 colonies from beehives used in migratory beekeeping. These colonies were random samples of approximately 44 worker bees from broodcombs.

The bees were preserved frozen (-20°C) and later dissected and examined using an image analysis system, and the IMAGO program from the Cordoba University working group SIVA.

All characteristics studied are as described by Ruttner (1986), unless otherwise stated: (PL) Proboscis length; (FL) Forewing length; (FW) Forewing width; (CVa) Cubital vein a; (CVb) Cubital vein b; (CI) Cubital index a/

b; (HL) Hindwing length; (HW) Hindwing width; (FeL) Femur length; (TL) Tibia length; (ML) Metatarsus length; (MW) Metatarsus width; (LTT<sub>4</sub>) Width of tomentum at tergite 4; (PT<sub>3</sub>) Pigmentation of tergite 3.

The data obtained were analyzed using the statistical program package SAS (Statistical Analysis System).

## RESULTS

Beekeeping work, and particularly migratory beekeeping activity has produced the general hybridization of bees and the impossibility of maintaining strains in pure condition. In Andalusia migratory beekeeping is

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**Table III. Analysis of variance.** (Análisis de la varianza).

Beehive	1	7	31	37	39	47	49	57	58	98	99
1		*			*	*	*	*	*	*	
7	*		*	*		*	*	*			*
31	*								*	*	
37	*								*	*	
39	*	*	*	*							
47	*			*							
49		*			*	*			*		
57	*				*		*		*	*	
58	*				*		*				*
98	*						*				*
99	*				*	*					

Tukey test result. In the horizontal the characteristic Hindwing length and in the vertical Hindwing width. (\*) Indicate the existence of significative differences.

**Table IV. Analysis of variance.** (Análisis de la varianza).

Beehive	1	7	31	37	39	47	49	57	58	98	99
1					*	*	*			*	*
7					*		*				*
31		*			*		*				*
37		*			*		*				*
39								*	*		
47	*	*	*	*	*						*
49						*		*	*		*
57		*				*					*
58						*					*
98			*	*		*		*			*
99						*					*

Tukey test result. In the horizontal the characteristic Cubital vein b and in the vertical Cubital vein a. (\*) Indicate the existence of significative differences.

**Table V.** *Analysis of variance.* (Análisis de la varianza).

Beehive	1	7	31	37	39	47	49	57	58	98	99
1					*	*	*			*	*
7	*						*			*	*
31							*			*	*
37		*					*	*			*
39	*						*	*			*
47							*	*			*
49	*							*	*		
57									*	*	*
58		*									*
98		*									
99		*			*		*	*			

Tukey test result. In the horizontal the characteristic Pigmentation of tergite 2 and in the vertical Width of tomentum at tergite 4. (\*) Indicate the existence of significative differences.

well-developed now, for which reason we have utilized samples coming from this apicultural activity, in order to establish the present characteristics of Andalusian bees.

**Table I** shows the mean values and mean deviation for all characteristics of the bees studied. Although two samples (37 and 98) contained six maximal and five minimal variable values, the rest of the samples contain almost one maximal or minimal value.

Data were analyzed using an analysis of variance (proceeding General Lineal Method). The object of this study was to search for the best morphological characteristics in order to distinguish the beehive colonies studied.

Tukey test results from the variance analyses are shown in **tables II to VIII**

(the F analysis values for all characters were all highly significant  $p < 0.001$ ). This result allowed three groups to be formed.

The first included morphological characteristics that present significant differences smaller than 40% among samples (Pigmentation of tergite 3 18%; Cubital vein b 29%; Femur length 30% and Metatarsus length 34%).

The second group included characteristics that present significant differences between 40 and 50% of the samples (Hindwing width 40%; Metatarsus width 40%; Hindwing length 41%; Cubital vein a 43%; Proboscis length 47%; Cubital index a/b 49% and Width of tomentum at tergite 4 49%).

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**Table VI. Analysis of variance.** (Análisis de la varianza).

Beehive	1	7	31	37	39	47	49	57	58	98	99
1		*			*		*			*	*
7			*	*		*					*
31		*			*		*			*	*
37	*	*	*		*		*			*	*
39	*	*				*		*			*
47		*					*			*	
49	*	*						*			*
57	*	*								*	*
58	*	*	*			*					*
98				*	*				*		*
99			*	*	*	*	*	*	*		

Tukey test result. In the horizontal the characteristic Proboscis length and in the vertical Cubital index a/b. (\*) Indicate the existence of significative differences.

**Table VII. Analysis of variance.** (Análisis de la varianza).

Beehive	1	7	31	37	39	47	49	57	58	98	99
1				*					*		
7				*			*		*		
31				*			*		*		
37	*	*	*		*	*		*		*	*
39				*			*		*		
47		*		*							
49		*		*							
57		*	*	*							
58	*	*	*	*	*	*	*	*	*	*	
98	*			*	*	*	*		*		
99				*	*	*	*	*			

Tukey test result. In the horizontal the characteristic Tibia length and in the vertical Femur length. (\*) Indicate the existence of significative differences.

The third group included the characteristics that present significant differences than 50% (Tibia length 54%; Forewing length 54% and Forewing width 61%).

## DISCUSSION

*A. mellifera* is a highly polytypic species with a tropical or subtropical origin, which has colonized North and Tropical Africa and the mediterranean and North Europe (Ruttner, 1986).

Moving from south to north, there is an overall increase in body size, and decrease in the size of some appendices (Ruttner, 1988). This separates Iberian strains from *A. mellifera intermissa* (North Africa breed) and *A. mellifera mellifera* European breed).

Our results coincide with those described for *A. mellifera iberica*

(Ruttner, 1986). Cornuet *et al.* (Cornuet y Fresnaye, 1989) studied six morphological characteristics in colonies from all over Spain. We have studied five of them (Proboscis length; Cubital vein a; Cubital vein b; Width of tomentum at tergite 4 and Pigmentation of tergite 3), and our data was included in the description.

Proboscis length is an important character (showing higher geographic variability), upon which the quantity of nectar gathered from certain flowers depends (Morimoto, 1968). Our data are very similar to those described by F. Ruttner (Ruttner, 1986).

The wing characteristics are important in classifying different bee breeds, and wing size influences flight ability (Mattu y Verma, 1989). Our results show the existence of important significant differences among the beehives studied from these characteristics.

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