

**CAN THE NUMBER OF OVARIOLES IN THE OVARIES BE
ESTIMATED BY EXTERNAL CHARACTERS OF LIVING QUEENS**

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Introduction

Honey production of a bee colony depends a great deal upon the number of worker bees in it, and this in turn, depends upon the number of eggs a queen can deposit. The number of eggs which a queen is able

to lay is determined by the number of ovarioles in the ovaries, where the eggs are produced. Therefore every beekeeper want to have queens with the highest number of ovarioles, because such queens are able to produce the highest number of eggs. The exact number of ovarioles can be counted

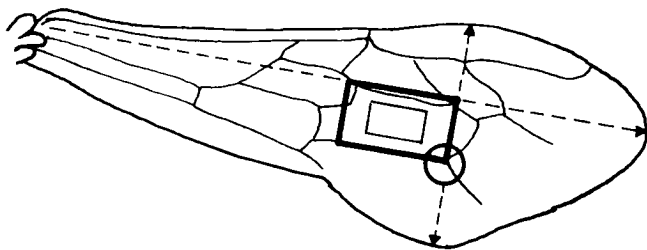


Fig. — Countings of the no. of bristles on the front wing

ed after the queens are killed and dissected. But the question arises : can the number of ovarioles be estimated by external characters while the queens are alive ?

Materials and Methods

An investigation was conducted on 105 queens reared from eggs and from larvae 1, 2, 3 and 4 days old.

Emerged queens were weighed. Next they were killed and dissected. The number of ovarioles in both ovaries was counted and the size of spermatheca was measured. Also the size of the front wing, as well as the wing index were measured and calculated. The number of bristles covering on area of $0.8 \times 0.5 = 0.4 \text{ mm}^2$ on the front wing was also counted Fig. 1.

Analysis of variance was applied and the Duncan multiple range test was used to find statistically significant differences between the means. Correlation coefficients as well as regression coefficients were calculated for different variables.

Results

Table 1 shows that the mean weight of queens decreased as the age of brood used for queen rearing increased. Differences between all means were statistically significant. Queens reared from eggs (209 mg) were about 1.5 times heavier than those reared from larvae 3 days old (147 mg). Increase of brood age by 1 day resulted in 20 mg loss of weight.

Number of ovarioles decreased from 317 and 308 for queens reared from eggs and 1 day old larvae to 272 and 224 for those reared from larvae 3 and 4 days old, respectively. Thus the last queens, had respectively 45 and 95 ovarioles less than those reared from eggs. The lowest difference between virgins reared from brood differing in age by 1 day occurred in those reared from eggs and and 1 day old larvae, and the

Table 1

Comparison of the size of reproductive organs of queens reared from brood of different age (eggs and larvae) with 5 other characters

Age of brood	No of queens	Weight mg	No. ovarioles	Volume spermath. mm ³	length mm	Wing width mm	Index	No bristles
Eggs	20	209a	317a	1.18a	10.01a	3.35a	2.50a	172a
1 day	25	189b	308b	1.09b	10.22a	3.31b	2.27b	169ab
2 days	25	172c	292c	0.94c	9.86b	3.28c	2.22bc	161bc
3 days	25	147d	272d	0.82d	9.77b	3.12d	2.03cd	152c
4 days	10	119e	224e	0.59e	9.18e	2.99e	1.09d	137d
Correlation coefficient between a character and no. of ovarioles								
		0.75	—	0.71	0.99	0.98	0.93	0.99
Regression coefficient between a character and no. of ovarioles								
		0.65	—	85.5	90.5	240	149	2.6

■ Different letters indicate statistically significant differences between means, $P < 0.05$

highest difference occurred between virgins reared from larvae 3 and 4 days old. Nevertheless differences between all means were statistically significant. Increase of brood age by 1 day decreased the average number of ovarioles by 15.

Correlation coefficient between number of ovarioles and weight of queens was $r = 0.75$. An increase of queen weight by 10 mg was related to an increase of 6.5 ovarioles.

Volume of spermatheca decreased also from 1.18 mm³ for queens reared from eggs to 0.82 and 0.59 mm³ in queens reared from larvae 3 and 4 days old, respectively. Queens reared from eggs had spermatheca 1.4 times larger than those reared from larvae 3 days old. Correlation coefficient between weight of queens and the volume of their spermatheca was $r = 0.71$.

Thus the weight emerging queens can indicate the number of ovarioles and the size of spermatheca. But the weight of older queens is variable, and this character can not be used as an indicator of the size of reproductive organs.

Therefore some other characters, which do not change during the life, were measured or counted. Next correlations between those characters and the number of ovarioles were investigated. Results concerning the wing are presented here.

Table 1 shows that the length of front wing decreased from 10.01 mm in queens reared from eggs to 9.77 and 9.18 mm in queens reared from larvae 3 and 4 days old, respectively. Correlation coefficient between the length of wing and the number of ovarioles was very high, $r = 0.99$.

Also the width of wing decreased from 3.35 mm in queens reared from eggs to 3.12 and 2.99 mm in those reared from larvae 3 and 4 days old, respectively. The correlation coefficient between the width of wing and number of ovarioles was also very high, $r = 0.98$.

Thus, some morphological characters of a queens body are highly correlated to the number of ovarioles, in a queen's ovaries. Unfortunately it is difficult to measure those characters in living queens.

Table 1, shows also that the index on the front wing decreased from 2.50 and 2.27 in queens reared from eggs and 1 day old larvae to 2.03 and 1.90 in queens reared from 3 and 4 days old larvae, respectively. Increase of the age of brood used for queen rearing by 1 day decreased the index by 0.14. Correlation coefficient between the index and the number of ovarioles was high, $r = 0.93$. The formula for calculating the number of ovarioles is : No ovarioles = $149x - 42$ ($x =$ index). Increase of index by 0.1 was related to an increase of 15 ovarioles. Thus queens with the highest index are the best.

The number of bristles on a determined area in the front wing, decreased also from 172 and 169 in queens reared from eggs and 1 day old larvae to 152 and 137 in queens reared from larvae and 3 and 4 days old, respectively. Increase of the age of brood by 1 day decreased the number of bristles on the front wings by 8.7. Very high correlation of $r = 0.99$ was found between the number of bristles on the wing and the number of ovarioles in the ovaries. The formula for calculating the number of ovarioles is : No ovarioles = $2.6x - 129$ ($x =$ No bristles). Increase of 1 bristle on that area was related to an increase of 2.6 ovarioles.

Correlation coefficients between the number of ovarioles and the index on the wing $r = 0.95$, as well as between that number and the number of bristles, $r = 0.99$, are higher, than the correlation coefficient between the number of ovarioles and the weight of emerging queens, $r = 0.75$.

Many queen breeders clip the wing of the queens, and both characters ; the index as well as the number of bristles can be easily measured or counted.

Thus, two characters were found which are very highly correlated with the number of ovarioles in the ovaries of the queens and which can be easily determined while the queens are alive. Both characters together or separately may be used to estimate the number of ovarioles in ovaries of living queens.

The best are queens with the highest wing index and the highest number of bristles on the wings.

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