

DOES INBREEDING LEVEL AFFECT THE HYGIENIC BEHAVIOR OF HONEY BEES?

Květoslav Čermák

Bee Research Institute Ltd., Dol, Breeding Stn. Zubří, 756 54 Zubří, Czech Republic

Abstract

The inbreeding is the basic method for maintaining the selection progress in honeybee breeding. The nature of honeybees' ability to resist the infectious diseases is strengthened by selecting for good hygienic behavior in their colonies. The question arises whether increasing the inbreeding level does not lower the hygienic reaction of bees.

The dependency of hygienic behavior on the inbreeding level of bee-workers (colony), their queen and father (drone queen) were assessed in an intensively selected breeding unit of Carniolan race (*Apis mellifera carnica*) in the years 1989 – 2000. A set of 495 colonies was analysed, in 450 of them queens were instrumentally inseminated. Part of the colonies were inter-line hybrids with inbreeding coefficient $F=0$ and part of them were inbreds with various inbreeding level (maximal value of $F = 31,4 \%$). The hygienic behavior was tested using the standard method (hygienic test).

The regression coefficients (b) of the hygienic test on the inbreeding coefficients of bee-workers, their queens and fathers were not statistically significant. Thus, inbreeding did not affect the hygienic behavior in the analysed selected population. Neither inbreeding depression nor the opposite trend - heterosis in inter-line hybrids were apparent inside the breeding unit of Carniolan race.

Introduction

The inbreeding is the basic method for maintaining the selection progress in the honeybee breeding. The nature of honeybees' ability to resist the infectious diseases is strengthened by selecting for good hygienic behavior in their colonies. A question arises whether increasing the inbreeding level does not lower the hygienic reaction of bees.

Material and methods

The dependency of hygienic behavior on the inbreeding level of bee-workers (colony), their queen and father (drone queen) were assessed in an intensively selected breeding unit of Carniolan race (*Apis mellifera carnica*) in the years 1989 – 2000. The inbreeding level was computed in pedigrees and expressed with the inbreeding coefficients (F). The method of F computations was described earlier (Čermák 1995a). The inbreeding coefficient F was determined for honeybee workers, queen and in case of instrumentally inseminated queen also for father, i.e. drone-queen mated to the queen, for each colony.

The set of 495 colonies was analysed, in 450 of them there were instrumentally inseminated queens and free mated queens in the rest. Part of the colonies were inter-line hybrids (F=0) and part of them were inbreds with various inbreeding level (maximal value F = 31,4 %). The hygienic behavior was tested using the standard method (hygienic test) (Čermák, 1995b) and expressed with the average time which a colony needs to complete removing of each purposely killed pupae out of the cells. The raw data of hygienic tests were logarithmically transformed before statistical analysis because of their non-normal distribution. Transformed data were processed by regression analysis.

Results and discussion

The dependency of hygienic test on inbreeding coefficients of bee-workers, queens and fathers are shown in three diagrams (Fig. 1). A weak influence of inbreeding on hygienic behavior is apparent.

The resulted regression coefficients (b) of the hygienic test on the inbreeding coefficients of bee-workers, their queens and fathers were not significant (Table 1): for F of bee-workers $b = -0,673$ ($P=0,208$), for F of queens $b = +0,104$ ($P=0,795$) and for F of fathers $b = +0,639$ ($P=0,150$).

Thus, the effect of inbreeding on the hygienic behavior did not prove to be significant in the analysed selected population with a maximum inbreeding level of F = 31,4 %. Neither inbreeding depression nor the opposite trend - heterosis in inter-line hybrids were apparent inside the breeding unit of Carniolan race. This makes

possible the selection of bees for behavioral resistance against brood diseases without negative affecting of inbreeding depression.

It is true for lower levels of inbreeding with F less than about 30 %. An inbreeding depression in a population with closer inbreeding mating systems, i.e. higher inbreeding coefficients, cannot be excluded.

The absence of a significant influence of inbreeding on hygienic behavior of bees may correspond with high heritability (Čermák, unpublished) of the character. Low heritable characters are more negatively affected with inbreeding, and vice versa. Also intensive selection of bee colonies for good cleaning behavior in the analysed breeding unit may have eliminated some of the effect of inbreeding depression.

References:

Čermák K (1995a) Calculating of inbreeding coefficients of bees from pedigree in the bee breeding program. In: Proceedings of the International Symposium on Bee Breeding on the Islands. Island of Vis, Croatia. April, 19-26, 1995, pp. 39-42

Čermák K (1995b) Hygienic test as a parameter of honey bee resistance to infective brood diseases. In: Proceedings of the International Symposium on Bee Breeding on the Islands Island of Vis, Croatia. April, 19-26, 1995, pp 64-67

Table 1

The regression coefficients of the hygienic test on the inbreeding coefficients (F) of bee-workers, their queens and fathers

Regression on F of	Value of regression coefficient b	Significance level P
WORKERS (colony)	- 0.673	0.208
QUEENS	+ 0.104	0.795
FATHERS (drone queens)	+ 0.639	0.150

Fig. 2a

Dependence of hygienic test on inbreeding level of bees

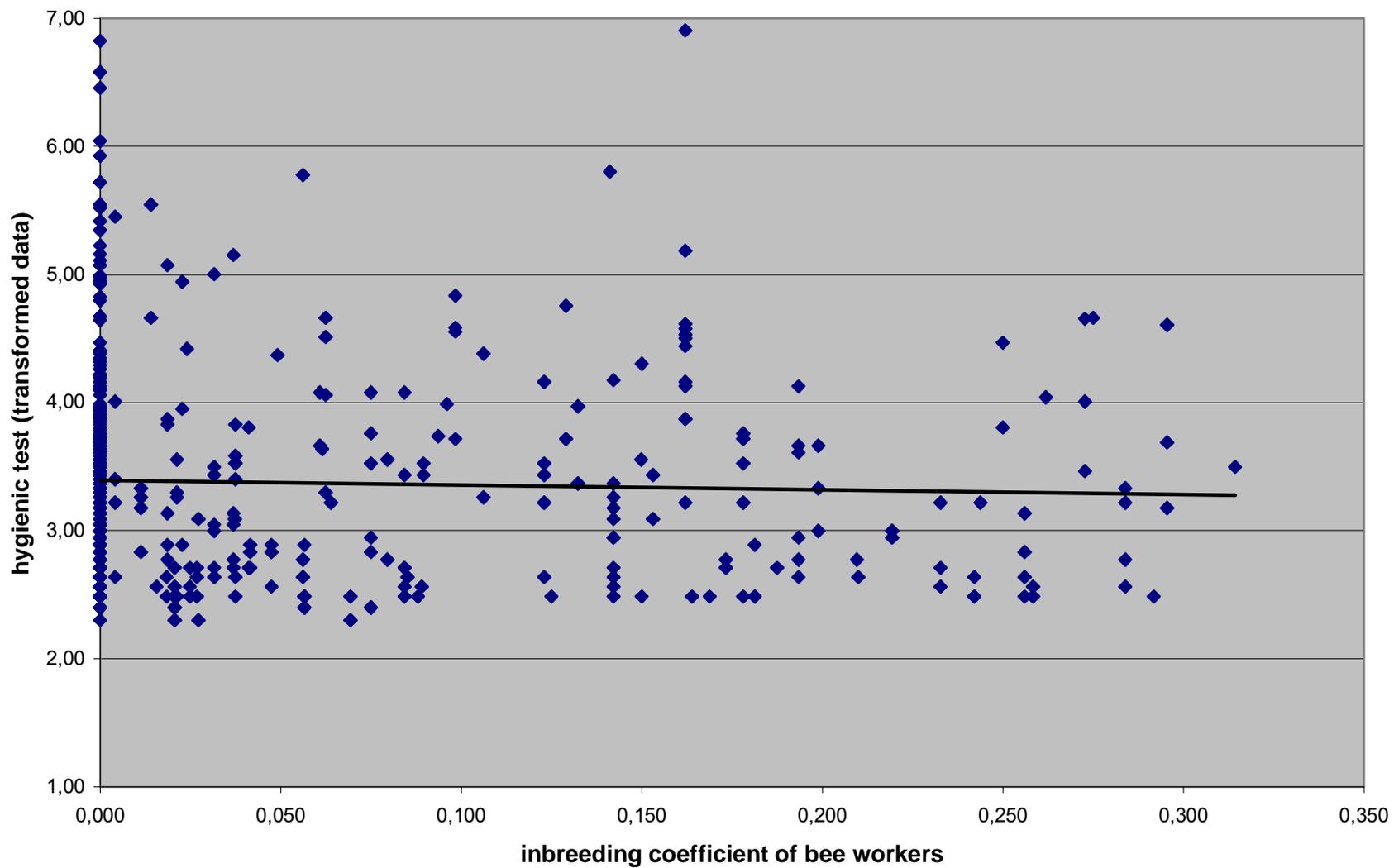


Fig. 2b

Dependence of hygienic test on inbreeding level of queens

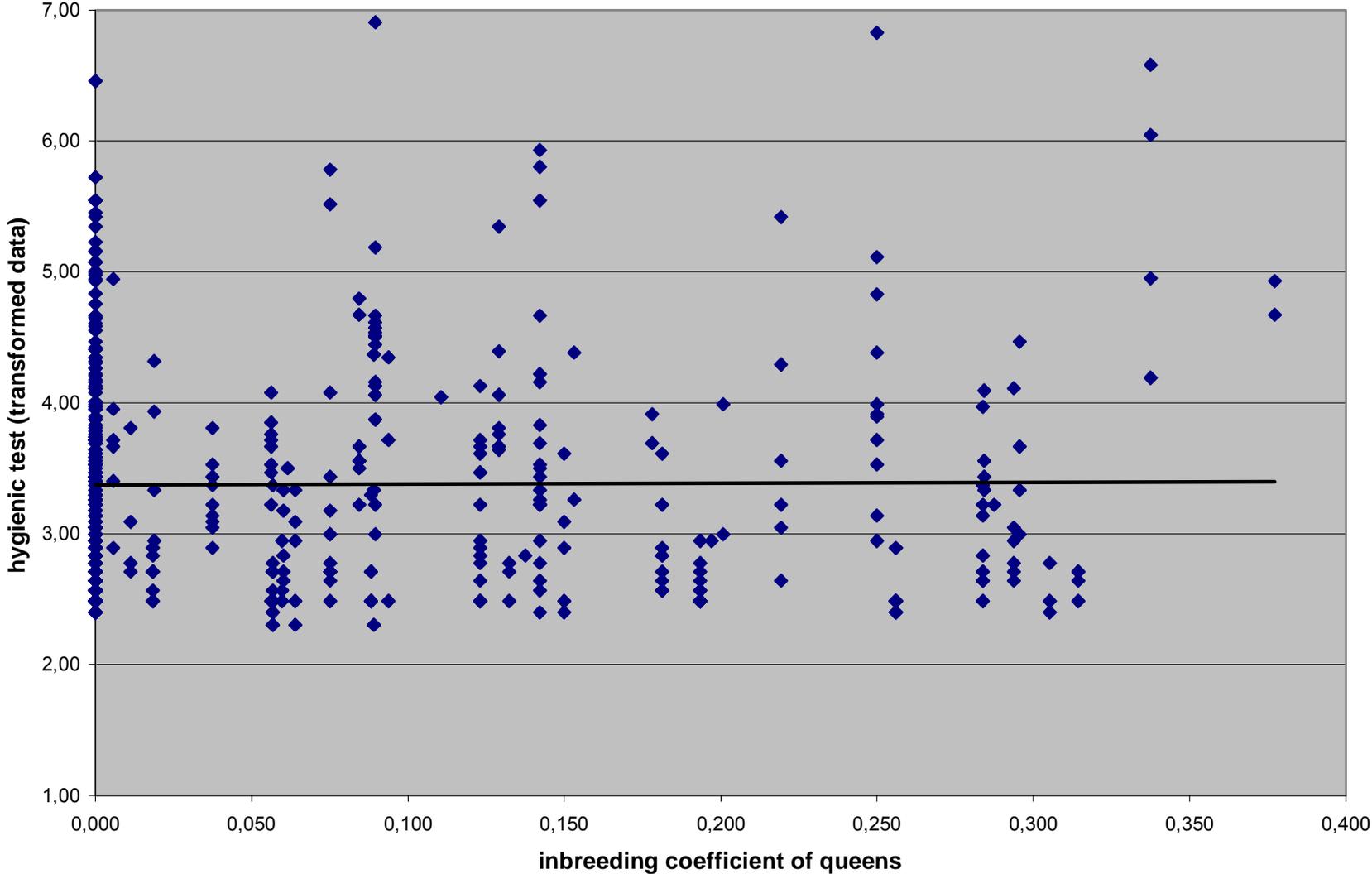


Fig. 2c

Dependence of hygienic test on inbreeding level of fathers

