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CORRELATION BETWEEN HONEY PRODUCTION AND SOME MORPHOLOGICAL TRAITS IN AFRICANIZED HONEY BEES (*Apis melifera*)

CORRELAÇÃO ENTRE A PRODUÇÃO DE MEL E ALGUMAS CARACTERÍSTICAS MORFOLOGICAS EM ABELHAS AFRICANIZADAS (*Apis mellifera*)

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SUMMARY

This study focused on the correlation between honey production length and width of the tibia of the third pair of legs, corbicular area, pupal weight, and glossal length, in Africanized honey bees in Viçosa/MG, Brazil. Correlation values were relatively low, though always positive. The traits glossal length and pupal weight presented the lowest correlation to honey production: 0.225 and 0.410, respectively. The highest correlations were observed between length of the tibia and corbicular area and honey production: 0.587 and 0.549, respectively. In all cases, except pupal weight, correlation was significant. These findings support the notion that worker bees with larger corbicular areas may have a better ability to carry larger quantities of pollen to their hives, so that it is possible to improve honey production through indirect selection of this trait.

Key words: ***Apis mellifera***, *Honey production, Bee selection.*

RESUMO

Foram estimadas as correlações entre as características produção de mel, comprimento e largura da tíbia do terceiro par de patas, área corbicular, peso pupal e comprimento da glossa de abelhas africanizadas em Viçosa/MG. Os valores das correlações foram relativamente baixos, embora todos positivos. As características peso pupal e comprimento da glossa foram as que menos se correlacionaram com a produção de mel, 0,225 e 0,410, respectivamente. A área corbicular e o comprimento da tíbia foram as mais correlacionadas com a produção de mel, 0,587 e 0,549, respectivamente. Todas as correlações, exceto o peso pupal, foram significativas. O trabalho dá suporte à idéia de que operárias de maiores áreas corbiculares são mais hábeis a levar mais pólen para suas colméias, sendo possível a obtenção de ganhos na produção de mel, por meio de uma seleção indireta nesta característica.

Palavras-chave: ***Apis mellifera***, *produção de mel, seleção de abelhas*

INTRODUCTION

Knowledge of the correlation between traits is of great importance for the improvement of such traits, especially if selection in one of them is difficult due to low inheritability, and/or because it presents problems of measurement and identification (CRUZ & REGAZZI, 1997). Correlation makes it possible to measure the magnitude and the direction of the relationship between two traits, thus being useful in evaluating the possibility of the use of indirect selection, which in some cases can provide higher gains than the selection of the one desired trait (CRUZ, 2001).

With bees, many of the economically valuable traits such as honey, propolis and pollen can only be measured at the colony level, being greatly influenced by the environment of the hive, both internal and external. This makes it difficult, in

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many cases, to establish the measurement and the accuracy of the parameter under study. Honey production, for example, can only be evaluated during the flowering periods, and because of it, it is heavily influenced by the environment, the production of the hives must be standardized by the mean of the apiary (SOUZA, 1998).

Limitation of the evaluation period for many traits delays the gains from improvement programs involving bees. To reduce this problem, experiments have been carried out to identify traits that are associated with production and easy to measure, thus allowing the use of indirect selection. MILNE (1985) discusses the importance of laboratory tests as an alternative solution to this problem. LAIDLAW & PAGE (1997) state that such tests easily control environmental conditions, which is much more difficult to achieve in field assessment. However, they warn that traits must present a very high correlation and inheritability, if indirect selection is to be feasible. Several traits have already been studied with this objective, some morphological, some behavioral, among which we can quote corbicular area (MILNE & PRIES, 1984); hoarding behavior (MILNE, 1980a), worker bee longevity (MILNE, 1980b) and pupal weight (MILNE, 1980c).

The corbicula – area where worker bees carry pollen to the colony – is related to their capacity of carrying greater quantities of pollen (MILNE & PRIES, 1984, 1986; MILNE ***et al.***, 1986). Pollen, which is the chief source of protein for bees, is indispensable for the development of the colony. If the capacity for pollen transportation per bee increases, it is possible that this will result in greater availability of field worker bees for the gathering of nectar, hence in increased honey production.

The length of the tongue is an important trait in determining the sharing of environmental resources. In Bombus, where there are species and castes with different tongue lengths, INOUYE (1980) observed a relationship between the length of the tongue and the depth of the corolla of the flowers that were visited. He concluded that tongue length was related to efficiency in nectar gathering during gleaning and to the pattern of flowers visited. RUTTNER ***et al.*** (1978) observed a variation between 7.98 and 9.69mm in tongue length among the several races of ***Apis mellifera***. This variation may be important in the exploitation of the environment resources, by guaranteeing greater efficiency to bees with longer tongues. Naturally this greater efficiency would also heavily depend on the local flora. KERR (1969) raised this possibility in relation to the strains developed from the subspecies ***Apis mellifera*** *carnica*, which have relatively long tongues.

Pupal weight in bees seems to be an important trait because it relates positively to honey production (MILNE, 1980c). It is thus possible that some gain may be obtained in the production of honey by selecting pupal weight.

The present study has therefore aimed at examining the relationship between the traits pupal weight, length and width of the tibia of the third pair of legs, corbicular area, and glossal length with honey production in Africanized bees.

MATERIAL AND METHODS

The individual production of 47 beehives was monitored in five apiaries located near Viçosa, in the state of Minas Gerais, Brazil. Pupal and adult samples were later collected from the hives whose queens had not been replaced during the experimental period. These data were used to determine the relationships among the traits under study.

The individual production of each hive was obtained by counting the number of honeycombs produced therein and multiplying it by the mean weight of the honey contained in one comb. In order to obtain the remaining data, 15 pupae and 15 adults, emerging or about to emerge, were collected from each hive. They were kept in an oven at 34ºC, for one or two days, after which they were killed and had their morphological traits measured.

The buccal apparatus and the left tibia of the third pair of legs were mounted between a slide and cover slip, and the glossa and the length and width of the tibia were measured with the help of an ocular micrometer. The pupae were collected with the help of tweezers and taken to the laboratory in Petri dishes, to be weighed. Due to the fragility of the material, about 20 pupae were normally collected, though only 15 of them were weighed.

The size of the sampling for data collecting was determined according to COCHRAN (1977), considering a significance level below 5%. Correlation between honey production and pupal weight, tibial width and length, corbicular area, and glossal length was estimated in accordance with procedures related by FALCONER (1981) and KEMPTHORNE (1973).

Thus, $r_{XY} = \dfrac{\hat{Cov}(X,Y)}{\sqrt{\hat{V}(X)\hat{V}(Y)}}$

Where r_{XY} is the estimator of phenotipic correlation coefficient between X and Y; Côv (X, Y) is the estimator of phenotipic covariance between X and Y; and V (X) and V (Y) are the estimators of phenotipic variance of X and Y. Significance of the correlation coefficient was evaluated through t test at 5% probability.

RESULTS AND DISCUSSION

Of the 47 beehives monitored, 25 did not undergo queen replacement and were used for collecting the material. An estimate of the correlation obtained between the traits under study can be seen in table 1. The correlation of honey production with the other traits under study, though always positive, was somewhat low. In all cases, except pupal weight, correlation was significant ($p<0.05$).

The traits pupal weight and glossal length were the ones least correlated to honey production, 0.225 and 0.410 respectively. Yet MILNE & PRIES (1984) have obtained a significant correlation between pupal weight and honey production (0.603). Such discrepancy in the results referring to pupal weight may be associated to the morphometric differences observable between Africanized bees and the European bees studied by MILNE & PRIES (1984).

Several studies, such as the ones carried by GONÇALVES (1970), KERR ***et al.*** (1970), RINDERER ***et al.*** (1986), among others, have shown that there exist morphometric and behavioral differences between Africanized bees and those of European races. It is possible that such differences contribute to the proximity or distance in the association of pupal weight and honey production.

Corbicular area and tibia length were the traits with the highest correlation to honey production, 0.578 and 0.549 respectively, constituting the area with the best correlation to the remaining traits. These results are in agreement with those reported by MILNE & PRIES (1984) for bees of European race. These investigators observed a significant correlation of honey production to corbicular area (0.575) and tibia length (0.551). According to them, a possible explanation for these results would be that bees with larger corbicular areas could carry larger pellets of pollen to their hives. The greater quantity of pollen carried in would then stimulate extensive brood rearing, thus increasing the population of the hive, which would result in greater honey production. The assumption that worker bees with a larger corbicular area could carry larger pellets of pollen was later verified by MILNE & PRIES (1986). MILNE ***et al.*** (1986) observed that the worker bees from a lineage selected to increase the amount of hoarded pollen had corbicular areas significantly larger than those of the bees from the lineage selected in the opposite direction. Such studies support the idea that worker bees with larger corbicular areas have a better ability to carry larger quantities of pollen to their hives. Thus, as the increasing quantity of pollen collected is significantly correlated to the queen's ovipositing rate (CALE, 1967) and with brood area (TODD & REED, 1970), these hives would turn out more populous. As there is also a positive correlation between the size of the population of a hive and its honey production (HARBO, 1986), it is possible that the explanation for the correlation detected here is, indeed, the one proposed by MILNE & PRIES (1984).

Table 1 - Estimate of the correlation obtained between honey production (Prod), Pupal Weight (PW) Tibial Width (TW) and Length (TL), Corbicular Area (CA), and Glossal Length (GL) in Africanized honey bees (***Apis mellifera***).

Trait	PW	TW	TL	CA	GL
Prod.	0,225	0,460**	0,549**	0,578**	0,410*
PW		0,552**	0,484**	0,602**	0,470**
TW			0,498**	0,901**	0,542**
TL				0,825**	0,328*
CA					0,521**

*, ** - significant at 1% and 5% respectively, according to t test

CONCLUSION

From the data obtained and analized in this study we can conclude that among all the traits analized in Africanized honey bees, corbicular area and tibial length are the ones that present the highest correlation with honey production. It is therefore possible to improve honey production through indirect selection of these traits.

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