Hoarding Behavior of European and Africanized Honey Bees (Hymenoptera: Apidae)[1]

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ABSTRACT

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European *Apis mellifera* L. in laboratory cages hoarded significantly more sucrose solution than Africanized honey bees. Bees from both populations increased hoarding in the presence of 2-heptanone.

Honey bees, *Apis mellifera adonsonii* L., from Africa were imported to Brazil in 1956 with the intent of improving Brazilian honey production (Kerr 1967). Descendants of the African imports (Africanized honey bees), distinguishable by both morphology (Daly and Balling 1978) and behavior (Michener 1975), have spread in South America. Despite their several strongly objectionable characteristics, Africanized bees are often reported to do well as honey producers (Kerr 1967, Gonçalves 1975). Several contrary reports concerning honey production by Africanized bees have come from Venezuelan beekeepers (personal commmunication).

In European stocks of bees, *A. mellifera* L., honey production by field colonies was significantly correlated with laboratory measurements of hoarding behavior (Kulinčević and Rothenbuhler 1973, Kulinčević et al. 1974). These characteristics were subsequently shown to be due to common genetic influences (Rothenbuhler et al. 1979). Additionally, environmental variables which changed hoarding behavior rates in the laboratory also changed honey production in the field (Rinderer and Baxter 1978). One of several environmental variables increasing hoarding is the presence of 2-heptanone (2-H) (Rinderer 1982). 2-H is a mandibular gland product that also functions as an alarm pheromone (Boch et al. 1970).

The experimental assessment of the value of Africanized bees as honey producers is desirable. As a contribution to this assessment, the hoarding rates of Africanized and European bees, with and without the presence of 2-H, were compared.

Materials and Methods

Experiments were conducted in Venezuela in 1979 with Africanized bees from local populations and European bees reared from queens imported from the United States.

Laboratory hoarding cages (Kulinčević et al. 1973) were constructed of cardboard, hardware cloth, and plastic film. Pieces of dark comb (2.5 by 8 cm) with a total of 40 cm^2 of exposed surface area (not including edges) were fixed to the backs of these cages. Each cage was supplied with 1 gravity feeder containing 50% (wt/wt) sucrose in water solution and another gravity feeder containing water.

Combs of emerging adult worker bees were obtained from seven colonies of Africanized bees and seven colonies of European bees. Adult worker bees (0 to 24 h old) emerging from combs obtained from each colony were placed, by groups of 30 (Rinderer and Baxter 1978), into the cages. Five replicate cages containing untreated comb and five replicate cages containing comb previously treated with 2-H (Rinderer 1982) were used to measure the hoarding response of bees from each colony.

These cages were held in a 35°C incubator. We first measured responses in cages with untreated comb. Three weeks later, we measured responses in cages with 2-H-treated comb. This second set of measurements required a second collection of emerging brood. These two separate periods of experimentation were necessary, since only a single incubator was available and 2-H volatizing from treated comb disperses throughout the incubator. Replicate hoarding measures through time are not expected to vary significantly as a consequence of time or time-related variables (Rinderer and Sylvester 1978).

Hoarding cages were inspected daily for 7 days; the amounts of sucrose solution removed from the feeders were recorded, and when necessary, feeders were replenished. Data were analyzed by analysis of variance.

Results

European bees hoarded more than Africanized bees ($P < 0.01$) (Table 1). Bees of both races increased hoarding in the presence of 2-H volatiles ($P < 0.021$). Interaction terms in the analysis did not indicate that interactions occurred between the variables of colony and comb treatment or race and comb treatment. Thus, bees from all colonies of both races increased hoarding in the presence of 2-H volatiles to similar levels.

Discussion

Africanized bees are more responsive to alarm chemicals in the defense of their colonies (Michener 1975). Yet they only moderately increase hoarding in the presence of 2-H. Apparently, colony defense and hoarding by Africanized bees are not influenced by 2-H to the same degree. This suggests that colony defense and hoarding have separate regulatory mechanisms and that increases in the levels of these characteristics in the presence of 2-H do not simply result from general chemical irritation.

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Table 1.—Amount (ml) of sucrose solution hoarded during 7 days by Africanized and European honey bees given either a single comb or a single comb treated with 2-H

Bee population	Comb treatment	Hoarding $\bar{x} \pm SE^a$
Africanized	No 2-H	15.5 ± 0.6
	2-H	16.8 ± 0.7
European	No 2-H	17.1 ± 0.7
	2-H	20.1 ± 1.4

$\bar{x} \pm SE$ of main effects	Bee population		Comb treatment	
	Africanized	European	No 2-H	2-H
	16.2 ± 0.4**	18.6 ± 0.8	16.3 ± 0.5*	18.4 ± 0.8

[a]The bee population by comb treatment means are calculated from data collected from five cages of bees from each of seven colonies. Main effect means are analysis of variance means calculated across either comb treatment or bee population. **, Means are significantly different at $P < 0.01$ ($F = 6.82$; 1, 136 df); *, means are significantly different at $P < 0.021$ ($F = 5.43$; 1, 136 df).

These results also suggest that Africanized bees are not superior honey producers in all cases. For European bees, high hoarding rates correlate well with honey production (Kulinčević and Rothenbuhler 1973, Kulinčević et al. 1974, Rinderer and Baxter 1978, Rothenbuhler et al. 1979) in specific North American conditions. Africanized bees, with their lower rates of hoarding, probably would not be superior honey producers in similar conditions. Perhaps low hoarding rates are related to successful exploitation of nectar resources in some conditions, whereas high hoarding rates are related to successful exploitation of nectar resources in other conditions. Such relationships would explain the contradictory statements of the relative value of Africanized bees as honey producers.

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