

Honey Bees¹: the Effect of Group Size on Longevity and Hoarding in Laboratory Cages²

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ABSTRACT

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Groups of 10 caged worker honey bees, *Apis mellifera* L., had a shorter longevity and hoarded less than groups of 20, 30, 40, 50, or 100 bees. Results indicated that a group size of 30 bees will yield acceptable data for such experiments.

A laboratory cage for honey bees (*Apis mellifera* L.) fitted with a piece of comb and a gravity feeder containing sucrose solution was described by Kulinčević et al. (1973). This cage is well suited for a variety of experiments on bees including longevity tests and hoarding behavior (the storage of sucrose solution in the piece of comb). Rinderer and Elliott (1977b) cite some of the reported uses of these cages and they are utilized in several laboratories for experimental work.

Experiments have followed the examples of Free and Williams (1972) and Kulinčević and Rothenbuhler (1973) of using 50 bees/cage. However, if fewer bees result in equally acceptable data, many experiments could be done more efficiently and other experiments would be feasible. Our experiment was designed to determine the lowest effective group size for longevity and hoarding experiments.

Materials and Methods

Bees were obtained from 5 source colonies of an open-mated commercial stock. Adult worker bees, 0–24 h old, were collected after they emerged from brood combs and placed in hoarding cages (Kulinčević and Rothenbuhler 1973).

Cages received either 10, 20, 30, 40, 50, or 100 bees of equal proportions from each source colony. Each treatment was comprised of 6 replicate cages. Each cage had a gravity feeder containing a 50% wt/wt sucrose solution, a gravity feeder containing deionized water, and an open-surface feeder on the floor containing a protein food (Rinderer and Elliott 1977b). Cages were maintained in a 35°C incubator at 50% RH.

Each cage was inspected daily, and the dead bees were removed and recorded. Hoarding, measured by the volume of sucrose solution removed from the feeder vial, was recorded for 7 days. Observations continued until ½ the bees in a cage had died.

Data on longevity, represented by the number of days required for ½ the bees in each cage to die, were analyzed by analyses of variance and a least significant difference test. Data on hoarding, expressed as ml of sucrose solution removed per bee during the course of the experiment, were transformed to logs to equalize variance and analyzed by analyses of variance and a least significant difference test. Lack of mortality during the hoarding period obviated the need to adjust the data to a ml/living/day scale (Rinderer and Elliott 1977a).

Results

All groups of bees had similar longevities except groups containing 10 bees. Groups with 10 bees had a $\bar{x} \pm SE$ longevity of 21.8 ± 1.4 which was lower ($P < 0.01$) than the longevities of the groups of 20 (32.3 ± 3.4), 30 (34.3 ± 2.5), 40 (31.2 ± 2.8), 50 (37.0 ± 1.7), or 100 (32.7 ± 1.3) bees.

Groups of 10 bees also hoarded less. Their hoarding rate ($\bar{x} \pm SE$) of 0.48 ± 0.05 ml/bee, was significantly lower ($P < 0.05$) than the rates of the groups with 30 (0.74 ± 0.05), 40 (0.78 ± 0.15), or 50 (0.79 ± 0.08) bees. Groups with 20 bees hoarded at the rate of 0.58 ± 0.09 ml/bee. While not significantly lower than the rates of groups with more bees, the numerical difference suggests that events which result in a lower hoarding rate with groups of 10 bees may still occur but to a lesser degree with groups of 20 bees. Groups of 100 bees hoarded at a rate of 0.58 ± 0.06 ml/bee. Observations of hoarding cages with 100 bees revealed that combs were often nearly filled with stored sucrose solution.

Discussion

The mechanisms which result in decreased longevity and decreased hoarding by groups of 10 bees are unclear. However, it seems reasonable to relate them to the social nature of honey bees. Perhaps too few bee-to-bee interactions per unit time result in stress which decreases both hoarding activity and longevity.

Our results show that the number of bees in experiments measuring longevity or hoarding need be no more than 30/cage, since both the longevity and the hoarding of groups of 30 bees are very similar to that of groups of 50 bees for both mean and standard error values.

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REFERENCES CITED

- Free, J. B., and I. H. Williams. 1972. Hoarding in honeybees (*Apis mellifera* L.). Anim. Behav. 20: 327–34.
- Kulinčević, J. M. and W. C. Rothenbuhler. 1973. Laboratory and field measurement of hoarding behavior in the honeybee (*Apis mellifera*). J. Apic. Res. 12: 179–82.
- Kulinčević, J. M., G. R. Stairs, and W. C. Rothenbuhler. 1973. The effect of presence of a queen upon outbreak of a hairless-black syndrome in the honey bee. J. Invert. Pathol. 21: 241–7.
- Rinderer, T. E., and K. D. Elliott. 1977a. Influence of nosematosis on the hoarding behavior of the honeybee. J. Invertebr. Pathol. 30: 110–1.
- 1977b. The effect of comb on the longevity of caged adult honey bees. Ann. Entomol. Soc. Am. 70: 365–6.

¹ Hymenoptera: Apidae.

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