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DEVELOPMENT PERIODS FOR EGGS OF AFRICANIZED AND EUROPEAN HONEYBEES[1]

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Summary

In a side-by-side test in Venezuela, 593 eggs from 7 Africanized queen honeybees and 355 eggs from 7 European queens (from USA) were kept in an incubator (35 ± 1°C) without adult bees. Eggs from the two groups hatched after 69·6 ± 1·06 h and 73·3 ± 1·14 h, respectively ($\bar{x}$ ± SD), indicating a basic physiological difference between development periods for eggs from the two populations.

Introduction

Honeybees (*Apis mellifera*) in tropical Africa develop more rapidly from oviposition to adult emergence than do European honeybees in the USA. Tribe and Fletcher (1977) reported an average development period of 18·6 days for African worker bees in South Africa, whereas Milum (1930) reported 20·5 days for European worker bees in Wisconsin. The mean development period for eggs from oviposition to hatching was 71 h for the African workers (Tribe & Fletcher, 1977) and 72-76 h for European workers (Dupraw, 1961).

To make valid comparisons of development periods, Bolten (unpublished) made side-by-side measurements. He confirmed that the descendants of African bees in Venezuela (hereafter called Africanized bees) had a shorter development period than the descendants of European bees that had been brought to Venezuela from the USA. Africanized workers averaged 18·8 days; workers from US stocks, simultaneously reared in the same colony, averaged 20·0 days.

In this study, we compared the development periods of eggs of Africanized and European honeybees by measuring the time between oviposition and hatching in an incubator, without adult worker bees.

Materials and Methods

Eggs from 7 Africanized and 7 European queens were collected near Maturin, Venezuela, in January 1980. We brought the Africanized queens from a nearby area (San José de Buja) where there were no known European bees; the queens free-mated in the Buja area. European queens 2 and 6 were inbred sisters from the Gk line in Baton Rouge, Louisiana; queen 7 was an inbred from the N line in Madison, Wisconsin; queens 1 and 5 were inbred sisters from the YD line in Baton Rouge. Each of the 5 inbred queens was instrumentally inseminated with semen from a single unrelated drone from Baton Rouge; the 5 drones were also unrelated to one another. European queens 3 and 4 came from commercial queen producers in Texas and Georgia, USA.

The queens were all laying eggs in small colonies containing 4 to 6 standard combs (43 × 21 cm) and *c.* 1 kg of bees. Two days before egg collection, to increase the egg-laying rate, we removed all combs of brood except one and replaced them with empty combs.

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[1]In co-operation with Louisiana Agricultural Experiment Station.

To collect eggs, we caged each queen for 3 h to a section of comb 8 × 8 cm. The combs were taken from other colonies a few days before the test, stored in a freezer for at least 12 h to kill wax moth, and then thoroughly warmed in the incubator immediately before the testing period. The cage was pushed into the comb and had queen-excluder material soldered to the top, to enable workers to pass through to tend the queen (Fig. 1). At the time of caging, we again removed all combs of brood except one, to concentrate the bees on the caged queen. Thus the eggs were laid ±1½ h from the midpoint of the caging period.

Immediately after the 3-h caging period, the combs with eggs were brought into a room that was kept at 35 ± 1°C and 60-80% RH. For ease in handling, the sections containing eggs were cut out and set into a cardboard frame that would stand upright on a shelf. The combs were then randomly arranged on a shelf and periodically rearranged to promote equal treatment of both groups of eggs.

A dissecting microscope was brought into the incubator room, and each comb of eggs was checked hourly, beginning 66 h after the midpoint of the caging period. Because caging periods were spaced 5 min apart, we could check each comb at or near the exact hour interval. However, hour 67 was skipped on the eggs from Africanized queen 5, so some of her eggs may have hatched at the earlier interval.

Data were analysed with the *t*-test.

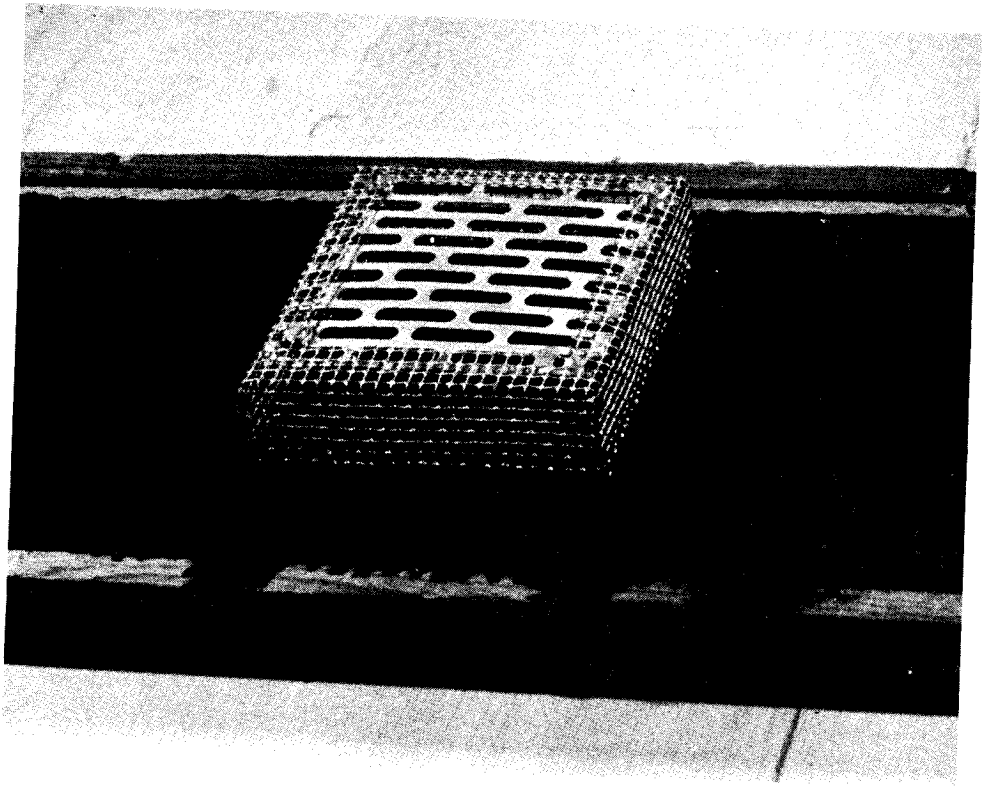

FIG. 1. Queens were confined in cages such as this, to obtain eggs of known age in a small area of comb.
The cage measured 8 × 8 × 2 cm and was made of ⅛-in (3-mm) mesh screen soldered to zinc queen excluder.

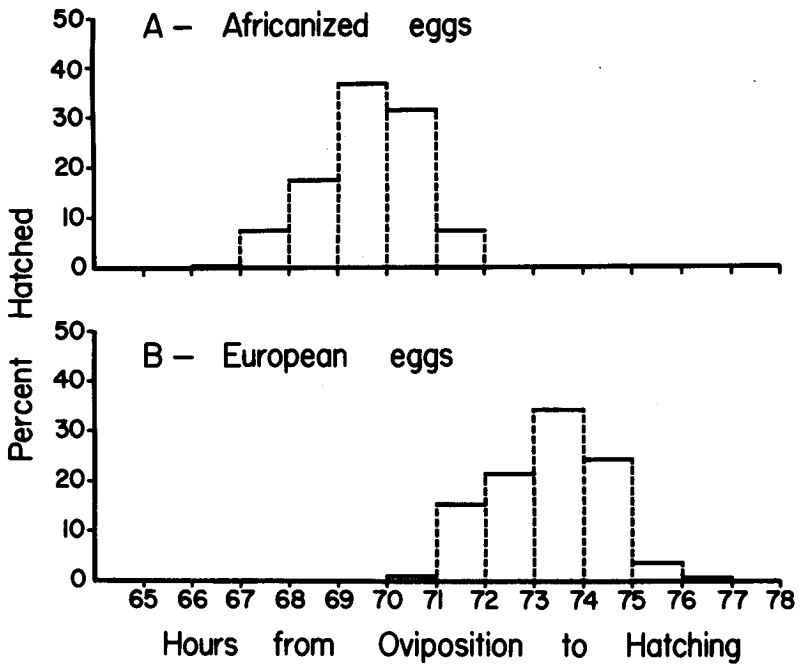

FIG. 2. Time from midpoint of oviposition period to hatching: Africanized honeybees (593 eggs from 7 queens); European honeybees (355 eggs from 7 queens).

TABLE 1. Development periods for eggs from Africanized and European queen honeybees.

Queen no.	*No. eggs**	*% hatching per hour (no. hours after midpoint of caging period**) 67*	*68*	*69*	*70*	*71*	*72*	*73*	*74*	*75*	*76*	*77*	*Development period±SD(h)*
Africanized													
1	70	1·4	28·6	38·6	31·4	—	—	—	—	—	—	—	68·5±0·8*a****
2	122	—	19·7	42·6	27·9	9·8	—	—	—	—	—	—	68·8±0·9*a*
3	112	—	—	17·9	62·4	15·2	4·5	—	—	—	—	—	69·6±0·7*b*
4	57	—	—	—	77·2	22·8	—	—	—	—	—	—	69·7±0·4*b*
5	3	—	—	66·7	33·3	—	—	—	—	—	—	—	— —
6	108	—	—	0·9	35·2	41·7	22·2	—	—	—	—	—	70·4±0·8*c*
7	121	—	—	—	6·6	81·8	11·6	—	—	—	—	—	70·5±0·4*c*
European													
1	53	—	—	—	—	1·9	50·9	45·3	1·9	—	—	—	72·0±0·6*d*
2	53	—	—	—	—	1·9	30·2	17·0	37·7	13·2	—	—	72·8±1·1*e*
3	24	—	—	—	—	4·2	16·7	29·2	16·7	16·7	16·7	—	73·3±1·5*e,f*
4	60	—	—	—	—	—	—	18·3	60·0	21·7	—	—	73·5±0·6*f*****
5	50	—	—	—	—	—	4·0	20·0	40·0	36·0	—	—	73·6±0·9*f*
6	75	—	—	—	—	—	6·7	9·3	38·7	40·0	5·3	—	73·8±1·0*f*
7	40	—	—	—	—	—	—	20·0	27·5	35·0	12·5	5·0	74·1±1·1*f*****

*Eggs that did not hatch (5-15%) are not included in the total count.
**All queens were caged for 3 h to obtain eggs that had the same age ± 1·5 h.
***Each group of eggs is significantly different ($P<0·01$) from groups not marked with the same letter.
****Although not significantly different from other *f* groups, these 2 groups were significantly different from one another.

Results and Discussion

Eggs from the Africanized queens developed more rapidly in an incubator at 35 ± 1°C than eggs from the European queens. The 593 eggs from the Africanized queens hatched 69·6 ± 1·06 ($\bar{x}$ ± SD) h after the midpoint of the caging period. The 355 eggs from European queens hatched after 73·3 ± 1·14 h (Fig. 2, Table 1). The difference was statistically significant ($P<0·01$). Moreover, the mean development period of the eggs from each of the Africanized queens was significantly shorter than that for eggs from any European queen.

In spite of the uniformity within the Africanized and European groups (Fig. 2), differences did exist. The mean hatching time for eggs from the 7 Africanized queens ranged from 68·5 to 70·5 h; that from the 7 European queens ranged from 72·0 to 74·1 h (Table 1). Many of these differences between queens within the Africanized and the European group were significant ($P<0·01$).

The variance in development period within each group of eggs was very low. All of the eggs from a single queen hatched within a 6-h period; most groups of eggs hatched within a 4-h period. Eggs from Africanized queen 7 provided an extreme example of nonvariability; they were laid within a 3 h period, and they hatched within a 3 h period.

Conclusions

In his side-by-side comparisons, Bolten (unpublished) found that the difference in total development periods between Africanized and European bees had a genetic basis. Either immature honeybees modified their environment by causing worker bees to feed or somehow treat them in a specific way (a behavioural difference), or there was a basic physiological difference in their rate of development. By measuring the period of egg development in an incubator without workers present, we showed that at least in the egg stage, the different development periods had a physiological basis.

Perhaps the difference between the development rates of the egg represents a constant value that is maintained throughout development, and can account for the difference in the total development periods of Africanized and European bees. In the controlled environment that we used, eggs from European bees required about 5·3% longer to develop than eggs from Africanized bees. If this 5·3% persists throughout the larval and pupal periods, it would extend the 18·8 days of development time for Africanized workers to 19·8 days for European workers; 19·8 is very close to the 20·0 that Bolten (unpublished) found.

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