

COMUNICACIONES

Infestation levels of the mite *Varroa jacobsoni* in worker and drone honey bee (*Apis mellifera*) brood in France and Brazil

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Resumen: En un muestreo de varios centenares de celdillas, las larvas de abejas obreras (*Apis mellifera mellifera*) en Francia, contenían un mayor número de hembras colonizadoras del ácaro *Varroa jacobsoni* que sus equivalentes "africanas" en Brasil (*Apis mellifera scutellata*). Las larvas de zángano de ambos subespecies fueron igualmente colonizadas por el ácaro. Cuando hubo larvas de zángano adyacentes a larvas de obrera en el mismo panal de abeja africana, se encontró un número mayor de ácaros en las larvas de obrera. Algunos factores que pueden ayudar a mantener un bajo nivel de colonización e infestación en las abejas africanas pueden ser: el pequeño tamaño de la celda; el período larval y de celda operculada más corto en la obrera; el nivel bajo de kairomona que atrae al ácaro o un nivel bajo de hormona juvenil en las larvas de obrera. Se sugiere que una forma de controlar *V. jacobsoni* en las colmenas de abejas de miel de origen europeo podría ser el uso de cera estampada con celdas de obrera más pequeñas que las usadas tradicionalmente.

Key words: *Varroa jacobsoni*, Mesostigmata, infestation, *Apis mellifera*, control.

In the last 20 years the Asian bee mite, *Varroa jacobsoni* Oudemans has become a major problem for beekeepers working with *A. mellifera* in Europe, the Middle East and South America. In 1987, the mite was discovered in the United States (Sanford 1987). There has been considerable research on the natural history and pathology of *V. jacobsoni* in search of an effective treatment for this destructive parasite. More than 100 chemicals have been tested (Smirnov 1978, De Jong *et al.* 1982).

In *A. cerana* colonies (its natural host) the mite reproduces usually in drone cells whereas in *A. mellifera* it prefers drone cells but also reproduces in worker cells (DeJong 1984). Various races and strains of *A. mellifera* seem to have genetic and behavioral "preadaptations" which confer varying degrees of resistance to the mite (Koeniger 1985). For example, there is evidence that in South America, *V. jacobsoni* does not cause severe problems in colonies of Africanized bees (DeJong *et al.* 1982, Ritter and DeJong 1984, Koeniger 1985, Camazine 1986, Ramírez and Otis 1986).

The degree of infestation in a honey bee colony can be measured by counting the number of adult female *Varroa* in at least 100 adult worker bees, or the number of colonizing females in capped cells, especially in drone cells. In this study, we compared the number of colonizing females of *Varroa* found in the capped bee cells, in both worker and drone cells as well as the effect of drone larvae surrounding worker cells in the same comb, for temperate (France) and tropical (Brazil) conditions.

Counts of colonizing *V. jacobsoni* females in recently capped worker and drone cells were done by W.R.B. in a single brood *A. mellifera mellifera* Langstroth chamber colony in Nice, France and in a similarly sized colony of South American "African" bees (*A. mellifera scutellata*) in Lapa, Curitiba, Brazil (Table 1). In France, counts were done in combs which contained only worker or drone brood; while in Brazil counts were done in combs with (1) only drone brood, (2) only worker brood and (3) mixed combs with worker and drone brood. The worker brood cells in France were based on

wax foundation while the drone cells lacked the foundation. All three types of combs studied in Brazil were naturally built and produced by a feral swarm collected in 1986 in Lapa, Curitiba. A sample of adult bees of the hive studied in Brazil was identified morphometrically as African ($p < 0.0001$).

Combs with recently sealed brood which were infested with *V. jacobsoni* were removed from the hives shaken free of bees and placed in a freezer for 24 hours. Then the cell caps were removed individually, and the bee pupae extracted with forceps. Foundress *V. jacobsoni* females were counted for each comb type.

Counts and analysis appear in Table 1 and Fig. 1. Generally, the European brood had more *Varroa* than the African bees. For African bees, the presence of drone larvae in a comb correlates with the number of *Varroa* females inside the worker cells. Worker larvae which share a comb with drone larvae were less attractive than drone cells in the African bees. All differences were significant ($P < 0.01$) (chi-square test).

TABLE 1

Number of colonizing females of *Varroa jacobsoni* in *Apis mellifera mellifera* (Nice, France) and *A. mellifera scutellata* (Curitiba, Brazil)

Kind of bee	Kind of cell	Total cells	Mean Number of colonizing females/cell
France	worker	103	1.25
	drone	102	1.94
Brazil	worker	100	0.02
	worker	102	0.06
	worker	100	0.01
	drone	100	1.22
<i>A. m. scutellata</i> combs with drone and worker cells (mixed combs)	drone	100	1.16
	worker	100	0.43
	drone	100	1.62
	worker	100	0.24

Drone and worker brood cells of European bees in France had higher infestation levels than those of Africanized bees in South America, while there was no difference between drone cells of both subspecies. Some factors which may explain these results for African bees are: (1) the small size of worker cells, (2) the shorter developmental period of worker larvae, (3) the shorter postcapping

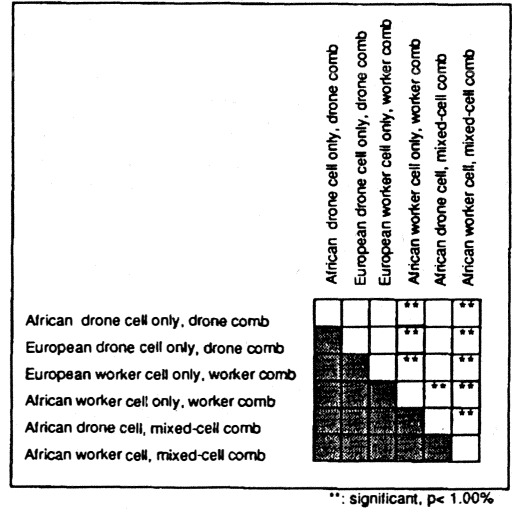


Fig. 1. Results of the Chi-square (contingency tests) for the comparisons among groups.

period of the worker larvae (Moritz & Hänel 1984, Ramírez & Otis 1986, Camazine 1986). (4) the amount of brood kairomone produced by the bee larvae (which may differentially attract the colonizing *V. jacobsoni* females to the cells and makes them stay inside), (5) the amount of juvenile hormone (JH) present in the haemolymph of the bee larvae, which is used by *V. jacobsoni* females for maturation of the eggs and possibly the spermatocytes (Ramírez 1986, Hänel & Koeniger 1986), and (6) the amount and type of proteins in the haemolymph in the adult and larvae (Tewarson 1983).

In the Cape honeybee *A. mellifera capensis* (Moritz and Hänel 1984) and in the Africanized bee in South America, the postcapping period of the worker larvae (sealed cell) is usually shorter than the period needed by *V. jacobsoni* for its normal reproduction, development (240 hr) and sexual maturation (264 hr). In contrast, the postcapping period of the worker larvae of most "European" races is more than 264 hr, allowing the reproduction of *V. jacobsoni* in worker cells. The worker larva, prepupa and pupa of the different races of *A. m. mellifera* and other "European" subspecies seem to have enough JH in their blood to allow normal egg and spermatocyte maturation and oviposition of female eggs by *V. jacobsoni* (Ramírez 1986, Hänel & Koeniger 1986).

According to Koeniger (1985), another factor which influences mite reproduction may be the different ratios of drone worker and brood

within a colony, while according to Grobov (1976) the worker brood has few mites when drone larvae are available in the same colony. This probably occurs because the drone brood is more attractive, as found in our study.

Female *Varroa* mites prefer drone, adults and larvae to worker brood because of: (1) the larger size of the drone larva and its cell when compared with that of the worker; (2) the longer drone development period; (3) the passive drifting behavior of the drone and (4) some unknown biochemical and/or physiological interaction between the parasites and the host. DeJong (1984) reports that the mites enter the drone cells in greater numbers than they do in worker cells. A question remains: How do they identify the larvae? Cell morphology may play a part, since the abnormally tall worker cells have a much larger number of mites (DeJong 1984), and the worker cells of large diameter are also preferred over those of smaller diameter (Message and Gonçalves 1983). Ramírez and Otis (1986) postulated that the female *V. jacobsoni* may be attracted by the carbon dioxide and/or by a kairomone produced by bee larvae. Kairomones produced by bee larvae may be indirectly related to the size of the cell and could be the determining factor in the attraction and occurrence of *V. jacobsoni* in larvae of different sizes in an indifferent bee races.

Whether the attractant is a brood pheromone, the carbon dioxide produced by the bee larvae or another substance, it could be assumed that larger larvae produce more attractants. It is known that larger bee larvae have a higher respiratory rate and consequently, a higher production of carbon dioxide (Eder *et al.* 1984). Camazine (1986) found that the infestation rates in "European" and "African" brood were similar. However, the combs he used were built by Africanized bees, drawn out from wax foundation for "European" bees. His results may also be related to the fact that he placed the "African" and "European" brood combs face to face in the same hive, thus the attractiveness of the comb with European bee larvae could have influenced that of the comb with "African" larvae. We have found that European worker bees have a developmental period of 19 to 20 days when they develop in African bee combs (1000 cells/dm²) instead of the 21 days associated to combs with European-sized cells. The use of wax foundation with smaller cells or the deve-

lopment of "European" honey bee races with shorter developmental and/or postcapping periods could help control *V. jacobsoni* as suggested by Moritz (1985) who noted that the duration of the postcapping stage in the honey bees seems to be genetically determined.

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