

# Susceptibility of European and Africanized honeybees (*Apis mellifera* L) and their hybrids to *Varroa jacobsoni* Oud

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**Summary** — This study was conducted to determine if European, Africanized, and hybrid honeybees differ in susceptibility to *Varroa* infestation and to determine if *Varroa* differentially reproduce on different types of brood. European brood was twice as attractive to female *Varroa* compared to Africanized brood, while hybrid brood was equally or more attractive than European brood. European adult workers were twice as susceptible to infestation as Africanized bees, whereas hybrid workers were not different from Africanized bees. *Varroa* reproduced on more than 69% of the infested hybrid brood, and on less than 52% of the Africanized and European broods, suggesting differences in host suitability for reproduction. Mite reproduction did not vary between European and Africanized brood. Genetic effects could explain some of these results. Other plausible hypotheses that could explain these results, and the implications of these findings on commercial and feral populations of honeybees are discussed.

***Varroa jacobsoni* / susceptibility to *Varroa* / *Apis mellifera* / Africanized bee**

## INTRODUCTION

Colony infestation by the parasitic mite, *Varroa jacobsoni*, is one of the most serious problems for beekeeping worldwide. The mite externally parasitizes adult honeybees, feeds on their blood and reproduces on their brood. Severe colony losses resulting from *Varroa* have been reported from temperate climates (De Jong, 1990) but it does not

appear to be a serious pest in the South American tropics. Some evidence suggests that colonies of Africanized bees [descendants of African (*Apis mellifera scutellata*) and European races of honeybees] maintain only low levels of infestation (De Jong and Gonçalves, 1981; De Jong et al, 1984; Ritter and De Jong, 1984; Ruttner et al, 1984; Camazine, 1986; Engels et al, 1986; Mendoza et al, 1987; Moretto et al, 1991; Rosenkranz and Engels, 1994).

*Varroa* mites, as well as Africanized honeybees, are now present in most countries in the Americas. As a consequence, most beekeepers in tropical and subtropical regions maintain colonies of bees that are Africanized to some degree and will have *Varroa*. Therefore, potential genetic mechanisms of resistance of Africanized bees need to be studied, and incorporated into breeding programs if possible. Potential mechanisms include the attractiveness of adults and larvae to female *Varroa*, and the effects of larvae on female *Varroa* reproduction. Reproductive components include the proportion of female mites that actually reproduce, the numbers of eggs laid on individual bee larvae, and the survival of mite progeny. The potential exists for selective breeding of *Varroa* resistance, using Africanized honey bees, if genetic variability between European and Africanized bees exists for any of these characteristics.

Differences in *Varroa* susceptibility between European and Africanized honey bees have been suggested (Camazine, 1986; Engels et al, 1986; Mendoza et al, 1987; Moretto et al, 1991; Rosenkranz and Engels, 1994), although there have been no confirmatory studies of genetic differences. In this study, we report differences in susceptibility to the infestation and reproduction of the parasitic mite *V jacobsoni* Oud among European, Africanized and hybrid honeybees.

## MATERIALS AND METHODS

Experiments were conducted in Mexico between October 1993, and July 1994. Bees were obtained in Ixtapan, Mexico, because the area was *Varroa*-free. European, Africanized, and hybrid bees were tested for mite susceptibility in Paso del Toro, Veracruz, and all laboratory work to determine *Varroa*-infestation in brood and adult bees was performed in Cuernavaca, Morelos.

Africanized honeybee colonies were selected from a population of 18 Africanized colonies

obtained from box traps used to capture swarms in the vicinity of Ixtapan, Mexico. Colonies of European honeybees were derived from descendants of queens that had been previously imported from the United States by a local beekeeper and maintained through instrumental insemination. Morphometric (Daly and Balling, 1978; Daly et al, 1982; Sylvester and Rinderer, 1987) and mitochondrial DNA analyses (Hall and Smith, 1991; Ebert and Page, unpublished data) of the progeny were used to assign Africanized or European origin to these colonies. The six colonies whose workers had the shortest wings (shorter than 8.8 mm) and the highest morphometric scores (discriminant scores higher than 2.0) were selected as the Africanized source; the six colonies whose workers had the longest wings (longer than 9.2 mm) and the lowest morphometric scores (discriminant scores lower than 0.0) were selected as the European source. Bees from colonies of the European source had European mitochondrial DNA, while those of the Africanized source had African mitochondrial DNA.

Queens and drones were reared from the selected colonies. Queens were instrumentally inseminated (Laidlaw, 1977) with the semen of drones to which they were not presumably related. The type of drones used for inseminations depended on the treatment. Treatment 1 consisted of four European queens that were inseminated with the semen of European drones; treatment 2 consisted of four Africanized queens that were inseminated with the semen of European drones; treatment 3 consisted of four European queens that were inseminated with the semen of Africanized drones; and treatment 4 consisted of four Africanized queens that were inseminated with the semen of Africanized drones. In this way, we were able to derive four colonies per each treatment: European, Africanized, and diallelic hybrid colonies.

Each inseminated queen was marked with a colored, numbered plastic tag (Graze KG, Weinstadt, Germany) that was glued to her thorax, had her right wing clipped, and was introduced into a jumbo-size hive containing approximately 2 kg of worker bees and four combs with brood, pollen, and honey. The Ixtapan area was considered *Varroa*-free, although colonies were screened for the presence of *Varroa* using two flouvalinate impregnated strips (Apistan®) in each colony's brood chamber. A white paper coated with petrolatum was placed on each hive's bottom board to catch falling mites. Colonies were

checked for the presence of mites, and the Apistan strips were removed three days later. No *Varroa* were found.

### **Experiment 1**

When all queens were laying, they were confined on combs inside screen cages placed into their respective colonies. All the combs used had been built on European bee-size wax foundation. Therefore, all of the treatment queens laid on comb cells of similar sizes. The screen of the cages used to place the combs, permitted workers to pass, but did not permit queens to leave the cages. Thus, workers could contact the queens. Queens laid eggs on these combs within 24 h after being caged. Combs were removed from these colonies and two square sections (each approx 25 cm<sup>2</sup>) containing eggs were cut out from each comb. In this way, 24 sections were obtained (two per hive x three hives per treatment x four treatments). Then, the sections were combined and installed in two different jumbo-size frames. Individual frames had been previously divided into 12 sections, each of which was identified with the colony number of the brood it would contain. The 12 sections in a frame were assembled in a block design to control for possible biases in positions in the frame, and to give all treatments similar chances of becoming infested in a common environment. Each of the two frames contained three sections of each treatment. These mixed combs were transported to Paso del Toro in a wooden box with wet paper towels placed on the bottom to prevent the eggs from dehydrating while being transported.

Each of these mixed frames was placed into a colony that was highly infested with *Varroa*. Infested colonies were prepared in advance to receive the mixed frames. One week before receiving the frames, infested colonies were equalized by removing bees and capped brood frames from the most populous colonies. The average population per colony, after adjustment, was five frames with capped brood and eight frames covered with bees. Additionally, the combs containing open brood cells were removed from these hives to increase the chances of *Varroa* mites infesting the experimental broods. Queens from these colonies were confined in regular Benton queen cages to prevent them from laying on the experimental comb sections.

Fifteen days after being introduced, the two experimental frames were removed from the colonies, placed in plastic bags, identified, and stored in a freezer at -18 °C until analyzed. At least 126 brood cells from several comb sections were randomly chosen, opened, and examined for each of the treatments. The number of adult and immature mites were counted for each cell.

### **Experiment 2**

This experiment was designed to determine differential infestation of adult bees. Thirty six comb sections containing eggs from the experimental colonies (three comb sections per colony x three colonies x four treatments) were obtained in the same manner as in experiment 1. Three frames with comb sections of the different mothers were introduced into a strong, well-fed colony, unrelated to any of the experimental bees. This was performed in Ixtapan to give all the treatments the same mite-free rearing environment. Eighteen days later, frames were removed from the nursing colony and each of the comb sections was confined into single specially-designed square-screen cages, that were kept in an incubator at approximately 32 °C and 60% RH. Adult workers emerged for 12 h, then they were marked on their thorax with one of four different colors of paint, according to their respective sources. After being marked, all experimental bees were transported to Paso del Toro, and were introduced into a colony that was infested with *Varroa*. This procedure was intended to diminish environmental variation between colonies to permit the expression of genetic differences among sources.

Two weeks after being introduced, marked workers were recovered from the infested colony and were deposited according to their color in one of four jars containing 95% ethanol. Adult bees were screened according to the method described by De Jong et al (1982), and each of the recovered bees was individually examined to search for mites. A proportion of bees infested with *Varroa* was then obtained for each treatment.

### **Analyses**

All analyses were performed blindly. Data for total bees (or cells) of each treatment were pooled

and square-root transformed. An analysis of variance was used for statistical analyses, and significant differences of means were derived from a protected LSD test (Sokal and Rohlf, 1981).

## RESULTS

There were significant differences between genetic groups in their susceptibility to become infested and the proportion of mites that reproduced (fig 1, 2, 3). There were no differences for the number of progeny that female mites produced.

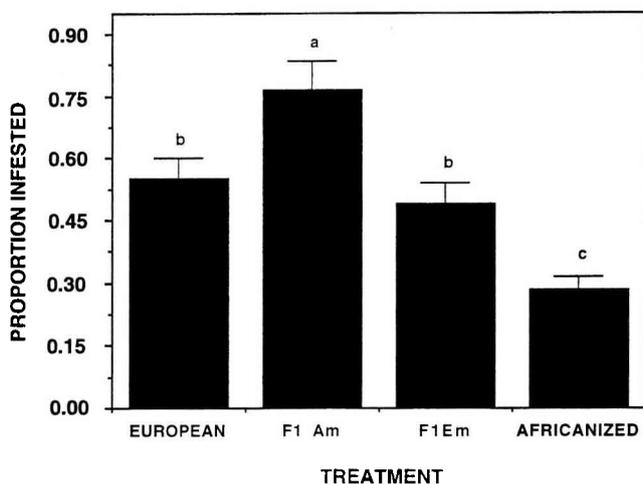
### *Infestation of bee brood*

European brood was 1.95 times more susceptible to *Varroa*-infestation than Africanized brood. Brood of one hybrid type (Africanized mother x European father) were 2.70 times more susceptible than brood of Africanized bees, and 1.39 times more susceptible than European bee brood. This hybrid type was significantly more susceptible than the other treatments, whereas

Africanized bee brood was the least susceptible ( $F = 15.695$ ,  $df = 3, 1014$ ;  $P < 0.0001$ ; fig 1).

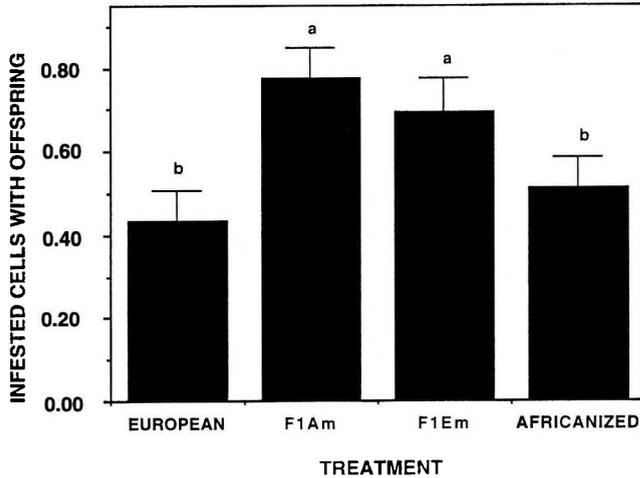
### *Mite reproduction*

Mite fertility (measured by the successful production of offspring) was significantly higher in hybrid than in European or Africanized brood ( $F = 8.691$ ,  $df = 3, 337$ ;  $P < 0.0001$ ; fig 2). A greater proportion of mites reproduced in infested cells containing hybrid brood (0.775 and 0.696 for hybrids of Africanized and European mothers respectively) than in infested cells of European (0.433) or Africanized (0.513) brood. Africanized and European treatments were not different from each other and there was no difference between hybrid treatments (fig 2). This pattern of mite reproduction was similar when only single infested cells were considered in the analyses. Infested cells of hybrid brood contained a greater proportion of reproductive mites (0.680 and 0.525 for hybrids of Africanized and European mothers respectively) than infested cells of

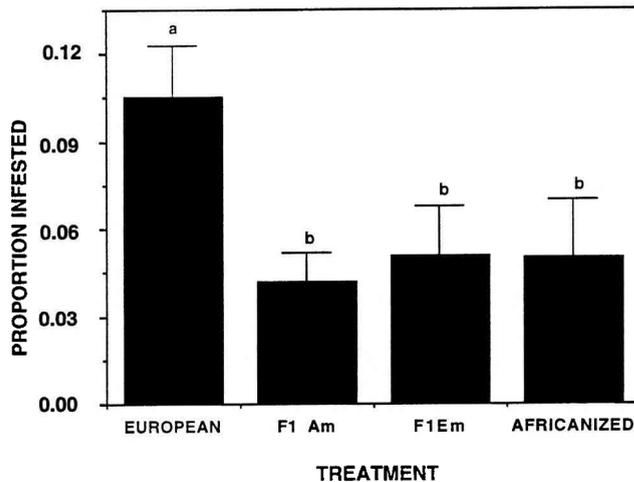


**Fig 1.** Proportion of capped brood cells infested with *Varroa* mites. European and hybrid brood were different from, and nearly twice as susceptible as, Africanized brood ( $F = 15.695$ ,  $df = 3, 1014$ ;  $P < 0.0001$ ). Different letters indicate significant differences of means based on ANOVA and protected LSD tests. Statistical tests ( $F$  and LSD) are based on square root-transformed data. Means and SE are actual nontransformed values.  $n = 275, 126, 287$ , and  $330$  for European, hybrids of Africanized mother (F1 Am), hybrids of European mother (F1 Em), and Africanized brood respectively.

**Fig 2.** Proportion of infested capped brood cells where *Varroa* females reproduced. Mite fertility was significantly higher in hybrids than in European or Africanized brood ( $F = 8.691$ ,  $df = 3, 337$ ;  $P < 0.0001$ ). European brood was not different from Africanized brood. Different letters indicate significant differences of means based on ANOVA and protected LSD tests. Statistical tests ( $F$  and LSD) are based on square root-transformed data. Means and SE are actual nontransformed values.  $n = 104, 71, 92$ , and  $74$  for European, hybrids of Africanized mother (F1 Am), hybrids of European mother (F1 Em), and Africanized brood respectively.



**Fig 3.** Proportion of adult bees infested with *Varroa* mites. European bees were at least twice as susceptible as Africanized and hybrid bees ( $F = 4.452$ ,  $df = 3, 1\ 030$ ;  $P < 0.0041$ ). Hybrids were not different from Africanized workers. Different letters indicate significant differences of means based on ANOVA and protected LSD tests. Statistical tests ( $F$  and LSD) are based on square root-transformed data. Means and SE are actual nontransformed values.  $n = 305, 433, 177$ , and  $120$  for European, hybrids of Africanized mother (F1 Am), hybrids of European mother (F1 Em), and Africanized bees respectively.



European (0.274) and Africanized (0.385) broods. The difference between hybrid and parental treatments was due to differences in the proportion of cells where female mites reproduced, and not due to differences in the number of immature mites produced per

*Varroa*. The average number of immature mites found in reproductive cells was not different ( $F = 0.881$ ,  $df = 3, 193$ ;  $P > 0.05$ ) among treatments and corresponded to 1.76, 1.96, 2.09, and 1.76 mites per cell for European, hybrid of Africanized mother,

hybrid of European mother, and Africanized brood respectively.

### ***Infestation of adult bees***

Adult European workers were twice as likely as Africanized bees to be infested by *Varroa*. Hybrid bees were not different from Africanized bees ( $F = 4.452$ ,  $df = 3$ , 1030;  $P < 0.004$  1; fig 3).

## **DISCUSSION**

These results suggest genetic variability among adults and broods for the likelihood that they will be infested by *Varroa*. They also suggest that female mites may vary in their reproductive capacity as a consequence of the genotypes of the brood they infest. Africanized brood was significantly less susceptible to becoming infested than were the other three brood treatments. Hybrid brood from Africanized mothers was the most susceptible, whereas the other hybrid brood type (from European mothers) was not different from European brood. Additionally, female *Varroa* produced significantly more offspring on hybrid than on European or Africanized brood. Genetic dominance for high susceptibility to become infested, and heterosis for increasing the reproductive capacity of female mites, could explain, at least in part, these results. However, other causes could also explain our results. For example, the distribution of *Varroa* females among brood of different origins may not only depend on an active choice of the mites. It could also be influenced by a specific brood-care behavior of nurse bees of the recipient colonies towards the introduced brood, or to differences in the density of the host bees per comb piece due to differences in the availability of brood cells of the genotypes tested. Additionally, *Varroa* females do not normally distribute

over brood combs, even in cells with comparable developmental stages (Fuchs, 1985). Therefore, the differences in infestation rates may have been the result of differences in *Varroa* distribution on the comb sections, as well as of an unnaturally high invasion pressure by the abundant *Varroa* mites of the host colonies, causing some genotypes to become more parasitized than others. However, in spite of these other possible explanations, our results are consistent in that both hybrid treatments were either similar to one parental origin, or different to the two parental genotypes in a common environment, which supports the hypothesis of genetic effects.

Our results do not support the findings of Camazine (1986), who did not find infestation differences between European and Africanized brood. However, our results are similar to those of De Guzman et al (1995) who also utilized a common environment to evaluate the attractiveness of larvae from four different genotypes of honeybees to *Varroa*. They found that larvae of the ARS-Y-C-1 genotype (*Apis mellifica carnica* from Yugoslavia), which has been selected for resistance to *Varroa*, were less attractive to female mites than the larvae of three other honeybee genotypes. They suggested a genetic component for attractiveness of larvae to *Varroa*. The cause of these differences in infestation rate is not clear, but it has been claimed that it may involve qualitative and/or quantitative differences in esters that serve as kairomones which are produced by the brood (Le Conte et al, 1989; Trouiller et al, 1994). However, other studies do not support this claim. Zetlmeisl and Rosenkranz (1994) showed that esters did not attract mites, but pentane extracts did. Aumeier and Rosenkranz (1995) concluded that esters are not important as kairomones and that hydrocarbons attract *Varroa* mites. Whatever the reasons that underlie attractiveness of larvae to *Varroa* mites, if there is genetic variation between

colonies for this trait, then perhaps the reproductive capacity of *Varroa* may be reduced by selecting for less attraction to worker brood.

Mite fertility was significantly higher in hybrids compared to European or Africanized brood. These results support the findings of De Guzman et al (1995) who also reported a higher fertility in cells containing hybrid brood compared to another three genotypes. Rosenkranz and Engels (1994) reported similar proportions of infertile *Varroa* females in European and hybrid brood; however, their hybrid treatment consisted of colonies headed by European queens that were mated naturally. Therefore, they did not control the genetic origin of the drones with which the queens mated.

The proportion of *Varroa* that reproduce varies with host race (reviewed by Fries et al, 1994; see also Rosenkranz and Engels, 1994). Reported values for percent reproduction of *Varroa* on worker brood of European bees vary from 21.9–92.7%; on Africanized bees the values are 25.0–60.0%. Values found in this study fall in the ranges previously reported. However, no significant difference in the proportion of mites that reproduced was found between Africanized and European brood, as has been suggested in other studies (Ritter and De Jong, 1984; Camazine, 1986; Engels et al, 1986; Rosenkranz and Engels, 1994). This may be due to the fact that our approach was designed to control environment and show genetic differences, whereas previous studies were designed to show phenotypic differences and subjected genetic treatments to different environmental effects. Environmental factors that have been said to affect reproduction include temperature (Le Conte et al, 1990; Marcangeli et al, 1992) and differences in proteins in parasitized larvae (Tewarson, 1983). Additionally, differences between previous studies and ours may arise due to possible genetic differences between South American and Mexican Africanized honeybee populations.

Differences in the number of progeny produced by female mites were not found among the genotypes tested, which supports the findings of Rosenkranz and Engels (1994). They reported that mites parasitizing Africanized and European honeybees did not differ in the number of offspring that they produced. These results suggest that the number of progeny generated per reproductive female mite does not seem to play an important role in explaining the observed differences of *Varroa* population growth between colonies of Africanized and European honeybees.

European worker bees were twice as likely to become infested with *Varroa* than Africanized bees, whereas hybrids were not different from Africanized bees, suggesting a probable dominant genetic effect for low susceptibility. Another possible explanation is that the differences in infestation could have been due to differences in contacts between host and experimental bees, but again, both hybrids were consistently similar to Africanized bees, and consistently different to European workers in a common environment. Moreover, our results are in agreement with previous reports that suggest phenotypic resistance of Africanized worker bees to *Varroa* infestations (Mendoza et al, 1987; Moretto et al, 1991, 1993).

Grooming behavior is the only mechanism of resistance known to affect the susceptibility of adult bees to become infested with *Varroa*. Workers infested with *Varroa* extensively groom themselves to remove the mites. If they cannot remove them, they perform a grooming dance and other, nearby workers use their mandibles to remove the mites (Peng et al, 1987; Ruttner and Hänel, 1992; Büchler, 1993). Africanized honeybees of South America seem to be better able to defend themselves from *Varroa* than are Italian honeybees. Moretto et al (1993) reported that in Brazil, Africanized workers were seven times more efficient than Italians in eliminating mites

from their bodies. The heritability of grooming behavior in Africanized bees was estimated to be 0.71, which suggests that selection for this trait is possible.

Genetic differences in *Varroa*-susceptibility among European, hybrid, and Africanized honeybee colonies, should result in higher numbers of Africanized colonies surviving mite infestations, as well as in higher numbers of European and hybrid colonies succumbing to mite infestations, especially among feral colonies that are not treated with miticides. This is of course not desirable for commercial beekeeping because the process of Africanization in commercial apiaries would be faster than expected because both European and hybrid bees from commercial apiaries would compete for matings in areas where feral colonies are highly Africanized. Moreover, feral Africanized colonies would be a constant focus of mite infestations for commercial colonies.

Even though our results are consistent in both brood and adult bees, and are consistent with reports of Africanized bees being less susceptible to the *Varroa* mite, more studies of this type are needed to clearly demonstrate genetic effects of *Varroa*-resistant mechanisms in honeybees, because in many long-term studies (for example Moretto et al, 1991; Eguaras et al, 1994; Rosenkranz and Engels, 1994) big variations have been observed.

If further studies confirm that certain strains of Africanized and European honeybees are resistant to the *Varroa* mite, then *Varroa*-resistant stocks could be developed. However, before any breeding program is initiated, it is necessary that more research be conducted towards understanding the mechanisms responsible for this resistance. Factors associated with host-dependent infestation and mite fertility in worker brood may be important in conferring resistance to honeybees.

## ACKNOWLEDGMENTS

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**Résumé — Sensibilité des abeilles européennes et africanisées (*Apis mellifera* L) et de leurs hybrides à *Varroa jacobsoni* Oud.** En climat tempéré l'acarien *Varroa jacobsoni* a causé des pertes importantes au cheptel apicole mais en Amérique du Sud, sous climat tropical, il ne semble pas représenter un grave danger. Certains faits suggèrent que les colonies d'abeilles africanisées ont une plus grande résistance au parasite. Les varroas, ainsi que les abeilles africanisées, sont présents dans la plupart des pays du continent américain. Il est donc important d'étudier les mécanismes génétiques de résistance potentiellement présents chez les abeilles africanisées. Nous avons étudié la sensibilité à l'infestation par *V jacobsoni* et sa reproduction chez des abeilles européennes et africanisées et chez leurs hybrides. Quatre groupes ont été formés en fonction de l'origine des reines et du sperme d'insémination : i) reines européennes et mâles européens ; ii) reines africanisées et mâles européens ; iii) reines européennes et mâles africanisés ; iv) reines africanisées et mâles africanisés. Des portions de rayons contenant les œufs pondus par les reines des différents groupes ont été assemblées dans des cadres. Chacun de ces cadres mixtes a été placé dans une colonie infestée par *V jacobsoni*. Quinze jours plus tard, les cadres ont été examinés. Les acariens adultes et immatures présents dans les cellules ouvertes ont été dénombrés. Dans une autre expérience, les portions de rayons assemblées de la même manière ont été introduites dans une colonie indemne de varroas afin de fournir à tous

les groupes le même environnement. Dix-huit jours plus tard, les cadres ont été ôtés de la colonie éleveuse et les portions de rayon ont été confinées individuellement dans une cage grillagée placée dans une étuve. Les ouvrières naissantes ont été marquées à la peinture sur le thorax en fonction de leur groupe d'origine et introduites dans une colonie infestée. Deux semaines plus tard, leur taux d'infestation a été déterminé. Il existe des différences significatives, entre les divers groupes d'origine génétique variée, en ce qui concerne leur sensibilité à l'infestation et la proportion d'acariens qui se reproduit. Il n'y a en revanche pas de différences pour le nombre de descendants produits par les acariens femelles. Le couvain européen était 1,95 fois plus sensible à l'infestation que le couvain africanisé, le couvain hybride du groupe 2 (reine africanisée x mâle européen), 2,70 fois plus sensible que le couvain africanisé et 1,39 fois plus que le couvain européen (fig 1). La fertilité des acariens (mesurée par le nombre de descendants viables) était significativement plus élevée dans les colonies hybrides que dans les colonies européennes ou africanisées (fig 2). Les ouvrières européennes adultes avaient 2 fois plus de chances d'être infestées par *V. jacobsoni* que les africanisées, alors que les hybrides n'étaient pas différentes des africanisées (fig 3). Ces résultats suggèrent l'existence d'une variabilité génétique parmi les adultes et le couvain en ce qui concerne la probabilité d'être infesté par *V. jacobsoni*. Ils suggèrent également que la capacité reproductrice des acariens femelles varie en fonction des génotypes du couvain qu'elles parasitent. Le caractère génétique dominant de la forte sensibilité à l'infestation et l'hétérosis qui accroît la capacité reproductrice des acariens femelles pourraient expliquer en partie ces résultats mais d'autres causes, non génétiques, ne sont pas à exclure. Nos résultats doivent être confirmés par d'autres recherches.

***Apis mellifera* / sensibilité résistance / *Varroa jacobsoni* / reproduction / facteur génétique / abeille africanisée**

**Zusammenfassung — Anfälligkeit europäischer und afrikanisierter Honigbienen (*Apis mellifera* L.) und ihrer Hybriden gegenüber einem Befall durch *Varroa jacobsoni* Oud.** Während in gemäßigten Klimazonen erhebliche Bienenverluste durch *Varroa jacobsoni* entstanden sind, scheint der Parasit in den südamerikanischen Tropen keine bedeutende Bienenkrankheit darzustellen. Es gibt einige Hinweise, daß afrikanisierte Bienen widerstandsfähiger gegenüber der Varroose sind. Sowohl Varroamilben als auch Honigbienen sind in den meisten Ländern Amerikas verbreitet. Es ist daher von großer Bedeutung, potentielle genetisch bedingte Abwehrmechanismen afrikanisierter Honigbienen genau zu untersuchen. Hier berichten wir über Unterschiede europäischer und afrikanisierter Bienenherkünfte sowie ihrer Hybriden. Es wurden vier Versuchsgruppen mit unterschiedlich besamten Königinnen gebildet: Gruppe 1: europäische Königinnen / europäische Drohnen; Gruppe 2: afrikanisierte Königinnen / europäische Drohnen; Gruppe 3: europäische Königinnen / afrikanisierte Drohnen; Gruppe 4: afrikanisierte Königinnen / afrikanisierte Drohnen. Wabenstücke mit den Eiern der verschiedenen Königinnen wurden zusammengestellt und gemeinsam in Wabenrähmchen eingesetzt. Jede dieser gemischten Brutwaben wurde in ein mit *Varroa* infiziertes Volk eingestellt. 15 Tage später wurden die Zellen geöffnet und die Anzahl der Jugendstadien und adulter Milben gezählt. In einem weiteren Experiment wurden wie oben beschriebene Kombinationswaben zunächst in varroafreie Völker eingestellt, um für alle Bienen die gleichen Pflegebedingungen herzustellen. Achtzehn Tage später wurden die Waben aus dem Pflegevolk herausgenommen und jedes der Wabenstücke einzeln in Drahtkäfigen in

einen Brutschrank überführt. Die schlüpfenden Arbeiterinnen wurden entsprechend ihrer Herkunft mit unterschiedlichen Farben auf ihrem Thorax gekennzeichnet und in eine mit *Varroa* infizierte Kolonie eingebracht. Nach zwei Wochen wurden sie herausgefangen und ihr Befall bestimmt. Zwischen den genetischen Gruppen bestanden signifikante Unterschiede in ihrer Anfälligkeit für einen Brutbefall und in dem Anteil reproduzierender Milben. Es bestanden aber keine Unterschiede bei den Anzahlen von Nachkommen der fertilen Milben. Die Brutzellen der europäischen Bienen wurden 1,95 mal stärker befallen als die der afrikanisierten Milben. Die Brutzellen des einen Hybridisierungstyps (afrikanisierte Königinnen x europäische Drohnen) war 2,70 mal stärker befallen als die Brut der afrikanisierten Bienen und 1,39 mal stärker als die der europäischen Bienen. Die Fertilität der Milben, gemessen an der erfolgreichen Erzeugung von Nachkommen, war bei den Hybridgruppe signifikant höher als bei der europäischen oder der afrikanisierten Gruppe (Abb 2). Adulte Arbeiterinnen waren doppelt so hoch befallen wie die afrikanisierten Arbeiterinnen. Die hybridisierten Arbeiterinnen unterschieden sich nicht von den afrikanisierten (Abb 3). Diese Ergebnisse legen genetische Unterschiede der Befallswahrscheinlichkeit zwischen adulten Arbeiterinnen und zwischen Arbeiterinnenbrut nahe. Weiter weisen sie auf Unterschiede der Vermehrung auf Grund des Genotypus der befallenen Brut nahe. Genetische Dominanz für hohen Befall und Heterosis für die Beeinflussung der Vermehrung der Varroamilben stellen eine mögliche Erklärung zumindest eines Teils der Ergebnisse dar, allerdings können andere nicht-genetische Erklärungen nicht völlig ausgeschlossen werden. Weitere Untersuchungen sind notwendig, um diese Befunde zu bestätigen.

***Varroa jacobsoni* / Anfälligkeit gegenüber *Varroa* / *Apis mellifera* / afrikanisierte Bienen**

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