Apidologie 30 (1999) 173–182
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Original article

Susceptibility of European and Africanized honey bees (*Apis mellifera* L.) to *Varroa jacobsoni* Oud. in Mexico

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(Received 10 August 1998; accepted 21 February 1999)

Abstract – The knowledge generated from several studies conducted in Mexico on the susceptibility of European and Africanized honey bees to *Varroa jacobsoni* is reviewed and compared with the situation in Brazil. There is evidence of genotypic variation for mite population growth, and for tolerance to the mite in honey bee colonies located in Mexico. However, Mexican honey bees seem to be relatively less tolerant to the parasite than bees in Brazil. The main difference is that mite fertility rates in Mexico are higher than those reported from Brazil. Hypotheses for why the situation is different in Mexico than in Brazil are discussed. © Inra/DIB/AGIB/Elsevier, Paris

***Varroa jacobsoni* / tolerance / *Apis mellifera* / Africanized bee / Mexico**

1. INTRODUCTION

Varroa jacobsoni (Acari: Varroidae) has caused severe loses of honey bee colonies in temperate climates but it does not appear to be a serious pest in Brazil [11]. Some evidence suggests that colonies of Africanized bees [descendants of European and African (*Apis mellifera scutellata*) races of honey bees] maintain low infestation levels presumably owing to different mechanisms of resistance against the mite and owing to climatic effects [7, 12–14, 16, 22, 26, 28, 29, 31].

Both *V. jacobsoni* mites and Africanized honey bees are now present in all of Mexico's states. Africanized bees were first

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detected in 1986 [21], whereas *V. jacobsoni* was reported for the first time in 1992 [8]. Because Mexico has Africanized bees and similar tropical and subtropical climatic zones as Brazil, it seemed important to know if *V. jacobsoni* would maintain low rates of population growth in bee colonies as is the case in the South American tropics.

In this article we review and discuss the results of specific studies conducted in Mexico. We present and discuss: 1) evidence of possible tolerance to *V. jacobsoni* in honey bee colonies; 2) evidence of the mechanisms conferring resistance to honey bees against the mite (brood attractiveness, host-induced non-reproduction, hygienic behavior, and grooming behavior); and 3) hypotheses that could explain why the situation is different in Mexico than in Brazil.

2. HONEY BEES AND *VARROA JACOBSONI* POPULATION DYNAMICS

Several studies conducted in Mexico have demonstrated that there is significant variation in the population growth of the mites among honey bee colonies ([32, 35], M.E. Arechavaleta, unpublished data).

The mite infestation rates of 24 Africanized bee colonies located in Veracruz (18°53' N, 96°56' W), a subtropical humid region, were monitored and compared with those of another 24 colonies (of the same type) established in Puebla (18°93' N, 98°05' W), a region with a temperate climate [32]. Colonies were mite-free at the beginning of the study. Adult bees were sampled from each colony and their level of mite infestation (i.e. number of mites per 100 bees) was determined every month for 12 months. The highest infestations were found between May and July for both places, which coincides with the reduced brood rearing in both locations during those months. However, the colonies located in the temperate climate were significantly more infested than those located in the subtropical climate (more than 8 %, versus less than 2 % on average, respectively).

In the study by Vandame [35], 20 colonies located in Veracruz were surveyed over 18 months. Ten of the colonies were identified as Africanized and ten as Europeans. Each colony was checked monthly to measure areas of open and capped brood, honey and pollen, and the total area occupied by bees. At the same time, a capped brood sample just prior to emergence was taken from each colony to determine the rate of infestation by adult mites (i.e. percentage of mite-infested cells). Adult worker bees were also sampled and their infestation rate determined. There was a significant effect of bee subspecies and month of sampling. Africanized bees occupied significantly more surface than European bees (i.e. comb cells containing open brood, capped brood, honey and pollen). European colonies survived only when supplemented with healthy brood. The analysis of brood samples also revealed significant variation in mite infestation, with a mean annual infestation level of 28 % in European brood versus 11 % in Africanized brood. The mean annual number of mites was 2 835 ± 855 mites per European colony versus 1 513 ± 595 mites per Africanized colony. Vandame also reported a seasonal increase of up to 2 500 mites per Africanized colony in the autumn, and a decrease down to 800 mites during winter and spring. Such a decrease in a *V. jacobsoni* population had never been described.

For his Master's thesis research, M.E. Arechavaleta (unpublished data), established 58 colonies derived from queens of seven different genotypic sources (seven different queen breeders) in Valle de Bravo, a temperate area in the State of Mexico (19°14' N, 100°06' W). After being treated with strips impregnated with fluvalinate (Apistan®), colonies were equalized to have a similar number of bees. They were then infested with an equal number of mites and were monitored by examining samples of capped brood and adult bees each month. Six months after the initial infestation, mite levels on adult bees varied significantly among colonies (range: 6–45 %), but no significant differences were found in the level of infestation of bee brood. The resistance of colonies to the mite population growth was broken down into genotypic and environmental variance components, and the broad-sense heritability for this characteristic was estimated to be $h^2 = 0.36$, which suggests that the variation found was partially genetic in origin.

The variation found in the above studies is consistent with that reported from other parts of the world [24, 27]. However, the infestation levels so far found in Mexico are higher than those of only 1–3 % reported from Brazilian bee colonies [11, 13].

3. BROOD ATTRACTIVENESS

The relative attractiveness of bee brood to *V. jacobsoni* varies among colonies [4, 6, 10, 17]. It may be possible to reduce the reproductive capacity of the mite by selecting for worker brood that is less attractive. Three studies conducted in Mexico report results on this variation in brood attractiveness to mites ([17, 35], M.E. Arechavaleta, unpublished data).

Guzmán-Novoa et al. [17] as well as Vandame [35] compared the attractiveness of Africanized and European bee brood to *V. jacobsoni* and obtained consistent results. In the study by Guzmán-Novoa et al. [17], four treatments were tested. Treatment 1 consisted of brood derived from European queens that were inseminated with the semen of European drones; treatment 2 consisted of brood derived from Africanized queens that were inseminated with the semen of European drones; treatment 3 consisted of brood derived from European queens that were inseminated with the semen of Africanized drones; and treatment 4 consisted of brood derived from Africanized queens that were inseminated with the semen of Africanized drones. Comb sections containing eggs from the different experimental queens were combined and installed in common frames. Each of these mixed frames was placed into a colony that was highly infested with mites. Fifteen days later, the experimental brood was analyzed. Capped cells were opened to determine mite infestation levels. There were significant differences among genetic groups for their susceptibility to infestation. European brood was 1.95 times more susceptible to mite infestation than Africanized brood. Brood of one hybrid type (Africanized mother × European father) was 2.70 times more susceptible than brood of Africanized bees, and 1.39 times more susceptible than European bee brood (*figure 1*).

In the study by Vandame [35] 34 worker bees and ten mites were enclosed within a 16 cm^2 wire-screen cage (0.5 mm mesh) on a piece of comb containing L5 brood (i.e. brood immediately before capping). The

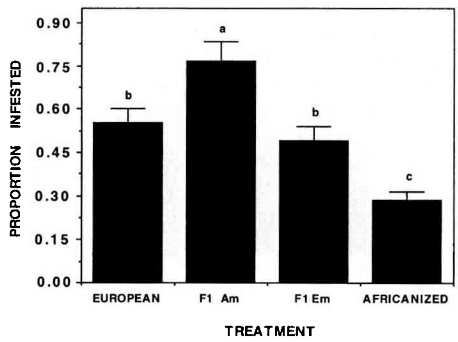

Figure 1. Proportion of capped brood cells infested with *V. jacobsoni*. Brood from European and hybrid colonies was nearly twice as susceptible as Africanized brood ($F = 15.695$, df = 3, 1 014; $P < 0.0001$). Different letters indicate significant differences of means based on an ANOVA and protected LSD tests. Statistical tests (F and LSD) are based on square root transformed data. Means and SE are actual non-transformed 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 [17].

experiment was repeated on 12 European and 12 Africanized brood frames. After 24 h the bees were anesthetized with CO_2 in order to count the number of mites they were still carrying. Capped cells were uncapped to verify that mites missing on the bees had entered the brood before capping. In European colonies, 66 % of the mites parasitized the brood cells and 34 % stayed on the bees. In Africanized colonies, only 38 % of the mites entered the brood cells, and 62 % stayed on the bees. The number of mites entering the brood was significantly different between the two genotypes tested. From the above two studies it can be concluded that European brood appeared to be twice as attractive to *V. jacobsoni* than Africanized brood.

In the third study (M.E. Arechavaleta, unpublished data), the methods were similar to the ones used by Guzmán-Novoa et al. [17] in which European and Africanized queens were inseminated with semen from European and Africanized drones. No significant differences were found among the genotypes tested. Colonies with extreme levels of adult infestation (i.e. with the highest and the lowest numbers of mites on adult bees) had similar brood infestation levels, suggesting that brood attractiveness was not important in restraining the mite population growth in the colonies under experimentation. However, Arechavaleta used genotypes obtained from commercial queen breeders, and thus his experimental colonies were not highly Africanized, which could explain the lack of differences in the results.

In studies of European bees in temperate climates, differences in brood attractiveness have been reported [4, 6]. The few studies conducted in the South American tropics have not demonstrated differences in attractiveness between Africanized and European brood to the mite [7].

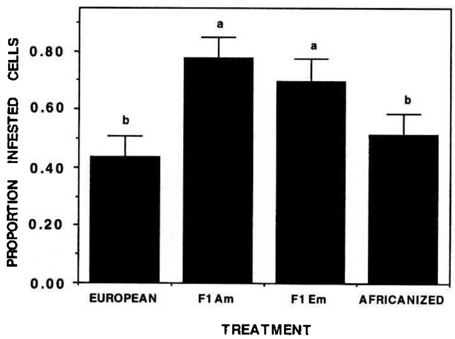

Figure 2. Proportion of infested capped brood cells in which *V. jacobsoni* females reproduced. Mite fertility was significantly higher in hybrids than in European or Africanized brood ($F = 8.691$, $df = 3, 337$; $P < 0.0001$). European brood was not different from Africanized brood. Different letters indicate significant differences of means based on an ANOVA and protected LSD tests. Statistical tests (F and LSD) are based on square root transformed data. Means and SE are actual non-transformed 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 [17].

4. HOST-INDUCED NON-REPRODUCTION

Varying proportions of female mites do not reproduce in the brood of different colonies of *A. mellifera* [18, 26, 28, 29, 31]. If variation for this characteristic results at least in part from genetic differences of the bee brood, then selective breeding for this trait might lead to the development of mite-tolerant stocks. Four studies have shown evidence that host-induced non-reproduction of the mites does not seem to play an important role in conferring resistance to honey bee colonies in Mexico ([17, 20, 35], M.E. Arechavaleta, unpublished data). Mite fertility was measured in the brood of the mixed-comb frames used in the study by Guzmán-Novoa et al. [17]. There were significant differences among genotypic groups for the proportion of mites that reproduced. Mite fertility was significantly higher in hybrid than in European or Africanized brood (*figure 2*), but no difference was found between Africanized and European treatments (the mite reproduced on more than 69 % of the infested hybrid brood, and on less than 52 % of the Africanized and European broods). There were no differences for the number of progeny that female mites produced.

Medina [20] found that out of 594 female mites that entered brood cells of Africanized bee colonies in Yucatan, only 64 (10.78 %) did not reproduce. The number of mites descended per fertile female (4–6) was not different from the number produced on brood of European bees [19]. The percentage of infested brood where no reproduction took place was similar to what Vandame [35] reported for European brood in Veracruz. Vandame counted the number of offspring produced by adult female mites in infested cells of Africanized and European bee colonies. The percentage of adult female offspring was 77.8 and 77.4 %, for European and Africanized broods, respectively.

M.E. Arechavaleta (unpublished data) did not find significant differences between high and low infested colonies for mite fertility (the mite reproduced on 78.5 and on 71 % of the infested cells in the high and low colony groups, respectively).

The figures on the mite's reproduction so far found in Mexico are higher than those reported from Brazil [23, 26] and from the United States [18].

5. HYGIENIC BEHAVIOR

Worker bees are able to detect capped brood cells that are infested with mites [1, 33]. They open the cells and remove the parasitized brood. If an infested cell is uncapped, the immature mites die, and the adult females must search for another cell, or are killed by the bees. This should slow the mite population growth in honey bee colonies.

Vandame [35] found that Africanized bees were more hygienic than European bees. To estimate the rate of removal of naturally infested brood over 10 days, Vandame observed about 600 brood cells containing L5 larvae in each of three Africanized and three European bee colonies. Bees in European colonies removed only 8 % of live infested brood, whereas the Africanized colonies removed nearly 32 % of the infested brood (*figure 3*). Guzmán-Novoa (unpublished data) found that bees from backcrossed colonies of the Africanized genotype, were more hygienic than those of the European genotype. These results agree with reports from Brazil [15] which state that Africanized bees are more hygienic than Europeans. M.E. Arechavaleta (unpublished data) also reported significant differences among colonies for hygienic behavior, but this characteristic did not explain much of the variation for the Varroa population growth in the colonies of his experiments.

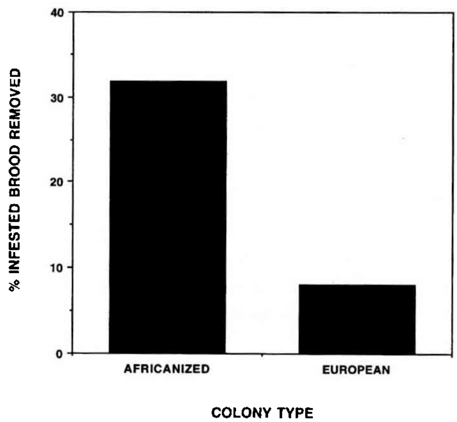

Figure 3. Hygienic behavior in colonies naturally infested with *V. jacobsoni* over a 10-day period. Hygienic behavior of worker bees was measured daily by calculating the rate of removal of naturally infested brood to total brood in 1 716 European cells and in 2 367 Africanized cells. European bees removed only 8 % live infested brood versus nearly 32 % in Africanized colonies. Infested brood in Africanized colonies was removed mainly between the fifth and seventh day after capping, a period that could coincide with a phase of mites activity that reveals their presence to the bees [35].

In the United States, Spivak [33] and Spivak and Reuter [34] reported that colonies selected for hygienic behavior had lower mite levels than non-hygienic ones in some experiments. However, the authors point out that further experiments are necessary to determine to what extent hygienic behavior reduces the mite load within a colony.

6. GROOMING BEHAVIOR

Worker bees infested with *V. jacobsoni* extensively groom themselves and each other to remove the mites [3, 29]. After removing a mite, a grooming worker may puncture it with her mandibles and discard it from the nest.

One study reported evidence of grooming behavior in honey bee colonies in Mexico (M.E. Arechavaleta, unpublished data). Arechavaleta inferred that grooming behavior was responsible for mite damage from experiments conducted in colonies and in an incubator. Sticky boards were placed on the bottom boards of 16 colonies, eight highly infested (i.e. with high rates of mite population growth), and eight low infested (i.e. with low rates of mite population growth). These colonies were selected after 6 months of being infested with an equal number of mites. Every week for 5 weeks, mites that had fallen and were captured on the sticky boards were counted and checked under a stereoscopic microscope for injuries to their dorsal shields, which could indicate damage caused by the bee's mandibles [23, 30]. In the incubator, bees from each of the same 16 colonies were caged and infested with mites. A piece of sticky paper covered with a wire mesh was placed on the bottom part of each cage, and the number of eliminated mites was recorded every 12 h, for 48 h. Mites were recovered and checked for injuries. Grooming behavior inferred from fallen and injured mites explained most of the variation for the mite population growth found among colonies. The number of injured mites on the sticky boards explained

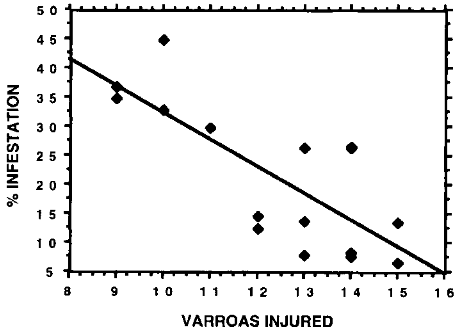

Figure 4. Regression between the colony's infestation rate and the number of injured mites. The regression equation is: Y = 78.105 – 4.582 X ($r^2 = 0.54$; $n = 16$; $P < 0.0001$) (M.E. Arechavaleta, unpublished data).

54 % of the variation found between groups of colonies ($r^2 = 0.54$, *figure 4*). The number of mites collected and the number of mites injured on boards both showed a significant correlation with the mite population growth ($r = -0.65$ and $r = -0.76$, respectively). Similar results were obtained from the tests in the incubator, confirming what was found at the colony level.

The above results are in agreement with those reported from Brazil by Moretto et al. [23]. They found that Africanized workers were seven times more efficient than Italians in eliminating mites from their bodies.

7. DISCUSSION

Studies conducted in Mexico have demonstrated significant variation in mite population dynamics among colonies. Factors responsible for this variation include honey bee genotype and climate, which is congruent with what has been reported from Brazil. Africanized colonies in Mexico regulate mite populations in a way that most colonies can survive without treatment, although this has not been the case for European colonies. Additionally, mite infestation levels are lower in warm and humid climates than in temperate climates, as in

Brazil. However, results of the studies also suggest that the tolerance of bee colonies to *V. jacobsoni* in Mexico is lower than that reported for colonies in Brazil. It is noteworthy that the populations of mites estimated in colonies in Mexico are far higher than those from Brazil. Arechavaleta (unpublished data), for example, reported infestation rates of up to 45 % on adult worker bees (estimating up to around 9 000 mites) of some colonies, which suggests that *Varroa* is a greater problem in Mexico than it is in Brazil.

Looking for factors to explain the bee's tolerance to *V. jacobsoni* in Mexico, two independent studies [17, 35] showed that European bee brood was twice as attractive to the mites as Africanized brood. The results of these two studies show a second difference from reports from Brazil. Camazine [7] did not find infestation differences between European and Africanized brood.

The main difference in mite tolerance between honey bee colonies in Mexico and Brazil is that mite fertility rates in Mexico are higher. In Brazil, low mite fertility rates (40 %) are reported to be responsible for bee resistance to *V. jacobsoni* [26]. In Mexico, the fertility rates in European and Africanized colonies did not differ in any of the studies conducted so far ([17, 20, 35], M.E. Arechavaleta, unpublished data), and appear to fall within the range of the data on mite fertility collected in Brazil and in other parts of the world (42–89 %).

Of the mites that do reproduce, no differences in the number of progeny produced by fertile female mites have been found in Mexico [17, 20, 35], which supports the same findings in Brazil [29]. These results suggest that the number of progeny generated per reproductive female mite does not explain the differences of mite population growth between colonies of Africanized and European honey bees.

As in Brazil, Africanized colonies in Mexico display a significantly higher degree of hygienic behavior than European colonies ([35], Guzmán-Novoa et al., unpublished data). Africanized bees removed three to four times more infested brood than European bees. However, studies conducted in other countries have not shown evidence to draw firm conclusions concerning the effect of hygienic behavior on the mite infestation levels within honey bee colonies.

Studies conducted in Europe, Brazil and Mexico, suggest that grooming behavior may be an important mechanism conferring resistance to honey bees against *V. jacobsoni* ([3, 5, 23], M.E. Arechavaleta, unpublished data). Thus, the study of this mechanism requires more attention. However, the effects of grooming behavior must be interpreted with caution, because the reliability of the indirect methods used to quantify this behavior is controversial [2].

Mexican honey bees seem to be relatively less tolerant to *V. jacobsoni* than bees in Brazil. Africanized bees have been in Brazil for more than 40 years, and the mites have parasitized colonies in that country for more than 20 years. In Mexico, Africanized bees have existed for 13 years, whereas the mites for only 7 years. This time difference could explain possible differences between the susceptibility of colonies in Mexico and Brazil. An alternative hypothesis is that the mites in Brazil are better adapted to their host, and have become less virulent than mites in Mexico. Moreover, differences in mite population growth may arise owing to possible genetic differences between South American and Mexican honey bee populations, and owing to genetic differences in the mite populations [9]. In addition, environmental effects and environment × genotype interactions may be different in Mexico than in Brazil. More studies considering all these factors need to be addressed to understand how environmental and genetic effects of the so-called mechanisms of resistance of honey bees affect *Varroa* population dynamics. Once we have a better understanding of the relative impact and heritability of several mechanisms, it may be possible to select for honey bees that are tolerant of *V. jacobsoni* infestation [25].

ACKNOWLEDGMENTS

R.V. thanks the Secretaría de Relaciónes Exteriores (Mexican government) and the Ministere des Affaires Etrangeres (French government) for bilateral support during Ph.D. studies. Some studies were funded by FAO and CONACYT.

Résumé – Sensibilité des abeilles européennes et africanisées à *Varroa jacobsoni* au Mexique. L'acarien *Varroa jacobsoni* Oudemans a été signalé pour la première fois au Mexique en 1992. Puisque le Mexique a des abeilles africanisées et des conditions climatiques semblables à celles du Brésil, il est important de savoir si la croissance des populations d'acariens dans les colonies d'abeilles se maintiendra à de faibles taux, comme c'est le cas au Brésil. Les résultats des études spécifiques qui ont porté sur la tolérance des colonies d'abeilles à *V. jacobsoni* au Mexique sont passés en revue et comparés avec la situation au Brésil. Plusieurs études ont montré que la croissance des populations d'acariens varie significativement d'une colonie à l'autre. Le génotype et le climat sont parmi les facteurs responsables de cette variation. Ceci est conforme avec ce qui a été observé au Brésil. Pourtant les résultats suggèrent aussi que la tolérance à *V. jacobsoni* au Mexique est plus faible que celle mentionnée au Brésil. Les taux d'infestation trouvés au Mexique sont beaucoup plus élevés (taux estimés à 45 % ou à 9 000 acariens / colonie) que ceux du Brésil (1–3 %). Deux études indépendantes [17, 35] ont montré que le couvain d'abeilles européennes était deux fois plus attractif que celui des abeilles africanisées. Dans l'une des études [17] le couvain européen était 1,95 fois plus sensible à l'infestation par *V. jacobsoni* que le couvain africanisé (*figure 1*). Au Mexique les taux de fertilité des acariens dans les colonies européennes et africanisées n'ont pas montré de variation dans aucune des études réalisées jusqu'à présent et ils semblent se situer dans la fourchette des valeurs trouvées au Brésil et dans d'autres régions du globe (42–89 %). On n'a donc pas encore retrouvé au Mexique le faible taux de fertilité de l'acarien qui semble expliquer la tolérance des colonies d'abeilles au Brésil. Dans l'une des études [17] néanmoins, la fertilité de l'acarien a été significativement plus élevée dans le couvain hybride que dans le couvain européen ou africanisé, mais aucune différence n'a été trouvée entre les couvains africanisé et européen (*figure 2*). Comme au Brésil, les colonies africanisées du Mexique ont un comportement hygiénique (elles éliminent significativement plus de couvain infesté) plus développé que les colonies européennes situées au même endroit (*figure 3*). Dans une autre étude, le comportement de toilettage, que l'on a pu déduire des acariens mutilés tombés sur le plancher, explique en grande partie la différence de croissance des populations d'acariens trouvées parmi les colonies (r^2 = 0,54, *figure 4*). Les abeilles mexicaines semblent relativement moins tolérantes à *V. jacobsoni* que les abeilles brésiliennes. Les abeilles africanisées sont présentes au Brésil depuis plus de 40 ans et les acariens les parasitent depuis plus de 20 ans, alors que les abeilles africanisées sont au Mexique depuis 17 ans et *V. jacobsoni* depuis 7 ans seulement. Cette différence de durée pourrait expliquer des éventuelles différences de sensibilité des colonies mexicaines et brésiliennes à *V. jacobsoni*. © Inra/DIB/AGIB/Elsevier, Paris

***Varroa jacobsoni* / abeille africanisée / tolérance / Mexique**

Zusammenfassung – Empfindlichkeit von europäischen und afrikanisierten Honigbienen (*Apis mellifera*) gegenüber *Varroa jacobsoni* in Mexiko. Über das Auftreten von *Varroa jacobsoni* Oudemans in mexi-

kanischen Bienenvölkern wurde 1992 erstmalig berichtet. Da Mexiko afrikanisierte Bienen und ähnliche klimatische Bedingungen aufweist wie Brasilien, war es wichtig festzustellen ob die Zuwachsraten der Milbenpopulation ähnlich niedrig wie in Brasilien sind. Dieser Beitrag gibt einen Überblick über die derzeit vorliegenden Studien zur Toleranz der Honigbienen gegen *V. jacobsoni* in Mexiko, und es wird ein Vergleich mit der Situation in Brasilien gezogen. Verschiedene Untersuchungen haben gezeigt, daβ es signifikante Unterschiede des Populationswachstums der Milben in den Bienenvölkern gibt. Die hierfür verantwortlichen Faktoren schlieβen den Genotyp und das Klima ein, wie dies übereinstimmend auch in Brasilien gefunden wurde. Die Ergebnisse weisen aber auch darauf hin, daβ die Toleranz mexikanischer Bienen gegen die Milben geringer ist als in Brasilien. Der Befallsgrad der Bienen in Mexiko liegt mit Schätzungen von 45 % oder bis zu 9 000 Milben pro Volk weit höher als der aus Brasilien berichtete Befallsgrad von nur 1–3 %. Als Erklärung der Toleranz der Bienen in Mexiko gegenüber *V. jacobsoni* wurde in zwei unabhängigen Studien eine doppelt so hohe Attraktivität der Brut der europäischen Bienen im Vergleich zu den afrikanisierten Bienen. In einer der Untersuchungen war die Brut europäischer Bienen 1.95 mal höher befallen als die der afrikanisierten Bienen (*Abb. 1*). Dagegen unterschieden sich die Fertilitätsgrade zwischen europäischen Bienen und afrikanisierten Bienen in Mexiko nicht und lagen etwa in dem Bereich der in Brasilien und in anderen Teilen der Welt gesammelten Daten (42–89 %). Als wahrscheinliche Erklärung der Milbentoleranz brasilianischer Bienen wird die geringe Fertilität angesehen, dies wurde bislang in Mexiko nicht gefunden. In einer der Untersuchungen war allerdings die Milbenfertilität in der Brut von Hybriden signifikant höher als in der Brut von europäischen oder von afrikanisierten Bienen, diese unterschieden sich allerdings nicht voneinander (*Abb. 2*). Ebenso wie in Brasilien wiesen die afrikanisierten Bienen in Mexiko ein ausgeprägteres hygienisches Verhalten auf als europäische Völker am gleichen Untersuchungsort (*Abb. 3*). In einer der Untersuchungen erklärte das anhand der abfallenden und verletzten Milben ermittelte Putzverhalten den gröβten Teil der Unterschiede des Populationswachstums der Milben in den Völkern ($r^2 = 0.54$, *Abb. 4*). Die mexikanischen Bienen scheinen eine geringere Toleranz gegenüber *V. jacobsoni* aufzuweisen als die Bienen in Brasilien. Afrikanisierte Bienen kommen seit mehr als 40 Jahren in Brasilien vor, seit über 20 Jahren werden die Bienenvölker dieses Landes durch die Milben parasitiert. In Mexiko dagegen kommen afrikanisierte Bienen erst seit 13 Jahren und die Milben erst seit 7 Jahren vor. Diese unterschiedliche Zeitdauer könnte die Unterschiede der Empfindlichkeit der Bienenvölker in Mexiko und Brasilien erklären. © Inra/DIB/AGIB/Elsevier, Paris

***Varroa jacobsoni* / Toleranz / *Apis mellifera* / afrikanisierte Honigbienen / Mexiko**

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