



Reproductive ability and level of infestation of the *Varroa destructor* mite in *Apis mellifera* apiaries in Blumenau, State of Santa Catarina, Brazil

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ABSTRACT. *Varroa destructor* mite causes mortality of *Apis mellifera* bees throughout the world. Its greatest damage to these colonies has been reported in European countries and North America. The impact of the mite is related to the climate and the bee race on each region in which the plague has been established. *Varroa* causes little damage to the colonies of africanized honeybees in Brazil and the levels of infestation are relatively small and stable. The reproductive ability of *Varroa* females was evaluated in pupae of workers of 17-18 days of age, obtained from eight beehives of africanized bees for twelve months. The average number of offspring (deutonymphs, protonymphs and eggs) each *Varroa* produced was 3.18 ± 0.19 . The average total number of deutonymph and protonymph was, respectively, 1.57 ± 0.15 and 1.61 ± 0.14 . The levels of infestation demonstrated that the plague continue reaching low levels, the average was 4.11 ± 3.42 .

Keywords: varroosis, grooming, hygienic behavior, tolerance, mortality.

Habilidade reprodutiva e níveis de infestação do ácaro *Varroa destructor* em colmeias de *Apis mellifera* no município de Blumenau, Estado de Santa Catarina, Brasil

RESUMO. O ácaro *Varroa destructor* é causador da mortalidade de abelhas *Apis mellifera* em várias partes do mundo. Seus principais danos foram relatados nos países da Europa e América do Norte. O impacto desse ácaro está relacionado às condições climáticas e à raça de abelhas em cada região onde a praga se estabeleceu. A *Varroa* causa poucos danos nas colônias de abelhas africanizadas no Brasil e os níveis de infestação são relativamente baixos e estáveis em crias e adultos. A habilidade reprodutiva das fêmeas do ácaro, foi avaliada em pupas de operárias de 17-18 idade, obtidas de oito colmeias de abelhas africanizadas, durante 12 meses. O número médio total de descendentes (deutoninfas, protoninfas e ovos) que cada varroa produziu foi de 3.18 ± 0.19 . Para o número médio total de deutoninfas e protoninfas foi, respectivamente, 1.57 ± 0.15 e 1.61 ± 0.14 . Os índices de infestação demonstram que a praga continua alcançando baixos níveis; a média foi de 4.11 ± 3.42 .

Palavras-chave: varroosis, grooming, comportamento higiênico, tolerância, mortalidade.

Introduction

Varroa destructor mite (ANDERSON; TRUEMAN, 2000) is the ectoparasite that causes the greatest damage to beekeeping worldwide. When the parasitism is not treated, it is responsible for major losses in *Apis mellifera* colonies, mainly in temperate climate countries (ROSENKRANZ, 1999). In some parts of tropical America and Brazil, it is not necessary to use pesticides, since honeybees demonstrate to have a tolerance to *V. destructor*. Several factors such as climate influence (MORETTO et al., 1991), bee race (DE GUZMAN et al., 2007) and

the mite's genetic lineage (STRAPAZZON et al., 2009b) are related to this tolerance.

The genetic variation of adult females in *V. destructor* examined by comparison of the mtDNA demonstrated that this species is a complex of six different haplotypes (ANDERSON; TRUEMAN, 2000; DE GUZMAN; RINDERER, 1999). The most common haplotypes known are generally called Korean (found in *A. mellifera* colonies in Europe, Asia and North America), and Japanese (found in Japan and also in South America) (SOLIGNAC et al., 2003). The Korean haplotype is considered to be more virulent than the Japanese. These

haplotypes can represent populations with different levels of virulence, which can explain why some colonies manage to survive and keep low levels of infestation (SOLIGNAC et al., 2005).

Several studies are being conducted to elucidate the reproductive dynamics of the mite (CALDERÓN et al., 2010). The low reproductive capacity of *V. destructor* female is considered one of the most relevant factors for low levels of infestation in some regions of the world, particularly in South America. Although the mite has already been found in Brazil for more than four decades without receiving any kind of infestation control treatment, no death of bee colonies due to varroosis was found so far (MORETTO; LÊONIDAS, 2003).

Another relevant factor that determines tolerance of *A. mellifera* to levels of infestation by *V. destructor* is related to the female's mite reproductive success in worker brood cells (CORREA-MARQUES et al., 2003). The number of the offspring per adult female mite that parasites worker brood is greater in European bees than in Africans and their hybrids (MEDINA; MARTINS, 1999). The reproductive ability of *Varroa* in worker brood cells also depends on the season of the year; female mites produce more offspring during times of pollen production than in any other season of the year (MORETTO et al., 1997). Studies comparing the level of infestation between Africanized bees and European honeybees demonstrated that for several reasons the Africanized bee is more resistant to this plague, besides other diseases (PICCIRILLO; DE JONG, 2003).

Recently, the reproductive ability of *V. destructor* in Brazil seems to be changing. In 2005, Carneiro et al. (2007) analyzed more than 1000 workers brood cells infested with *Varroa* females, and found an increase of 30% in the proportion of mite fertile females compared with 1986, increasing from 56 to 86%. The percentage of females that produced deutonymphs was 35% in 1986, being higher in 2005-2006, increasing to 72%.

The purpose of this work was to verify the reproductive ability of the *V. destructor* mite and the level of infestation on Africanized bees colonies in apiaries located in Blumenau, State of Santa Catarina, Brazil.

Material and methods

The reproductive ability of *Varroa* females was evaluated monthly in eight colonies of Africanized bees in the experimental apiary of the Regional University of Blumenau, State of Santa Catarina,

Brazil. Worker brood cells with 17-18 day-old, were uncapped with a forceps and the number of *Varroa* adult females and their offspring were checked. The number of eggs of *Varroa*, protonymphs and deutonymphs was recorded from a single infestation in 1,300 infested worker brood cells.

To estimate the level of infestation of *V. destructor* mite in adult bees, it was used the methodology of Stort et al. (1981). The number of *Varroa* was obtained from 200-300 adult workers by honeybee colony. Samples were collected from 4 to 5 colonies in each of four apiaries located in the city of Blumenau. Bees were collected in plastic bottles containing approximately 200 mL of ethanol at 70%. Later, bees and mites were separated by shaking, with the aid of a plastic bottle cut in the middle and with a net allowing separation of mites and bees. The estimate level of infestation was performed by the expression:

Level of infestation (%) = number of varroas ÷ number of bees X 100.

Results

Of the 1,300 pupae cells analyzed, 1,204 (93%) were infested with *Varroa* females that left at least some type of descendant. Considering the percentage of females that produced only deutonymph, female that can reach the adult stage, the average level of infestation in a period of twelve months was $77 \pm 5\%$. The overall average number of deutonymphs, protonymphs and eggs that each *Varroa* produced was 3.18 ± 0.19 . For deutonymphs and protonymphs the overall average number was respectively 1.57 ± 0.15 and 1.61 ± 0.14 . In the four apiaries together, the level of infestation on adult bees in spring, summer, autumn and winter, were respectively, 3.0, 3.2, 3.1 and 7.3 varroas per 100 adult bees. Statistically, the level of infestation was significantly different between the four seasons of the year ($F = 9.3$, $p = 0.000$). According to the mean values observed in the seasons, Tukey's test evidenced that the infestation was higher in winter.

Discussion

Since the introduction of *Varroa* in Brazil more than 40 years ago, the reproductive potential of the mite has been considered low, since females produce only a few descendants per cycle, thus not worrying Brazilian beekeeping (MORETTO, 2002). Levels previously reported between the decades of 1980-90 have verified that the chance of each mite to leave descendants was about 50% (MORETTO et al., 1991).

However, works are showing a reproductive increase of the mite. Garrido et al. (2003) and Carneiro et al. (2007) have verified an increase in the *Varroa* female fertility to levels higher than 80% in Ribeirão Preto, São Paulo State and Blumenau, Santa Catarina State. In the present study, 93% of females were able to leave at least one type of descendant in worker brood cells and $77 \pm 5\%$ of these females left deutonymph descendants, showing an increase in relation to the results found by Carneiro et al. (2007) also in Blumenau, State of Santa Catarina. Another change observed was in the average number of descendants left by female *Varroa*. Carneiro et al. (2007) have demonstrated that *Varroa* used to leave an average of 2.6 descendants per reproductive cycle in Santa Catarina. The average number in this work rose to 3.18 descendants, showing up an increase of 22%.

Other surveys on the *Varroa* biology were developed to elucidate how the virulence has different aspects in the various countries where the plague develops (ROSENKRANZ et al., 2010). One of the evidences suggests that there was a change in the genotype of the parasite, explaining the reproductive increase. Previously, the haplotype K (more virulent) was found in European countries, United States and in Asia, where the problems with *Varroa* were more serious, and the haplotype J was found in countries where there were low levels of infestation like Brazil and Japan (WARRITA et al., 2006). Guerra Jr. et al. (2010) using RAPD markers (DNA nuclear) have indicated only the existence of the R genotype (more virulent) in South America, Mexico and Cuba. In the State of Santa Catarina, Brazil, Strapazzon et al. (2009b) examined the mitochondrial genome of the mite, observed only the haplotype K, and we believe this change is the main reason for the observed increase on the reproductive ability.

Another reason for the infestation to remain low was observed by Strapazzon et al. (2009a) who verified a possible overestimation in the analyses on mite reproduction in worker brood cells of 17-18 days old. The average of deutonymphs that were able to reach the adult stage was 1.07. Given these different types of interactions between bees and mite, it is known that many factors interfere with the reproductive success of *Varroa*, which determines the tolerance by the bees.

Besides this increase in reproductive ability, shown by both the percentage of females that left any type of descendant and the increase in the average number of offspring, the levels of infestation remained low. The level of infestation achieved in this study showed an infestation of approximately 4%, which probably

means that the bees are managing to keep the colonies "clean" through defensive mechanisms such as grooming (CURRIE; TAHMASBI, 2008) and hygienic behavior (EVANS; SPIVAK, 2010). Nevertheless since all forms of energy are important resources in any ecosystem, the more efficient are female mites at reproduction, the costlier is their removal to the colony, as they spend at least some time and energy exhibiting defensive behavior. As pointed out by Calderón et al. (2010), the recent arrival of the haplotype K in Brazil demands further investigations on the dynamics of this host-parasite interaction.

Conclusion

In summary, the *Varroa destructor* mite presented a high reproductive ability, although maintaining the infestation in adult bees within a level below 5%.

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