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Fertility and reproductive rate of *Varroa* mite, *Varroa destructor*, in native and exotic honeybee, *Apis mellifera* L., colonies under Saudi Arabia conditions

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ABSTRACT

Varroa mite is the most destructive pest to bee colonies worldwide. In Saudi Arabia, preliminary data indicated high infestation levels in the exotic honeybee colonies; such as *Apis mellifera carnica* and *Apis mellifera ligustica*, compared to native honeybee subspecies *Apis mellifera jemenitica*, which may imply higher tolerance to *Varroasis*. In this study, fertility and reproductive rate of *Varroa* mite, *Varroa destructor*, in capped brood cells of the native honeybee subspecies were investigated and compared with an exotic honeybee subspecies, *A. m. carnica*. Mite fertility was almost alike (87.5% and 89.4%) in the native and craniolan colonies respectively. Similarly, results did not show significant differences in reproduction rate between both subspecies ($F = 0.66$, $Pr > F = 0.42$). Number of adult *Varroa* daughters per fertile mother mite was 2.0 and 2.1 for native and craniolan honeybee subspecies respectively. This may indicate that mechanisms of keeping low infestation rates in the native honeybee colonies are not associated with *Varroa* reproduction. Therefore, potential factors of keeping lower *Varroa* infestation rates in native honey bee subspecies should be further investigated.

1. Introduction

Varroa mite, *Varroa destructor*, is still the most destructive pest of the western honeybee, *Apis mellifera* L. worldwide (Dietemann et al., 2013 and Rosenkranz et al., 2010). Being a vector for many viral diseases associated with colony collapse disorders (Cox-Foster et al., 2007 and de Miranda et al., 2010), makes its association with the Western honeybee more complex. Based on infestation levels, fertility and reproductive rates of *Varroa* mite in colonies of the Western honeybee, few tolerant honeybee subspecies, *A. mellifera*, were documented, the most well-documented examples are the Africanized honeybee, *A. mellifera*, in Brazil (De Jong et al., 1982; Rosenkranz et al., 2010), the native honeybee of Tunisia, *A. m. intermissa*, (Ritter et al., 1990) and the African honeybee in Kenya, *A. m. scutellata*) Frazier et al., 2010).

In Saudi Arabia, preliminary studies indicated lower *Varroa* infestation levels in the native honeybee compared with exotice subspecies; *Apis mellifera carnica* and *Apis mellifera ligustica* (AlGhamdi, 2002). Moreover, the native honeybee of Saudi Arabia is characterized as the smallest honeybee subspecies of the Western honeybee (Alattal et al., 2014; Alghamdi et al., 2012; Ruttner, 1988), and is being highly adapted to extreme high temperatures (Alattal and Alghamdi, 2015; Ruttner, 1988). Therefore, this honeybee subspecies may show unique association with *Varroa* mite. Thus, fertility and reproductive rate of the *Varroa* mother mite in capped brood cells of the native honeybee *A. m. jemenetica* is the focus of this study.

2. Materials and methods

Four native honeybee colonies, *A. m. jemenetica,* were obtained from purebred regions in the southern part of Saudi Arabia; four other honeybee colonies were headed with craniolan honeybee queens, *A. m. carnica* obtained from certified producer (Australian queen bee exporters, Australia). Subspecies loyalty was confined morphometrically according to Ruttner (1988). After standardization, colonies were treated according to Apimondia guidelines of performance testing (Ruttner, 1972). Each colony consisted of

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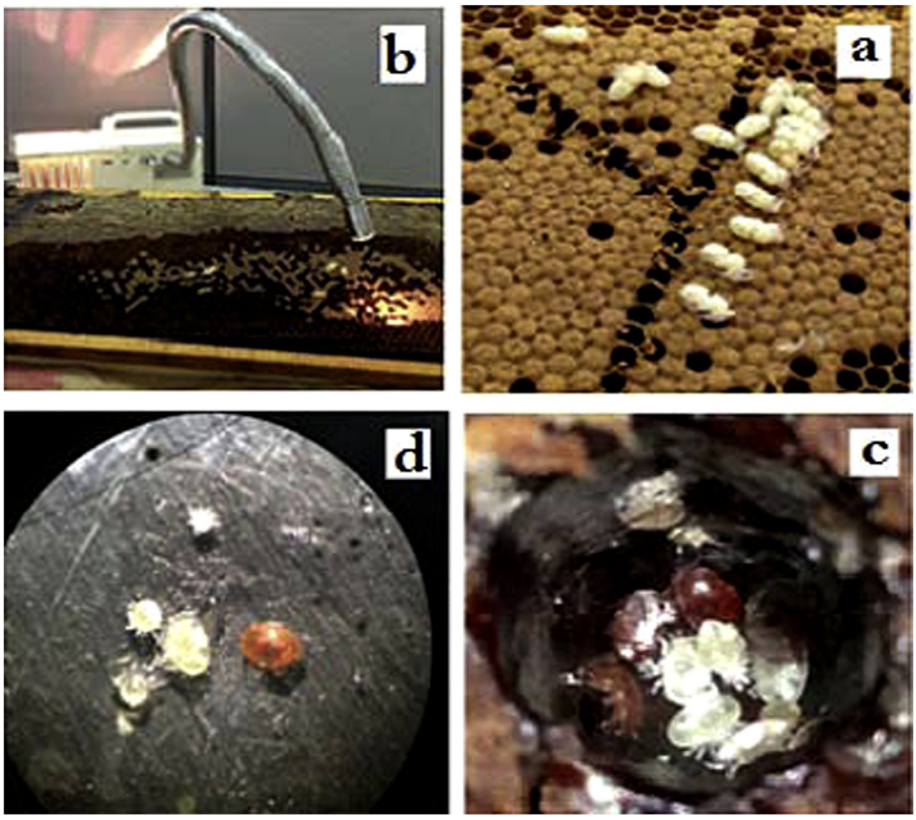

Fig. 1. Inspecting capped brood cells for the presence of *Varroa* mite: (a) sampling of capped brood cells for inspection (Dietemann et al., 2013), (b) using of cold light to inspect the inside of the cells for *Varroa* presence, (c) example for two *Varroa* families inside one brood cell, (d) Progeny for one mother mite.

3–4 brood combs and 7–8 adult bee combs. Mite fertility; mites were considered fertile if they laid at least one egg in brood cells capped before 120 h. For this purpose, 100 infested capped worker-brood cells from each colony were used to evaluate mite fertility (Fig. 1). Brood cells with multiple mite infestations were not considered in this assessment (Rembold et al., 1980 and Rosenkranz and Engels, 1994). The number of immature stages and adult mite daughters were counted in examined brood cells to evaluate the reproductive rate (=number of emerged viable adult daughters per fertile female *Varroa* mite) of both subspecies. For this purpose, only brood cells, which contain fully developed and singly infested adult worker bees (>270 h after cell capping) infested with only one reproducing female mites were considered to evaluate the reproductive rate. However, mite progeny (males, nymphs, adult daughters and eggs) was also counted in brood cells, which were opened before 270 h after cell capping and was presented according to the developmental stage of the bee pupae (Rembold et al., 1980). The change in the number of different mite progeny throughout the time of bee pupae development was also represented. Statistical separation of means was done based on ANOVA and LSM at $P = 0.05$ (SAS, 2008).

3. Results

Mite fertility was almost alike in colonies of both honeybee subspecies. Average fertility was 87.5% in native honeybee subspecies, *A. m. jemenetica* and 89.4% in exotic craniolan honeybee, *A. m. carnica* ($N = 800$). Mite reproductive rate shows insignificant variations between both subspecies (Fig. 2). Average number of adult mite daughters per mother mites were 2.0 and 2.1 in the native honeybee, *A. m. jemenetica*, and the craniolan honeybee, *A. m. carnica*, respectively (Fig. 2a) with no significant differences ($F = 2.46$, $Pr > F = 0.12$). Results show significant variation in number of laid eggs between both subspecies at early stages of bee pupae (Fig. 2b), however these significant variations disappears when the total number of laid eggs between both subspecies was considered ($F = 0.66$, $Pr > F = 0.42$). Male mite progenies were 1 and 0.9 male per fertile mother mite in native honeybee, *A. m. jemenetica* and exotic honeybee, *A. m. carnica* respectively, with insignificant differences ($F = 3.3$, $Pr > F = 0.07$) (Fig. 2c). Number of eggs and immature stages of *Varroa* mite were approximately the same in both subspecies (Fig 2 d, e and f).

4. Discussion

The documented mite fertility in this study demonstrated two important aspects; first: high fertility levels of *Varroa* mite in native honeybee subspecies, *A. m. jemenetica*, compared to an average mite fertility value of 85% reported for the western honeybee, *A. mellifera*, colonies (Fries et al., 1994). Second: no variation in mite fertility and reproductive rate were documented between the native honeybee race, *A. m. jemenetica*, and the craniolan honeybee, *A. m. carnica*, under Saudi Arabia environmental conditions. This indicates that the native honeybee of Saudi Arabia is not more *Varroa*-tolerant than the Carniolan honeybee, *A. m. carnica*, when fertility and reproductive rate were addressed. Results indicated high similarity in the rate of *Varroa* reproduction in craniolan honeybee colonies under the condition of this study and that of central Europe (Rosenkranz et al., 2010), Syrian honeybee, *A. m. syriaca*, in Jordan (Alattal et al., 2005) and Egyptian honeybee, A. m. *lamarcki*, in Egypt (Omran et al., 2011), which are considered as suitable hosts for *Varroa* mite. In conclusion, it is clear that fertility and reproduction rate do not form any constrains or boundaries for *Varroa* development in both honeybee subspecies at the study

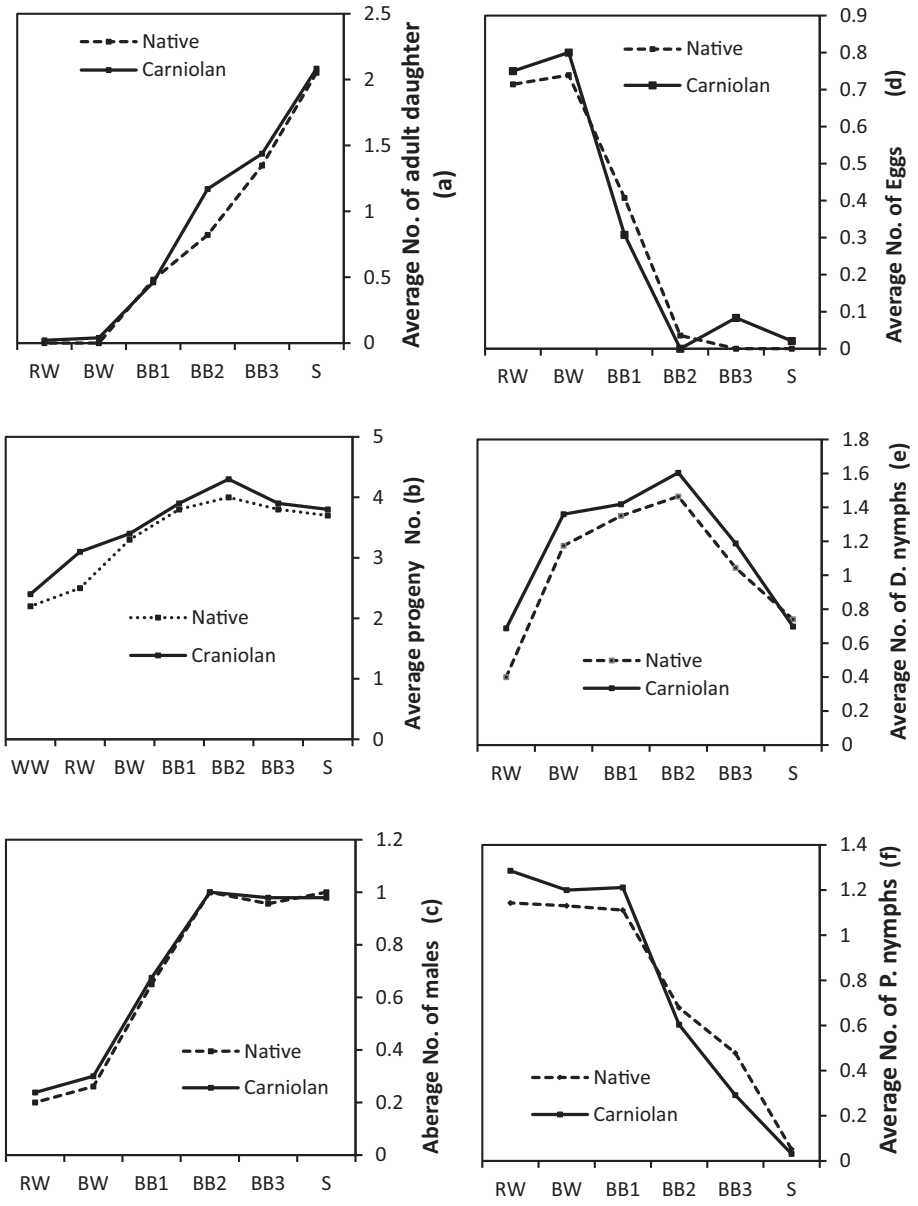

Fig. 2. No. of *Varroa* mite progeny presented at different developmental stages of honeybee pupae which were categorized according to Rembold et al., (1980); RW = red eyes and white body (168 h after capping), BW = dark brown eyes and white body (192 h after capping), BB1 = dark brown eyes and grey body (214 h after capping), BB2 = black; eyes and grey body (243 h after capping), BB3 = black eyes and body (266 h after capping), and S = adult bee shortly before emergence.

area; consequently noticeably lower infestation levels of the native honeybee subspecies could be related to other factors.

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