

Infestation rates of *Varroa destructor* and *Braula coeca* in the savannah honey bee (*Apis mellifera scutellata*)

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The honey bee (*Apis mellifera* L.) colony hosts a diversity of pathogens, parasites and pests. The introduced ectoparasite, *Varroa destructor* Anderson & Trueman (Acari: Varroidae), is regarded as one of the most serious threats to honey bee health today (Rosenkranz *et al.*, 2010). The population dynamics and negative effects of *V. destructor* have been well documented in Europe and the USA (Rosenkranz *et al.*, 2010). In contrast, the population size and impact on colonies of *Braula coeca* Nitzsch (Diptera; Braulidae), a wingless fly, are less well documented. This fly is generally considered to be a minor pest (Hepburn, 1978), but a large number of individuals on queens might decrease their ability to lay eggs (Argo, 1926; Crane, 1990) and their larvae can cause physical damage to honey combs when they tunnel below the wax cappings (Hepburn, 1978; Ellis, 2008).

The presence of *V. destructor* and *B. coeca* has been reported in most countries around the world (Ellis and Munn, 2005). The widespread use of acaricides to control *V. destructor* has reduced the prevalence of *B. coeca* in most regions (Kulinčević *et al.*, 1991; Sammataro and Avitabile, 2011). However, in South Africa, few or no acaricides are used in honey bee colonies, which was confirmed in a recent survey on colony losses (Pirk *et al.*, 2014), and *B. coeca* populations have been maintained.

In South Africa, little is known about *B. coeca* infestation rates, but the near universal presence of *V. destructor* has been confirmed (Allsopp, 2006; Strauss *et al.*, 2013). The infestation rates of *V. destructor* and *B. coeca* were examined in adult savannah honey bees, *A. m. scutellata*, in order to assess whether they vary in time and whether they could pose a risk to colonies.

Adult honey bees (*A. m. scutellata*) were collected each season from July 2010 to August 2011 from 13 apiaries (not exposed to acaricides) situated in the Gauteng region of South Africa (Strauss *et al.*, 2013). A total of 51 colonies were sampled across seasons in six

apiaries, and 33 colonies from seven apiaries were sampled only once. *V. destructor* and *B. coeca* were washed off adult honey bees (Allsopp, 2006) and counted. Infestation rates were calculated as follows: number of *V. destructor* or *B. coeca* divided by the number of honey bees per sample and multiplied by 100. Following standard guidelines (Pirk *et al.*, 2013), a Pearson correlation was performed to determine whether there was a correlation between *V. destructor* and *B. coeca* infestation rates.

For all seasons, no significant correlations ($-0.11 < R < 0.20$, $P > 0.05$) were found in the infestation rates of *V. destructor* and *B. coeca*. *V. destructor* infestation rates were consistently higher than those of *B. coeca* (Fig. 1). Both species were common in *A. m. scutellata* colonies and the average infestation rates over all seasons were 2.1 ± 2.3 *V. destructor* and 1.2 ± 1.5 *B. coeca* per 100 adult honey bees.

A. m. scutellata colonies were infested with *V. destructor* during all seasons, but the highest rates were recorded during winter 2011, with 3.0 ± 3.6 mites per 100 bees. Allsopp (2006) found that the average infestation rates of untreated *A. m. scutellata* colonies measured during autumn and winter of 1999 were 7.7 and 1.0 mites per 100 adult honey bees, respectively. In *A. m. capensis*, the neighbouring subspecies, *V. destructor* infestation rates also differed between the winter of 1999 (3.5 mites per 100 adult honey bees) and 2000 (7.5 mites per 100 adult honey bees) (Allsopp, 2006). In Africanised honey bees that are also tolerant to the parasitic mite, comparable infestation rates of 3.5 mites per 100 adult honey bees were recorded (Medina *et al.*, 2002). These figures (<3.5 mites per 100 adult honey bees) correspond to those for European honey bees that survive in the presence of *V. destructor* after acaricide treatment (Genersch *et al.*, 2010; Guzman-Novoa *et al.*, 2010) and therefore seem to be at a level where several of the honey bee subspecies can tolerate the parasite.

B. coeca was found across all seasons in *A. m. scutellata* colonies. In Benin, Paraiso *et al.* (2012) observed similar infestation rates as in our study that ranged from 0.3 to 4.6 individuals per 100 *A. m. adansonii* workers. We recorded the highest infestation rates during winter 2011. In contrast, *B. coeca* numbers in other regions of the world peaked at different seasons (spring and autumn in USA, Smith and Caron, 1984; summer and autumn in Jordan, Zaitoun and Al-Ghzawi, 2008). The climatic differences between these regions might explain the differences in *B. coeca* numbers. Indeed, varying climatic conditions not only between regions but also between years could explain the differences in the infestation rates of both *V. destructor* and *B. coeca* in South Africa in the winters of 2010 and 2011; with values during the first winter being lower and more comparable with the other seasons.

The lack of a significant correlation between the seasonal infestation rates of *V. destructor* and *B. coeca*, indicates that there is minimal or no direct competition between these organisms. This becomes even more apparent when considering the life history of the two organisms; *B. coeca* larvae emerge from eggs laid on honey cappings (Ellis, 2008), and are not dependent on developing honey bee brood for survival during maturation. Conversely, *V. destructor* mites depend on sealed honey bee brood for their reproductive phase and their main food source is honey bee haemolymph and not honey, pollen or food secretions as is the case with *B. coeca* (Ellis, 2008; Rosenkranz *et al.*, 2010). Although the adults of both species spend a considerable time on adult honey bees, *V. destructor* prefers to attach itself to the abdomen to feed but can also be found between the head and thorax of honey bees (Bowen-Walker *et al.*, 1997), while *B. coeca* rests on the thorax and moves to the head of honey bees to feed (Ellis, 2008). This suggests that competition for space on adult honey bees or for food is unlikely.

In this study, the low *V. destructor* and *B. coeca* infestation rates suggest that they do not have a significant effect on the health of the honey bee population studied. In addition, few honey bee viruses were detected in this region (Strauss *et al.*, 2013) and this might explain why the South African *A. m. scutellata* population is able to survive in the presence of *V. destructor*, without treatment, 16 years after the mite was first introduced into the country.

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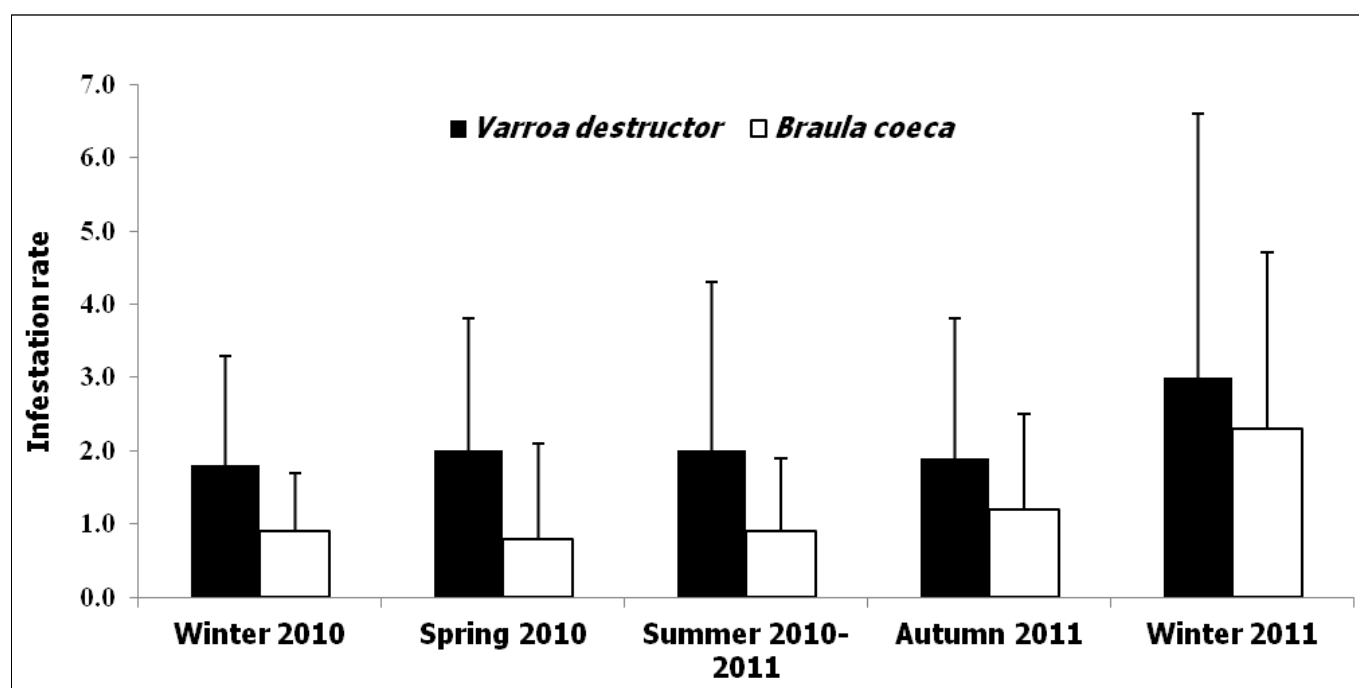


Fig. 1. Infestation rates (mean \pm SD) of *Varroa destructor* and *Braula coeca* per 100 adult honey bees in *Apis mellifera scutellata* colonies .

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