Using safe materials to control Varroa mites with studying grooming behavior of honey bees and morphology of Varroa over winter

Hossam F. Abou-Shaara

Department of Plant Protection, Faculty of Agriculture, Damanhour University, Damanhour 22516, Egypt

ARTICLE INFO

Keywords:
Honey bees
Morphology
Grooming
Propolis
Drones

ABSTRACT

Extracts of drone larvae and propolis as safe materials are anticipated to boost the grooming behavior of honey bees against Varroa mites. It is also expected that grooming behavior of bees and morphology of Varroa are stable during the least active period of the year to bee colonies (i.e., winter). Sugar syrup alone or mixed with drone larvae extract or propolis extract were examined as potential Varroa control materials to test these hypotheses. Moreover, percentages of groomed mites along with body lengths and widths of Varroa were studied on weekly basis during winter. The results showed that propolis extract was able to increase the number of fallen mites under field conditions but with lethal impacts on bee workers in the laboratory than extract of drone larva or sugar syrup. All the treatments were not able to boost the grooming behavior of bees. The results proved that grooming behavior was stable during winter. Therefore, it is better to select colonies with grooming potential against Varroa during winter in selection programs. December was significantly the minimal month in percentage of groomed mites based on the overall means. Means of measured characteristics of Varroa populations without harming the bees.

Introduction

Honey bees, Apis mellifera, are very valuable to the agricultural sector. They are the main pollinators to various plants and beekeeping is considered as source of income to many people (Morse and Calderone, 2000; Chazovchii et al., 2013; Quaiser et al., 2013). Honey bees are the main target to many pests and parasites including Varroa mites. These mites can cause severe damages to the bees. Honey bees can protect their colonies from Varroa mites using specific behaviors including grooming behavior (GB). Causing damages to Varroa mites (i.e., GB) is a heritable character in A. mellifera (Pritchard, 2016). Phoretic Varroa mites; foundress, gravid or daughter mites are exposed to grooming by bees especially daughter mites (Kirrane et al., 2012). The GB includes self-grooming and social grooming which compasses of groomers and recipient bees (Bozic and Valentinic, 1995). The GB can be stimulated using some safe materials including inert sugar (Stevanovic et al., 2012). Other safe method to control Varroa includes sprinkling bees with sugar syrup (Pileckas et al., 2012). Using sugar syrup as a spray over bees has been found to be less harmful to bees than sugar dusting (Abou-Shaara et al., 2016). Varroa mites attract to nurse bees, forager bees or even larvae at certain ages based on various factors including the reproductive stage of the mites (Kraus, 1994), and distance from open brood cells (Goetz and Koeninger, 1993). It is known that Varroa mites attract to drone cells more than worker cells (Fuchs, 1990). Thus, it is hypothesized that using drone larva extract mixed with sugar syrup as a spray over bees can disturb Varroa mites and enhance the GB. Propolis extract is another material that can be mixed with sugar syrup to control Varroa. Propolis extracts have shown narcotic and lethal effects on Varroa mites (Garedew et al., 2002a, 2002b; Damiani et al., 2010a, 2010b).

The GB is differed among bee species, subspecies and hybrids (Balhareth et al., 2012; Bak and Wilde, 2015; Pritchard, 2016). GB can be evaluated under filed conditions by calculating the percentage of damaged mites from the total number of fallen mites (Stanimirovic et al., 2010). A laboratory assay has been developed by Aumeier (2001) to assess the GB of honey bees artificially infested with Varroa mites. Fluctuations have been found in Varroa populations over months (Narendra et al., 2016). In fact, the stability degree of the GB within the same bee colonies in the course of time especially during winter period has not been fully studied. It is known that brood rearing activity is very low during autumn and winter (e.g., Allen and Jeffree, 1956; El-Sarrag, 1993). Also, the longevity of winter bees is high (Sakagami and Fukuda, 1986; Amdam and Ombolt, 2002). Thus, it is expected that adult bee populations in the colonies are greatly stable during winter. Therefore, it is hypothesized that using drone larvae extract mixed with sugar syrup, to control Varroa, may increase the number of mites that are grooming, without harming the bees.
studying the GB of the same group of bees is possible.

There are various species of Varroa mites but Varroa destructor is the one causing damages to *A. mellifera*. This particular species is common in various parts of the world including Egypt (Awad et al., 2011; Abou-Shaara and Tabikha, 2016). This species can be differentiated than other Varroa species by measuring body length and width to calculate ratio of body size (Dietemann et al., 2013). There are approximately 15 haplotypes of *V. destructor* (Zhou et al., 2004). It is possible to identify four morphotypes of Varroa mites using morphometric characterization (Aude et al., 2016). So far, it is not completely known if the body morphology can be fluctuated (i.e. increased or decreased) within the same population of Varroa over time. A study in Ukraine has shown variations between morphological characteristics of summer and winter Varroa mites (Akimov et al., 2004). Still, the fluctuations in morphological characteristics, mainly body length and width, need more investigations especially during winter. During this season foraging activity of honey bees is very low due to low air temperature and rains (Abou-Shaara, 2014). Thus, the transportation of new Varroa mites by forager bees to their colonies is not highly expected. Also, it is anticipated (i.e. incomplete chelicera, legs and/or shield) were considered as deformed. Then, percentage of groomed Varroa was calculated by dividing the number of groomed Varroa on the total number of Varroa X 100. The percentages of groomed Varroa were then compared over the experimental period.

Fluctuations in Varroa morphology

The fallen Varroa mites were collected from the six colonies over the period from November 2016 until February 2017. The lengths and widths of Varroa were measured weekly. Only Varroa mites with complete bodies were considered to obtain correct widths and lengths while those with deformed body shields were not. The mites were scanned using scanner (Canon, k10352, LiDE 110, Vietnam) at a high resolution of 1200 dpi to obtain clear images. The lengths and widths were subsequently measured using computer program (ScanPhoto method, Abou-Shaara and Al-Ghamdi, 2012). The measurements were compared over the study period to detect any morphological fluctuations. Also, the body ration (= body width/body length) was calculated.

Materials and methods

Honey bee colonies

The colonies were located at an apiary at Damanhour city, Egypt. Each colony was provided with a lower drawer to facility the collection of fallen Varroa mites. Wire meshes were used to separate the beehive bodies than the drawers. Therefore, any fallen mites cannot be attack again by the bees. All the colonies were hybrids of Carniolan honey bees.

Effects of sugar syrup (SS), extracts of drone larvae (EDL) and propolis (EP) on Varroa mites and honey bees

Effects of three safe materials on the grooming behavior of honey bees were evaluated during spring 2017: (I) sugar syrup (SS) 1:1 (sugar:water, w/w) (using 4 ml per comb), (II) sugar syrup 1:1 mixed with drone larvae extract (EDL) (20 drone larvae at 5th day were dissolved in 100 ml water and filtered, then 2 ml of the extract was mixed with 2 ml sugar syrup per comb), and III) sugar syrup 1:1 mixed with propolis extract (EP) (5 gm propolis was mixed with 100 ml water and filtered, then 2 ml of the extract was mixed with 2 ml sugar syrup per comb). Four Carniolan hybrid colonies were used per each treatment. The colonies had approximately the same strength with 5 combs covered with bees. The fallen mites over 11 days were collected directly prior the treatments. Then, the cumulative fallen mites after the treatment period (each treatment was repeated three times with 4 days interval with a total period of 11 days) were collected directly. The grooming behavior of the colonies was assessed as percentage of groomed mites from the total number of collected mites. The percentages of groomed mites were compared after and before treatments.

The effects of these materials on nurse bee workers were assessed under laboratory conditions. Each of SS, EDL, and EP were replicated four times (four jars and 15 bees per jar, a total of 60 bees per treatment). The jars were covered with mesh covers. The treatments were presented daily to the bees using cotton pieces saturated with each treatment above the mesh covers. The number of dead bees was counted daily for 7 days. Then, the mortality rates were calculated in each jar by dividing the daily number of dead bees on the total number of bees per jar (15) x100. Means were then calculated and compared.

Results

Fluctuations in the grooming behavior

This experiment and the next one were done using 6 colonies. Number of Varroa mites collected from these colonies was counted weekly from November 2016 until February 2017. The mites were classified as normal or deformed (groomed) using a light microscope. The mites with body malformations (i.e. incomplete chelicera, legs and/or shield) were considered as deformed. Then, percentage of groomed Varroa was calculated by dividing the number of groomed Varroa on the total number of Varroa X 100. The percentages of groomed Varroa were then compared over the experimental period.

Statistical analysis

The comparison between groups was done using ANOVA followed by Post Hoc using Duncan’s Multiple Range test. Also, t-test was used to compare percentage of groomed Varroa mites before and after the treatments. Each of degree of freedom (DF), F value and P value were presented. The variations were considered significant when \( P \leq .05 \). The percentages were transferred using arcsine transformation before the analysis. For percentage of dead bees, Kaplan-Meier test was used to calculate the estimated survival means of the groups. Then, the significant differences between groups were determined using Log Rank (Mantel-Cox test). The data were analyzed using SAS v. 9.1.3 and SPSS v. 16.

Effects of sugar syrup (SS), extracts of drone larvae (EDL) and propolis (EP) on Varroa mites and honey bees

The mean number of fallen mites as difference between after and before the treatments was high to EP with 10.50 ± 2.06 mites, followed by EDL with 8.50 ± 3.71 mites and finally SS alone with 5.25 ± 2.21 mites. However, neither EP nor EDL were significantly different than SS (DF = 2, \( F = 0.92, P = .43 > .05 \)). The mean percentage of groomed mites before treatments was 0.33 ± 0.04, 0.38 ± 0.06, 0.39 ± 0.06 mites to SS, EDL, and EP, respectively. The mean percentage of groomed mites after treatments was 0.64 ± 0.12, 0.43 ± 0.04, and 0.36 ± 0.03 mites to SS, EDL, and EP, respectively (Fig. 1). No significant differences were found in percentage of groomed mites before and after the treatments (t statistic = 1.92, 0.86, and 0.34, and \( P = .15, .44, \) and .75 for SS, EDL, and EP, respectively). The percentage of groomed Varroa after the end of the treatment period were insignificantly higher to SS than the treatments with EP and EDL (DF = 2, \( F = 3.27, P = .08 > .05 \)).

The percentage of dead bees increased from 0.00 ± 0.00, 3.00 ± 0.01, and 4.00 ± 0.03% at day 2 to 16.00 ± 0.02, 29 ± 0.04, and 54 ± 0.07% at day 7 for SS, EDL, and EP, respectively (Fig. 2). The highest percentages of dead bees from day 2 to day 7 were to EP followed by EDL and finally SS. The percentages of dead bees from day 2 to 7 were significantly higher to EP than EDL and SS.
دریافت فوری
متن کامل مقاله

امکان دانلود نسخه تمام متن مقالات انگلیسی
امکان دانلود نسخه ترجمه شده مقالات
پذیرش سفارش ترجمه تخصصی
امکان جستجو در آرشیو جامعی از صدها موضوع و هزاران مقاله
امکان دانلود رایگان ۲ صفحه اول هر مقاله
امکان پرداخت اینترنتی با کلیه کارت های عضو شتاب
دانلود فوری مقاله پس از پرداخت آنلاین
پشتیبانی کامل خرید با بهره مندی از سیستم هوشمند رهگیری سفارشات