

EFFECT OF VARROA DESTRUCTOR INFESTATION ON THE QUALITY OF EGYPTIAN HONEYBEE QUEENS

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ABSTRACT: *The aim of this study was to evaluate the role of Varroa destructor mite infestation on acceptance, mating success and initiation of oviposition of Egyptian virgin queen's (Apis mellifera lamarckii Cockerelle) introduced into Egyptian honeybee colonies. Experimental colonies divided into three groups according to the level of infestation. Each level of infestation contained 10 colonies. The low level of infestation was 3% ± 0.3, while in both moderate and high levels of infestation it was 8% ± 0.5 and 15% ± 0.8, respectively.*

The results showed that the varroa level influence significantly on virgin queens acceptance, mating success and somewhat on their onset of oviposition.

Virgin queen was more accepted at low level of infestation than both moderate and high level of infestation. The queen mating success was 100% at low level of infestation, while in both moderate and high level of infestation was 85.71% and 83.33%, respectively. The pre-oviposition period of queen was 7.9 ± 1.07; 10.4 ± 0.95 and 11.0 ± 1.25 days at low, moderate and high levels of infestation, respectively. From the results it was obvious that mite infestation affect on the queen acceptance, mating and pre-ovipositon period.

Key words: *Honey bee, Apis mellifera lamarckii, queen acceptance, mating, ovipositon, Varroa destructor.*

INTRODUCTION

Queen quality in turn depends on genetic, environmental factors and good management. Colonies with a one year old queen have a larger colony population and produce 27-30% more honey yield compared to colonies with two year old queens (Woyke, 1971; Genc, 1992). As queens lives on average 1-2 years (Page and Peng, 2001), periodic requeening is considered an important management practice in commercial beekeeping to develop strong colonies and to obtain a maximum production during nectar flows (Guzman-Nova et al., 1998). Requeening is also required as colonies led by young queens are more productive than those led by old queens (Kostarelou-

Demiandou *et al.*, 1995). Successive generations of self-raised queen bees may result in a reversion to undesirable characteristics such as a progressively more aggressive colony which is difficult to manipulate, reduce resistance to diseases such as Chalkbrood and European foulbrood, lower honey production, and reduce effectiveness as pollinators. Beekeepers either loose a great amount of their colonies in winter or they start with a weak colony population in the spring season. The use of old queens and the level of varroa infestation could be the main reason for the loss of colonies in winter (Genc, 1990; Kaftanoglu *et al.*, 1995). The parasitic mite *Varroa destructor* (Anderson and Trueman, 2000) is an external parasite of the honey bee (*Apis mellifera*) that feeds on the haemolymph of immature and adult bees (Harbo and Harris, 2001). It is a damaging parasite of the honeybee throughout the world (Correa-Marques *et al.*, 2000) causes decrease lifespan, damage wings, physiological abnormalities, and decrease body weight and sometimes loss of appendages of the emerging bee (De Jong *et al.*, 1982). It can cause the collapse of untreated colonies within a few years (Achou and Soltani, 1997). Colony collapse is not only due to mite infestation, but also to secondary viral, bacterial and fungal infections (Hung *et al.*, 1996). This parasite has spread rapidly and now infests most of the world's *Apis mellifera* causing much concern to beekeepers (Rinderer *et al.*, 2001 and Sanford, 2001).

Many factors had been considered to influence the acceptance of virgin queens introduction in the honey bee colonies such as the weight of the virgin queens at emergence (Szabo, 1977), queen age at introduction (Abdel-Rahman *et al.*, 2008), availability of nectar and pollen, general foraging conditions, worker bee behavior toward the new queen, the age of workers in mating nuclei (Gregorc *et al.*, 1992), season of queen introduction and general hive conditions (Rhodes *et al.*, 2004; Mangum, 1997), and caging period of the virgin queens before being released (Mantilla and Gonçalves, 1987).

Little has been reported on the effect of varroa mite infestation on Egyptian virgin queen acceptance, mating success and initiation of oviposition in Egyptian honey bee colonies. So the aim of the present work was to determine the influence of different population levels of varroa mites on Egyptian queen introduction, mating success and onset of oviposition.

MATERIALS AND METHODS

This work was carried out at Assiut Valley Natural Protectorate location, Assiut Governorate, Upper Egypt, during February and March, 2010. Queens were reared by dry grafting method according to Doolittle, 1889, using about 1 day old worker larvae from the same Egyptian queen breeder. Thirty colonies of Egyptian (*Apis mellifera lamarckii* Cockerelle) honey bees, were chosen for this work and divided into three groups. Each group

contains ten colonies of nearly equal strength and mite population. Mite population was determined from these experimental colonies by using the method of Goodwin and Eaton, (2001). About 300 bees were collected in 500 ml preserving jar and covered with a piece of wire mesh. The bees were taken from at least three brood frames from each experimental colony and add about 1 tablespoon of icing sugar on top of the bees. The sugared bees were gently rolled for 3-5 minutes. Let the jar sit for a few minutes, then the jar was turned upside down and shackd above a piece of paper. The mites and sugar will pass through the wire mesh, but the bees will remain and the mites could be counted. Level of mite infestation was calculated by the following formula (Alloui *et al.*, 2002) in the experimental colonies and divided to three levels (Table 1) .

$$Tx = \frac{Nv \times 100}{Na}$$

Where, Tx: infestation rate; Nv: number of varroa; Na: Number of honeybees.

Table (1): Level of varroa mite estimation in the experimental colony before introducing the virgin queen

Low level of infestation (Mean % ± S.D.)	Moderate level of infestation (Mean % ± S.D.)	High level of infestation (Mean % ± S.D.)
3 ± 0.3 ^c	8 ± 0.5 ^b	15 ± 0.8 ^a
N = 10		

^{a, b, c} Means at the same row differ significantly at p<0.05.

The low infested level was (3% ± 0.3), while the second level with moderate infestation was (8% ± 0.5) and third level with high infestation was (15% ± 0.8). The reared virgin Egyptian queens were weighed after emergence and marked with paint (Medina and Gonçalves, 2000). The weight of the reread virgin queens at emergence was ranged between 125-135 mg.

The experimental colonies were dequeened before introducing the virgin queen. The caged virgin queens (3 days age) were introduced into these dequeened colonies. The caged virgin queen was released after two days of introduction. The colonies were examined after 24-hours, in order to check the acceptance or rejection to virgin queen by worker bees. The colonies were checked in the morning (08:30 -10:30 am) when virgin queens were not performing orientation or mating flights and their observation were possible (Medina and Gonçalves, 2000). Queens that were not injured by workers after liberation and found alive were considered accepted. Queens found dead

inside the cage, injured after liberation or not found were considered as rejected (Rhodes *et al.*, 2004). After queen releasing the combs in the colonies were checked daily for 25days till queen laid eggs and the percentages of queen mating success and onset of oviposition were recorded (El-Sarrag and Nagi, 1989).

Percentages of queen acceptance and queen mating success were transformed using arcsin method, then, analysis of variance (ANOVA) was carried out using MSTAT-C software program (MSTAT-C, Michigan State University Version 2.10) and least significant difference (LSD) values were calculated when F-value were significant for infestation effects according to the method of Waller and Duncan (Waller and Duncan, 1969).

RESULTS AND DISCUSSION

Data in Table (2) represents the influence of varroa mite infestation on Egyptian virgin queen introduction and acceptance in Egyptian honeybee colonies. The number of virgin queens introduced and accepted at the three levels of infestation were significantly difference at $p < 0.05$. The highest percentage of acceptance was 90% recorded at low infested colonies, while, the lowest acceptance was 60% found at high infested group.

Table (2): Number and percentage of the virgin queen acceptance at three levels of infestation

Queen	Low level of infestation	Moderate level of infestation	High level of infestation
Introduced	10	10	10
Accepted	9	7	6
Acceptance (%)	90 ^a	70 ^b	60 ^c

^{a, b, c} Means at the same row differ significantly at $p < 0.05$.

The results agreed with Rateb *et al* (2010) whom mentioned that the number of Carniolan virgin queens introduced and accepted between the three level of infestation (low infestations $5\% \pm 0.3$, moderate infestations $12\% \pm 0.7$ and high infestations $20\% \pm 0.9$) were significantly different and the highest percentage (100%) was recorded at low infested group, while the lowest acceptance (66.67%) was found at high infested group.

The results in Table (3) represented that the high queen mating success percentages was 100% at low infested group and the least was found at the high infested group (83.33%). Results differed significantly between the first group and both of the second group and the third group at ($p < 0.05$).

Table (3): Number and percentage of mating success of the virgin queen at the three levels of varroa mite infestation

Queen	Low level of infestation	Moderate level of infestation	High level of infestation
Accepted	9	7	6
Mated	9	6	5
Mating success(%)	100 ^a	85.71 ^b	83.33 ^b

Means headed by the same letter at the same row don t differ significantly at $p < 0.05$

This result was resembled that was found by Rateb *et al.*, (2010). They mentioned that the mating success in Carniolan queen bees was (100%) at low varroa infested group while at both of the moderate infested group and the high infested group it was 91.67% and 80%, respectively.

From the results in Table (4) it was noticed that there was a significant difference between low infested level and both of high and moderate level of infestation. The low infestation level showed the shortest pre-oviposition period (7.9 ± 1.07 days) with a range of 6-10 days. The pre-oviposition period (10.4 ± 0.95 days) was recorded at moderate infestation group with a minimum of 7 days and a maximum of 12 days. The longest onset of oviposition was 11.0 ± 1.25 days noticed at high level of infested colonies with a range of 8-13 days.

Table (4): Pre-oviposition period (days) of the queens at the three levels of varroa mite infestation.

Preoviposition period in days	Low level of infestation	Moderate level of infestation	High level of infestation
Number of mated queens	9	6	5
Mean periods \pm S.D.	7.9 ± 1.07^b	10.4 ± 0.95^a	11.0 ± 1.25^a
Range of period	6 - 10	7 - 12	8 - 13

Means headed by the same letter at the same row don t differ significantly at $p < 0.05$.

The results agreed with that found by Rateb *et al.*, (2010). They mentioned that the rate of mite infestation had influenced on the time of oviposition of Carniolan queen bees. The shortest pre-oviposition period was 8.9 ± 1.05 days at the low infested level, while in the moderate infested group it was 11.1 ± 0.85 days and the longest oviposition period was 11.6 ± 1.45 days noticed at the high infested group. Cargel and Rinderer (2009) mentioned that Italian colonies are known to be susceptible to mites, and queen introduction has been reported to be more difficult in Italian colonies.

Overall, the results presented here provide strong evidence that elevated levels of varroa in colonies decrease queen acceptance and mating success. Also, may be pre-oviposition period somewhat affecting as a result of mite infestation. For practical purpose to obtain a high acceptance and matting

success, it might be productive for beekeepers to treat colonies they intend to re-queen or divide prior to queen introduction.

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تأثير الإصابة بالفاروا *Varroa destructor* على كفاءة الملكات المصرية لنحل العسل

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الملخص العربى

أجريت هذه الدراسة بغرض تقييم دور مستوى الإصابة بطفيل الفاروا على قبول الملكات العذارى ونجاح عملية التلقيح وكذلك على الفترة اللازمة لتبدا الملكة في وضع البيض وذلك عندما أدخلت في طوائف نحل العسل المصري. تم تقسيم طوائف التجربة تبعاً لمستوى الإصابة بالفاروا إلى ثلاث مجموعات تحتوي كل منها على ١٠ طوائف وهي: مجموعة منخفضة الإصابة (٣ ± ٠,٣) مجموعة متوسطة الإصابة (٨ ± ٠,٥) والثالثة مرتفعة الإصابة (١٥ ± ٠,٨). أظهرت النتائج أن مستوى الإصابة بالفاروا يؤثر وبصورة مغنوية على قبول الملكات العذارى وعلى نجاح عملية التلقيح وتؤثر إلى حد ما على بداية وضع البيض. أشارت النتائج إلى أن الإصابة المنخفضة أظهرت وبوضوح أعلى نسبة من قبول الملكات ونجاح التلقيح بنسبة ١٠٠٪ وذلك عن كل من الإصابة المتوسطة والإصابة المرتفعة حيث كانت نسبة نجاح التلقيح بهما (٨٥,٧١٪، ٨٣,٣٣٪) على الترتيب. سجلت فترات ما قبل وضع البيض (١,٠٧ ± ٧,٩ ، ١,٢٥، ١٠,٤ ± ١١ يوماً) وذلك في كل من مستويات الإصابة المنخفضة والمتوسطة والمرتفعة على الترتيب. وإنه يمكن للنحالين الحصول على فائدة اقتصادية من الملكات المخلطة وزيادة قبول الإدخال وكذا نجاح التلقيح وذلك بمكافحة طفيل الفاروا قبل إدخال الملكات.