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APPROXIMATED DAMAGE THRESHOLD LEVEL FOR VARROA MITE *Varroa destructor* INHABITING HONEY BEE COLONIES

[56]

El-Bassiouny[1], A.M.; A.A. Gomaa[1]; Late M.A. El-Banby[1] and M.A.M. Ali[1]

ABSTRACT

The present work was carried out on honeybee *Apis mellifera* L. colonies wintered in the North center region of USA at the apiaries attached to the University of Nebraska. The selected colonies were left for natural infestation with varroa mite *Varroa destructor (jacobsoni)* Oudemans. Colonies were grouped according to the infestation levels into four different categories. The first group contains colonies with reliable infestation, while the second group harbour colonies with0.001-0.100 mite/bee. The third group however contains colonies with 0.11 -0.20 mite/bee. The last group contains colonies with 0.21 -0.30 mite/bee. Monitoring the spring brood individuals in colonies wintered with the selected four population densities expressed as varroa infestations during the winter of 1999 were carefully examined. The obtained data revealed the presence of insignificant F value for the differences between the parameters expressed as brood area, number of frames of brood, and number of frames covered with bees in colonies ranged between 0.0 to 0.12 mites / bee. Colonies with densith above 0.26 mites / bee demonstrates a significant reduction figures for the three parameters of performance. This study suggests that varroa infestation levels up to 0.12 mites / bee (12% infestation) will keep wintering colony and for award for performance the following spring.

Key words: Honey bee, *Apis mellifera,* Varroa mite, *Varroa jacobsoni,* Damage threshold

INTRODUCTION

Varroa mite *Varroa jacobsoni* is considered an serious ectoparasite of honey bee in many parts of the world. During the last decade, this parasite spreaded intensely thus causing reliable economic damage to beekeeping. Mite emigration (**Dinar and Effart, 1990**), the amount of brood and the length of the brood rearing season (**Fries *et al* 1994**) and climatic differences (**De Jong *et al* 1984 and**

1- Plant Protec. Dep., Fac. of Agric., Ain Shams Univ., Shoubra El-Kheima, Cairo, Egypt

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Hood and Delaplane, 2001) can affect the rate of Varroa population growth. Average numbers of mites in temperate colonies increase 10 folds per year, and sometimes as much as 100 folds (**Korpela** ***et al*** **1992 and Fries, 1993**). Infestation levels ranging between 0.03 to 0.07 mites per bee in early spring had a significant economic impact on honey production (**Gatien and Currie, 1995**) therefore, affecting honey production as well as crop pollination (**De Jong** ***et al*** **1982**).

The present study was undertaken to estimate the approximate damage threshold level of varroa ectoparasitic mite.

MATERIAL AND METHODS

On February 3, 1999, mite infestation levels expressed as number of mites / bee were estimated in selected 65 colonies attached to the University of Nebraska's Agricultural Experimental station near Mead (Saunders County) Nebraska. U.S.A. Recommended method described by **Shimanuki and Knox (2000)** was considered and accordingly colonies were grouped into four different categories of infestation levels as follows:

Group I: contains colonies with no detectable mites.

Group II: contains colonies with scarcely number of mites i.e. 0.001- 0.1 mites / bee.

Group III: contains colonies with mild number of mites i.e. 0.11- 0.20 mites / bee.

Group IV: contains colonies with 0.21- 0.30 mites / bee.

The following parameters were assessed during the present study:

Colony vigour assessment

Three measurement figures of colony strength were recommended during this study. These measurement figures were (a) square centimetres of brood size (determined by measuring the brood area using a roller), (b) number of frames of brood and (c) number of frames relatively covered with bees (determined by visually inspection). All three measurement figures of strength were determinated starting from April 6-8, 1999.

Mites recovered on sticky boards

On March 7, 1999; Dewill@ sticky boards (38 x 31cm) were inserted in 21 colonies, three meshes per cm hardware cloth was placed above the sticky surface. Eleven sticky boards were inserted in group II, six sticky boards were inserted in group III and four sticky boards were inserted in group IV. No sticky boards were inserted in group I which was kept free from mite infestations as control. After 48 hours, sticky boards were removed and mite individuals were counted and recorded.

RESULTS AND DISCUSSION

Colony vigour assessments

The mean number of mite per bee individuals were 0, 0.023, 0.124 and 0.257 in the four successive groups, respectively (Table, I), The statistical analysis of the data yielded significant F value thus revealing the presence of significant differences between these means when the L.S.D. value was estimated.

a - Square centimetres of brood size

No significant differences between averages of the brood size for the first three mean levels of infestation; however these three groups combined were significantly differed as a group from IV group. Square centimetres of brood averaged 5446.01, 5651.74 and 5641.72 for the first three successive levels of infestations, respectively infestation level was reduced significantly expressed as square centimetres of brood size in group IV (2303.22).

b- Average number of brood frames

No significant differences were estimated for the average number of brood frames for the first three successive groups; the average numbers of brood frames were 6.53, 7.17 and 7.55 in the first three groups, respectively. The average number of brood frames in IV group was 3.83 thus revealing significantly the presence of the lowest.

c- Number of Frames Covered with Bees

When the statistical analysis was worked out, it reveals the presence of insignificant difference figures expressed as number of frames covered with bees for the first three infestation levels. The numbers of frames covered with bees were 13.07, 12.98 and 11.00 in the first three successive levels (I, II, and III), respectively. However, the average number of frames covered with bees was 5.33 in group IV demonstrate lower number than that estimated for the first three groups.

Monitoring the population density of mites per bee and the corresponding number of Varroa mite recovered on sticky boards

The data in Table (2) reveal the relationship between the infestation levels of mites recovered on sticky boards. The total number of mites recovered on sticky boards differed among the three groups of colonies compared with detectable mites, colonies in level IV, which contains highest infestation level than colonies of the other two groups. The numbers of mites recovered on sticky boards were 8.82, 37.50 and 44.75 in levels II, III, and IV, respectively. These results may suggest that colonies with 37.50 or more mites falling on sticky boards after 48-hour period harbour comparatively the lowest population density of bees during the following spring.

The analysis of variance when worked out reveal the presence of significant differences among the three colony strength parameters measured in colonies with 0.0 to 0.12 mites per bee. Colonies with more than 0.26 mites per bee exhibited a significant reduction in all three measures of performance. These findings agree with the findings recorded by **Delaplane and Hood (1997)**, they found that acaricide treatment was justified in late season when mite populations exceed 0.12 mites / bee with. 1,825 cm2 of brood. Furthermore, results are in agreement with **Gatien and Currie's (1995)** they reported that infestation levels of 0.03 -0.07 mites per bee in the spring resulted in high winter mortality. Also, **Fries, (1993)** estimated a 10-folds increase in mite infestation level during the summer; they clearly suggest that high colony mortality will occur. **Martin, (1998)** suggested that

Table 1. Mean numbers of honey bee brood area size (cm^2), average number of frames of brood/hive and number of frames covered with adult bees / hive, at four levels of varroa mite infestation throughout activity period of February, 1999 in Nebraska, USA (Means ± s.e)

Level of mite infestation	n	No. of mites/bee	Brood area (cm^2)	No. of frames of brood	No. of frames of bees
I	15	0.00 d	5446.01 a	6.53 a	13.07 a
			±372.65	±0.50	±0.78
II	36	0.023 c	5651.74 a	7.17 a	12.98 a
		±0.004	±280.50	±0.33	±0.64
III	9	0.124 b	5641.72 a	7.55 a	11.00 a
		±0.016	±829.50	±0.82	±1.34
IV	6	0.257 a	2303.22 b	3.83 b	5.33 b
		±0.012	±454.75	±0.54	±0.56
F value		191.43**	8.86*	5.53*	8.76*

Table 2. Relationship between three infestation levels of varroa mite and the number of varroa mites recovered on sticky boards in colonies after 48 hours in February. 1999 at Nebraska (Means ± s.e.)

Level of mite infestation	No. of colonies	No. of mites/bee	No. of varroa on sticky board
II	11	0.023 ± 0.004 c	8.82 ± 2.54 a
III	6	0.124 ± 0.016 b	37.50 ± 12.11 ab
IV	4	0.257 ± 0.012 a	44.75 ± 23.23 b
F value		191.43**	4.16*

colonies would collapse in winter when mite populations exceed 2,500. Results of this study are not support the findings of **Phibbs, (1996)**, who reported that colonies with as few as 0.01 mites per bee in the fall exhibited high winter mortality.

It could be concluded that honey bee colonies can tolerate a certain levels of infestation express as level of 0.12 mites per bee during the winter without evidence of colony injury. If we assume that 75% of the mites are in brood cells when available **(Woyke, 1987)**, the results suggest that 0.3 mites per bee in mid-August should trigger beekeepers to remove surplus honey promptly and take action to reduce mite load in their colonies for both bee and the corresponding mite populations needed to be considered as damage threshold level for mite infestation when making projections to prevent recommended control measurements as far as possible.

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مجلة حوليات العلوم الزراعية ، كلية الزراعة ، جامعة عين شمس ، القاهرة ، م٤٩ ، ع(٢)، ٧٨٧ - ٧٩٢ ، ٢٠٠٤

دراسة الحد الحرج للضرر نتيجة لاصابة النحل بطفيل الفاروا

[٥٦]

عادل محمد البسيونى[١] - احمدعلى جمعة[١] - المرحوم محمد على البنبى[١] - محمود عبد السميع محمد على[١]

١- قسم وقاية النبات - كلية الزراعة - جامعة عين شمس - شبرا الخيمة - القاهرة - مصر

أجريت هذة الدراسة بمناحل جامعة نبراسكا و بعض المناحل الخاصة بالولايات المتحدة الأمريكية ١٩٩٩ بهدف تحديد الحد الحرج للضرر نتيجة لاصابة النحل بطفيل الفاروا حيث تم تقدير ما يأتى بكل طائفة من الطوائف التجريبية. مساحة الحضنة، عدد اقراص الحضنة، عدد الأقراص المغطاة بالنحل البالغ،وذلك فى الطوائف التى قضت فصل الشتاء حيث تم تقسيم الطوائف المصابة طبيعيا بالطفيل الى اربعة مجاميع كل مجموعة تمثل مستوى اصابة معين وهذة المستويات هى صفر، ٢,٣% ، ١٢,٤% ، ٢٥,٧%. وقد اظهرت النتائج المتحصل عليها انة عند مستوى لصابة يتراوح ما بين صفر و ١٢,٤% لا توجد فروق معنوية فى مساحة الحضنة وعدد اقراص الحضنة وعدد الأقراص المغطاة بالنحل البالغ فى الطوائف التجريبية ، بينما حدث انخفاض معنوى فى القيم المتحصل عليها للمقاييس البيولوجية السابق الاشارة اليها عند مستوى لصابة ٢٥,٧% او اعلى. وقد توصلت الدراسة الحالية الى ان نسبة لصابة ١٢% بطفيل الفاروا بالطائفة يعتبر هو الحد الحرج للضرر حيث ان وجود اقل من ٠,١٢ فرد من الطفيل علي النحلة الواحدة لا يؤثر على مساحة الحضنة ولا على عدد اقراص الحضنة وكذلك على عدد الأقراص المغطاة بالنحل البالغ بالطوائف التجريبية خلال فصل الشتاء و فى الربيع التالى. بينما عند ارتفاع نسبة الاصابة عن هذا الحد فانه يلزم البدء فى اجراء عمليات المكافحة . وجدير بالذكر ان هذا الحد الحرج قد تم تقديره تحت ظروف الولايات المتحدة الأمريكية و انه يلزم اعادة تقديره تحت ظروف جمهورية مصر العربية.

تحكيم: أ.د جميل برهان الدين السعدنى
أ.د محمــد عطيــة عــويس