

The Effects of *Varroa* (*Varroa destructor*) Infestation Level on Wintering Ability and Survival Rates of Honeybee (*Apis mellifera* L.) Colonies

Ethem AKYOL *  Halil YENİNAR **

* Nigde University, Ulukışla Vocational College, TR-51900 Nigde - TÜRKİYE

** Kahramanmaraş Sütçüimam University, Agriculture Faculty, TR-46100 Kahramanmaraş - TÜRKİYE

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Summary

This study was carried out to determine the effects of the *Varroa* (*Varroa destructor*) infestation level (in fall) on the wintering ability and survival rates of honeybee (*A. mellifera*) colonies. Four different infestation levels of *Varroa* in honeybee colonies were tested in this study. Ten honeybee colonies, in which infestation levels were similar, were used for each group. The average wintering abilities in low, medium, high and extreme groups were found to be 94.28%, 91.42%, 63.92% and 23.28% respectively. An average survival rate for the low, medium, high and extreme groups were found to be 100%, 100%, 80% and 40% respectively. Differences among the groups for wintering ability ($P<0.01$) were significant.

Keywords: Honeybee, *Varroa* infestation, Wintering ability, Survival rates

Bal arısı (*Apis mellifera* L.) Kolonilerinde *Varroa* Bulaşıklık Seviyesinin Kolonilerin Kışlama Yetenekleri ve Yaşama Oranları Üzerine Etkisi

Özet

Bu çalışma bal arısı (*A. mellifera* L.) kolonilerinde *Varroa* (*Varroa destructor*) bulaşıklık seviyesinin kolonilerin kışlama yeteneklerine ve yaşama oranlarına etkilerini belirlemek amacıyla yürütülmüştür. Denemede dört farklı *Varroa* bulaşıklık seviyesine sahip koloniler kullanıldı. Her grupta *Varroa* bulaşıklık seviyesi birbirine yakın 10 koloni ve dört grupta toplam 40 koloni kullanılmıştır. Düşük, Orta, Yüksek ve çok yüksek bulaşıklık seviyesine sahip gruplarda ortalama kışlama kabiliyeti sırayla %94.28, %91.42, %63.92 ve %23.28; aynı gruplarda ortalama yaşama oranı ise sırayla %100, %100, %80 ve %40 olarak belirlenmiştir. Kışlama kabiliyeti üzerine gruplar arasındaki farklılıklar istatistiki olarak önemli bulunmuştur ($P<0.01$).

Anahtar sözcükler: Bal arısı, *Varroa* bulaşıklığı, Kışlama kabiliyeti, Yaşama oranı

INTRODUCTION

The productivity of colonies in Turkey is below the world standard ¹. Poor struggle against parasites and diseases of honeybees and bad management conditions could be the main reasons of this fact ². *Varroa* damage is one of the most important factors that increases the wintering losses ³. When the *Varroa* infestation increases, resistance of the colonies decreases against the bad conditions ². High levels of *Varroa* infestation may reduce the pupae and adult weight of the honeybees more than

10% and one *Varroa* fed with hemolymph of the honeybees could cause 0.1-0.2% loss of body weight every two hours ⁴. It was found that the average adult weight of infested bees on emergence was 6.3-25% less than average weight of healthy bees ⁵. It was reported that while un-infested bees during pupae lived an average 27.6 days, infested bees with 2 or more mites lived an average only 9 days ⁵. Because of high *Varroa* infestation and *Varroa* damages, beekeepers lose a lot of colonies



İletişim (Correspondence)



+90 533 3599260



eakyol@nigde.edu.tr

in the winter and most of their colonies begin the spring season with weak colony population sizes ^{6,7}. The rate of *Varroa* infestation is one of the most important factors that influence colony population, performance, and wintering losses of the colonies ⁸.

This study was carried out in the fall season to determine the effects of the *Varroa* infestation level on the wintering ability and survival rate of the honeybee colonies under middle Anatolia conditions.

MATERIAL and METHODS

This study was carried out on 40 honeybee (*A. mellifera*) colonies which were set in standard Langstroth hives at the Taskent district of Konya province between 12 October 2008 and 24 May 2009. Prior to our research, all colonies in the survey were equalized with regard to colony strength, sealed brood area, and food stock. All of the survey colonies came from same genetic origins and had the same age queens. The Queens had been reared by the grafting method described by Laidlaw ⁹ and naturally mated in the same location.

After determining the *Varroa* (*Varroa destructor*) infestation level on the adult worker bees of all colonies, four experimental groups were formed. Average *Varroa* infestation level of the Low, Medium, High and Extreme groups would be 0.67±0.11% (lower than 1%), 2.20±0.23% (between 1% and 3%), 4.30±0.28% (between 3% and 5%) and 14.85±1.31% (higher than 5%) respectively. Each group had 10 colonies which meant there was a total of 40 colonies used for the experiment. The wash and roll technique that is described by De Jong et al.⁵ was used to determine the *Varroa* infestation level (%) on adult bees at both the begin and the end of the experiment.

The average wintering ability (WA) was calculated as: WA(%) = [(The number of combs covered with bees after winter)/(The number of combs covered with bees before winter) x (100)]. The survival rates (SR) were calculated as: SR = [(The number of colonies after the experiment)/(The number of colonies before the experiment) x (100)].

These formulas are described by Dogaroğlu et al.¹⁰. The wintering abilities of the groups were statistically analyzed with randomized plot design ¹¹. Group comparisons among the means were done with Duncan's multiple range test. Analysis of survival rates between the groups were performed by Chi Square (χ^2) non-parametric tests ¹². All colonies were wintered outdoors under similar conditions and the same management applications were applied to all colonies throughout the experiment.

RESULTS

Average *Varroa* infestation levels, wintering abilities and survival rates of the Low, Medium, High, and Extreme groups are summarized in *Table 1*. The highest wintering ability and survival rate were found to be in the low infestation group and the lowest survival rate and wintering ability were found to be in the extreme infestation group.

Wintering abilities and survival rates of the colonies were significantly affected (df = 3, M.S. = 5295.65, F = 7.19, P<0.01; Duncan, N = 10, α = 0.01) by the *Varroa* infestation level (*Table 1*).

DISCUSSION

The level of *Varroa* infestation significantly (P<0.01) affected the wintering abilities and the survival rates of the colonies during the winter season (*Table 1*). Akyol and Kaftanoğlu ¹³ had reported that the average wintering abilities of honeybee colonies were 86.2%. Dodoloğlu and Genç ¹⁴ reported 68.89% wintering abilities in the cold climate regions of Turkey. The average wintering abilities of the Low and Medium groups were found to be consistent with Akyol and Kaftanoğlu ¹³ result, but were found to be higher than Dodoloğlu and Genç ¹⁴ result. The average wintering abilities of the Extreme group were found to be lower than Akyol and Kaftanoğlu ¹³. Doğaroğlu et al.¹⁰ and Akyol et al.¹⁵ had calculated that the average survival rate of the honeybee colonies would be 64.29% and 90% respectively. The average survival rate

Table 1. Infestation levels of *Varroa*, wintering abilities and survival rates of the experimental group colonies (%)

Tablo 1. Araştırma kolonilerinin *Varroa* bulaşıklık seviyeleri, kışlama kabiliyetleri ve yaşama oranları (%)

Infestation Levels of Groups	Average <i>Varroa</i> Infestation Level				Wintering Ability (%)	Survival Rates
	Before Experiment		After Experiment			
	X±Sx	n	X±Sx	n	X±Sx	(%)
Low	0.67±0.11	10	4.87±0.57	10	94.28±6.94 a*	100
Medium	2.20±0.23	10	5.86±0.39	10	91.66±3.49 a	100
High	4.30±0.28	10	10.28±0.85	8	63.92±17.20 ab	80
Extreme	14.85±1.31	10	12.88±0.56	4	24.28±15.25 b	40
Average	5.50±1.31	40	7.5361±0.80	32	68.54±8.53	80

* Different letters indicate significant differences among the means (P<0.01)

of the Low, Medium and High groups were calculated higher than Doğaroğlu et al.¹⁰. The average survival rate of the Extreme group was found to be lower than Doğaroğlu et al.¹⁰ and Akyol et al.¹⁵. Colonies infested with less or no mites showed better wintering ability and survival rates than colonies infested with high rates of mites. The best wintering ability and survival rate were obtained from Low and Medium groups which had lower than 3% *Varroa* infestation before the experiment. The calculations showed that there was a strong relationship between the wintering ability, survival rates and the level of *Varroa* infestation ($r = -71$, $r = -69$). These results support the previous data that the level of the *Varroa* infestation is one of the most important factors affecting the wintering ability and survival rates of the colonies⁸.

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