Honey Bee Colony Losses in Isparta and Burdur Provınces of Turkey During The Winter of 2011-2012

Türkiyenin Isparta ve Burdur İllerinde 2011-2012 Kışı Boyunca Bal Arılarında Görülen Koloni Kayıpları

Research Article

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ABSTRACT

The winter losses of honey bees have been recorded in many parts of the world since 2006. Scientists have been studied to find out the causes of honey bee colony losses and try to prevent the losses. Using questionnaire that was developed in COLOSS network studies, information on honey bee losses has been adopted in Burdur and Isparta, Turkey. The aim of this work was to investigate the extent of this problem and to point out possible causes. In this study, we analysed 88 questionnaires completed by beekeepers. According to the data obtained during the survey, 35.6 % and 27.1 % colony mortality were recorded in Burdur and Isparta respectively. Although there were no difference between two provinces in terms of colony-loss, statistical comparisons between districts of each provinces were determined to be significant due to the differences of geographical structure. Within the groups, the higgest percentage of beekeepers was the colonies between 1 to 50 (49.9% and 44.5%). There is no relationship between hive substitution and altitude with colony-loss rate for each provinces, respectively. In conclusion, winter losses are thought to increase with interactions of factors such as pathogens, genetic factors and environmental factors that affect honey bees.

Key Words
Honey bee, Colony losses, Turkey, Apis mellifera, COLOSS

ÖZET

2006 yılından beri dünyanın birçok yerinde kış sonu bal arısı kayıpları gözlenmektedir. Bilim adamları bal arısı koloni kayıplarının nedenlerini bulmak ve bu kayıpları önlemek için çalışmalar yapmaktadır. COLOSS ağı çalışmalarında geliştirilen anket formu kullanılarak, Burdur ve Isparta'da görülen bal arısı koloni kayıpları hakkında detaylı bir şekilde bilgiler toplanmıştır. Bu çalışmanın amacı, bu sorunun ne boyutlarda olduğunu araştırmak ve olası nedenleri tespit etmektir. Bu çalışmada, arıcılara uygulanan 88 anket analiz edilmiştir. Araştırma sırasında elde edilen verilere göre, Burdur ve Isparta'da görülen koloni mortalitesi sırasıyla %35.6 ve %27.1 olarak belirlenmiştir. Koloni kaybı açısından iki il arasında fark olmamasına rağmen, her ilin kendi ilçeleri arasındaki istatistiksel karşılaştırmalar, coğrafik yapıdaki farklılıklar nedeniyle anlamlı olarak belirlenmiştir. Grupların içinde en yüksek kayıp yüzdesi, 1-50 koloni arasında arılığa sahip arıcılarda (%49.9 ve %44.5) olmuştur. Her bir il için koloni kayıp oranları ile sırasıyla kovan yer değiştirme sayısı ve rakım arasında herhangi bir ilişki bulunamamıştır. Sonuç olarak, kış sonu kayıplarının, bal arılarını etkileyen patojenler, genetik faktörler ve çevresel faktörler gibi faktörlerin birbirleriyle etkileşimi ile geliştiği düşünülmektedir.

Anahtar Kelimeler
Bal arısı, Koloni kayıpları, Türkiye, Apis mellifera, COLOSS

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INTRODUCTION

In recent years, unexplained losses of honey bee colonies were observed many parts of the World especially in USA and Europe [1, 2, 3, 4, 5, 6]. In the beginning, many scientists have tried to explain these losses, but they didn't find any reason for these colony losses. In this context, International COLOSS network was established to investigate the causes of colony losses and to protect the health of honey bee colonies [4]. With the establishment of COLOSS, a number of studies were carried out in order to find the causes of colony losses and as a result a common idea about some of these issues has been reached. However, the cause or causes of this condition is still being considered.

In the previous years, many lost colonies have been reported as having disappeared with no, or only a few remaining living bees, a phenomenon referred to in the current study in "Colony Depopulation Syndrome" (CDS) [5]. In USA, a proportion of dead and dying colonies were characterized by a more extensive set of symptoms. This syndrome was termed as "Colony Collapse Disorder" (CCD) [6]. However, it is very difficult to select any of the syndromes, because the symptoms of these syndromes are generally similar to each other [7].
Beekeeping has become a major source of income in Turkey because of the wide range of plant flora and almost a whole year flowering time. Honey bee colony losses have been observed in Turkey as well in recent years. These colony losses not only have serious damage to the beekeeping industry, but also may lead to the food shortage in the coming years [8].

The epidemiological Working Group 1 (WG1) of the COLOSS network aims to determine how the colony losses happened and to find the effects of beekeeping practices on these losses. For this reason, a standartized questionnaire was developed by this group members [5]. This questionnaire was prepared in order to compare colony losses in each year both within the country and between countries. The member countries of COLOSS network have implemented this survey every year. The status of colonies and apiaries are determined with questions in the survey.

The aim of this work was to determine the rates of the colony losses by using the standartized questionnaire and to point out possible causes of these losses.

MATERIALS & METHODS

The questionnaire study

In this study, questions in the questionnaire were asked to the beekeepers in Isparta and Burdur provinces of Turkey. The selection of apiaries was performed randomly and the number of apiaries were determined in adequate levels for both provinces. 2011/2012 winter colony loss rates and the number of colonies belonging to beekeepers were determined with the questions in this survey. According to this, all the questions in the questionnaire were answered in dialogue with beekeepers. In addition, the location and environmental factors were recorded for each apiary during the survey.

We obtained a lot of information from this questionnaire such as; 1. Name of beekeeper and adress information, 2. The number of colonies before and after winter 2011/2012, 3. The number of lost colonies during the winter, 4. Bee race, 5. Honey yield in 2011, 6. The number of colony location that changed in 2011/2012 winter, 7. Which drugs were used for bee diseases.

Statistical analyses:

This survey was carried out before the division of colonies. Therefore, the average colony losses and the number of lost colonies during winter were calculated. SPSS 14 software was used for statistical evaluation of data. Pearson's chi-square and independent t-test were used to compare honey bee mortality rates in 2011/2012 winter. Pearson's correlation test was performed to compare whether there were any correlation between possible causes and colony losses. These tests were chosen on the basis of available data and were carried out in 95% confidence intervals.

To compare possible differences in colony losses between different sizes of operation, operations were classified into two groups, namely hobbyist

Table 1. 2011/2012 Winter Colony-Loss comparison of Burdur and Isparta provinces.

Province	Number of apiaries	Number of colonies at apiaries in 2011 autumn	Number of dead colonies in 2011 spring	Colony loss rate (%)
Burdur	38	2543	905	35.6
Isparta	50	3937	1065	27.1

Table 2. Statistical comparison of Burdur and Isparta provinces in terms of colony losses (İndependent t-test, p > 0.05.

Province	Number of apiaries	t	Ss	P*
Burdur	38	1.621	86	0.109
Isparta	50			

*The difference not significant

beekeepers (1-50 colonies) and professional beekeepers (51-500), respectively.

RESULTS

Questionnairies were held to 88 beekeepers in the provinces of Burdur and Isparta. However, this study was adequate due to the seletion of the sample which contains all places of beekeeping in these provinces.

Statistical analyses were performed with data collected from 4430 colonies in 88 apiaries. The data was analyzed individually and the rates of colony losses were determined on the basis of province (Table 1). Independent t-test was applied and comparison of colony losses of these provinces were performed at the level of p >0.05 (Table 2).

In this study, a survey was conducted in the districts of Isparta and Burdur provinces, the colony loss rates were also determined separately in districts of these provinces and focused on the reasons for the deviation in districts that deviate from the average (Table 3). Colony losses in the districts that have different levels, gives more details about the distribution (Figure 1 and Figure 2). A comparison of both districts of provinces was carried out using Pearson's Chi square test (Table 4).

A comparison between average colony losses and colony size classes of apiaries (1-50 and 51-500 colonies) was performed in 95% confidence interval for the two provinces (Table 5). Adequate data has been collected for each two-class in comparison.

Beekeeping is actively maintained in Turkey. Migratory beekeeping is carried out in a large scale, especially in the provinces of Burdur and Isparta. Beekeepers usually take the hives more than one places throughout the winter. According to the data obtained from the questionnaire study, relationship between the number of hives migration and colony

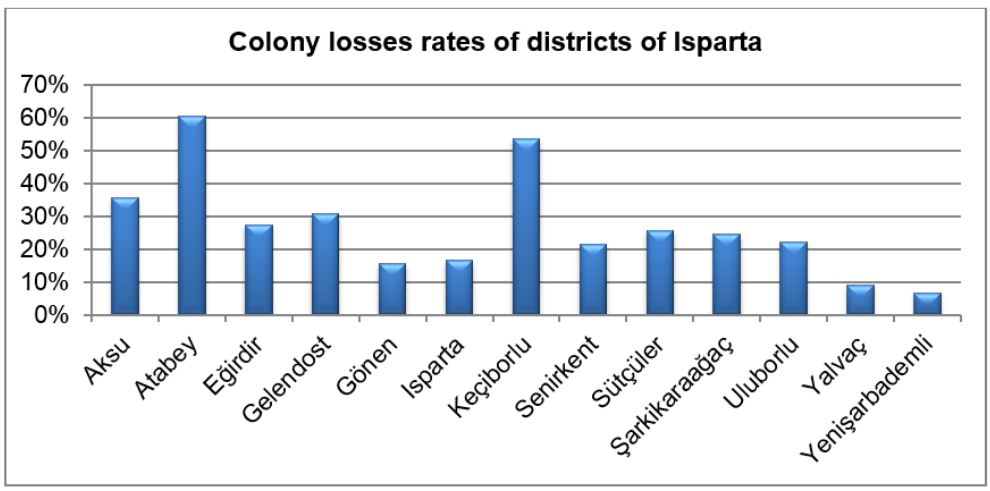

Figure 1. The colony-loss percentages of each district in Isparta.

Table 3. Colony loss comparison between districts of Burdur (Pearson Chi-square, p < 0,05).

Burdur	N	Pearson Chi-square	Ss	P*
Districts	2643	45.538	7	0.000

*The difference significant

Table 4. Colony loss comparison between districts of Isparta (Pearson Chi-square, p < 0,05).

Isparta	N	Pearson Chi-square	ss	P
Districts	3937	334.254	12	0.000

*The difference significant

Table 5. Number of apiaries (by size) with a winter 2011/2012 mean colony-loss.

Province	1-50 Colonies			51-500 Colonies		
	Number of apiaries	Number of colonies before 2011/2012 winter	Mean colony-loss (%)	Number of apiaries	Number of colonies before 2011/2012 winter	Mean colony-loss (%)
Burdur	16	420	49.9	22	2123	35.0
Isparta	18	601	44.5	32	3336	25.5

loss rate was determined using Pearson's correlation test (Table 6). With this data, the relationship can be detected more clearly by using Scatter Plot (Figure 3).

During this study, altitude values of apiaries were obtained with these surveys. In order to determine the altitude where the bees affects the quality of their life situation, colony losses based on the rise of altitude value was determined using the Pearson correlation (Table 7). The data supported by Scatter Plot for each province (Figure 3).

We found that bee genetics or race of the bee was important even when the geographic region influences were statistically controlled. Highest colony losses occurred in hybrid race that was created using A.m. caucasica in 2011-2012 winter (Table 8). Local races and A.m. anatoliaca showed the lowest levels of colony losses.

DISCUSSION

The data collected by questionnaire indicates that

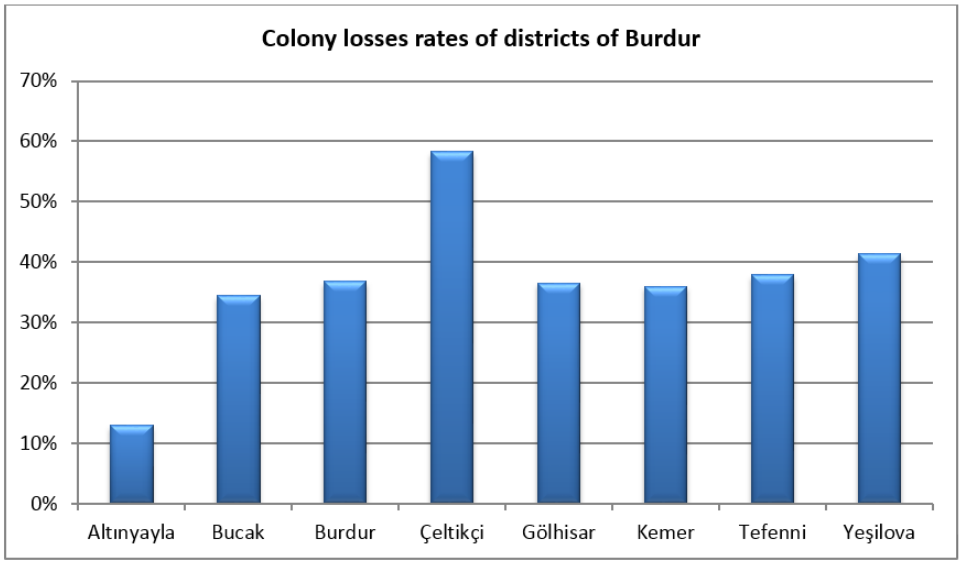

Figure 2. The colony-loss percentages of each district in Burdur.

Table 6. The relationship between the number of hives migration and colony loss rate (Pearson correlation test).

Province	Pearson Correlation	
Isparta	The correlation coefficient	0.167*
	P	0.247
	N	50
Burdur	The correlation coefficient	0.110*
	P	0.510
	N	38

*There is no relationship between colony-loss and hive migration for each provinces

Table 7. The relationship between altitude and colony loss rate (Pearson correlation test).

Province	Pearson Correlation	
Isparta	The correlation coefficient	-0.178*
	P	0.216
	N	50
Burdur	The correlation coefficient	-0.041*
	P	0.808
	N	38

*There is no relationship between colony-loss and altitude for each provinces

Table 8. The winter bee deaths comparison in terms of bee races in Burdur and Isparta provinces according to survey data.

Province	Honey bee race	Number of colonies at apiaries in 2011 autumn	Number of dead colonies in 2011 spring	Colony loss rate (%)
Burdur	***Apis mellifera anatoliaca***	346	113	32.7
	Local race	258	53	20.5
	Hybrid race (caucasica)	1939	739	38.1
Isparta	***Apis mellifera anatoliaca***	182	48	26.4
	Local race	505	78	15.4
	Hybrid race (caucasica)	3250	939	28.9

colony loss rates during the 2011/2012 winter season of each provinces are higher than the expected value (Table 1). Although heavy bee losses were seen in Turkey since 2006, it declined to 11,2% in 2011 [9]. However, the heavy bee deaths in Isparta and Burdur provinces between 2011/2012, may suggest that there has been an increase in overall Turkey. Statistical studies that were used to compare the bee deaths between Isparta and Burdur provinces, showed there were no differences between the two provinces (Table 2). Even the colony loss rate of Burdur was higher than Isparta, there was not a statistically significant difference between the two provinces ($p>0.05$). Statistical studies between the districts of Burdur and Isparta provinces in terms of bee deaths were determined among themselves ($p<0.05$). Statistical comparisons were determined to be significant between districts of each provinces (Table 3 and 4). This situation shows that different districts of each province have different bee mortality rates. Especially in some of the districts of the same province, different mortality rates between the districts are normal due to the sharp differences of the geographical structures.

When the correlation between overwintering mortality rates and the number of bee colonies were examined, the people who were beekeeping as a hobby indicates to be irrational and inadequate than to the professional beekeepers (Table 5). This finding suggests that apiary management plays an important role at beekeeping. According to van der Zee et al. [5], the results of surveys conducted in many countries indicates that most of the bee

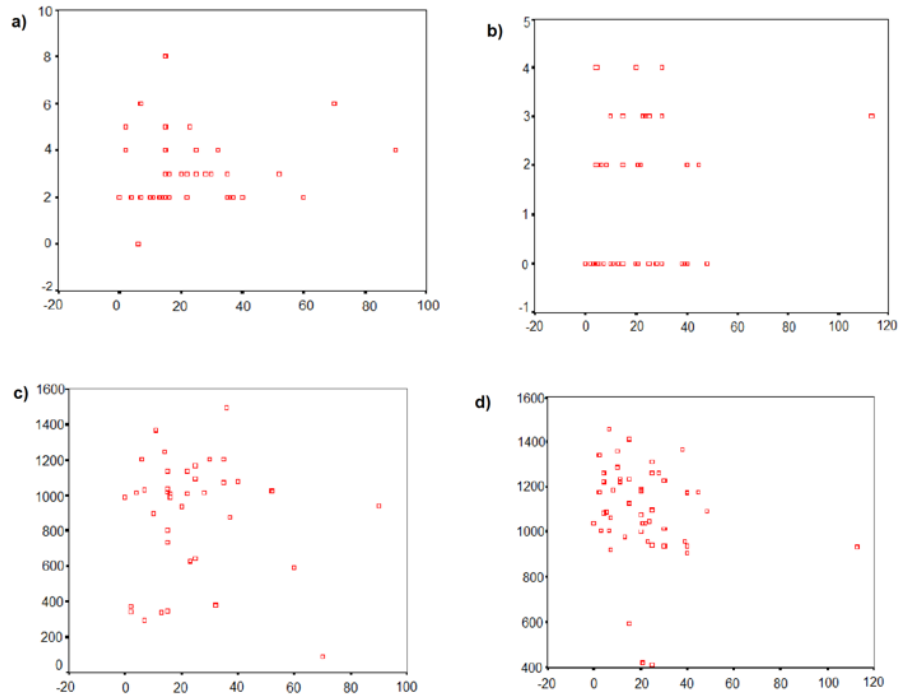

Figure 3. The scatter plot of correlation between hive migration and altitude with colony-loss; hive migration and colony-loss correlation in Burdur (a) and Isparta (b), the altitude and colony-loss correlation in Burdur (c) and Isparta (d).

mortalities were seen in the apiaries which have the colonies between 1-50. This situation shows that hobbiest beekeepers have more colony losses in general.

The statistical studies were made in order to understand whether there was any correlation between honey bee colony losses and the number of migration in both provinces. The correlation coiffecient (r) values were found 0,110 and 0,167 in Burdur and Isparta respectively (Table 6). These values shows that there is no relationship between colony-loss and hive migration for each provinces. There are many factors that affect the bee losses, and the formation of stress due to migratory beekeeping is regarded as one of these factors.

During the field work, altitude value of apiaries and colony-loss rate compared to the correlation analysis (Table 7), r values were found -0,178 and -0,041 in Burdur and Isparta respectively and the non-linear scatter plot shows that there is no relationship between bee mortality rate and the altitude value. Therefore, it seems unlikely to happen as altitude-related bee deaths.

Bee races that are used outside their normal habitat may lead to death because they do not provide adequately adoption to this regions. Local bee race has a low rate of colony loss due to most likely adapted race in their location. Thus, Giray et al. [8] 's research about bee losses in Turkey showed that using the bee races outside of their regions lead to further losses and bee mortality can be reduced with the selection of local bee race.

As a result, it is thought that many factors and interactions between these factors have caused the colony-losses in Burdur and Isparta provinces. In addition, compared to last year, hard and long winter season may have affected the bee losses. Unfortunately, people who are dealing with beekeeping were found to be uneducated and inadequate about bee diseases and beekeeping technic in Isparta and Burdur provinces. This situation weakened the bees and bee colonies. Moreover, it caused an increase in deaths. In conclusion, the incidence of bee deaths is thought to decrease with the use of right control methods against bee disease agents like *Varroa destructor* and *Nosema spp*. and local bee race.

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