



A Survey on Beekeeping Activities and Colony Losses in Turkey

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Abstract: The study was planned to investigate colony feeding practices, the selection methods of colonies, the control methods of diseases, yearly losses from 2008 to 2011 in each operation and included both migratory and local colonies in Turkey. The beekeepers (92.6%) used to feed their colony in early spring and autumn with supplemental food. The most of local (37.7%) and migratory (62.4%) beekeepers preferred to feed their colonies with both syrup and supplemental food. The beekeepers generally prefer colonies that are not aggressive and with high honey production (47.6%) and also tendency to high swarming (14.2%), resistant to diseases (5.2%) and other factors such as subspecies and physiological characteristics of queens are causes of preference. The colony losses due to winter in 2008-9; 2009-10; 2010-11 were observed as 14.5%, 18.6%, 12.6%, respectively and also the significant correlation ($P<0.01$) were found between 2009-2010. Our study reveals regular survey studies play a crucial role to improve both colony management and monitoring of colony losses.

Keywords: *Apis mellifera*; beekeeping, colony losses; honeybee; Turkey

Türkiye'deki Arıcılık Faaliyetleri ve Koloni Kayıpları Üzerine Araştırma

Öz: Bu çalışmada, gezginci ve yerel kolonilerde besleme uygulamaları, kolonilerin seçim yöntemleri, hastalıkların kontrol metotları ve 2008-2011 yılları arasındaki koloni kayıpları değerlendirilmiştir. Verilere göre arıcıların %92.6' ı kolonilerinde erken ilkbahar ve sonbahar beslemesi yapmaktadır. Yerli arıcıların bir kısmı (%37.7) ve göçer arıcılar (%62.4) kolonilerini beslemede şurup ve diğer besin maddelerinin ikisini birden tercih etmektedir. Arıcılar, saldırganlık davranışı olmayan ve yüksek bal verimi olan (%47.6), ayrıca oğul verme davranışı yüksek olan (%14.2), hastalıklara dayanıklı (%5.2), kraliçe arının alt türüne ve fizyolojik özelliklerine göre kolonilerini seçmektedir. Kışlatmaya bağlı koloni kayıpları sırasıyla 2008-9 yıllarında %14.5, 2009-10 yıllarında %18.9 ve 2010-11 yıllarında %12.6 olarak gözlemlenmiştir. 2009-2010 yılları arasındaki koloni kayıpları arasında korelasyon önemli bulunmuştur ($P<0.01$). Çalışma düzenli saha tarama çalışmalarının koloni yönetiminin ve koloni kayıplarının takibinde önemli olduğunu işaret etmektedir.

Anahtar Kelimeler: *Apis mellifera*; arıcılık, koloni kayıpları; bal arısı; Türkiye

1. Introduction

Honey bees (*Apis mellifera* L., Insecta: Hymenoptera) are economically and ecologically important as they contribute conservation of biodiversity through pollination of most of the plants and agricultural crop yield as well as production of honey and other bee products

(Tunca, 2009). Furthermore, the economic value of total production is estimated as 140 million euro and the economical contribution to crop production due to pollination are nearly ten folds (14.2 billion euro) in Europe. The economic value of the pollination in US is estimated as 15 billion dollars and also the worldwide economic value of

crop pollination by the insect pollinators reaches to 153 billion in 2005 (Gallai et al., 2009). Because of the economic values of honey bee in the world, the honey bee diseases, parasites, rearing applications, and colony losses are very important for the countries. Especially, recent colony losses alarmed and threatened the pollination of both natural biodiversity and crop production (Whitaker et al., 2010).

The studies showed that the number of the colonies decreased in both Europe (26.5%) and North America (49.5%) but increases were determined in Asia (426%), Africa (130%), South America (86%), and Oceania (39%) in period of 1961 and 2007 (vanEngelsdorps and Meixner, 2010). Also, in recent years, serious colony losses were observed in western honey bee (*Apis mellifera* L.) colonies mainly in North America and Europe (Van der Zee et al., 2012). This phenomenon called as Colony Collapse Disorder (CCD) has gathered great attention from scientists. The possible causes have been published and most of these publications concentrated on pathogens, mites, and pesticides etc. But recent studies illustrated that synergistic effect such as *Nosema* microspores and imidacloprid, use of antibiotics, nutritional stress, and water resources (Aston, 2010; Alaux et al., 2010; Brodschneider et al., 2010; Charrière and Neumann, 2010; Currie et al., 2010; Dahle, 2010; Ellis et al., 2010; Gajger et al., 2010; Giray et al., 2010; Gray et al., 2010; Hatjina et al., 2010; Higes et al., 2008; Ivanova and Petrov, 2010; Mutinelli et al., 2010; Neumann and Carreck, 2010; Topolska et al., 2010; vanEngelsdorps et al., 2009, 2010, 2011; Vejsnæs et al., 2010; Van der Zee et al., 2012).

Honey bees have been influenced by diseases and pests during their life similar to all other living organisms. The losses of colonies and yields due to bee diseases and pests forced scientists to discuss and solve the problems of breeders related to diseases and pests (Siralı and Dogaroglu, 2005). Therefore, the survey studies play a crucial role in the diagnosis and solution of the problems (Çakmak et al., 2003; Siralı and Dogaroglu, 2005). The survey results will help to

determine the policies about beekeeping and create new projects related to problems (Siralı and Dogaroglu, 2005).

In this study, we tried to investigate colony feeding practices, selection methods of colonies, factors of colony destruction and losses, the control methods of diseases in all beekeepers and also yearly losses from 2008-9, 2009-10 to 2010-11 within migratory and local beekeepers.

2. Materials and Methods

The study included between 2008 and 2011 periods (2008-9; 2009-10; 2010-11 seasons) in Turkey. We surveyed both migratory and local beekeepers to investigate the effects of migratory beekeeping on honey bee loss. The surveys were carried out both by face to face interview or by distributing the questionnaire to the beekeeper associations and collecting them later. In March 2012, the last results of survey from beekeepers reached our department. The survey questions were prepared for project supported by developmental agency and examples were taken from a more limited area than other survey studies for Turkey. A total of 231 beekeepers containing 130 local and 101 migratory beekeepers from 19 provinces (Adana, Ağrı, Antalya, Aksaray, Artvin, Aydın, Çankırı, Eskişehir, Kars, Kastamonu, Kırklareli, Kırşehir, Konya, Nevşehir, Muğla, Ordu, Osmaniye, Şanlıurfa, Tokat) in Turkey responded to survey and 49 questions were answered. All statistical analyses; the Correlation Analysis for the colony losses, Confidence Intervals (CI), Kruskal-Wallis test were performed using MINITAB15 statistical program (MINITAB inc., State College, PA, USA).

3. Results

The evaluation of the results about feeding in spring and autumn showed that 92.6% of beekeepers fed their colonies in early spring and autumn, 2.2% of them did not feed and 5.2% of beekeepers did not give information about feeding activities. The types of feeding before early spring and fall showed that the local beekeepers preferred to feed their colony with only

supplemental food (20%), only syrup (33.1%), and 37.7% of local beekeepers fed their colony with both syrup and supplemental food. Also 9.2% of them did not give information about feeding activities. The migratory beekeepers preferred to feed their colony with only supplemental food (4.9%), only syrup (28.7%), both syrup and supplemental food (62.4%). There was no information given by 5% of the migratory beekeepers.

The beekeepers generally prefer colonies that are not aggressive and with high honey production (47.6%) and also tendency to high swarming (14.2%), resistant to diseases (5.2%) and other factors such as subspecies and

physiological characteristics of queens are causes of preference.

The beekeepers answered the question which factors damage or led to losses of your colonies and the percentages of their answers were given in Figure 1. Most of them mentioned that pesticides much more destroyed and led to losses of their colonies than other factors (62.4%). Environmental pollution like waste, exhaust gas and fertilizer also damaged the colonies according to 24.6% of breeders. Climate changes gave rise to colony losses from 4.5% of beekeepers and 3.0% of them indicated that other factors like wasp, ant, human etc. led to colony losses. The others did not comment about damaging factors.

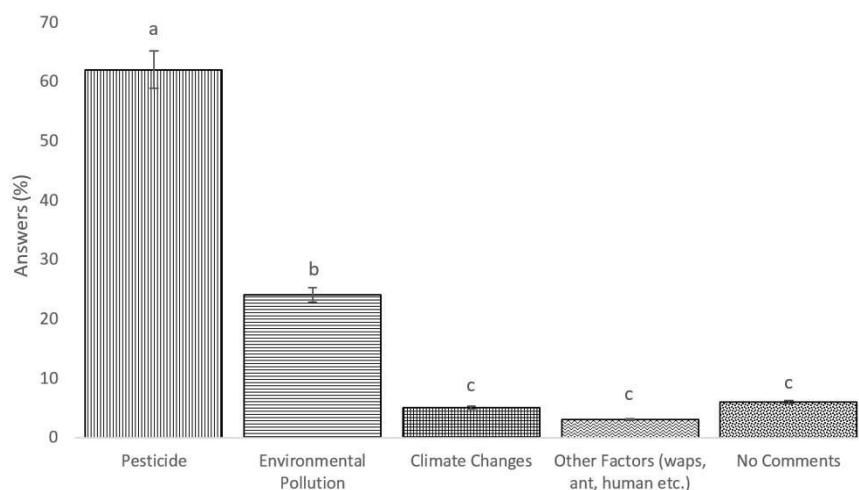


Figure 1. The percentages of beekeepers who answered the question about the factors which led to colony losses or damaging.

The answers about control methods for diseases from breeders showed that using amitraz was the most common active substance against to varroa parasite among beekeepers (2008-9: 57.7%; 2009-10: 59.4%; 2010-11: 55.3%). During

three years, usage of formic acid (2008-9: 1.0%; 2009-10: 1.9%; 2010-11: 3%) and herbal application (Mint, thyme etc). (2008-9: 4.6%; 2009-10: 5.2%; 2010-11: 7.9%) had been increased.

Table 1. The Colony Losses Percentage for over wintering in three years

Periods	Migratory Beekeepers	Local Beekeepers Colony Loss (%95 CI)	Total Colonies	Total Colony Numbers
2008-2009	13.2 (9.50-16.87)	14.7 (10.36-19.05)	14.1 (11.24-17.70)	21922
2009-2010	14.7 (11.05-18.37)	21.6 (12.57-30.57)	18.6 (13.27-23.87)	26271
2010-2011	11.3 (8.61-13.98)	13.6 (5.24-21.91)	12.6 (7.77-17.39)	30417

The winter colony losses were higher in 2009-10 than the other years for migratory (14.7%) and local beekeepers (21.6%) (Table 1). Kruskal Wallis test indicated that the total colony losses were significant among three years ($H= 11.41$ $P<0.01$) in local beekeepers whereas there is no significant differences for losses in migratory beekeepers ($H= 2.1$ $P>0.05$). For all colonies including migratory and local beekeepers, the

significant differences was observed ($H= 12.85$ $P<0.05$). All colonies were evaluated for overwintering losses and there were highly significant correlation detected between 2008-9 and 2009-10 in migratory ($r= 0.362$ $P<0.01$) and total colonies ($r=0.154$ $P<0.01$) (Table 2). Furthermore, there were no significant correlations detected for overwintering in local colonies for three years.

Table 1. The correlation results for overwintering losses in local, migratory and total colonies results for three years (** $P<0.01$)

Years	Local		Migratory		Total	
	2008-9	2009-10	2008-9	2009-10	2008-9	2009-10
2009-10	0.136	-	0.362**	-	0.154**	-
2010-11	0.117	0.058	0.127	0.118	0.111	0.063

4. Discussion

The current status illustrated that the vast majority of the beekeepers understood of the importance of feeding in spring and fall periods. The survey results are higher than previous study included only Thrace region (29.8%) beekeepers feeding practices (Sirali and Dogaroglu, 2005). The beekeepers generally preferred to feed their colonies with combine methods (supplemental food and syrup).

The vast majority of them preferred to use chemical methods against to disease. It is commonly known that synthetic chemicals leave residues in honey bee products. This might negatively affect both human and bee health. So beekeepers should be given training on the use of organic acids, biological and cultural methods of the struggle with diseases and pests rather than use of synthetic chemicals. Furthermore, more bee breeding programs should be applied to resistant bee breeds against diseases and pests. This bee breeds should be serviced to beekeeping sector.

The colony losses due to wintering were observed in Turkey during three years (Table 1). The losses due to winter for Turkey were observed as 14.1% in 2008-9. This value is smaller than Ireland (21.7%), Belgium (18.0%), Netherlands (21.7%), UK (16.0%) but it is higher

than Austria (9.3%), Germany (10.4%), Denmark (7.5%), Italy (6.3%), Norway (7.1%), Poland (11.5%), Switzerland (9.1%) and Bulgaria (5%) according to mean winter losses per countries in 2008-2009 (Van der Zee et al., 2012; Ivanova and Petrov, 2009). In the period 2008-2009, the wintering losses were observed to be 29% in USA (vanEngelsdorp et al., 2010) and 33.9% in Canada (CAPA, 2011) that was higher than winter losses in Turkey.

According to survey data about winter losses for 2009-10 in Turkey, it was observed as 18.6%. When these result were compared with other countries, the mean winter losses in Belgium 26.0%, Canada 23.8%, Finland 19.6%, Ireland 22.4%, Italy 29.8%, Netherlands 29.3%, Scotland 25.5%, Slovenia 21.1%, Spain 19.2%, Sweden 27.5%, Switzerland 20.0%, had higher percentage than Turkey (Van der Zee et al., 2012). The losses in Austria 14.7%, Bosnia Herzegovina 8.6%, China 4.2%, Croatia and Slovakia 7.4%, Denmark 15.1%, England/Wales 17.5%, Northern Ireland 14.1%, Norway 8.8%, and Rep. Macedonia 6.8%, Poland 15.3% were smaller than Turkey in 2009-2010 (Van der Zee et al., 2012). In the same year, the colony losses due to winter were reported for Turkey as a 17.4% in COLOSS survey studies

(Van der Zee et al., 2012). Our survey results of colony losses supported the COLOSS results for Turkey (including wide range of operations). In the same period, the average colony losses for USA were informed as 42% (vanEngelsdorps et al., 2011).

In 2010-2011 period, the winter losses for Turkey were detected as 12.6%. Also mortality due to wintering losses during the winter period in Canada and USA were 29.3% (CAPA, 2011) 29.9% (vanEngelsdorps et al., 2012) which was higher than Turkey. Also the preliminary results of honey bee colony losses in Austria for 2010/2011 were reported as 15.8% (Brodschneider et al., 2011) and mean colony losses for Switzerland between 1 October 2010 and 1 April 2011 was informed as 14.4%, (Williams et al., 2011). These results were also higher than the colony losses in Turkey.

The previous survey studies in Turkey about colony losses indicated that highly significant correlation was observed from 2003 to 2006. However, both 2006-2007 and 2003 data were evaluated separately from each other; there were no significant correlation among them (Giray et al., 2010). The present results showed that the colony losses due to wintering were observed in Turkey during three years. When these results compared with the other countries, these levels of the losses were not higher than some countries. Although colony management did not take into account for the breeders, the colony losses were lower than expected. This should be considered in a large amount of genetic variation (*A. m. caucasica*, *A. m. syriaca*, *A. m. meda*, *A. m. anatoliaca* and *A. m. carniaca*) in honeybee populations of Turkey reported based on morphometry, allozymes (Kandemir et al., 2000) and microsatellites (Bodur et al., 2007; Tunca, 2009). The high level of losses was observed in local beekeepers than the migratory. The possible reason is that the local beekeepers are generally hobbyist not commercial and also have fewer colonies than the migratory beekeepers. Although the beekeepers selected their colonies according to their own methods, most of them selected their colonies to honey production.

In conclusion, the present survey illustrated that the colony losses due to winter were observed in local and migratory beekeepers during three years but no high rates than many European countries, USA and also Canada. The overwintering colony losses results for this survey supported the COLOSS results for Turkey applied for whole country. The most of the beekeepers understood of the importance of feeding in spring and fall periods. The spring feeding is important for the development of brood in colonies in case of variable weather conditions and discontinuous nectar flow and also fall feeding is crucial role for support the colonies before the winter season. Although the vast majority of beekeepers preferred to use synthetic chemicals against to disease and pests, the usage of formic acid and herbal applications had been increased during three years. Consequently, regular survey studies play a crucial role to improve both colony management and monitoring of colony losses. These survey results will help to determine the policies about beekeeping and creation of new projects related to problems.

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The authors declare that there is no conflict of interest.

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