PRELIMINARY SURVEY RESULTS ON 2006–2007 COLONY LOSSES IN TURKEY

Türkiye'de 2006–2007 Koloni Kayıplari Ön Raporu

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ABSTRACT

Extraordinary colony losses have been reported in early 2007 from several eastern provinces of Turkey. We have conducted a questionnaire study on a subsample of beekeepers from Turkey. This is the first report on 80 questionnaires representing over 10,000 colonies. We investigated whether there has been extraordinary winter losses in comparison to previous years through pairwise analysis of self-reported past and present losses of same beekeepers. This analysis indicated regional extraordinary bee losses. In addition we have analyzed a battery of 9 question groups to investigate several hypotheses related to causes of bee deaths. These hypotheses included; irregular season, known bee diseases, colony collapse disorder, honey bee genetic source, use of different beekeeping inputs such as sugar feed, wax foundation, queens, and parasite and disease treatments. The results support hypotheses related to irregular season and an unknown regional factor.

KEYWORDS: Anatolia, bee deaths, colony losses, climate, disease, pesticide, bee races, colony collapse disorder.

INTRODUCTION

There has been unexpected and alarming colony losses in different regions of the world in the last few years. Most recently, concurrent with the sudden colony losses in the US (Johnson 2007, Kandemir, 2007), there has been colony losses reported in Turkey (Kandemir 2007). We have investigated extent and causes of colony losses experienced in Turkey through a questionnaire study. We also compared the losses observed in Turkey to the losses observed in the United Sates.

Honey bees are important for humans because they provide pollination services to crops and other plants. The world-wide contribution to crop production of honey bees through pollination has been estimated as high as 200 billion dollars per year (Costanza et al. 1997). Therefore a loss of 30 to 60 % of bees in different countries directly influences people of the world.

In the United States first attempts at quantifying the loss lead to conflicting assessments, varying from only typical losses to very high losses (Kandemir 2007, Handerson et al. 2007). This was mostly because the losses reported by different scale beekeepers were combined in one analysis. To avoid such problems we compared past and present colony losses of individual beekeepers. We have asked questions related to the colony collapse

disorder symptoms to be able to assess similarity of losses in Turkey and the US. Our questions focused on nine mechanisms hypothesized to be important for honey bee health in Turkey (see Materials and Methods).

This is the preliminary report on the first 80 questionnaires received within 10 days of distribution of the questionnaires and organization of the Workshop to Investigate Honey Bee Losses in Turkey (Middle East Technical University, 2nd of June 2007). The resolutions of the workshop are published in the August 2007 issue of the Uludag Bee Journal.

MATERIALS AND METHODS

The questionnaire study:

The questionnaire was thought necessary because different laboratories examining the effected colonies or bees were reporting different potential causes ranging from hunger to parasites and disease organisms to pesticides (personal communication: Aslı Özkırım, Nuray Şahinler, Mehmet Ekici; unpublished observations: Levent Aydın, İbrahim Çakmak, Ahmet İnci). Beekeepers and beekeeper organizations were reporting no losses to extreme losses. An assessment of the situation was necessary.

A short, one page questionnaire has been prepared by combining hypotheses produced by veterinarians, academicians, bee keepers, agricultural scientists, and biological scientists with familiarity of the local beekeeping practices and current proceedings in the world apiculture scene. The original questionnaire can be reached on the internet (http://www.uludagaricilik.org.tr). The content and questions are explained below.

We have used the only academic and trade journal for beekeeping in Turkey to reach 1500 beekeepers subscribed to the journal across Turkey. We collected the questionnaires through local beekeeping organizations, internet (http://www.uludagaricilik.org.tr), Turkish mail, and field representatives of NGOs with beekeeping interest. At the time of this writing over 200 questionnaires have been returned to the authors. We are collecting the questionnaires until publishing of these first results. The complete results will be analyzed and published in an international forum.

Through nine questions and subquestions we have examined possible effect of several factors implicated in colony losses in other countries such as the United States (Oldroyd 2007):

Question 1. The location and transportation

Beekeepers in Turkey many times move their colonies to follow the nectar flow and to overwinter the colonies under more favorable conditions. This practice could influence distribution of disease organisms and exposure to environmental factors. We have asked the location and movement pattern of the beekeepers.

Question 2. The beekeeper

We have investigated the level of interest, experience, and education of the beekeepers as potential correlates of management practices that could influence colony losses. We also asked type of beekeeping: for honey or for queen production. These also could influence the colony management and colony losses.

Question 3. The bees

We asked the honey production and brood production status of colonies for 2006 to assess colony conditions before the 2006 winter and before the reported losses.

Question 4. The losses

To be able to better evaluate extent of losses we asked beekeepers to report their winter losses for the past three years. In a paired analysis we were able to evaluate the difference of the current 2006–2007 losses to the previous years. Instead of asking percent losses we asked colony numbers in fall 2006 and in early spring 2007.

Question 5. The queens

One recurring problem in Turkish beekeeping is lack of queen replacement. To assess effect of presence or absence of queen replacement we asked whether the beekeeper has replaced queens, with what frequency (once a year to once every 3 years), source of replacement queens (commercial or produced on location), any effect of replacement queen on honey production.

Question 6. The food.

Proper feeding of colonies in preparation for winter and in early spring are important management procedures. Any practices that could impact these

feedings could impact colony losses. We asked feeding practice and feed source and type.

Question 7: The disease history

Presence of major diseases and parasites in Turkey (Varroa, foulbrood, and nosema) were asked. Methods of Varroa control used by beekeepers and any other medications applied to colonies were asked.

Question 8a. The Genetics

We asked the bee race used by beekeepers to assess possible connections between bee genetics and colony losses.

Question 8b. The Foundation

The wax foundation produced by clandestine operators were found to be infested by disease agents. This is the result of inadequate sterilization. We asked beekeepers different wax foundation sources they used to examine any possible connection with the bee losses.

Question 8c. The environment

We asked beekeepers to answer as yes or no the presence of factories, agricultural pesticide application, and urban settlements near their apiaries. These questions were hoped to show any relation between environmental pollution, pesticides, or urban effects and colony losses.

Question 8d. The climate

We asked beekeepers to compare temperature and precipitation experienced in 2006–2007 winter to previous years.

Question 9. The Colony Collapse Disorder

We listed the symptoms of colony collapse disorder and asked if these were observed in colony losses experienced. The symptoms characteristic of colony collapse disorder asked from beekeepers were: whether colony populations decreased precipitously, whether colonies remained with brood but few workers; whether in their colonies queen, attending workers and honey present were present when most other bees were absent; whether wax moth or other cleptoparasites absent (e.g. Oldroyd 07).

Statistical Analyses

Statistical analyses were done using the JMP program. The colony losses over past years and in 2006–2007 were compared in a paired t-test. This helped determine the level and nature of bee deaths in 2006–2007. The bee losses in 2006–2007 were first analyzed acoording to their distribution to geographic localities to determine any heterogeneity that would prevent pooled analyses of other factors. Regions with similar losses were than grouped and analyzed for impact of hypothesized factors on colony losses in 2006–2007. To be conservative, each factor was individually evaluated for impact on colony losses. This preliminary analysis would help determine the details of multivariate analysis to be performed on the complete set of questionnaires.

RESULTS

Colony losses in 2006–2007

Bee losses in 2006–2007 was the highest in comparison to previous years (See Figure 1). In a correlation analysis bee losses reported for 2003, 2004, and 2005 were shown to be significantly correlated. Only bee deaths for 2006–2007 was not correlated with previous losses (Table 1). This shows that even beekeepers who usually manage their colonies well and have low bee losses in other years may have lost high number of colonies last winter. In general, of the 13000 colonies beekeepers reported to have in the fall of 2006 only 7000 have survived to the spring of 2007. This represents over 40 % colony loss for beekeepers returning the questionnaires.

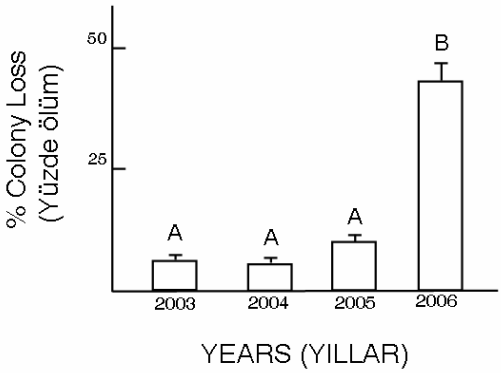

Figure 1. Percent colony losses (mean±SE) in 2006–2007 and the previous three years. The bars with different letters indicate significantly different percent colony losses at P<0.05. (2006–2007 ve önceki 3 yıl için yüzde kovan kayıpları. Farklı harf taşıyan çubuklar birbirinden istatistiki anlamlı farklı kovan kaybı yüzdeleri belirtmektedir.)

Table 1. Correlation between colony losses of 80 beekeepers in different years. R indicates correlation coefficient, P indicates statistical significance, NS means not significant. (Değişik yıllarda 80 arıcının kovan kayıpları arasındaki bağlantı. R korelasyon, P istatistiki değer, NS istatistiki önemsiz demektir.)

	2003	2004	2005
2006	R=0.00 NS	R=0.09 NS	R=0.03 NS
2003		**R=0.68 P<0.001**	R=0.20 P=0.10
2004			**R=0.40 P<0.001**

Where did the losses occur?

The extraordinary losses seen in 2006–2007 concentrated in three geographic areas: Southeast, Northeast, and Southwest of Turkey (Figure 2). In a comparison with three previous years, only one province, Hatay, consistently showed higher colony losses than other provinces over the years. But these losses were around 20% and never reached the levels of 2006–2007 (Figure 3).

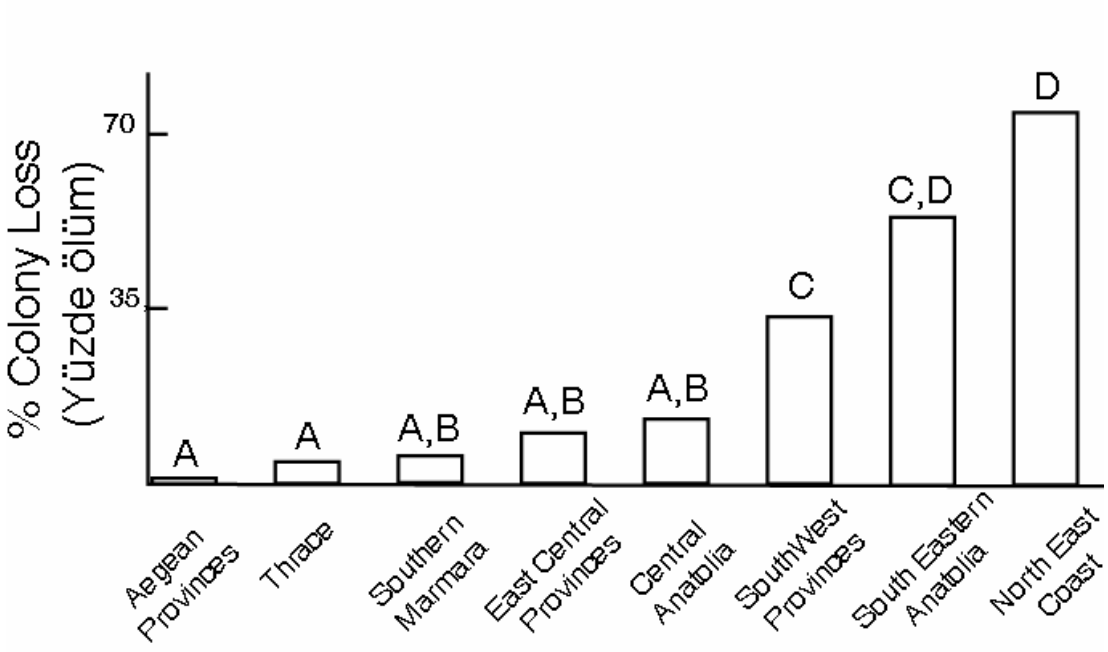

Figure 2. Percent colony losses in 2006-2007 in different regions of Turkey. The bars with different letters indicate significantly different percent colony losses at P<0.05. (Farklı yörelerde 2006-2007'de yüzde kovan kayıpları. Farklı harf taşıyan çubuklar birbirinden istatistiki anlamlı farklı kovan kaybı yüzdeleri belirtmektedir.)

Factors not related to colony losses

We found no significant relation between colony losses of beekeepers and foundation comb used (P>0.2, n=80), bee feed type or source (P>0.5, n=80), source of queens (P>0.2, n=80), pesticide use, urban vs rural areas, presence-absence of industry, or presence-absence of known bee diseases (P>0.5, n=80).

Factors related to colony losses

We found that bee genetics or race of the bee was important even when the geographic region influences were statistically controlled. Highest colony losses in 2006–2007 winter occurred in A*.m. caucasica* from Turkey, and *A.m. carnica* or *ligustica* of European origin (See figure 4). The hybrid queens from Turkey, or local races, especially A.m. anatoliaca, showed the lowest levels of colony losses.

We also found that local climatic conditions as perceived by beekeepers were important in explaining extraordinary colony losses. In areas where beekeepers reported 2006–2007 winter to be colder than other years, or was similar to other years colony losses were not high or unusual. In areas where colony losses occurred beekeepers reported the weather to be warmer and drier than usual in the 2006–2007 winter. Extraordinarily wet weather conditions for fall of 2006 were reported for the Northeastern regions, where the highest levels of colony losses occurred.

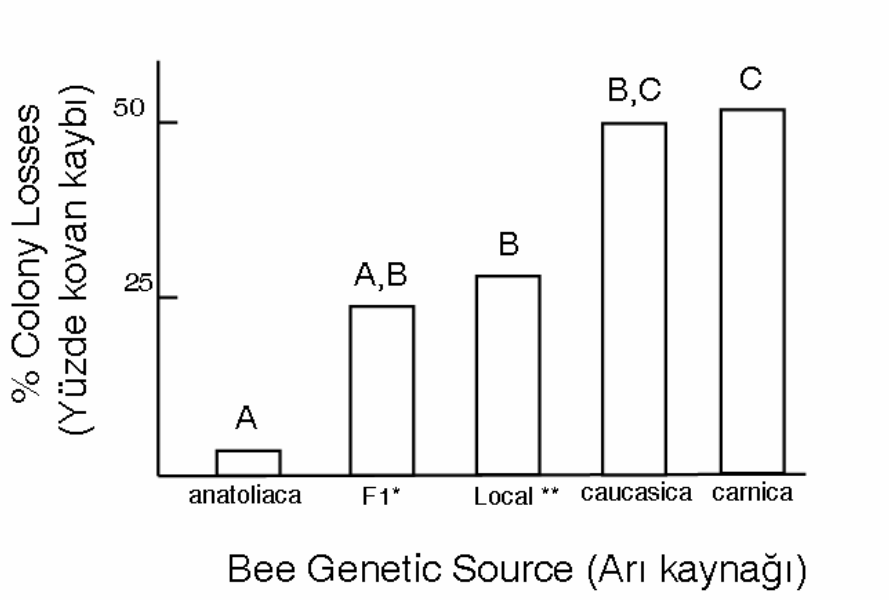

Figure 3. Percent colony losses in 2006–2007 for colonies of different genetic origin. In this analysis colonies reported for Ardahan and Artvin were not included because in these areas reportedly only *A.m. caucasica* bees are used. *F1 stands for colonies produced by *A.m. caucasica* queens mated to drones from local races. **Local races include Thrace bee (*A.m carnica* type from Turkey), Mugla bee (see in the text), Hatay bee (*A.m.syriaca*) and other undefined local bee populations but not *A.m. anatoliaca*. The bars with different letters indicate significantly different percent colony losses at P<0.05. (Farklı genetik kaynaktan gelen arılar için 2006-2007'de yüzde kovan kayıpları. * F1 Kafkas anaların yerli erkeklerle çiftleşmesi ile oluşan kovanları belirtmektedir. **Local: yerel arılar demektir. Trakya ya da Kırklareli arısı (yerli *A.m carnica*), Muğla arısı, Hatay arısı (*A.m.syriaca*) ve diğer tam tanımlanmamış yerli arı toplumlarını içerir. Anadolu arısı (*A.m. anatoliaca*) ayrı olarak belirtilmiştir. Farklı harf taşıyan çubuklar birbirinden istatistiki anlamlı farklı kovan kaybı yüzdeleri belirtmektedir.)

Colony Colapse Disorder

When beekeepers were asked for presence or absence of symptoms characteristic of colony collapse disorder only 16 of 80 repondents reported symptoms consistent with colony collapse disorder.

DISCUSSION

The major result of the preliminary analyses of colony losses questionnaires is that there are regional extraordinary colony losses in Turkey. Significantly, beekeeping inputs, colony collapse disorder, and environmental quality were not found to influence the colony losses. Instead, these colony losses are related to warmer than usual weather conditions perceived and reported by beekeepers. Local genetic variation appears to be important in reducing the impact of any factor that may induce the observed colony losses, highlighting significance of preserving and studying honey bee genetic resources.

The concurrent reports of extraordinary colony losses from Turkey and the United States in early 2007 caused us to investigate the extent of losses in Turkey. Because studies in the United States lead to conflicting interpretations of the level of losses at first, we decided to compare losses of individual beekeepers in 2006–2007 and three previous years. This helped us determine that the extraordinary losses occurred in several regions. These regions are about 600 kms apart from each other, found in very distinct climatic regions. North East coastal area is characterized by temperate rainforests, South East coastal area has dry Mediterranean climate, and South West has semi-humid Mediterranean climate. The losses in such a diverse range of habitats, distributed over a large geography makes it unlikely that a contagious agent spread over the geography could be responsible for the losses. The only known common aspect to losses in these regions were the irregular weather conditions of 2006–2007. But

this irregularity was also present in other regions where no significant colony losses has been reported. The colony losses then require one or more other local factors. These factors may or may not be shared across the different regions. Possible hypotheses include use of agricultural pesticides, local emergent diseases to name a few.

The bee losses in US were linked to different factors; infectious diseases, varroa and viruses, toxic agents such as insecticide imidacloprid, genetically modified plants, even cell phones. Recent papers in Amer. Bee J. report different causes for recent bee losses.

Mussen (2007) review different agents and conclude that poor weather and consequently malnutriton and lack of polen make bees more succeptible to infections and toxins. Pettis et al. (2007) reports high number of disease organisms in CCD colonies particularly high prevalence of fungi that also indicates stress or compromised immune system. Vanenglsdorp et al. (2007) estimated manage colony losses considering CCD and non-CCD colonies in 2006–2007 in US as 38% losses and reasons for the losses were explained due to; starvation, varroa, tracheal mites, small hive beetle, weather, weak colonies in the fall, and queen-genetic problems.

Turkey, unlike United States, has a large bee genetic source. There are at least 5 bee races in Turkey (Kandemir et al. 2000). The bees used for beekeeping are mostly *Apis mellifera anatoliaca, caucasica*, and their hybrids. However, some local beekeepers do use *A.m. carnica* native to Thrace (the Turkish *carnica* as opposed to *carnica* from Europe), A.m. *ligustica* in Western provinces. In addition, small scale beekeepers many time use only the local bees available which include *Apis mellifera syriaca*, and other racially less defined bees with particular behaviors. To a lesser extent there are also beekeepers who buy and use bees from Europe. For example; *A.m. anatoliaca* is adapted to harsh environments as long, freezing winters and long, dry, hot summers (Ruttner 1988). This bee will be more resistant to weather changes and the results here support this hypothesis.

The results were encouraging in that inputs related to beekeeping do not appear to be responsible for the bee losses. In addition, it appeared that local genetic diversity could be useful in reducing colony losses. Turkish beekeepers may be in better shape than elsewhere since honey bee genetic variability is a resource not readily available in most parts of the world (Kandemir et al. 2000; Bodur et al. 2007, Kence 2006). On the other hand, the there is concern because situation may get worse next year. A concerted effort in examining bee losses on the ground in the shortest time frame may be necessary to prevent any losses approaching the losses in the United States.

ACKNOWLEDGMENTS

We would like to thank Uludag Beekeepers Association, Turkish Beekeepers Union, Turkish Foundation to Combat Soil Erosion (TEMA). We also thank comments by two anonymous reviewers that helped improve presentation of this work.

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ÖZET

Türkiye'de 2007 başında arıcıların bildirmeğe başladığı yüksek kovan kayıplarını araştırmak üzere bir anket çalışması düzenlenmiştir. Bu anketle daha önce ABD'de kovan kayıplarını araştırmak üzere düzenlenen anketin sonuçları da gözönüne alınarak geçmiş yıllar ve bu yıl görülen kayıplar karşılaştırılmıştır. Bu yıl geçen yıllara göre istatistiki anlamlı bir koloni kaybı anketlerde bildirilmiştir. 2006–2007 ortalaması % 43, 2005 ortalaması % 10, 2004 ve 2003 ortalaması % 10 altında olarak bulunmuştur (Şekil 1). Arıcıların 2003, 2004 ve 2005 kayıpları birbiri ile oranlı iken 2006–2007 kayıpları arıcının önceki kışlatma başarısı ile alakasız bulunmuştur (bkz. Tablo 1). Bu sonuçlar arıcıların besleme, kovan yönetimi gibi konularda farklı yaklaşımlarının kovan kaybı ile ilgisi olmadığı kanısını desteklemektedir.

Koloni kayıplarının dağılımı incelendiğinde olağanüstü kayıpların üç bölgede toplandığı görülmektedir (Şekil 2): Batı Akdeniz (Muğla, Marmaris), Güney Doğu Anadolu (Hatay, Diyarbakır), Kuzey Doğu Anadolu ve Karadeniz'in doğu kıyısı (Artvin, Ardahan, Trabzon, Rize, Giresun). Bu dağılım yörelerde arıcıların belirttiği anormal iklim koşullarını işaret etmekle birlikte komşu bölgelerde kayıpların olmaması yerel başka bilinmeyen etkenlerin önemli olduğuna işaret ediyor. Olağanüstü hava koşullarına karşı arıcılara özel meteoroloji raporlarının hazırlanması arıcıların hazırlıklı olmasını sağlayacağından önemli olabilir. Diğer bilinmeyen etmenler tarımda kullanılan kimyasal maddeler veya bilinmeyen yeni hastalıklar olabilir. Arı kayıplarının bulunduğu bölgeler ve bunun dışındaki bölgelerin ve buralardan alınacak örneklerin sistemli olarak incelenmesi bilinmeyen etmenleri bulmak için önemli olabilir.

Sonuçların iyi bir yönü şüphelenilenin aksine arıcılık girdilerinin ölümlerle ilgili görünmemesidir. Kullanılan ana arıların kaynağı, arıya verilen kek ve diğer besin tipi ve kaynağı, bilinen hastalıklar ve bunlara karşı kullanılan ilaçlar, kullanılan temel petek kaynakları ölümlerle alakalı bulunmamıştır. Türkiye'deki kovan kayıpları ABD'de görülen Koloni Çökme Bozukluğu'ndan farklı bulunmuştur. İncelenen 80 ankette yalnız 16 yanıt Koloni Çökme Bozukluğu belirtileri ile uyumlu bulunmuştur. Koloni Çökme Bozukluğu kovanlarda arı sayısının bir hafta gibi kısa bir zamanda azalması, bu sırada kovanda yavru miktarının azalmaması, çoğu kez ana arı ve bir avuç kadar arının kovanda kalması, buna rağmen kovanlarda balın kalması ve mum güvesi gibi parazitlerin kovanlarda görülmemesi olarak özetlenebilir. Bu gözlemlerin yapıldığı az sayıda anket genele dağılmamış, yalnız Rize ve Ardahan'dan gelmiştir.

Önemli ve umut verici bir bulgu yerli arı ırklarından (Anadolu, Suriye, Muğla ve Trakya arıları), ve yerli arılarla melezlenmiş Kafkas ırkından arıların, Artvin ve Ardahan dışında %20'nin altında kayba uğramasıdır (Şekil 3). Yöresi dışında kullanılan saf Kafkas ve Avrupa kökenli arılar en çok kayba uğramışlardır. Bu sonuç Türkiye'ye dışardan arı getirilmesini yasaklama uygulamasının yerinde olduğunu da göstermektedir. Koloni kayıplarının nedenleri araştırılırken yerli arı ırklarını seçerek arıcıların biraz olsun bu kayıpları azaltabileceklerini düşünmekteyiz.

Anahtar Kelimeler: Koloni Çökme Bozukluğu, *Apis mellifera,* balarısı, Türkiye, kovan kayıpları, iklim, hastalık, pestisit.