DERLEME MAKALESİ / REVIEW ARTICLE

BEEKEEPING AND RECENT COLONY LOSSES IN TURKEY

TÜRKİYE'DE ARICILIK VE GÜNCEL KOLONİ KAYIPLARI

(Genişletilmiş Türkçe Özet Makalenin Sonunda Verilmiştir)

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ABSTRACT

Beekeeping has a long history in Anatolia going back to Hittite civilization, B.C. 1300 about 9000 years. Also Turkey having at least five subspecies of *Apis mellifera* is a bridging country connecting Europe, Asia and Africa by Middle East and gene center of western Honey bee *Apis mellifera*.

Anatolia also has three out of 37 phytogeography rich areas in the world and there are about 10.000 plant species and 3506 of them are endemic to this country. Turkey is representing one of the highest potential in world beekeeping with about 7,709,636 colonies, more than 150.000 families in beekeeping business, 79 Beekeeping Unions in each province as parts of Central Beekeeping Union of Turkey representing 56,000 professional beekeepers and 107,665 tons of honey production annually in Turkey.

There are a number of factors affecting colony losses up to 80% high in some areas in Turkey including such as Varroosis, Nosemiosis, Foulbrood diseases, new generation of pesticides as neonicotinoids, queen failure, colony management and large scale long distance migratory beekeeping.

Finally, Turkey still has great potential of genetic reservoir of western honey bee, *Apis mellifera* and may provide vital solutions for a number of beekeeping problems in the world facing today.

Keywords: Honey bees, *Apis mellifera*, Beekeeping, Colony losses, Turkey, Anatolia

ÖZ

Bu çalışmanın amacı ülkemizde genel olarak arıcılığın durumu ve son yıllardaki arı kayıplarının nedenlerinin açıklanmasıdır. Anadolu'da arıcılık milattan önce 1300 yılından, yaklaşık 9000 yıl öncesine kadar uzanmaktadır. Türkiye en az 5 arı ırkı ile Avrupa, Orta Doğu ve Asya kıtalarını birbirine bağlayan bir köprü durumunda olup batı bal arısının gen merkezi durumundadır.

Anadolu dünyadaki 37 fitocoğrafya bölgelerinden üçüne yaklaşık 10,000 bitki türüne sahip olup bunlardan 3506'sı endemik olarak bulunmaktadır. Türkiye 7,709,636 koloni, 150,000 den fazla aile arıcılık ile geçimini sağladığı, 79 arı yetiştirici birlikleri, 56,000 profesyonel arıcı ve 107,665 ton yıllık bal üretimi ile arıcılıkta dünyanın en yüksek potansiyeline sahip ülkelerinden biridir.

Türkiye'de bazı bölgelerde % 80'lere kadar varabilen koloni kayıplarını etkileyen faktörler oarak; varroa, nosema, yavru çürüklüğü, yeni nesil tarım ilaçları olan nikotin türevi neonikotinoidler, ana arı yetersizliği, koloni yönetimi ve uzun mesafeli gezginci arıcılık sıralanabilir.

Sonuç olarak Türkiye batı bal arısının genetik merkezi olarak büyük bir potansiyele sahip olup bugün dünyada karşılaşan birçok arıcılık sorunlarının çözümünde hayati çözümler sunabilecek durumdadır.

Anahtar Kelimeler: Bal arısı, *Apis mellifera*, Arıcılık, Koloni kayıpları, Türkiye, Anadolu

BEEKEEPING IN GENERAL

Beekeeping has long history in Anatolia about 9,000 years and it is known one of the oldest agricultural activities. The first beekeeping laws of 202 clauses in the world about B.C. 1300 belong to Hittite civilization that has been found in Anatolia (Sarıöz, 2006, Akkaya and Alkan, 2007). In addition to this, In the Middle East, the oldest known apiary has been found recently in archeology research dated 3000 years ago in the ancient city of Tel Rehov in Jordan (10th–early 9th centuries B.C.E) and identifiedas *Apis mellifera anatoliaca*, (Picture 1) a subspecies found only in what is now Turkey (Bloch et al. 2010).This finding suggests the long time relations between humans and honey bees.

Picture 1. Anatolian worker honeybee

Turkey is geographically bridging country of Asia Europe, and Africa by Middle East. Potential of this country with at least five *Apis mellifera* subspecies has not been emphasized sufficiently in the world beekeeping literature.

Anatolia has three out of 37 phytogeography rich areas in the world and there are about 10,000 plant species and 3506 of them are endemic to this country. About five hundred of them provide large amount of nectar and pollen for bees (Sorkun, 2008). Migratory beekeepers move with approximately 3,5 million colonies and average 2,000 km in the country (Güler and Demir, 2005; Yılmaz and Canlı, 2012). Anatolia with different climatic zones and habitats can also be provide great diversity of honeybees, *Apis mellifera* in Turkey. Therefore at least five different races of *Apis mellifera; A.m. anatoliaca, caucasica, meda, syriaca* and *carnica* exist in this country (Kandemir et al., 2000; 2006). Recently another honey bee subspecies "*A .m macedonica*" in Greek border area is suggested to exit (Pers. Comm.).

These different races adapted to different habitats and have differences in many characters such as size, over-wintering ability, honey production, defensiveness, resistance to parasites and diseases, flower fidelity and all can be evaluated and selected for different purposes (Ruttner 1988; Çakmak 1998; Kandemir et al., 2000; Çakmak, 2001; Akyol et al., 2003). The great diversity of honeybees has not been used efficiently for breeding purposes in Turkey so far but some studies such as resistance to parasites and diseases are on the way to explore these traits (Çakmak, 2010; Öztürk and Akyol, 2010; Çakmak and Fuchs, 2013).

There are recently about 7,709,636 million colonies, more than 150,000 families in beekeeping business, about 56.000 professional beekeepers, 79 Beekeeping Unions in each province as parts of Central Beekeeping Union of Turkey and 107,665 tons of honey production annually in Turkey (Yılmaz, 2013, Haygem, 2016).

There is considerable progress in beekeeping industry in Turkey in recent years and almost all provinces have established beekeeping union and all united as Central Turkish Beekeeping Union (TAB). The number of beekeepers and colonies are mostly registered and supported financially by the Turkish Ministry of Food, Agriculture, Husbandry and each beekeeper has an identification number in that can be tracked down for the products. This brings better control of production when consider consumers' concern about health and residue problems and artificial feeding of colonies during nectar flow. There was only one beekeeping journal in 1980's but now there are three scientific journals and half a dozen beekeeping magazines published mostly by beekeeping unions. When it comes to different types of honey, Turkey with different geographical regions and climate, about 10,000 plant species offer a great diversity of honey with different taste, color and aroma (Sorkun, 2008). Pine honeydew in the world is mostly (about 85%) produced in Turkey (Yılmaz, 2008).

There are also growing interest of research on honey bees and hive products. Culturally and in religious perspective, Turkey is called "honey country". Honey bees are well respected because there are two Surahs or chapters with the name of Al Nahl (16:68-69) in "Holly Kur'an" explaining about honey bees, honey and the healing effects of bee products. There are also words mentioning about bees and honey in the Bible and Torah (Sarıöz, 2006). Honey and bee products are consumed not for only food but also for health concerns as natural medicine. However, there is a serious concern of consumers for adulterated honey, pollution in most regions, residues, and also non-hygienic process and packaging and handling. Beekeepers are concerned with bee products recently such as pollen, propolis, royal jelly, apilarnil, bee venom. Also api-therapy or api-cure is catching great interest not only beekeepers but also many others including hive air.

Beekeeping in Turkey is a great growing industry with new types of hives, wood, plastic, and Styrofoam materials including smart hives recently. Also the Turkish Ministry of Forestry and Water Resources supports some areas as honey forest area or designates some areas to beekeeping in order to use for honey production.

Turkey as a gene center of western honeybee and may hold the solution of major beekeeping problems particularly recent colony losses. Because genetic variation of honey bees may provide natural protection against predators and pathogens such as *Varroa destructor* that has been thought the major factor of colony losses. Of course there are a number of problems waiting for solution such as chemical residues, agricultural pesticides beside varroa mite. However, such problems are usually linked to each other. Preserving endemic honeybee subspecies and ecotypes are essential for future beekeeping industry not only for Turkey but also for the world.

First, we all have to find ways to preserve and protect our native honeybee subspecies and ecotypes in their natural habitats in preserved areas or isolated areas such as islands. Turkey has also some islands in Marmara and Aegean Sea that has good flora for bees such as Marmara Island in Marmara Sea and Gokceada in Aegean Sea (Picture 2).

Picture 2. Honey bee colonies in Marmara island.

Caucasian or mountain bee *Apis caucasica* is also preserved in northeast Anatolia, border region with Georgia in military zone. The rest of four subspecies are not preserved and large scale migratory beekeeping in Turkey threatens this great diversity of honey bees.

Breeding work is in very small scale and queen breeders and queen production are very low compared to USA. If not done properly with many lines of breeder queens, large scale queen production with a few breeder lines may cause to lose genetic variation and may lead to small gene pool in a country. Swarm catching is still wide spread way of increasing colony number and this keep genetic variation in high level of natural way of selection of highly reproducing colonies in the country.

Using chemicals for parasites and diseases may slow down the process of natural selection and artificially selecting more honey producing colonies, beekeepers end up with sensitive and weak colonies against different ecological factors such as climate, parasites, diseases, chemicals, stress etc.

BEE PRODUCTS, API-THERAPY and POLLINATION

Interest to other hive products such as propolis, royal jelly, pollen, apilarnil and bee venom have been increasing. Honey is produced in all areas in Turkey and pollen in most areas and royal jelly and propolis is mostly produced in Marmara and Bursa province and bee venom and apilarnil are only for curiosity by interested beekeepers since no market

is available for these at this moment. Apitherapy (or Api-cure) has growing area of interest and api-therapy association of Turkey has been established recently. Apitherapy studies are just starting to take place as a new section in meetings, congress and symposiums.

Bee products such as honey has always been major part of beekeeping production, and recently pollen, royal jelly, bee wax, particularly propolis and bee venom are produced. Pollen, propolis, and royal jelly production have been increased recently. There is more emphasis about trials and research in propolis use. Also organic-ecological-biological beekeeping gets more supports from universities and Ministries because of increased health concern recently and chemical residue problems in bee products (Picture 3).

Total colony number in Turkey is determined as 7,709,636, out of this number primitive hive number 223,015 and modern hive number 7,486,621 in the year of 2015. Honey production has increased from 81,115 in 2010 to 107,665 tons in 2015 and honey is the most produced bee product in Turkey and yearly production of honey is reported as 14 kg per colony in the years of 2012-2015 but this level is actually lower in the field when all colonies considered. Bee wax production is 4750 tons in 2015 (Haygem, 2016).

Pollen production varies year to year and there is no sufficient data to calculate yearly production. The same is true for royal jelly, propolis, and bee venom yearly.

Bee wax production is not sufficient to meet the demand in recent years and some wax has been imported in recent years. Organic bee wax is also highly demanded when some beekeepers need for production. It seems that bee wax production should be supported to make progress in Turkish beekeeping because bee wax quality and safety is also important to avoid chemical residues disturbing effects in beekeeping.

Queen production is an important part of productive beekeeping. However selected queens are not sufficient and queen production is about 100,000. This number is far from meeting the queen demand in Turkey. Also package bee production stimulates production of honey in some countries and this line of bee production is not practiced sufficiently in Turkey.

Pollination has been considered the most important part of beekeeping on economic perspective in USA and also in EU. Honey bee colony use for pollination has been limited in small areas for a few crops such as cherries, almonds and sunflowers areas. The great potential of beekeeping has not been used for pollination purposes in Turkey. However, pollination research is still mostly lacking sufficient interest and only a few scientists working in this field. Turkey has a huge density of honey bee colonies and also great number of wild bees including many solitary species. Pollination deficiencies might be compensated in most years with great density of bees (Özbek, 2003; Çakmak, 2004; Öz et al., 2008, 2009, Gonzales et al., 2014). Recently bumble bees are produced and used in greenhouses extensively in small boxes. (Gösterit and Gürel, 2005; Gürel et al., 2011; Gösterit and Gürel, 2014).

The Turkish Ministry of Food, Agriculture and Husbandry has started to provide more support for pollination particularly for bumble bees in green houses. This should be extended to use of honey bees colonies for a number of crops. More progress is expected in pollination of crops by honey bee colonies in the near future.

The economic value of insect pollination has been estimated about 22 billion euros in EU (Gallai et al., 2009). About 84% cultivated plants in Europe depend on insect pollination (Williams, 1994) and wild and honeybees are the main pollinators of these crops (Garibaldi et al., 2013; Rader et al., 2012). Honey bees are mostly responsible for cultivated crops. The economic value of pollination has been estimated more than 18 billion dollars in USA (Mader et al., 2011). Recent study suggests that economic value of pollination comes from pollinators 266 billion euros for 60 crops per year worldwide (Lautenbach et al., 2012). Economic value of pollination by honey bees is under investigation recently in Turkey.

Picture 3. Bee products

Pollination is a huge industry and increase quality and quantity of crop production. A few studies have also been performed in Uludag University and crop production had been increased significantly such as sunflower and canola. Even though Turkey has big honeybee industry and GAP is a huge agricultural project, honeybee pollination has not been used effectively. Reduced crop production is significant in some years and honey bees pollination is not considered as one of the main reasons for reduced crop production. On the other hand, there are some good improvements to use honey bee colonies for pollination. Recently some fruit producing companies and some farmers rent colonies for pollination of some crops such as cherry, almond, canola, sunflower (Oz et al., 2008; 2009; Pers. Comm.).

HONEY BEE RESEARCH

There are already ten honey bee research centers in four different universities and there is one Honey bee Institute that belongs the Turkish Ministry of Food, Agriculture, Husbandry. These research centers are aiming mostly to increase production, breeding best honey bee races or ecotypes, better treatment for parasites and diseases, to conserve local or regional races and ecotypes to support organic-ecological beekeeping, to educate beekeepers, to determine local honey and other hive products, to investigate pollination problems and suggest solutions and etc.

The Beekeeping Institute belongs to Turkish Ministry of Food, Agriculture, Husbandry was established on the date of 22 December 1994 in the Blacksea region, Ordu province and publish "The Beekeeping Research Journal" in Turkish. Ordu province has the second highest number of beekeepers in Turkey. and it is also well known for migratory beekeeping and comb honey production in Turkey.

These ten research centers in different Universities are;

AGAM, (Beekeeping Development-Research and Application Center) was established in Uludag University, in 2004 in Marmara region, Bursa province, and has published "Uludag Beekeeping Journal" since 2001 in Turkish with extended abstract in English mainly but articles in English are also published.

HARUM (Hacettepe University Beekeeping Research and Application Center) was established in Hacettepe University in the same year 2004, in Central Anatolia, Ankara province and has published "Mellifera" since 2001 journal in English.

There are also some beekeeping magazines published by various beekeeping unions in Turkey.

DAGEM, (Düzce University Beekeeping Research and Application Center) was established in Duzce University in 2009, in western Blacksea region, Duzce Province.

ARIUM, (Mustafakemalpaşa University Beekeeping and Silkworm Application and Research Center) was established in 2010 in Southeast Anatolia, Antakya Province, in Syrian border.

INAGAM, (İnönü University Beekeeping Development-Research and Application) was established in Easter Anatolia, Malatya Province in 2013.

Muğla Sıtkı Koçman University "Beekeeping and Pine Honey Application and Research Center and Beekeeping and Silkworm Research and Application Research Center was established in 2013 in Wetern Anatolia, Mugla province. Mugla has been known for having the highest number of beekeepers in Turkey and and well known for pine honey production in the World.

Bayburt University Beekeeping Research and Application Center was established in 2015 between Blacksea and Eastern Anatolia, Bayburt Province.

Van Yüzüncü Yıl University Beekeeping Research and Application Center in East Anatolia, close Iranian border, Ardahan University Caucasian Bee Research and Application Center in East Anatolia, close to Armenian border, Bingöl University Beekeeping Research and Application Center.

Among these research centers AGAM is unique and has become a pioneer in leading the Turkish beekeeping integrating with the world beekeeping by collaborating with the Uludag Beekeeping Association first, then start publishing the Uludag Bee Journal, organizing International Beekeeping meetings and becoming the first emphasizing the Apimondia membership and applying for membership to Apimondia in Turkey. Uludag Bee Journal has been used as the link to beekeepers in Turkey and other countries. AGAM has also researchers from different background or disciplines work together. Researchers from Biology, Veterinary Medicine, Agricultural Sciences, Food, Economy work together to investigate or find solutions for different problems.

The main research focus areas in AGAM; honeybee pathology (varroa and other parasites and diseases), behavioral ecology, pollination, bee products, beekeeping equipments.

A new team of scientists has started to collaborate in different research projects in AGAM and progress and important developments are expected in the near future. Graduate program in Honey bee science or apiculture is not present in Turkey but a new graduate program as inter disiplinary area as Beekeeping or Apiculture in preparation and expected to offer a MSc degree in Uludag University.

COLONY LOSSES and Honey Bee Parasites and Diseases

Honey bee parasites and diseases cause significant colony losses and since it was called winter losses by the beekeepers. The most important of these parasites and diseases are; varroosis, brood diseases and nosemiosis (Bailey and Ball, 1991; Aydın et al., 2003; Çakmak, 2012). Previous survey results in Marmara region suggested that colony losses mostly occurred in the fall and winter by varroa, brood diseases, nosema and chalkbrood (Aydın et al., 2003; Çakmak et al., 2003b; Doğaroğlu and Sıralı, 2005).However recently unpredictable high colony losses have been reported by beekeepers up to 80% in some areas of Marmara region and other regions of Turkey (Giray et al., 2007, Pers. Comm.).

Varroa destructor is the most serious problem in Turkey. It was reported that in Marmara region varroosis has been found the first and chalkbrood the second the most serious problem in some years (Aydın et al., 2003, Çakmak et al., 2003b). Varroa mite was not known to occur in Turkey before 1977, and then only in the far western area of the country. Soon after however, varroa had reached all regions of Turkey due to the large migratory beekeeping industry, with 600,000 colonies reported lost each year to this disease alone in the country by 1984 (Anonymous). *Varroa destructor* is the main focus research area since this parasite is responsible for most colony losses, low honey production and residue problems. Actually *V destructor* opens the door for other parasites and diseases by weakening the bees particularly transferring viruses. Since *V destructor* is the most serious problem not only in Turkey (Picture 4) but also in the world recently more researchers are interested in varroa research. The goal is to select varroa resistant/tolerant bee colonies (Fries et al. 2006, Fries and Bommarco, 2007).

Picture 4. Varroa on bees

The most popular method of selection is hygienic behavior by pin or liquid nitrogen to select the most hygienic colonies that remove dead pupae in usually 24 hours. A number of papers published on

hygienic behavior (Spivak, 1998; İbrahim et al., 2007; Harris, 2007; Wilson-Rich et al., 2009; Çakmak, 2010). However, varroa problem still continues with almost same speed and even worse and more chemicals have been developed for this parasite. Other researchers select the colonies with "live or die" method. These methods are more exact but not so practical since all colonies or most of them die in two years and it is almost impossible to continue selection process (Kefuss et al., 2004; Fries et al., 2006; Fries and Bommarco, 2007; Seeley, 2007; Bühler et al., 2010). Therefore more applicable method (good strategy) is to treat colonies with high level of mites very effectively and leave low mite colonies untreated. All three methods bad, ugly and good strategy were applied in Uludag University Beekeeping Development-Application and Research Center (AGAM) and the last one proved to be more applicable to continue this line of selection research. Also varroa selection research includes island study on beekeeping level as an isolated area and artificially insemination to control mating on professional level in AGAM (Kefuss et al., 2004; Fries et al., 2006, Çakmak and Fuchs, 2013; Unpublished data).

Picture 5. Powder sugar method and varroa mites

Çakmak et. al (2003a) reported the incidence of varroa (*Varroa destructor*) and tracheal mites (*Acarapis woodi*) in Turkish honey bees (*Apis mellifera*). *Acarapis woodi*or other*Acarapis*spp were not found in any of the 10,200 bees examined. The data suggest that for unknown reasons tracheal mites appear to be very rare or do not exist in Turkey. Even though there has been one study suggested that tracheal mite presence in small quantities in Turkey (Özkırım and Keskin 2005) this report has not been verified by later research and it seems that tracheal mites are not present in Turkey. The question why there is no tracheal mitesin Turkey needs to be explained.

Different materials and chemicals (ether, alcohol, detergent and etc.) had been used to determine varroa level in the past and about 200 bees were taken and these bees were killed (Sammataro and Avitabile, 2011). Powder sugar method provide better way to estimate varroa level with 94% accuracy compared to detergent method with 300 bees from brood area and these bees are returned alive to their colonies (Çakmak et al., 2011). Powder sugar method (Picture 5) has recently been improved to be more exact to determine varroa level and also the efficay of treatment methods used to control varroa mite (Çakmak and Çakmak in Preparation).

This method also provides better estimate of mites when considering the ants carrying out mites (Picture 6) from the pollen traps or drawers. Fackimzadeh used powder sugar to control varroa mites but not for determining varroa level of each colony (Fakimzadeh, 2001; 2010).

Picture 6. Ants carrying varroa mites

Pollen traps had been reported to reduce varroa load up to 35-50% (Çakmak et al, 2002; 2006). Amitraz, (smoke, plastic strips). Coumaphos (pouring), Flumethrin (wood, plastic stipt), Tau-Fluvalinat, Tyhmol (jel, pastry) Formic acid (stript, House-made) oxalic acid (Syrup, Smoke) treatments are used for varroa control in our country. Unfortunately no studies has been reported to about ineffectiveness of varroa treatment and varroa resistance The sufficient results had not been obtained due to wrong treatment time, migratory beekeeping to control varroa mite problem (Temiz, 1983; Girişgin and Aydın, 2010;Sammataro and Aviatible, 2011). A promising result has been obtained by selection studies with artificial insemination and natural

mating of selected colonies (Çakmak et al., 2011; Cakmak and Fuchs, 2013; Çakmak et al., In preparation).

Viruses carried by varroa mites actually kill the honey bee colonies (Yang and Cox-Foster, 2005; 2007). Viral diseases of honey bees were studied and deformed wing virus, acute bee paralysis, bee paralysis, black queen cell virus and Isareli acute paralysis virus were determined by RT-PCR method, in bee larva and this is the first molecular study of reporting honey bee viruses in Turkey. Chronic bee paralysis was not identified in any samples analyzed (Gülmez et al., 2009; Muz and Muz, 2009; Okursoy et al., 2010; Beyazit et al., 2012; Özkırım and Schiessen, 2013).

Nosemiosis are reported in most regions to be present except in desert and poles and more in beekeeping developing and humid areas than others and reported differently depending on geography and beekeepers' breeding conditions in Turkey (Ellis and Munn, 2005). Nosemiosis had been removed in category of WORLD Animal Health (WAHID-OIE) diseases list in 2004, Paris 72 and also it has been removed in 2012 honey bee disease emergency diseases list in General Assembly".

Nosema has been an important one in Marmara and Black Sea regions in some seasons particularly in wet season, spring. This new species in Europe and US, *Nosema cerenae* in recent years has become an important part of CCD (Colony Collapse Disorder) or colony losses in reports and research results had been linked *N ceranae* for colony losses (Higes et al., 2006). This new nosema species *N cerenae* has ben also reported in Turkey recently (Muz and Muz, 2010; Muz et al., 2010; Özkan-Koca et al., 2016). Recently the new Nosema species Nosema cerena has been identified in Turkey and suspected or causes more colony losses than expected (Muz and Doğaroğlu, 2011). *N ceranae* has some symptoms such as diarrhea in bees and dead colonies without seeing dead bees around colonies were called "silent death" by beekeepers. Also it seems that *N apis* is replaced by *N cerenae* (Higes et al., 2006).

Nosemiosis has been found in different rates in different regions and provinces in Turkey in different ratios (Topcu and Aslan, 2004;Aydın et al. 2005; Sıralı and Doğaroğlu, 2005; Simsek, 2005; 2007). Molecular identification of nosemiosis has been done in 2004 (Webster et al., 2004). Molecular identification between *N apis* and *N cerenae* has been performed by PCR-RFLP and by PCR method (Ütük et al. 2010, Muz et al. 2010, Muz and Muz 2010, Özkan-Koca et al. 2016). It has been reported that there was a positive relation with rain and nosemiosis if the nosema spore level is over one million per bee clinical symptoms get very clear and there are more risk of nosemiosis in North and Northwest of Turkey (Bailey and Ball 1991, Traver and Fell 2014). The fumagillin has been used for nosema treatment and since EU has put limits for usage of Fumagillin and menthol, tymol and mixture of these have also been used recently (Doğaroğlu 2008).

Brood diseases have been not investigated sufficiently and might be one of the major factors affecting colony losses in Turkey. Generally brood diseases cause by non-hygienic beekeeping applications and dirty water sources Özakın et al. (2003). New and old foundations were analyzed and 54,5% from old foundations were found to include more than one type of bacteria (total 14) that had been isolated and neither American foulbrood (AFB) nor European foulbrood had been diagnosed. Some similar hygienic problems were determined as a result of unhygienic packaging from honey samples from markets and beekeepers (Özakın et al. 2007). Beyazit et al. (2012) determined 5 (1,27%) AFB (*Paenobacillus larvae*) from 394 apiaries, 4 (1,01%) EFB (*Melissococus pluton*) and 5 (1,27%) chalkbrood (*Ascosphera apis*) isolated and AFB had not been identified from 73 wax foundation from companies.

Foulbrood diseases as European (EFB) and American foulbrood (AFB) has been diagnosed in regions of Turkey. A few cases from apiaries comb with honey bee larva and in honey and bee wax were analyzed and in different regions around the country has been reported (Şimşek and Özcan, 2001; Şimşek, 2007; Dümen et al., 2007; Yalçınkaya and Keskin, 2010). Some researchers even reported 16,6% AFB (Özkırım ve Keskin, 2005; Yalçınkaya ve Keskin, 2010). However other bacterial agents other than European or American foulbrood also cause some damages if not treated properly or without requeening process. Some of these brood diseases caused by unknown reasons such as queen failure that produces not resistant workers to soil bacteria (vanEngelsdorp et al., 2013; Çakmak In Preparation). In Turkey, AFB has been declared mandatory notification by the Turkish Ministry of Food, Agriculture, Husbandry.

Mandatory notification and general quarantine applies and these bees must be destroyed. According to EU laws and in Turkey antibiotic use to control bacterial brood diseases in honey bees has been prohibited.

Chalkbrood and stonebrood are sometimes seen and wax moth might be a serious pest in summer and fall in mostly western part of Turkey. Fungal diseases in honey bees the most common are chalkbrood (*Ascosphera apis*) and stone diseases (*Aspergillus*) in Turkey. Borum (2006) analyzed old foundations and found *Ascosphera apis* %100 and 20% *Penicillium* spp. Even though some medications used for chalbrood diseases (Zeybek, 1991) in recent years instead some practical beekeeping methods have been used with great success such as strong colonies, changing queens from healthier colonies with no chalkbrood history, reducing humidity and stress factors for colonies (Çakmak unpublished data).

Wax moth (G*aleria mellonella)* has been reported in apiaries in Egean region (Beyazıt et al., 2012). However, this may reach to 100% in storage rooms with suitable conditions for wax moth. Recently cold storage rooms have been started to be used to prevent wax moth damage for foundations. Also some plant extracts (walnut, thyme, leaves and etc.) and/or formic acid are used to prevent wax damage to foundation in most areas.

There are some species such as bee eater, wasps (hornets), bee wolves that must be considered serious threat to bee colonies particularly in late summer and fall to decrease the number of bees or entirely decimate the colonies (Çakmak, 1997;Özbek ,2014).

Finally, the future threats as the other mite from South Asia, *Tropilaleps clarea* and Small hive beetle (*Aethina tumida*) have not been reported yet in Turkey and also as a major threat, Asian hornet, *Vespa velutina* has not been notified yet in Turkey.

COLONY LOSSES and Pesticides

Pesticides have been known to affect honey bees in the agricultural fields (Johansen and Mayer 1990). However, the new generation of pesticides, the neonicotinoids have been major concern in recent years. Neonicotinoids affect the insect more than mammalian system and affect insect nervous system. Consequently these new insecticides have been used extensively in most of the world including Turkey and new reports about the effects of neonicotinoids have been emphasized on recent colon losses (Blacquere et al., 2007; Alioune et al., 2009; Bryden et al., 2013; Lui, 2014; Fisher et al., 2014; Report in Turkish Ministry of Food, Agriculture and Husbandry 2014).

The neonicotinoids have been major concern in EU and some neonicotinoid use has been suspended for some years such as in France (Cressey, 2013). In recent years some studies have begun on neonicotinoids including Imidocloprid, Thiometoxan and others in Turkey. Neonicotinoids do not kill the bees in sub-lethal doses but affect the foraging behavior and consequently the food deposited by foraging bees decrease for winter. Also colonies die during the winter by consuming more dosages of neonicotiniods in the hives (Lu et al., 2014; Karahan et al., 2015). Up to 80% colony losses were reported in European part of Turkey in 2007 an also some reports from Egean and Eastern Anatolia (Ünal et al., 2010)

Neonicotinoids have been investigated recently by universities and research Institutes and new data are expected to be seen in the near future.

COLONY LOSSES and Queen Failure and Colony Management

Queen failure (old queen, non-productive or disease sensitive queen) is also one of the major factors affecting colony losses particularly in early spring and late summer. In early spring it is very difficult to requeen colonies due to insufficient drones or low temperature for mating flights. Colony management as adjusting frames of bees inside the hive or adding insulation for temperature security and feeding the colonies are crucial in early spring time. Some colonies die due to a lot of brood frames and insufficient food stores inside the hives (unpublished data).

COLONY LOSSES and Large Scale Migratory Beekeeping

Beekeepers, about over 75% of them, move their colonies three times in a year in Turkey (Güler and Demir, 2005; Yılmaz, 2013). Large scale migratory beekeeping causes a major problem in the long run for colony losses. Because this long distance movement of many colonies around the country

causes genetic pollution and loss of local bee subspecies/ecotypes that are well adapted to ecological factors including various climatic changes and the habitats. Consequently, migratory beekeeping not only causes genetic pollution and loss of important genes but also distribute all resistant varroa mites, other parasites and diseases to other colonies in the areas visited. Therefore, these resistant mites and other agents even treated with very effective chemicals do not die and colonies in winter time die due to high level of infestation/infection. The other reason that is migratory beekeepers lose a lot of colonies because these colonies are not well adapted to the environment and die in winter time mostly (personal comm.). The health of colonies should be inspected before any permission given by authorities for transportation of colonies.

CONCLUSION

The number of colonies has been increasing yearly in Turkey even though honey bee colony losses have been reported in some areas. This is a contradiction. The explanation is that the Ministry of Food, Agriculture and Husbandry in Turkey has increased the financial support to beekeepers for each colony every year and beekeepers have been trying to capture more swarms and making more splits every year. However the net production of honey per colony is in decrease. For example; the production of honey per colony has been decreased from 18 kg to 14 kg recent years (Haygem, 2016).

The ecosystem is so complex and there are a number of factors affecting honey bee colony losses. Even though varroa mite has been the major factor contributing the most colony losses in every parts of the world. It is important to consider chain reactions of many factors in the environment particularly recent insecticides, herbicides and habitat loss of wild bees that provide pollination services of weeds that continuously provide pollen for bees also (Bloch et al., 2015).

The Anatolia as the genetic center of Western honey bee *Apis mellifera* might be holding the solutions for a number of problems in beekeeping in the world. Therefore, it is vital to preserve and protect the native honey bee subspecies or ecotypes in Anatolia to find natural and healthy solutions in the future.

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GENİŞLETİLMİŞ ÖZET

Amaç: Dünyada ve ülkemizde son yıllarda arıcılık konusunda güncel bir konu olan koloni kayıpları ve olabilecek nedenleri konusunda tartışmalı konular bulunmaktadır. Bu konu ülkemizin genel arıcılık durumu ile yakından ilgili bir konu olduğundan ülkemizin genel arıcılık konusu ile birlikte ele alınmıştır. Bu çalışmanın amacı ülkemizde genel olarak arıcılığın durumu ve son yıllardaki arı kayıplarının nedenlerinin açıklanmasıdır.

Tartışma ve Sonuç: Bu derlemede ülkemizde arıcılığın tarihsel kökleri, ülkemizin doğal kaynakları ve arıcılık açısından özellikle ballı bitkilerin çok olması, ülkemizin coğrafik konumu ile farklı topoğrafyası ile en az beş farklı arı ırkına *Apis mellifera; A.m. anatoliaca, caucasica, meda, syriaca* and *carnica*ve çok sayıda bal arısı ekotipine ev sahipiliği yapmasının önemli bir potansiyel olduğu vurgulanmaktadır. Bal ne bal arısı konusunda Kuranda Nahl suresinin 68-69. ayetlerinde bal ve bal arısından bahsedildiği İncil ve Tevrat'da da arı ve baldan bahsedildiği görülmektedir. Dolayısı ile balın çok önemli bir gıda olmasının yanında şifa kaynağı olarak tıbbi yönününde bulunduğu belirtilmektedir.

Koloni sayısı ve son yılardaki Gıda, Tarım ve Hayvancılık Bakanlığının da desteği ile tüm illerde Arı yetiştirici birliklerinin kurulması ve tüm kolonilerin kayıt altına alınarak üretilen ürüne kadar geri gidebilme imkanı sağlanması gibi yenilikler sıralanabilir. Ülkemizde üretilen arı ürünlerinin hem miktar ve hem de çeşitliliğinin artması ve bu arada oldukça çelişkili olan koloni başına verimin hala oldukça düşük olması gibi konular irdelenmektedir.

Ülkemizde 7,709,636 sayı ile koloni sayısının dünyada ilk sıralarda, 56,00 profesyonel arıcı ve 150,000 fazla ailenin arıcılık ile geçinmesi, 107,665 ton bal üretimi ile ülkemizin 10,000 fazla bitki türü ve bunları 3506 sının ülkemize has bitkiler olması ve bunları 500 civarının arıcılık açısından ballı bitkiler grubuna giren ve nektar ve polen açısından zengin bitkiler olduğu görülmektedir.

Bunun yanında ülkemizde arıcılık konusunda hem yaygın olarak bilimsel arıcılık dergiler ve Arı yetiştirici birliklerinin çıkardığı arıcılık dergileri, son yıllarda kurulan arıcılıkta araştırma merkezleri gibi bir çok ilerleme ve yenilikler görülmektedir.

Son yıllarda ülkemizde arıcılık konusunda gelişmelerden biri de arı ürünlerinde çeşitliliğin artması ve yeni ürünlerin artmasıdır. Bunlardan birisi özellikle Apiterapi konusunun giderek daha çok gündeme gelmesi ve uygulama olanakları tartışılmaktadır.

Bunun yanında son yılarda oldukça gündemde olan koloni veya arı kayıpları ve bunların olabilecek nedenleri olarak başta varroa ve diğer parazit ve hastalık etkenleri (Yavru çürüklüğü, nosema yeni türü Nosema ceranae, Marmara Bölgesi'nde bazı yıllar yaygın görülen kireç v.b.) ana arı üretimi ve kolonilerde kullanımı, pestisitler ve özellikle son yıllarda güncel olan yeni nesil neonikotinoid adı verilen insektisitler, koloni yönetimi ve uzun mesafeli gezginci arıcılık gibi nedenler üzerinde durulmaktadır.

Sonuç olarak ülkemizde bir taraftan bal arısı koloni sayısı artarken diğer taraftan bazı bölgelerde önemli koloni kayıpları rapor edilmektedir. Bu bir çelişkidir ve bunun nedeni olarak Gıda, Tarım ve Hayvancılık Bakanlığının giderek artan destekleri ve arıcıların her yıl doğal oğul ve suni oğullarla koloni sayısını artırmaya çalışmasıdır. Bunun yanında ülkemizde koloni başına bal üretimi doğal olarak 18 kg dan 14'e kadar düşmüştür.

Ülkemizde arıcılık konusunda çok önemli bir potansiyel sahip olduğu, batı bal arısının gen merkezi olması ve farklı topoğrafyası ile çok çeşitli ballı floraya sahip olması nedeni ile ve bugün ve gelecekte dünya arıcılığında daha çok önemli olacağı ve bir sorunun çözümünde rol oynayabileceği önerilmektedir.