

BEEKEEPING STRUCTURE, PROBLEMS AND COLONY LOSSES IN THE AEGEAN REGION OF TURKEY

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Abstract

We aimed to determine the socioeconomic structure, colony management practices, colony losses and problems of beekeeping in the Aegean region of Turkey. According to the stratified sampling method, enterprises were divided into five groups according to the number of colonies. We determined that the average age of beekeepers was between 47.1±2.35 years (Group III) and 56.1±3.05 years (Group I). Beekeeping experience ranged from 14.4±2.3 years (Group I) and 26.4±2.91 years (Group V). The wintering losses of the groups between 2009 and 2012 varied from 6.0% (Group IV) to 29.4% (Group I) and the honey yield ranged from 11.4±2.30 kg (Group I) to 21.4±1.38 kg (Group V). The primary problems of beekeepers in the region are overcrowding of migratory beekeepers at certain times of the year, varroa mite and diseases and lower honey prices. In conclusion, a lower education level, an increased beekeeper age, concern about colony management, wintering with weak population and increasing varroa mite and diseases problems due mainly to overcrowding of migratory beekeepers in the region are some of the characteristics of beekeeping in the Aegean Region. These problems can be solved by reorganizing the baiting of beekeepers, providing support only to beekeepers that make a living from beekeeping (Group IV and V) and creating an organizational structure among beekeepers.

Key words: Beekeeping, colony losses, honey yield, problems, questionnaire

INTRODUCTION

Beekeeping contributes to crop production via pollination and is one of the most commonly performed agricultural activities in the world, valued its honey, pollen, royal jelly, bee venom, propolis, beeswax, queens and production of packaged honeybees. According to FAO statistics from 2012, China is the world's beekeeping leader with 8.9 million colonies; Turkey is in second with 6 million colonies. China is also the highest honey-producing country in the world with its production of 446,000 tons. Turkey, the United States and Argentina follow with productions of 94,000, 67,000 and 59,000 tons, respectively [1].

The Aydn province, located in the south of the Aegean region of Turkey, since the first ages, has been an important settlement center because of its fertile soil, favorable

climate and its location on trade routes. Approximately 49% of the territory is cultivated in the province. Olive, fig and orange orchards and cotton fields occupy the lowland; hard-leaved, drought-resistant dwarf shrubs and arbutus, myrtle, laurel, turpentine tree, oleanders and some medicinal plants such as thyme, mint, lavender flowers are also seen. In addition, approximately 38% of the territory is covered by forests, pine, chestnut, sycamore, ash and linden trees, which are seen in the highlands.

Because of the Mediterranean climate and the thick pine forests along the coastal regions, many Turkish beekeepers prefer living in the Aegean region of Turkey to benefit from its rich nectar and pollen sources [2, 3]. When the nectar and pollen sources are exhausted in May in the region, the beekeepers start migrating to the central regions and then to the northern and eastern regions of Turkey during the summer. In September, beekeepers move back to the *calabrian pine* (*pinus brutia*) forests because

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of the rich pine cochineal (*Marchalina hellenica*) in these forests in the Muğla, Aydın and Izmir provinces in the region. In autumn, nearly half of the Turkish beekeepers migrate to the region to winter their colonies there.

The ecological characteristics of the region resulted in the Muğla ecotype of the Anatolian bee (*Apis mellifera anatoliaca*). The Muğla ecotype is also known as the Aegean ecotype. In some studies, it has been reported that the morphological and physiological characteristics of the Aegean ecotype differ from those of other native honeybee genotypes in Turkey [4, 5, 6, 7].

With the goal of attracting many beekeepers to migrate to the south of the Aegean region, it is beneficial to determine the problems, practices in colony management and wintering losses in the region. After the high colony losses seen in recent years in many countries, regular survey studies collecting information about colony losses, current beekeeping problems and drug usage information have become important [8, 9, 10].

Aegean region of Turkey, with its climatic characteristics and rich flower and pine honey sources, is an important locale for migratory beekeepers and merits studies of the socio-economic characteristics, colony management and colony losses in recent years.

MATERIAL AND METHODS

We relied on face-to face meetings with the beekeepers in Aydın province, Turkey. In September and November 2012, we visited 79 beekeepers and collected data via surveys. The questionnaire was composed of 115 questions related to personal, colony management, wintering losses, diseases and varroa mites, marketing and organization. In order to sample, 79 out of the 878 members (of the Aydın Beekeepers Association (9%) were selected according to stratified random sampling. The beekeeping enterprises were divided into five groups according to the colony numbers: 9 beekeepers in group I (<50 colonies), 22 beekeepers in group II

(51–125 colonies), 18 beekeepers in group III (126–200 colonies), 16 beekeepers in group IV (201–350 colonies) and 14 beekeepers in group V (>351 colonies). Chi-square test (Fisher's Exact Test) was used to analyze the data statistically.

RESULTS AND DISCUSSIONS

The first group of beekeepers stated that they generally do beekeeping as a hobby and an interest for meeting the needs of their family and relatives. On the other hand, beekeepers in groups II and III do beekeeping for extra work to increase the income of their family. Approximately 80–85% of beekeepers in groups IV and V stated that they do beekeeping as a profession and added that their main income was beekeeping. In general, approximately half of the beekeepers in all groups were primary school graduates; university graduates constituted only about 4.5% of beekeepers in groups III and IV and 10% of beekeepers in group V. About 70% of the beekeepers specified that the reason they started their beekeeping business was because of their father's occupation.

The family labor contribution to the beekeeping business was very low in group I; the family labor contribution was determined to be about 50% in the other groups. In all groups, the beekeepers found that their knowledge about honeybee diseases was insufficient, but they indicated that they were willing to improve their knowledge about this topic. Half of the beekeepers (52%) acknowledged that their regular source of information was the exchange of knowledge with experienced beekeepers. In addition, books and journals about apiculture were the second source of information (29%) for the beekeepers. Beekeepers in groups IV and V (23%) also used the internet to obtain information about honeybee diseases. The average age, experience and number of family members of the beekeepers were determined to be 50.4 ± 1.20 years, 18.3 ± 1.09 years and 4.0 ± 0.14 persons, respectively (Table 1).

Table 1 Socio-economical structure of beekeeping depending on the size of the enterprises

Group	n	Age (years)	Experience of beekeeping (years)	Number of persons in family
I (<50 colonies)	9	56.1±3.05	14.4±2.24	3.3±0.87
II (51–125 colonies)	22	51.7±2.05	15.5±1.36	3.8±0.24
III (126–200 colonies)	18	47.1±2.35	15.5±2.20	4.5±0.26
IV (201–350 colonies)	16	50.9±3.15	20.4±2.65	3.9±0.30
V (>350 colonies)	14	48.3±2.94	26.4±2.91	4.1±0.35
Overall	79	50.4±1.20	18.3±1.09	4.0±0.14
χ^2		1.877	4.481	2.994
P		0.758	0.345	0.228

The beekeepers generally record the age of the queen and renew the queens in the spring (April–May). The renovation of the queen annually, biennially and triennially occurred in 25.3%, 64.6% and 10.1% of cases, respectively. In addition, the beekeepers said that they acquired queen bees from swarm queen cells or the division of strong colonies.

The local genotype of the region, the Aegean ecotype of the Anatolian bee, predominated among the beekeepers. In addition, the preferences for Italian and Caucasian genotypes increased depending on the increase in colony numbers (13% in group II, 33% in group III, 44% in group IV and 79% in group V).

In all groups, about 80–90% of the beekeepers fed their colonies in autumn and they described that in the first months of autumn sugar syrup and later on sugar cake were provided; about 12% of the beekeepers added vitamins to the sugar cake and sugar

syrup. About half of the beekeepers also fed their colonies in the winter months. Nearly 80% of the beekeepers indicated that before wintering the average number of combs covered with bees was between 2 and 5; they also left 1–2 kg honey on each comb.

The honey yield and sugar consumption averages of the groups are listed in Table 2. We determined that the differences among the group averages in terms of honey yield were statistically significant ($P < 0.01$). The lowest (11.4±2.30 kg) and highest (21.4±1.38 kg) honey yields were found for groups I and V, respectively. Group I was similar to group II, but differed from groups III, IV and V ($P < 0.05$). Group II was also different from groups IV and V ($P < 0.05$). The average sugar consumption among the groups, on the other hand, was found to be statistically similar ($P > 0.05$) and the average sugar consumption per colony changed from 6.5 kg to 7.9 kg.

Table 2 Honey yield (HY) per colony and sugar consumption (SC) of groups per year

	Groups				
	I	II	III	IV	V
HY (kg)	11.4±2.30Aa	14.2±1.25Aa	16.4±1.47ABab	20.0±1.78ABb	21.4±1.38Bb
SC (kg)	7.1±1.40	6.5±1.09	7.9±1.51	7.2±1.13	6.5±1.10

A, B; $P < 0.01$, a, b; $P < 0.05$

The beekeepers in groups I and II usually stopped over within the boundaries of Aydin

and Muğla provinces over the entire year, but groups III, IV and V typically changed their

locations 4–5 times per year. Beekeepers in groups III, IV and V moved to the north of the Aegean region and the central Anatolia region; sometimes, they went to Thrace to benefit from the sunflower honey. While groups I, II and III harvest honey once or twice per year, more frequent harvests (three or four times per year) were conducted by beekeepers in groups IV and V. The beekeepers in all groups stated that they produced both flower and honeydew honey. In addition to honey production, 15–20% of beekeepers in groups II and III groups, and 45% of beekeepers in groups IV and V produced pollen as well.

All of the beekeepers indicated that they can identify the varroa mite, American and European foulbrood diseases and the greater wax moth (*Galleria mellonella*). Except for group I, all beekeepers can identify the chalk brood, bee paralysis, nosema and wax moth; in group I, only 50% of beekeepers can identify these diseases. Since 90% of all beekeepers struggle with the varroa mite, they generally employ drug to combat the mites. However, 10% of beekeepers prefer to use an organic

acid (formic acid, oxalic acid, etc.). All of the beekeepers indicated that they struggle with varroa mites four times per year. The average wintering losses from 2009–2010 to 2011–2012 are listed in Table 3.

We determined that the highest colony loss in these three wintering seasons was group I (16%), and the lowest loss was for group IV group (7.6%). The beekeepers' proposed reasons for colony losses included the varroa mite (56.9%), poor colony population (44.3%), climatic conditions (31.6%), diseases (31.7%), colony management problems (22.8%), queen loss (16.5%) and starvation (12.5%).

Beekeepers generally market their honey wholesale within a tin (about 27 kg of honey) to merchants or mediators at a price of about 90 US\$ per tin. Only 10% of the beekeepers market their honey in the jar. Beekeepers propose that the main problems with beekeeping in the region include the varroa mite, accommodation problems, the low price of honey, the cost of moving colonies, diseases, inadequacy of government promotion and subvention.

Table 3 Winter colony losses of the groups (%)

Years	Group					Overall
	I	II	III	IV	V	
2009–2010	7.2	10.0	8.7	6.0	7.5	8.2
2010–2011	11.4	11	8.6	7.0	8.7	9.3
2011–2012	29.4	12.4	12.8	9.8	11.4	13.8
Overall	16.0	11.1	10.1	7.6	9.3	

In this study, even though the average ages of beekeepers in the different groups were similar, the number in the groups decreased as the colony number increased, but the experience of the beekeepers increased. Beekeepers in groups IV and V (colony numbers between 200 and 500) acquired beekeeping as a profession, producing flower and pine honey and pollen; these individuals also want to improve their knowledge about the varroa mite and diseases.

In this study, even though changing the queen every two years is accepted as a good

practice, the higher migration rate seen in groups IV and V results in aging queen bees quickly because of their higher rates of egg-laying almost over the course of the entire year. Due to the higher migration rate seen in groups IV and V, changing the queen honeybees every year may be advised.

In order to increase honey production, beekeepers in groups IV and V try to use different genotypes (*Caucasian* and *Italian*). Recently, some beekeepers tried using *Carniolan* honeybees in production and others were willing to try this honeybee, too.

This pattern shows that some beekeepers imitate the practices of others, which is a typical traditionalist structure among beekeepers in many regions. During the production period, the beekeepers in Turkey start moving all over Turkey, from the Aegean and Mediterranean regions to the central and eastern Anatolia regions and then they come back to the Aegean region again. The beekeepers in groups IV and V observed that the performances of *Caucasian* and *Carniolan* honeybees in central Anatolia, eastern Anatolia and the Thrace region exceeded those of the Aegean ecotype. This observation, explained by the beekeepers in this study, supports the idea that a genotype cannot be expected to provide satisfactory results in all regions [11].

In recent years, one of the most important issues all over the world has been wintering losses in beekeeping. In this survey, we noted that wintering losses (between 6% and 29%) increased as the year advanced (Table 3). This result is in agreement with a study conducted in the Aegean region by [12]. However, for the Aegean region, reported a higher mortality rate than was found by our study [13].

The main reasons for the high mortality rates could include the varroa mite and diseases resulting from the intensive migration rate and the closed architectures of the bee yards. Furthermore, wintering weak colonies, more sunny and warm days and high differences between the day and night temperatures in winter (which causes the winter cluster narrowing and expansion) and also early physiological aging because of the larger number of daily flights in winter may be responsible [13, 14, 15]. It was found a strong correlation ($r = -71$, $r = -69$) between over wintering ability of colonies and the varroa mite infestation rate [16].

Wintering losses in this region may not be a real problem for beekeepers compared with beekeepers in the United States and other countries. However, in some periods of the year in which the herbicide usage is high in intensified agriculture, an increased mortality rate is typically observed.

One of the most important problems that the beekeepers mentioned was the accommodation locale and the closed nature of the apiaries during accommodation. Especially in the honeydew flow time, overcrowding of migratory beekeepers in the region increases these problems and creates negative effects for the local beekeepers. Overcrowding in the region results in sharing nectar resources, feeding colonies frequently and increasing the likelihood of contamination from rapine, varroa mites and diseases. As a result, the productivity of colonies decreases. In Turkey, there are approximately 7 colonies per square kilometer. At certain times in the Aegean region, however, because of the high migration rate, the colony density increases. However, in Canada and Australia, where the most honey is produced per colony, the number of colonies per square kilometer is far below one [2].

CONCLUSIONS

In conclusion, the rich nectar sources (pine forests and flowers) and mild climatic conditions made the Aegean region a center of attraction for beekeepers. The migration of a significant number of beekeepers to certain places in the region irregularly results in important problems such as accommodation, crowded bee yards, varroa mites and diseases and also results in shortages of the nectar resources. In addition, intensive pesticide usage in industrial agriculture in the lowlands and weak colony wintering because of mild winters in the region sometimes results in high colony losses in the region. In order to address the problems plaguing beekeepers in the region, reorganizing the baiting of beekeepers, providing support only to the beekeepers make a living from beekeeping (groups IV and V) and creating an organizational structure among beekeepers are suggested.

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