MELLIFERA RESEARCH ARTICLE

Apis mellifera Keeping in Mila District from Algeria: Colony Management and *Varroa destructor* Control Practices

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A B S T R A C T

This study was carried out to evaluate the level of beekeepers knowledge and to determine the current state of Varroa destructor infestation and treatment strategies used for its control among different groups of beekeepers. A questionnaire was also conducted to investigate management practices among 41 beekeepers during April- May 2018 in Mila district, northeastern of Algeria. It was found that 53.65% of beekeepers are between 20 and 40 years old, 46.34% have a secondary school level, and 19.51% have a university level. This is considered a constraint to the development of this activity. Most of the beekeepers have 30 to 100 beehives (41.46%) and often exercise transhumance (80.48%). The renewal of the hive is periodic according to the professional experience and the technicality, the majority of whom are artificial swarming (82.92%). Statistical analysis revealed a large difference in the behavior of apiaries ($p < 0.05$). Losses of colonies are reported by 62% of beekeepers. The mortality in front of the hives is declared by 73.17% beekeepers. For monitoring and screening of varroa infestation, 39.02% of beekeepers never followed up. This screening is often carried out at the end of the season (36.58% after treatment). More than half of beekeepers practicing screening (60.97%) monitor natural mortalities. Thus, 43.90% of these beekeepers examined less than 20% of the colonies. This study visualizes a critical situation of beekeeping in this region, which needs an adequate strategy to develop it.

Keywords: Algeria, beekeeping management, honey bee, sustainable development, *Varroa destructor*

Introduction

The bee constitutes an essential element of the environmental balance in the world as a pollinator of very many plant species. It also has other interests including the production of honey, propolis, royal jelly, and wax. Over the past decade, several testimonies and press articles have reported an unusual weakening and mortality of bee colonies in several countries of the world [1]. Colony Collapse Disorder (CCD) remains poorly understood by scientists and beekeepers and is often unexplained. The health of the bee has become a real challenge to the development of beekeeping and the conservation of this species of multiple interests. The health of the bee has become a real challenge with annual declines and colony losses for more than a decade. Many environmental and chemical factors and biological pathogens can be blamed as the cause of colony loss [2].

The number one suspect for CCD is, without question, *Varroa destructor*, not only in Algeria but also in several countries of the world such as the United

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States, Austria, Luxembourg, Lichtenstein, and Canada [3]. *Varroa* mites are an external parasitic hematophagous of bees [4]. It parasites not only adults but also brood, with a clear preference for the larvae of false bumblebees [3]. Originally parasitic of *Apis cerana*, it has long since started to adapt its life cycle to that of *Apis mellifera* [4]. It sucks the hemolymph of the bee and transmits to it, by the same token, several diseases, such as the virus of deformed wings, the fungus causing plastered brood, and the virus of acute paralysis of bees [5]. In addition, it weakens the bee's immune defenses, making it even more vulnerable to attack by other parasites, bacteria, or fungi. Studies have also shown that the presence of *Varroa* in a colony reduces the weight and life expectancy of bees by 30%. Other research has shown that in parasitized bees, there is a reduction in fatty substances that are used to store proteins, especially useful during the winter period. Beekeepers have several means of combating varroasis, but it is mainly acaricides such as coumaphos and fluvalinate that have proved their worth [6].

In Algeria, there are few studies and surveys on the situation of bee colonies, although, for several years, phenomena of abnormal mortality have often been reported by beekeepers. Several questions are worth asking; How to assess the losses of local bee colonies? What are the risk factors and what can be their interactions with the honey bee about the reported losses?

This study aimed to clarify the existing relationships between the various factors which harm the health of the local honey bee *Apis mellifera* intermissa and interfere with the development of this sector and to provide answers to the previous questions by a field survey in the region of Mila, northeastern Algeria.

Materials and Methods

In determining the number of beekeeping enterprises to be surveyed in the study. Although N is known, indicating the total number of enterprises, in cases where standard deviation and variance values cannot be determined, the following "equality-1" was used, which is included in the Simple Random Sampling and whose details are described by Yamane [7]. Accordingly, in 2018, 41 beekeeping

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enterprises among 126 enterprises engaged in beekeeping in Mila district were identified and a face-to-face survey was conducted with these owners. The required sample size was calculated according to the following formula:

$$\mathbf{n} = \frac{[\mathbf{N} \times \mathbf{t^2} \times \mathbf{p} \times \mathbf{q}]}{[(\mathbf{N}-\mathbf{1}) \times \mathbf{D^2} + (\mathbf{t^2} \times \mathbf{p} \times \mathbf{q})]}$$

Where;

n = number of samples

N = cluster size

D = accepted or desired sampling error

t = table value

p = the rate to be calculated

q = 1-p

A written questionnaire was chosen as an information evaluating tool on bee diseases from the interviewed beekeepers. The advantage of this method is that it allows collecting a large amount of information in a short time. For the sake of brevity, we have privileged direct questions.

Several axes were developed in the questionnaire and each axis was devoted to obtaining particular information about;

1. The beekeeper (age, school level) and the apiary (number of hives);

2. The conduct of apiaries (type of breeding and renewal of hives);

3. The symptoms observed by the beekeeper on the bees and on the brood, colony losses and their season of observation;

4. The screening and monitoring of varroa infestation;

- Screening practices (yes/no)
- Difficulties to screening and monitoring (timing and practices)
- Monitoring objectives (the need or the evaluation of treatment)
- Different times of screening (beginning (February-March) or end of beekeeping season (end of July-September)

5. The practices and behavior during the detection and monitoring of varroa infestation;

- Screening and follow-up method (Washing bees with alcohol, Uncapping of worker brood, Uncapping of male brood, Natural mortality monitoring of varroa)
- Number of colonies to be screened (Less than 20%, Between 20 and 30%, More than 30%, 100% of colonies)
- Natural mortality monitoring (Greased diaper, ungreased diaper)
- To behave (Depends on number of colonies and infestation rate, Change the treatment strategy, Consider and / or maintain treatment)
- Methods used for control (Division of colonies, Male brood trapping, Use of natural medicinal products, Use of veterinary products).

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The data obtained from the survey are made ready for analysis with Microsoft Excel spreadsheet. Findings are expressed as frequencies and percents for features that can be counted and summarized in two-dimensional tables. The Chi-square test was used in the analytical evaluation.

Results and Discussion

It has been found that most of the beekeepers surveyed are between 20 and 40 years old. Regarding the literacy level, 46.34% of the beekeepers have a secondary school level, and only 19.51% have a university-level. This is considered a constraint to the development of this type of breeding in our country. Most of the beekeepers have 30 to 100 beehives (41.46%) and often exercise transhumance (80.48%).

The renewal of the beehive frames is periodic according to the professional experience and the technicality of the beekeepers, the majority of whom do artificial swarming (82.92%) (Tab. 1).

Table 1. Analysis of apiaries and their behavior.

Category	Frequency (%)	P-value	Category	Frequency (%)	P-value
Age			**Type of bees breeding**		
20 to 40 years	22 (53.65)	0.011*	Sedentary	8 (19.51)	< 0.000**
41 to 60 years	12 (29.26)		Transhumant	33 (80.48)	
Over 60 years	7 (17.07)		**Renewal bees approaches**		
School-level			Purchase of swarms	7 (17.07)	< 0.000**
Primary	4 (9.75)	0.018*	Artificial swarming	34 (82.92)	
Medium	10 (24.39)		**Season of losses**		
Secondary	19 (46.34)		Summer	7 (17.07)	0.000**
University	8 (19.51)		Spring	8 (19.51)	
Hives number			Winter and autumn	26 (63.41)	
Less than 30	13 (31.70)	0.009**			
30 to 100	17 (41.46)				
101 to 200	6 (14.63)				
Over 200	5 (12.19)				

*—significant; P-value is significant at $P \leq 0.05$; **— Very significant; P-value is very significant at $P \leq 0.01$

The results show that only 12.19% of beekeepers have more than 200 hives. Most of the beekeepers have secondary activities, and that beekeeping is practiced by a very large number of amateurs, who have a technical level, often, insufficient.

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The technical quality of beekeepers can be considered as one of the causes of disease occurrence as well as its frequency in the different regions. The majority of beekeepers (83%) rely only on artificial swarming to enlarge their apiaries. This reproductive technology has an impact on the sensitivity of hives to certain pathogens [8, 9], as well as on the transmission of diseases [10]. The disease can be transmitted by an alternative between two modes, a vertical transmission between one of the parents of the first generation towards the descendants, this mode of transmission is considered to be the least virulent with little impact on the physical conditions of the host [10], a horizontal transmission can occur between individuals in the same colony and between individuals in different colonies. The latter mode is the most dangerous [11]. The horizontal transmission can be ensured by the transhumance of the apiaries. In this study, it was noted that 79% of the apiaries in the study area are transhumant.

In addition, Chahbar [12] reported that regions, which are characterized by high beekeeping production, are also characterized by a high transhumance frequency. Transhumance (migratory beekeeping) is an important factor in the spread of beekeeping diseases according to Fernandez and Coineau [13].

Losses of colonies are reported by 63.41% of beekeepers, during the winter and fall periods (Tab. 1). These beekeepers recorded the presence of Colony Collapse Disorder (CCD) symptoms with a high rate, including mortality near or in the hives (Tab. 2). The different characteristics of the studied beekeeping farms influence significantly the efficiency of beekeeping management in these farms ($p<0.05$).

The losses of the colonies in the world are considerable. Europe was one of the first continents to worry about excess bee mortalities [2]. The highest mortality rates were observed during the winter period [14]. High winter losses, between 20% and 50%, have been reported in some countries of the world, such as Italy [15]. In contrast, winter loss rates were acceptable in other countries, which were reported at 10% in Bulgaria [16].

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Table 2. Bee symptoms and behavioral changes observed by beekeepers.

Symptoms	Frequency (%)
Dead bees in the alveoli	27 (65.85)
Deformed wings	9 (21.95)
Bee aggressiveness	25 (60.97)
Mortality at the bottom of the hive	7 (17.07)
Irregular egg-laying	21 (51.21)
Mortality in front of the hive	30 (73.17)
Cluster mortality	17 (41.46)

Table 3. Analysis of screening and monitoring of varroa infestation.

Category	Frequency (%)	P-value	Category	Frequency (%)	P-value
Screening practice			**Monitoring objectives**		
yes	25 (60.97)	0.071	Assess the need for treatment in winter	05 (12.19)	0.009**
no	16 (39.02)		Assess the need for treatment in summer	12 (29.26)	
Screening and monitoring challenges			Evaluating the effectiveness of a treatment	24 (58.53)	
It takes time	09 (21.95)	0.045*	**Monitoring time**		0.198
We don't know how to do it	17 (41.46)		Early winter	07 (17.07)	
No use	04 (9.75)		Start of season	09 (21.95)	
What is about it?	11 (26.82)		End of the season before treatment	10 (24.39)	
			End of the season after treatment	15 (36.58)	

*—significant; P-value is significant at $P \leq 0.05$; **— Very significant; P-value is very significant at $P \leq 0.01$

In this study, we asked beekeepers about the all four seasons losses, because winter losses alone do not provide a complete picture of annual losses. However, summer losses are low, less than 5%, or higher and vary depending on region and year [15]. In the United States, in 2012–2013, beekeepers who observed the symptoms of Colony Collapse Disorder in their apiaries, with inexplicable bee mortality, lost many more colonies compared to beekeepers who did not observe CCD signs in their apiaries [17].

In Algeria, five bee diseases appear on the list of animal diseases with a compulsory declaration, fixed by executive decrees n ° 95-66 of March 15, 2006, modified and supplemented. These are varroasis, rags, nosemosis, acariasis and infestation of the hive by the beetle *Aethina Tumida*. Despite the absence of real data on colony losses in Algeria, a previous survey revealed that

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most beekeepers reported mortalities of more than 10% in 2011 [18].

In our survey, we highlighted the role of the parasite *Varroa destructor* as an agent mainly suspected in the mortalities observed, according to the signs recorded and the detection of the parasite by beekeepers. *Varroa destructor* has existed in Algeria since 1981 [19]. This mite caused a lot of damage in the apiaries of the country, despite the treatments carried out by beekeepers declaring mortalities of more than 10% [18]. According to a field survey carried out in 2009 by the National Institute of Veterinary Medicine (INMV) of Algeria, varroasis remains one of the main pathologies that affect beekeeping farms. It is widespread in all the regions studied and present in 100% of the sampled hives, followed by nosemosis with a lower number of outbreaks. Other bee diseases remain less reported.

For monitoring and screening for varroa infestation, about 39.02% (n=16) of the beekeepers surveyed never followed up, allowed them, and 26.82% of them do not know what it is (Tab. 3).

This screening is often carried out at the end of the season after or before treatment. A total of 58.53% of beekeepers practiced monitoring to ensure the effectiveness of a given treatment. Also, for 12 beekeepers (29.26%), monitoring is used to assess the need to treat at the start or end of the season (Tab. 3). The uni-varied analysis of the data from the screening procedure showed that the objectives set differ significantly ($p<0.05$).

A good understanding of the population dynamics of *V. destructor* within bee colonies is essential for the development of new methods of pest control and the application of recommended strategies. The first thing to keep in mind is that varroa population's increase throughout the season as soon as the brood is present in the colony, thus allowing the founder females to reproduce. Thus, following the infestation of a new colony by the varroa mite, the latter can grow until reaching a disproportionate population in just a few years [20]. *Varroa* population growth is influenced by the characteristics of the parasite, such as its reproductive capacity and longevity, as well as by its host, including the size of the bee colony, the presence of brood (workers or males), swarming, and hygienic behavior. Other factors, such as the time of year, the climate, and the presence of bee pathogens also influence the development of mites in the colony [20].

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Varroa screening allows beekeepers to estimate the population of mites parasitizing a colony and to apply the best suited control strategy to their situation. This is an essential step in pest control in beekeeping, which allows, in particular, to know the level of parasitism in a colony before and after treatment. Thus, precise monitoring and a good knowledge of the levels of infestation are the basis of an adequate integrated pest management strategy.

More than half of beekeepers practicing screening (60.97%) and follow up on natural fall, others (21.95%) have used male brood uncapping to assess the degree of infestation. The two procedures for monitoring natural varroa mortality have been reported in Table 4.

Thus, 43.90% of these beekeepers examined less than 20% of the colonies, on the other hand only 5 beekeepers (12.19%) detected more than 30% of colonies. Generally, *Varroa* screening is best when carried out at least four times during the year [21]. Among the screening methods described in the literature, the alcohol washing method and that of powdered sugar (icing sugar) are the ones that provide the most reliable estimates of varroa populations according to The Honey Bee Health Coalition [21]. These two methods consist of removing phoretic varroa mites from the body of adult bees and counting mites to establish a percentage of infestation (number of varroa mites / 100 bees). The main difference between the two methods is that powdered sugar is not lethal to bees, which means that bees can be returned to the hive after screening. On the contrary, the use of alcohol implies that the bees sampled will be sacrificed.

Giovenazzo [22] having demonstrated that screening by natural fall of varroa is the most precise method to estimate the mites population in colonies. Natural fall on self-adhesive cardboard is the most sensitive of the screening methods in a colony with or without brood [23]. This method does not allow a percentage of infestation to be calculated, however, the natural fall of parasites is strongly correlated with the total number of varroa mites in the colony [24]. It is a simple, precise method and does not require the opening of the colony. On the other hand, the hive requires a major modification (anti-varroa plate) and two consecutive visits. Also, ethanol washing is a method of monitoring bee infestation level. Bees (about 200 bees) are collected from the brood chamber frames and placed in a jar containing 250 mL of ethyl alcohol [25]. This method is

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inexpensive, fairly precise, and is done in one visit to the apiary. On the other hand, it requires the opening of the colony and the sacrifice of a few hundred young bees.

In Quebec beekeepers, the detection of varroasis is done mainly by the method of natural fall and, to a lesser extent, by the method of washing with alcohol [26]. Other screening methods are sometimes used by beekeepers, but these often prove to be less effective, less precise, or less constant [27, 28]. Among these, note the ether rolling method, which only detects 50 to 60% of varroa mites present, and the examination of the brood of bumblebees, the results of which are difficult to interpret as a percentage of infestation [21].

If the infestation rate is above average, 73.17% of beekeepers plan and/or maintained treatment for varroa mites. Ten of them (24.39%) used natural products such as garlic, thyme, and figs without using chemicals or veterinary drugs. Others beekeepers (63.41%, n=26) used two products; Apivar (sold in the form of resin pads. It is composed of Amitraz (0.5g / strip)) and a second product which is composed of natural herbs and derivatives of vegetable oils which directly affect the life cycle of the parasite called Menthocaros, it is mainly composed of Thymol (26%) and Eycalypyol (22%). No information about the frequency and duration of use of these products was collected. It must be scientifically reasoned and carried out by zootechnical, biotechnical, and medicinal means [1]. The simplest, most effective, and most used treatment at present is the Apivar® [29].

Thus, according to Quebec standards, treatment should be applied if the number of varroa mites per sticky carton is equal or greater than one mite per day, in spring and fall. During the summer, additional treatment is recommended if the daily fall of varroa mites is between 10 and 25 mites and this treatment becomes necessary if the daily fall is equal or greater than 25 mites [30]. Furthermore, although the densities of varroa mites may vary from one colony to another, all the colonies in the same apiary should be treated at the same time and with the same method of control, whether chemical or not [21]. This recommendation aims to avoid the parasite drifting from the untreated colonies to the treated colonies [31].

Most beekeepers (84%) observed symptoms of varroasis during the season (Tab. 4). It seems that beekeepers take significantly different measures and practices ($p<0.05$), which interferes with the income of beekeeping farms and their

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continuity in terms of sustainable development.

There are beehive management approachs that vary significantly from one beekeeper to another, revealing heterogeneity of beekeeping practice, which influences the sustainability of apiaries in terms of communicable diseases between apiary due to the lack of effective trade and sales control measures. The choice of a varroa control method depends on several factors, including the time of year, the presence of brood or honey spikes, the temperature, the production management (conventional or organic), the products used in subsequent years, etc.

Table 4. Behavior characteristics during screening of *Varroa* infestation**.**

Category	Frequency (%)	P-value	Category	Frequency (%)	P-value
Screening and follow-up method			**To behave**		
Washing bees with alcohol	2 (4.87)	0.000**	Depends on the number of colonies and infestation rate	7 (17.07)	< 0.000**
Uncapping of brood brood	5 (12.19)		Change the treatment strategy	4 (9.75)	
Uncapping of brood male	9 (21.95)		Consider and / or maintain treatment	30 (73.17)	
Natural mortality monitoring	25 (60.97)		**Control methods**		
Number of colonies to be screened			Division of colonies	1 (2.43)	0.001**
Less than 20%	18 (43.90)	0.010*	Male brood trapping	4 (9.75)	
Between 20 and 30%	14 (34.14)		Use of natural medicinal products	10 (24.39)	
More than 30%	5 (12.19)		Use of veterinary products	26 (63.41)	
100%	4 (9.75)				
Natural mortality monitoring					
Greased diaper	32 (78.04)	< 0.000**			
Ungreased diaper	9 (21.95)				

*—significant; P-value is significant at P ≤ 0.05; **— Very significant; P-value is very significant at P ≤ 0.01

Chemicals registered in Canada for the control of varroasis include synthetic acaricides (amitraz, tau-fluvalinate, coumaphos, and flumethrin), organic acids (formic acid and oxalic acid), and essential oil (thymol). Certain plant extracts as well as other organic acids and essential oils have also been tested and demonstrate variable effectiveness against varroa mites, effects sometimes harmful for bee and human health [32, 33, 34].

Oxalic acid is effective on phoretic mites only. To obtain maximum effectiveness, it must be used during a period of absence of brood. So the use of oxalic acid is favored in the regions where there is a stop of the

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laying during the year. This is the case in temperate regions in autumn and winter. Thymol is fat-soluble and it binds and collects in wax. However, it degrades between treatment periods. Bees can withstand the concentration of thymol they emit very well, while it turns out to be very toxic to *Varroa*. These treatments are simple, quick, and effective. They have been the subject of several research studies aimed at testing their effectiveness in different beekeeping conditions. In general, these works show an efficiency which varies between 54% and 98%. The highest efficiencies are obtained when the temperatures are between 15 °C and 25 °C and when the brood is absent [35, 36].

Although the means of combating varroasis are numerous, beekeepers in Mila district prefer to use artisanal devices based on strips impregnated with tau-fluvanilate and amitraz. These strips are introduced into the colonies and left for several months. The active ingredient circulating in the colony is very concentrated at the start, whereas, after a few weeks, there is practically nothing left. There is, therefore, the first overdose, then underdosing [37]. These conditions are known to develop the phenomenon of resistance which has been reported in various countries about several active substances, such as amitraz, flumethrin, fluvalinate, and coumaphos [38]. Due to the unavailability of other approved products on the market, the drawbacks of applying traditional treatments, are linked to their low efficacy and the risk associated with the presence of residues in beehive products [18].

It is now widely recognized that integrated pest management is the best approach to control varroasis in beekeeping. This approach relies on the integration of a set of proactive, non-chemical, and chemical methods, which offers beekeepers the best strategy to control the parasite and limit damage to colonies [21, 24]. Among other things, these tactics are aimed at controlling densities of mites before they threaten the productivity and survival of colonies, rather than responding after the damage has occurred.

An integrated varroa control strategy, therefore, includes the following aspects: 1) frequent and rigorous surveillance of varroa populations to detect colonies requiring control and to assess the effectiveness of the treatments used; 2) the use of cultural and physical practices to curb the growth of varroa populations; and 3) a rotation of the chemicals used which

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takes into account the population dynamics of mites and bees and which minimizes the development of varroa mites resistance to chemical miticides [21].

Conclusions

Modern beekeeping requires precise monitoring of the colonies to be able to decide, in an increasingly difficult and changing context, of the actions to be carried out according to the objectives and orientations of each beekeeper (level of intensification of honey production, time available for tracking bees, costs, etc.). Unfortunately, academics practicing beekeeping in Algeria are relatively few, which represents another constraint that can disadvantage the development of this type of breeding. We have found that beekeeping is practiced by a very large number of amateurs. Consequently, the level of technicality is insufficient and the good beekeeping practices applied are limited. It is very difficult to blame a single cause for bee colonies loss. Risk factors are multiple and often interact. The beekeepers questioned declared the presence of CCD symptoms with high rates.

Screening and monitoring the *Varroa destructor* infestation fits completely into this context and can provide healthier colonies capable of reproducing faster and better survival in winter.

As we have shown previously, it is true that screening takes time and is not totally reliable, but some techniques and tools make it possible to optimize the time spent and to carry out quality monitoring. Degradation of the ecosystem (decrease in honey flora) and climate change influence the development of hive management. All of these threaten the local bee and negatively affect honey production. This forces us to establish national surveys over several years as part of a beekeeping sector observatory, to allow us to obtain rigorous monitoring of loss rates and to try to understand the causes and guide experimental scientific work, through laboratory analyzes of pathogens present in apiaries. Likewise, it is important to carry out toxicological analyzes and to look for residues of all kinds, in particular heavy metals, in the products of the hive, throughout the season.

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Cezayir'in Mila Bölgesi'nde Arıcılık: Koloni Yönetimi ve *Varroa destructor* Kontrolüne Yönelik Uygulamaları

Bu çalışma, arıcıların bilgi düzeyini değerlendirmek ve *Varroa destructor* istilasının mevcut durumunu ve farklı arıcı grupları arasında kontrol için kullanılan tedavi stratejilerini belirlemek amacıyla yapılmıştır. Cezayir'in kuzeydoğusundaki Mila bölgesinde Nisan-Mayıs 2018 döneminde 41 arıcı arasında yönetim uygulamalarını araştırmak için bir anket düzenlenmiştir. Arıcıların % 53.65'inin 20-40 yaş aralığında, % 46.34'ünün ortaokul ve % 19.51'inin üniversite düzeyinde olduğu tespit edilmiştir. Eğitim seviyesi, arıcılığın gelişiminde bir kısıtlama olarak öne çıkmıştır. Arıcıların çoğu 30 ila 100 arı kovanına sahiptir (% 41,46) ve genellikle yaylacılık yapmaktadır (% 80,48). Kovanın yenilenmesi, mesleki tecrübe ve teknik arıcılık bilgisinin seviyesine paralellik göstermektedir ve katılımcıların çoğunluğu (% 82.92) yapay oğul verdirme eğilimindedir. İstatistiksel analiz, arı kovanlarının davranışında büyük bir fark olduğunu ortaya koymuştur ($p < 0.05$). Arıcıların % 62'i koloni kayıpları rapor etmektedir. Arıcıların % 73,17'i ölümlerin kovan önlerindeki ölü arılar şeklinde olduğunu beyan etmektedir. *Varroa* istilasının izlenmesi ve taranması için, arıcıların % 39.02'i hiçbir zaman takip yapmadıklarını ifade etmişlerdir. Taramalar genellikle sezon sonunda yapılmıştır (% 36,58 oranında tedaviden sonra). Tarama yapan arıcıların yarısından fazlası (% 60,97) doğal ölümleri gözlemlemektedir. Dolayısıyla, düzenli tarama yapan arıcıların % 43,90'ının kolonilerin % 20'inden azında tarama yapmaktadır. Bu çalışma ile bu bölgede, koloni yönetimi ve *Varroa destructor* kontrolüne yönelik uygulamaları geliştirmek için uygun bir stratejiye ihtiyaç duyulduğu saptanmıştır.

Anahtar kelimeler: Cezayir, arıcılık yönetimi, bal arısı, sürdürülebilir kalkınma, *Varroa destructor*

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