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ESTIMATE THE LOSSES OF HONEY BEE COLONIES AND THEIR POTENTIAL CAUSES WITHIN THE BEEKEEPERS AT NEW VALLEY GOVERNORATE DURING TWO YEARS SURVEY BY USING QUESTIONNAIRE METHOD.

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ABSTRACT

Estimate the losses of honey bee colonies are an important measure of honey bee health and productivity. This study records the data of two years, 2011/2012 and 2012/2013 survey of losses in managed honey bee colonies in New Valley Governorate. The survey of colony losses and potential causes was obtained via questionnaire method. The surveyed beekeepers had loss a total of 373 colonies between September and March each year. Colony loss percentages were 35.5% in 2011/2012 and 38.8% in 2012/2013. Survey information indicated that colony losses range widely depending on the operation size of the beekeepers. Hobbyist beekeepers (≤ 15 colonies) and intermediate beekeepers (16-50 colonies) lost the lower number of colonies as compared to semi-commercial beekeepers (those operating more than 51 - 100 colonies). Oriental hornets, starvation, Varroa mite, CCD-like symptoms and poor quality queens were the leading self-identified reasons of losses as reported by most beekeepers. Finally, it must circulate such as this questionnaire over all Egypt to understand the extent of the problem and try to find out the resolve.

Keywords: Honey bee, *Apis mellifera*, colony loss, mortality, oriental hornets, poor quality queens, New Valley , questionnaire.

INTRODUCTION

New Valley is located in the southwestern part of the Arab Republic of Egypt is bordered to the Governorates of El-Mania, Giza, Marsa Matrouh, bounded on the east of Assiut, Sohag, Qena and Aswan, bounded to the west and Egypt's international borders with Libya, and is bounded to the south Egypt's international borders with Sudan. Covers an area of 440,098 km² to maintain the equivalent of 44% of the total area of the Arab Republic of Egypt. The local pure honey bee, *Apis mellifera carnica* which reared in Dakhla oasis (isolated area) are very important, it’s considered as a source of pure queens in Egypt. There are 115 apiary contain of 30-50 colonies. The distance between of these villages was 110 km, approximately.

Indeed, honey bees are the most economically valued pollinators and it is estimated that 35% of human food consumption depends directly or indirectly on insect mediated pollination (Delaplane and Mayer, 2000). Beekeepers in New Valley Governorate have recently been confronted with unusually high losses of colonies. Wintering mortalities are well known to beekeepers, twenty years ago; it was acceptable to have 5 to 10% winter colony losses. Today, the losses are often up to 20% or more in many areas.

The other expected losses can be expectable. There have been unexpected and alarming colony losses in different regions of the world in the past few years (Oldroyd, 2007, EFSA, 2008 and Van-Engelsdorp *et al*., 2008).

Elevated colony losses have recently been reported from Europe (Crailsheim *et al*., 2009), USA (Van-Engelsdorp *et al*., 2009 & 2010), Middle East (Haddad *et al*., 2009, Soroker *et al*., 2009 and Abdel-Rahman & Moustafa, 2012) and Japan (Guttierrez, 2009).

Many well intentioned suggestions as to the possible causes of colony losses including such improbable ideas as mobile telephones, genetically modified crops and nanotechnology, have perhaps overshadowed the more much explanations such as pests and diseases, pesticides, loss of forage and beekeeping practices. Lack of hard field data on losses, limits a better understanding of the causative factors (Neumann, 2008).

The aim of the present study was to investigate the extent of colony losses problem and point out potential causes.

MATERIALS AND METHODS

This study was carried out in New Valley Governorate. The surveying of honey bee colony losses carry out during two periods of September 2011 to March 2012 and from September 2012 to March 2013, respectively.

Questionnaire Method was used to survey the colony losses and potential causes by meetings; 36 beekeepers at the respective years of study. Questionnaire form contained mainly the following questions:

1- In what district do you keep your hives?

2- How many colonies did you have alive in September?

3- How many colonies did you have alive until next March?

4- To what do you attribute the following cause(s) of death for the colonies that died?

(Oriental hornets, *Vespa orientals* attack, American foul brood, Starvation, Poor queens, weather, Varroa mite, *Varroa destructor*, Pesticides poisoning, phenomenon of Colony Collapse Disorder (CCD) – like symptoms, Management or Others).

In order to compare possible differences in colony losses among different sizes of operation, the beekeepers were arranged into three groups namely; hobbyist beekeepers (≤ 15 colonies), intermediate beekeepers (16-50 colonies) and semi-commercial beekeepers (51-100). The mean number of dead colonies per beekeeper was divided by the mean number of colonies alive before winter. The resulting fraction was multiplied by 100 to give a percentage. The mean colony loss rate was calculated for each location, for various group classifications and for each possible cause (out of total loss).

The mean of individual operation losses was calculated to determine the average loss among subgroups.

Survey of responding beekeepers from certain locations of New Valley governorate reported the honey bee colony losses on 2011/2012 and 2012/2013, respectively. These locations namely: El-Hendaw, El-Aweyna, El-Rashda, El-Moosheya, El-Maasara, Mout, El-Mowhob, El-Sheikh Wali, El-Qalamon, El-Kaser, Bedkholo, El-gadeada and El- Dakhla.

Statistical analyses:

Percentages of colony losses were transformed using arcsine method, then, analysis of variance (ANOVA) was carried out using MSTAT-C software program (MSTAT-C, Michigan State University Version 2.10) and least significant difference (LSD) values were calculated when F-value were significant for times of introduction effects according to the method of Waller and Duncan (Waller and Duncan, 1969).

RESULTS

Losses in reference to the year:

Thirty six beekeepers were responded to the questionnaire survey during two years, 2011/2012 and 2012/2013. The beekeepers managed a total of 1000 colonies in September. The surveyed beekeepers had loss a total of 373 colonies between September and March each year. Colony losses were 35.5% in 2011/2012 and 38.8% in 2012/2013, respectively (Fig.1). Colony losses in 2012/2013 were the highest in comparison with 2011/2012 year.

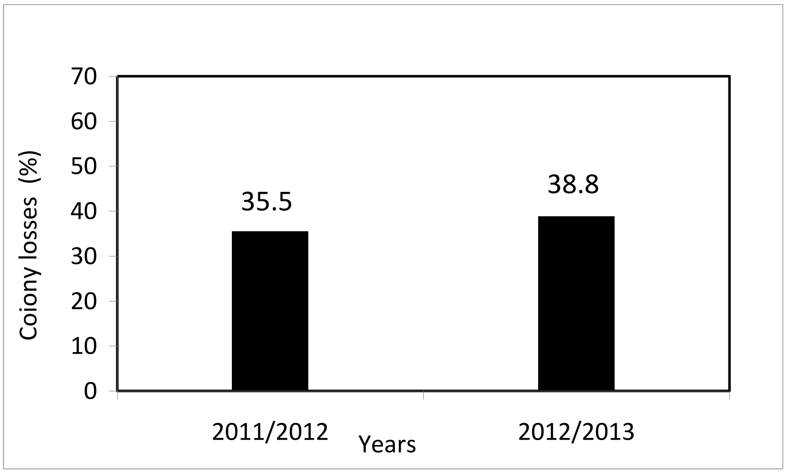

Fig. (1): Average colony losses among the respondents during the two years of 2011/2012 and 2012/2013.

During 2011/2012 year, the beekeepers were arranged in three groups, those who have less or equal to 15 colonies constituted 22.8% out of the total respondents. The percentages of 68.6% and 8.6% were to whom operate 16 to 50 and 51 to 100 colonies, respectively. During the second year 2012/2013 of study, 27.8% of respondents own less-than or equal to 15 colonies; 63.9% of respondents operate 16 to 50 colonies and 8.3% of respondents operate 51 to 100 colonies (Fig. 2, A).

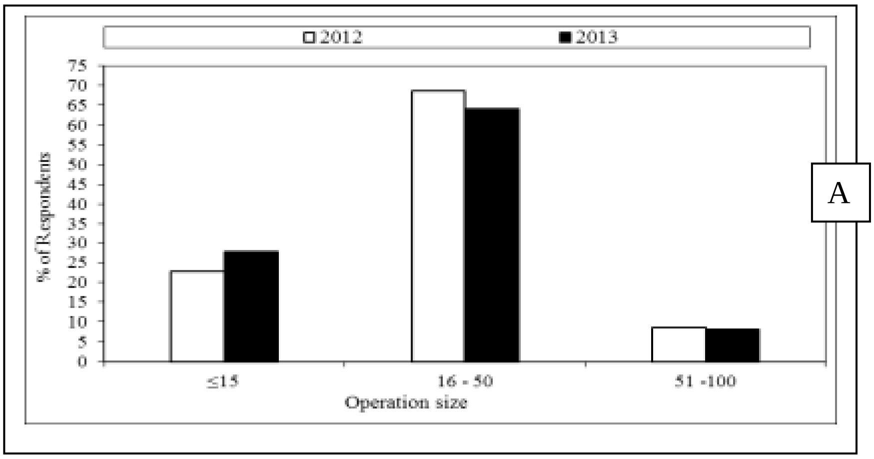

Fig. (2-A): Distribution of beekeeping operation size percentages of years, 2011 /2012 and 2. 012/2013 among respondents to the survey.

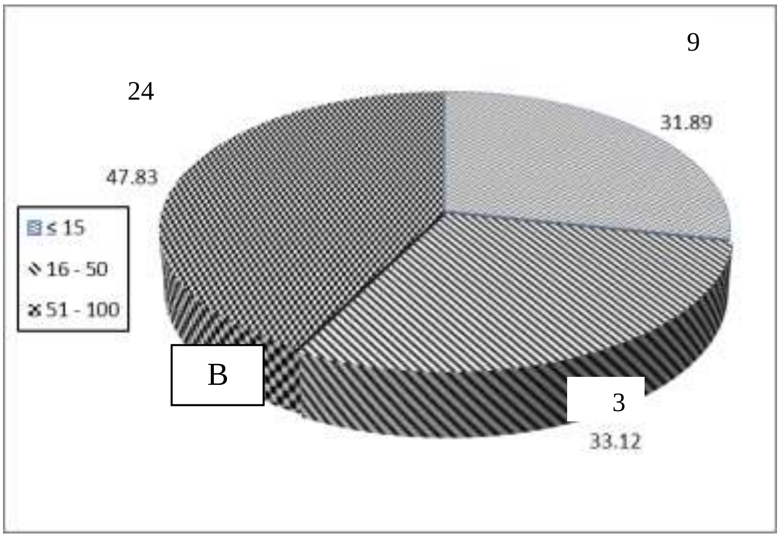

Fig. (2-B): General total and mean of beekeeping operation size distribution among respondents to the survey

In general, the beekeepers who contributed the data can be arranged as 31.89% of respondents, hobbyist beekeepers, operate ≤ 15 colonies. 47.83% of respondents, intermediate beekeepers, operate 16-51 colonies and 33.12% of respondents, semi-commercial beekeepers operate 51-100 colonies (Fig. 2- B).o

Losses in reference to studied locations:

The numbers and percentages of colony losses by over the locations are summarized in (Table 1). It may be noted that, there was variation in the percentage average of colony losses on 2011/2012 and 2012/2013 and general mean. The data was showed lost 35.51% on 2011/2012 year of their bee colonies. While, the highest of loss 38.82% was obtained on 2011/2012 year.

Table (1): Total numbers and percentages of colony losses in locations of New Valley Governorate during two years, 2011/2012 and 2012/2013.

	2011/2012			2012/2013		
	No. of colonies at September 2011	No. March 2012	% losses	No. of colonies at September 2012	No. March 2013	% Losses
El-Hendaw	280	95	33.93	285	109	38.21
El-Aweyna	71	20	28.17	82	28	34.15
El-Rashda	137	41	29.931	162	71	43.83
El-Moosheya	131	54	41.22	122	54	44.26
El-Maasara	52	5	9.62	62	18	29.03
Mout	125	49	39.2	159	63	39.62
El-Mowhob	58	20	34.48	48	14	29.17
El-Sheikh Wali	25	3	12	33	12	36.36
El-Qalamon	12	4	33.33	12	4	33.33
El-Kaser	24	7	29.17	30	12	40
Bedkholo	20	9	45	11	5	45.45
El-gadeada	25	8	32	20	5	47.37
Dakhla	35	17	33.93	38	18	38.25
General Total & Mean	935	332	35.51	1064	413	38.82

Losses in reference to the operation size:

It was found that, the hobbyist beekeepers (≤ 15 colonies), and intermediate beekeepers (16-50 colonies) tended to have lower average losses, which were significantly different from the semi-commercial beekeepers (51-100), (Table 2).

Table (2): Average loss experienced by all responding beekeepers grouped by operation size during two years, 2011/2012 and 2012/2013.

The numbers and percentages of colony losses due to the operation size are recorded in (Table 3). Respondents across all sizes of operation indicate high frequencies of severe bee losses over the two years. There was considerable variation in the percentage of loss suffered accompanied by operation size. The high loss percentages were 41.39% and 51.77% for the group sized 51-100 colonies in both 2011/2012 and 2012/2013 years. While, the low percentage of loss were 30. 68 and 35.57 for the size operation 16-50 colonies, also 25.84% and 37.70% for the group sized ≤ 15 colonies in the same years, respectively.

Table (3): Total and percentages of colony losses experienced by all responding beekeepers in New Valley Governorates during two years, 2011/2012 and 2012/2013.

years	No. of respondents and Colony losses (No. & %)	Colony losses			General total and mean
		≤ 15	16-50	51-100	
2011/2012	Respondents	8	24	3	35
	September, 2009	89	691	215	995
	March, 2010	23	220	89	332
	% of losses	25.84	30. 68	41.39	33.37
	Rank	3	2	1	
2012/2013	Respondents	10	23	3	36
	September, 2010	122	745	197	1064
	March ,2011	46	265	102	413
	% of losses	37.70	35.57	51.77	**38.82**
	Rank	2	3	1	

Factors that explaining losses of colony inside the different groups of operation size illustrated in table (4). The causes of losses varied widely among the size of operations. The smaller operations are more likely to have suffered from oriental hornets more severe losses than largest operations. While the largest operations are more likely to suffer from Starvation more than smaller operations.

Table (4): Factors affecting the colony losses during two years, 2011 /2012 and 2012/2013.

Operation size	Mean &%	Factors								
		Oriental hornet	**Varroa Mite**	**AFB**	**CCD-like symptoms**	**Pesticides**	**Weather**	**Poor queens**	**Starvation**	**Management**
≤ 15	Mean	25.5	4.5	0	0	0	0	2	2.5	0
	%	24.17	4.26	0	0	0	0	1.89	2.36	0
16-50	Mean	146.5	27.5	5.5	13.5	3.5	0.5	13	26	6.5
	%	20.40	3.8	0.7	1.8	0.49	0.07	1.81	3.62	0,91
51-100	Mean	45	4	0	17	0.5	5.5	5	18.5	0
	%	21.84	1.94	0	8,25	0.24	2.67	2.43	8.98	0

The Perceived reason(s) of colony losses:

When the respondents were asked to identify the reasons they thought to responsible for colony losses, they listed nine different potential causes of colony mortality most frequently (Table 5). The importance of these causes listed by beekeepers were clearly differed among the years of questionnaires 2011/2012 and 2012/2013. For instance, oriental hornet caused 51.81% and 63.44 of colony losses during two years, 2011/2012 and 2012/2013, respectively. Another example, Starvation caused 11.7% and 13.32% of colony losses during two years, 2011 /2012 and 2012/2013, respectively. The loss caused by Varroa mite had decreased from 13.55% in 2011/2012 to 6.55% in 2012/. While, the important of poor queens nearly wasn't differentiating, while this factor responsible for 5.72% and 5.08% of colony losses during two years 2011/2012 and 2012/2013, respectively.

Table (5): The commonly causes perceived of colony losses recorded on March of two years, 2011/2012 and 2012/2013 in New Valley governorate.

Years	Colony losses (%)	causes of colony losses									Total
		Oriental hornet	Varroa mite	AFB	CCD-like symptoms	Pesticides	Weather	Poor queens	Starvation	Management	
2001/2012	% of losses	51.81	13.55	2.71	9.34	1.20	1.81	5.72	11.7	2.1	100
	Rank	1	2	6	4	9	8	5	3	7	
2012/2013	% of losses	63.44	6.55	0.5	7.27	0.97	1.45	5.08	13.32	1.45	100
	Rank	1	4	9	3	8	7	6	2	7	

DISCUSSION

Information quantifying on honey bee colony losses has been collected for New Valley governorate. This is an important data set that wills all subsequent fluctuations to be properly monitored. Colony losses in 2012–2013 were the highest in comparison to 2011/2012 year. While (Abdel-rahman and Moustafa, 2012) who recorded the colony losses in 2010/2011 the highest in fall and winter in Upper Egypt (Qena & Luxor Governorates, where beekeeper lost about 30.73% of colonies. The distribution of colony losses during two years, 2011/2012 and 2012/2013 showed a different variation among locations (Table 1).

he highest of figures beekeepers lost constituted about 51.77% of their colonies for the group who owned 51-100 colonies (Table 3). This finding suggests that the apiary management plays an important role. The professional management might have played a significant role in prevention of losses.

There are undoubtedly various causes for colony losses. Responding beekeepers most frequently self-identified causes such as, oriental hornets; Starvation; Varroa mite and poor quality queens, as the leading causes of mortality in their operations (Table 5). Survey information indicates that oriental hornet, caused 51.81% and 63.44 of colony losses during two years, 2011/2012 and 2012/2013, respectively. Hussein and Shoreit, (2000) recorded the oriental hornet attacking honey bee colonies and is a major predator of honey bees and destroy entire apiaries in Upper Egypt.

The primary perceived problem for beekeepers was poor queens, about 5.72% and 5.08% of colony losses during the two years, 2011/2012 and 2012/2013, respectively. In USA, poor queen and starvation played a key role in colony losses from fall 2007 to spring 2008 (Van-Engelsdorp *et al*., 2008). A queen's quality is not only a function of her own reproductive potential but also how well she is mated. Camazine *et al*., (1998) estimated the number of sperm in the spermathecae of 325 queens from 13 different commercial queen breeders. They found that 19% of the queens were "poorly mated" (i.e., they carried fewer than 3 million sperm), as defined by (Woyke, 1962).

The number of stored sperm, however, is not the only measure of a queen's mating success. Queens are highly polyandrous, mating with an average of 12 drones on their mating flight(s) early in life (Tarpy and Nielsen, 2002). It has been shown that polyandry, and the resultant intracolony genetic diversity of the worker force, confers numerous benefits to a colony (Palmer and Oldroyd, 2000). First, genetic diversity may increase the behavioral diversity of the worker force (Fuchs & Schade, 1994; Moritz & Fuchs, 1998 and Mattila & Seeley, 2007), such as enabling colonies to exploit different foraging environments more efficiently (Lobo & Kerr, 1993 and Mattila *et al*., 2008) Second, genetic diversity may reduce the impacts of diploid male production as a consequence of the single-locus sex determination system (Ratnieks, 1990 and Tarpy & Page, 2002). Third, genetic diversity may reduce the prevalence of parasites and pathogens among colony members (Hamilton, 1987; Sherman *et al*., 1988; Palmer & Oldroyd, 2003; Tarpy, 2003; Cremer *et al*., 2007; Seeley & Tarpy, 2007 and Wilson-Rich *et al*., 2009). So that, determining the number of mates by a queen and not just the number of sperm, is one final measure of a queen's reproductive quality. Determining the factors that result in low-quality queens is therefore of fundamental importance for improving colony productivity and fitness.

About 11.7% and 13.32% of all the colonies losses during two years, 2010/2011 & 2011/2012, respectively in the New Valley Governorate died because of the starvation.

According to Crailsheim (1998) and Schmickl & Crailsheim (2002), food requirements have increased exponentially, as the bees are raising large quantities of brood for the future field force, to bring in the spring nectar flow. It is very easy for a hive at this time to outrun its reserve food supply. It is a sad sight to see a powerful hive die or be devastated by starvation, just before they could have turned around and begun building food reserves. A hive that begins to starve will suck the body fluids from the brood, in the attempt to save the colony. Brood that appears undamaged may actually be dead, because the bees did not have the energy (or population) to keep it warm; it may be chilled. Weakened and starving bees may not get nectar, because they don't have enough sugar reserves to power their wing muscles.

At the same time, the weather conditions cause colonies losses where 1.41% and 1.85% of the honeybee died during two years, 2010/2011 & 2011/2012, respectively in the New Valley Governorate.

Cold nights limit the hours bees can work. They cannot start until it warms up, sometimes in late morning. It generally takes sustained warm weather and plenty of sunshine for most flowers to yield nectar, just a few cloudy, rainy, or cold days can mean sudden starvation for the hives of an inattentive beekeeper. This affliction most commonly affects the strongest and best hives (Crailsheim *et al*., 1999).

In spite of low percentages of colony losses 1.20% and 0.79% is due to the pesticides in the New Valley Governorate during the two years 2010/2011 & 2011/2012, respectively, many types of pesticides are considered poisons that damage the nervous system of the honey bees as a result, the bees are unable to communicate accurate (Radunz and Smith, 1996). Communication between honey bees is essential for food sources and dangerous spots. The infected honey bee flies back and contaminates the whole colony. The weakened colony dies as a result of the pesticide.

This survey information indicates that, about 9.34% and 7.27% of all the colonies losses during two years 2010/2011 & 2011/2012, respectively in the New Valley Governorate died by CCD-like symptoms. As a result of climatic differentiation, there are differences between the countries and the regions for reasons lead to colony losses. Malnutrition is a stress factor to bees; a weak immune system can affect a bee's ability to fight pests and diseases as well as immunosuppressant caused by pathogen or parasite attack (Glinski & Kostro, 2007). Pollen nutrients had a positive influence on genes affecting longevity and the production of some antimicrobial peptides (Alaux *et al.*, 2011). In Poland, and Canada, *Varroa destructo*r (with associated virus infections) and Nosema spp. played the same role in colony losses during the winter (Pernal, 2008). A mixture of original research articles; addressed the possible causes of honey bee colony losses: virus (Berthoud *et al*., 2010; Carreck *et al*., 2010 a & b and Martin *et al*., 2010), Nosema ceranae (Paxton, 2010 and Santrac *et al*., 2010); *Varroa destructor* (Carreck *et al*., 2010 b; Dahle, 2010 and Martin *et al*., 2010), Pesticides (Chauzat *et al*., 2010 and Medrycki *et al.,* 2010), the effects of acaricides (Harz *et al*., 2010), the loss of genetic diversity (Meixner *et al*., 2010) and loss of the habitats (Potts *et al*., 2010).

Scientists investigated the lack of genetic diversity and lineage of bees, both related to queen quality, as possible causes of CCD. This lack of genetic biodiversity can make bees increasingly susceptible to any pest or disease that invades the system. The importance of genetic diversity has been noted at the individual the colony, the population and subspecies level in honey bees. There are examples of reduced fitness at the individual and colony level, due to reduce genetic.

Increased rates of colony losses in New Valley are probably the result of regional differences in weather patterns that affected forage availability of bees, starvation, Vespa, foulbrood and other diseases, in addition to poor quality queens and pesticides. These stresses interacting in combination with each other affected colony survival are believed to be the most important factors related to colony losses.

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تقدير الفقد الحادث في طوائف نحل العسل وأسبابه المحتملة لدي مربي النحل بمحافظة الوادي الجديد خلال عامين حصر بأستخدام طريقة الأستبيان.

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سجلت هذه الدراسة حصر لمدى فقدان طوائف نحل العسل في محافظة الوادي الجديد خلال عامين (2011/2012 و2012/2013) . تم حصر الطوئف المفقودة والاسباب المحتملة للفقد باستخدام طريقة الاستبيان . مربي النحل الذين شملهم الحصر فقدوا ما مجموعه 373 طائفة نحل في الفترة ما بين سبتمبر و مارس . كانت نسبة الفقد % 35.5 في عام 2011/2012 وفي عام 2012/2013 كانت % 38.8 . وتشير نتائج الحصر الي ان معدل فقد الطوائف يعتمد بصورة كبيرة علي عدد الطوائف . فقد وجد ان النحالين الهواة (اولئك الذين يتعاملون مع اصغر من او يساوي 15 طائفة) والنحالين المتوسطين (16-50 طائفة) فقدوا عدد اقل بمقارنتهم بالنحالين شبه التجاريين (الذين يتعاملون مع اكثر من 50 طائفة). أوضح معظم النحالين أن الدبور الشرقي و الجوع و طفيل الفاروا واعراض مشابهه لأختفاء النحل (CCD) والملكات الضعيفة هي أهم الأسباب التي تؤدي الي فقدان طوائفهم .في النهاية يجب ان يعمم مثل هذا الأستبيان في عموم مصر للوقوف علي حجم المشكلة ومحاولة فهمها وأيجاد الحلول لها.

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