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STUDY OF THE POPULATION DYNAMIC OF *VARROA DESTRUCTOR* IN ALGERIA

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ABSTRACT

In this article, we describe some dynamics of varroa, incorporating more recent data specifically on the invasion of brood cells by phoretic mites and their total population, and changes in mortality. Populational model of the mite is related with the modeling of bee colony (*Apis mellifera intermissa*). This allows a more realistic evaluation of events when the distribution of mites on the bees and the brood is important. We have shown in this study varroa population increases in spring then from June we have sean decline of population varroa.

Population approximately follows the development of its host, the maximum population is recorded during this month is on average 4417 mite by colony; also it appears that the level of infestation of this mite in colonies varies depending on the weather (season) and internal conditions of each colony.

KEYWORDS: Apis Mellifera Intermissa, Varroa Destructor, Population Dynamics, Phoretic,

INTRODUCTION

The mite *Varroa destructor* is the scourge that destroys *Apis mellifera* colonies around the world, it is a major reason cited by scientists to explain bee mortality in general **[1]**. On top of the ability to replicate only in a honeybee colony, *Varroa destructor* is an external parasitic mite that can be attached on the external body of the bee and suck hemolymph that results in a disease called varroatosis **[2]**. The existence of *Varroa destructor* in Algeria has been reported for the first time in 1981 in the East **[3]**. Its spread has made throughout the national territory through the trade in bees and transhumance **[4]**.

Population dynamics is a part of the ecology that describes changes in population abundance in nature and researches the causes **[5]**.

The study of the dynamics of parasite populations in the bee colony can know the characteristics of the development of mites in a given region under climate defined and with a known bee. It provides the foundation needed to control varroasis and compares the evolution of pest populations from one colony to another or from one place to another.

Several authors argue that climate change does not affect the reproduction of varroa because the temperature in the brood hardly changes **[6]**. However, the indirect effects of climate on brood production can play an important role in fertility mites **[7]**,**[8]**, **[9]**, **[10]**.

The population dynamics of varroa has only been studied in the Mitidja region (**Adjlane, 2003, Benseghir, 2010**) and Chlef (**Koudjil, 2007**).

In this study, we considerate two phases of the population mite. The phoretic phase and the mite in worker and drone brood reproductive phase, and natural mortality of the mite *Varroa destrctor***.**

MATERIAL AND METHODS

The study was conducted between February and June 2010 in an experimental apiary in the Kabylie region.

Description of the Population Dynamics of Varroa

Varroa Population Brood

Every three weeks and each in the ten colonies, a sample of 100 brood cells, nascent and open, this has the purpose of determining the rate of brood infestation. It is a method that requires a good knowledge of varroa and it's immature; the rate of brood infestation is the parameter that best reflects the degree of infestation of the colony **[6]**.

Population of Varroa Phoretic

To estimate the population of varroa in each colony, we must first determine the rate of adult colonies. Shake bees in various ways to detect the presence of varroa in honeybee samples killed **[7]**, **[11]** and **[12]**.

The method involves taking several frames 100-200 bees with blow of brush of up and down, causing the fall of the bees in jars. This will help us after counting varroa phoretic. A simple rule of three allows us to know the rate of infestation of bees.

Total Population Varroa

The Evolution of the population of individuals of varroa was observed in the brood and adult bees. The total population of varroa is the number of phoretic mites and varroa brood **[13]**, **[14]** and **[15]**.

The Death Varroa

To follow the natural mortality of varroa, hives are equipped with greased mixture placed at their bottom, protected by a metal grid. The fallen varroa were counted every five to seven days.

RESULTS

Population of Varroa Brood

Evolution of the Surface of the Brood

The results illustrated in Figure 1, shows an evolution of the surface of brood during the months of March and early May, due to:

- The stimulant feeding performed from February 14, which strengthened colonies;
- The favorable weather conditions recorded during this period with an average temperature of 15.9 ° C, and rainfall: 83.4 mm;
- A plenty of honey resources including citrus
- The reduction in the area of the brood in the final months of study, is due to:
- At precocious blocking of the queen (as in the case beehive;
- A reorientation of some settlements in the storage of honey during the month of June;
- At the regression of pollen collection; and climate disruptions.

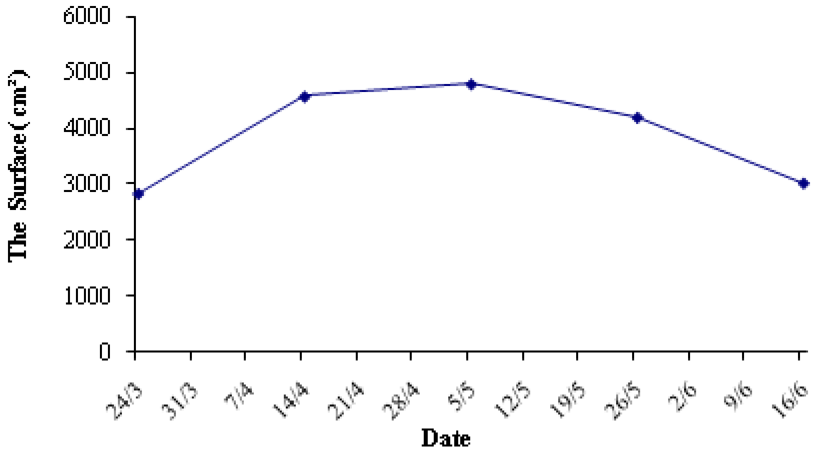

Figure 1: Evolution of the Surface of the Brood in the Bee Colonies

Brood Infestation Rates (IRT)

The infestation rate (IRT) through the brood colonies shown in Figure 2 is 26.92% in March, where we see an increase in the intensity of the infestation remarkably, since that rate was 42.31% at the beginning of May. This period corresponds to the flowering period that is characterized by a high number of population of bees and the brood frames which is the ideal site for the reproduction of varroa.

From the beginning of May, there is a decline in infestation rates over time, reaching a value of 25.61% in mid-June, this could be due to: the decrease the number of cells closed brood caused by the cessation of egg laying and reduction in pollen intake;

In addition, analysis of variance revealed no significant effect (p = 0, 40) of sampling time on the level of infestation of the brood.

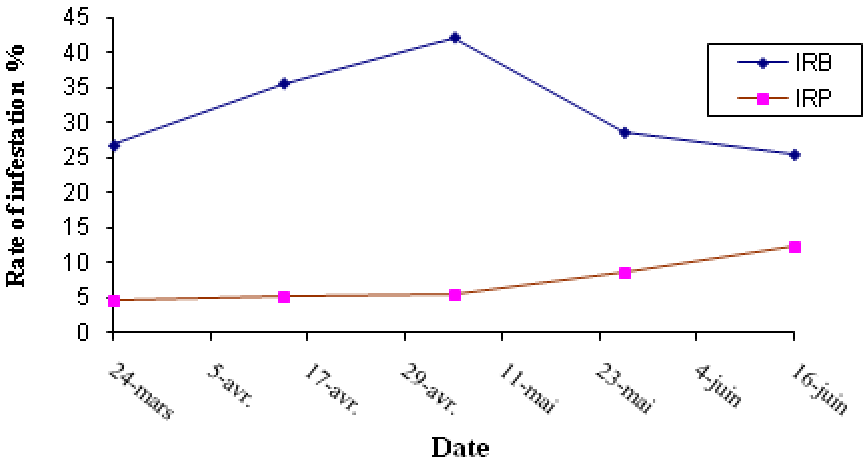

Figure 2: Evolution of Brood Infestation Rates (IRB) and Bees (IRP)

Figure 2 show that the rate of infestation of adult bees in early spring is 4.56%. Then there appears a gradual increase until June, where we noticed a peak of 12.27%.

This large number is due to the increase in the number of bees. Note that more the number of the bee population increases, the intensity of the parasitism of adult bee's increases, in parallel the number of bees had increased from 11,488 to 34,155 bees.

Infestation Rate of Bees: Varroa Phoretic

According to the analysis of variance of infestation of adult bees rate varies only slightly from one colony to another, for against a highly significant effect (p=0.015) is observed between the sampling periods (the presence varroa of different periods of the year).

Therefore, infestation rates are classified into three groups, The first group had the highest rate of infestation (12.27%), the second intermediate group whose recorded infestation rate is 8.47% and the third group represents the lowest infestation rates which varies from 4.56% to 5.33%.

The Number of Varroa in the Brood

Knowing the rate of infestation in brood and the number of cells in the closed brood per colony during the entire trial period, we could draw the curve of the evolution of the number of Varroa in the brood (Figure 3). Analysis of variance reveals a significant difference (p=0.0017) in a visit to the next.

In early May the maximum number of the population of varroa averaged was of 14,589 varroa per colony. This is due to the increase of the surface of the brood thus increasing the number of capped brood, the average number of varroa obtained in April and end of May was 9496 varroa per colony. However, a minimum varroa population was recorded end of March and mid-June.

The Number of Varroa Phoretic

The estimate of the population of varroa phoretic is obtained by multiplying the number of adult bees with the rate of infestation of adult bees. Given the results, the population of Varroa has variations from one colony to another. A significant influence (p=0.047) is observed between the sampling periods.

The number of varroa phoretic increased from 546 to 4417 individuals per colony. The maximum population of varroa was recorded in June where there is an average of 4417 varroa per colony.

Total Population of Varroa

The average number of varroasis were classified into three groups, with the highest number (16 044) which was recorded in early May. The second group is intermediate whose number of Varroa was 10945. The last has the lowest rate of infestation of varroa whose number was 5910.

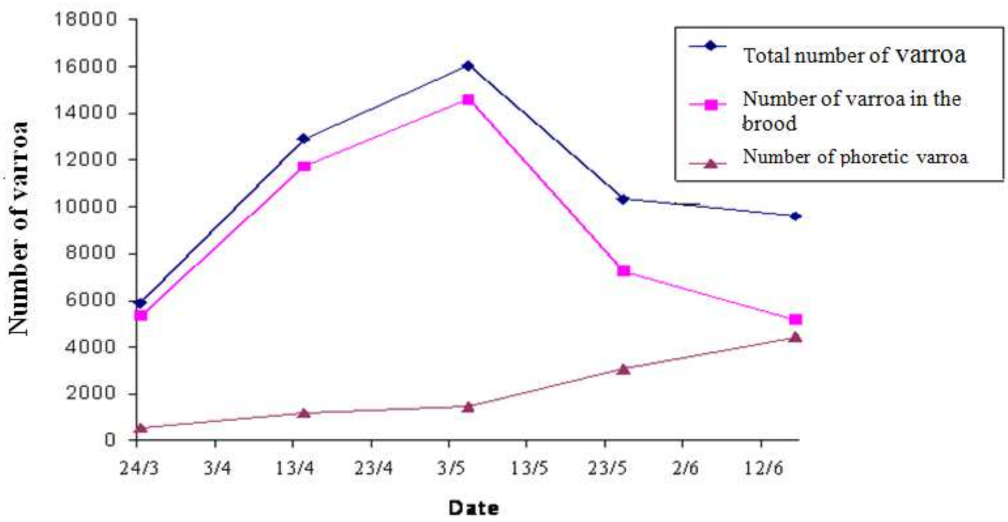

Figure 3: Evolution of the Population of Individuals of Varroa

Evolution of Natural Mortality

Varroa mortality varies according to time of year (figure 4).We distinguish two periods: -From March until early May: When the colonies have a high infestation rate, mortality was 275 Varroa.

At the beginning of May to mid-June: When the rate of brood infestation is relatively small it is around 124 varroa.

We noticed that the weekly natural mortality follows approximately the size of the Varroa population in the hives. Indeed, many authors note that natural mortality is a way which follows the evolution to the total population of varroa in colonies **[8]**, **[16**], **[15]**.

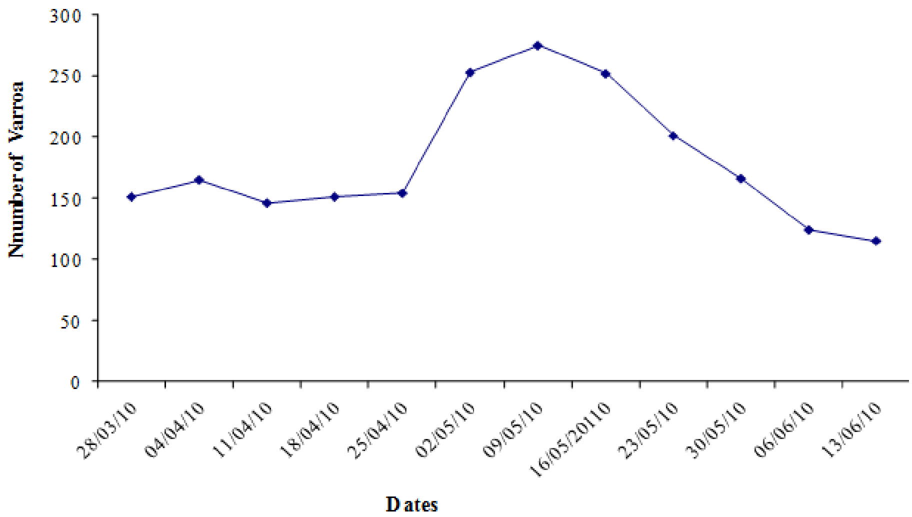

Figure 4: Evolution of Natural Mortality

DISCUSSIONS

The results of our experiments on the dynamics of varroa highlight the following points: - Population of varroa of brood with the greater rate of infestation in March of around 26.92% and 42.30% pass in early May, this period is the flowering period is characterized by a high number of bee population as well as frames of provisions and brood, there is a considerable drop in varroa from the month of May, the mean population increased from 14,589 to 5182 varroa per colony, June is the period of honey and especially with the arrival of hot weather which exert an inhibitory action on the laying of the queen.

In the case of our study, the period of high temperatures that occurred from May which limit the pollen resources, which slowed the development of the colonies by a renewal of young bees, similar results to those of **[17]** While in Germany, **[18]** and **[19**] found the thresholds in July and August. Indeed the brood begins to decrease in the colonies, meaning that the Varroa who were in the brood became phoretic we noticed also a very meaningful comparison between the increase in population of varroa phoretic and decreased numbers of cells and the number of varroa in the brood. Therefore **[20]** and **[21]** found that temperatures below 10 ° C may also alter the development period of capped brood causing increased growth of the population of mites.

However, according to a study in Mexico, **[22]** reveals that the maximum of varroa phoretic is reached in the spring, and hypothesized that the varroa females are subjected to a compromise between the phoresy in order to deaminations and the infestation of the brood in the breeding goal .

Over the past two months, the population increases gradually to reach its maximum at the beginning of May (16044 varroa). Then we notice a drop in the population of varroa, with an average of 96000 varroa in mid June. Indeed the total number of varroa depends on climatic conditions and the conditions of each colony demonstrated by a study conducted by **[23]** in Brazil under 3 types of climates in which they found that rate infestation of bee and the rate infestataion of brood are higher in cold climates, and concluded that the evolution of varroa depends more on climate than genetics of the bee.

This work is a preliminary to further analyze that could be conducted using the sequence of accidental events colonies on the one hand and the linking with winter deaths other. This task would require so more sophisticated statistical models. Therefore, the result obtained must be interpreted, at high densities, and carefully.

CONCLUSIONS

The simultaneous changes in the number of varroa and bee population reflect the intensity of the infestation of varroa in colonies. Based on such results, it appears that the level of infestation of varroa in the colony varies depending on weather conditions (season) and the internal conditions of each colony.

Indeed, our study shows that life cycle of the varroa mite is linked to that of its host. Also a significant decrease in population of varroa in times of extreme heat.

We showed that, it is in spring that the population is at its peak, with a maximum threshold of 15 000 varroa, similar to those of **[24**] in the Mitidja region. When a certain threshold is exceeded, there is a decline in populations of varroa at an average level of about 400-500 Varroa per colony toward the end of this period.

In all the colonies, populations of varroa presented during the spring exponential growth curve, which explains the continued presence of brood, following this phase of growth, occurs the collapse phase of varroa populations, that under our experimental conditions occurred in late June.

Finally, immediate research should be launched to define varroa infested and free areas of the country as a whole with parallel setting up of controlled experiment to estimate the economic impacts of varroa mite on local bees with developing its control means.

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