MELLIFERA RESEARCH ARTICLE

Dynamics of the population *Varroa destructor* at the Level of Local Bee Colonies *Apis mellifera intermissa* in the North Central of Algeria

Assia HABBI-CHERIFI *[1], Noureddine ADJLANE [2], Ferroudja MEDJDOUB-BENSAAD[3], Nizar HADDAD [4]

[1]Faculty of Biological Sciences and Agronomic Sciences, Mouloud Mammeri University, Tizi-Ouzou, ALGERIA.

[2] Department of Agronomy ,M'Hamed Bougara University, Boumerdès, ALGERIA.

[3]Animal Biology and Physiology Laboratory, ENS Kouba, Algiers, ALGERIA

[4]National Agricultural Research Center - NARC, Amman, JORDAN

** Corresponding author e-mail:assia_cherifi@yahoo.fr*

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A B S T R A C T

The population dynamics of the *Varroa destructor* mite in local bee colonies *Apis mellifera intermissa* was studied for about two years (March 2016 to December 2017) in the Tizi-Ouzou region in northern Algeria with a Mediterranean climate. Observations were made monthly on colonies treated against *varroa* mites and have not undergone any acaricide treatment. The development of *varroa* populations was monitored taking into account natural mortality, the rate of adult bees and brood infestation rate. Our results show that the *Varroa* population is very important during the first year of study at untreated colonies divided into two apiaries to register a slight decrease during the second year. In contrast, treated colonies at site 1 have a high level of infestation despite being treated with Bayvarol® in October 2015. Our results suggest that the level of *Varroa* infestation in the colonies varies according to the climatic (seasonal) and internal conditions of each colony.

Keywords: *Apis mellifera intermissa*, *Varroa destructor*, dynamics

Introduction

Varroasis is considered one of the most common and dangerous diseases. It is caused by the parasitic mite *Varroa destructor* which parasitizes both brood and adult bees, thus causing considerable losses for beekeeping in the world and particularly in Algeria [3]. Indeed, trade (sale of queens and swarms) and

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transhumance have resulted in the distribution of the parasite spread from Asia to Europe and America [1]. In Algeria, this parasitosis appeared in 1982 and since several acaricidal molecules have been used but Varroais observed in the colonies all the time.

In order to develop a better strategy for controlling this parasite, study the host-parasite relationship study must have priority. In Algeria, little work is done on the dynamics of the *Varroadestructor* [2,3] For this purpose, we have been interested in this study in the development of *Varroa* populations in colonies already treated against this parasite and in colonies that have not been treated following the seasonal evolution of this parasite in the brood, on the ground adult bee as well as natural mortality.

Materials and Methods

Presentation of the study environment

Our study was conducted at 28 colonies spread over two sites, each with two apiaries contain 7 hives in each. of 7 hives each:

- Site 01 is located in the region of Sid Ali Bounab at an altitude of 400m contains Apiary A whose hives are not treated against the Varroa parasite for more than three years and Apiary A 'whose hives are treated in the month of October 2015.

- Site 02 is in the village Azib Ahmed at an altitude of 200m; it contains the Apiary B whose hives have not been treated for more than three years and the Apiary B' whose beehives are treated in October 2015. The study took place during the period from March 2016 to November 2017.

The study stations are characterized by

- a mild spring with average temperatures ranging between 12 ° C and 19 ° C in 2016 and 14 ° C and 21 ° C in 2017;

- a hot summer with average temperatures ranging from 24 ° C to 27 ° C in 2016 and from 26 ° C to 29 ° C in 2017;

- Quite significant rainfall in the month of March of the year 2016 with 185mm and very low in the month of March 2017 with 29mm.

Three parameters were studied

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-Brood Infestation Rate (TIC): Every 3 weeks, a sample of 25cm2 emerging is opened to determine brood infestation rate. [4]

-Infestation rate of adult bees (TIA): about 100 bees per colony were sampled and poured into a 70º alcohol solution. After the bees are dead, the mixture (alcohol + bees) is agitated well so that the varroa can be detached from its host [5]**;** thereafter we count the varroa found there.

- The natural mortality of Varroa *:* Each hive is equipped with a lange, coated with greasy material, placed on the floor (the plateau) of hives. Each lange is protected by a metal grid preventing bees from accessing it. The count of dead Varroa is done every three weeks throughout the studyperiod.

Results and Discussion

Dynamics of the bee population

The highest number of cells in the operculum brood was recorded in June of the first year in apiaries B and C with a peak of 23785.71 and 20765.14 alveoli respectively. While during the second year, we find that brood development marks a slight regression in all apiaries. However, the colonies of the 4 apiaries marked their peak of evolution in June with the highest average rate of cells recorded at the Rucher B with 18225.14 alveoli.

However, the highest average number of bees is 29542.89 bees recorded during the month of June 2016 at apiary C and there are 23500 bees at apiary B at the end of summer 2017 (Figure 1).

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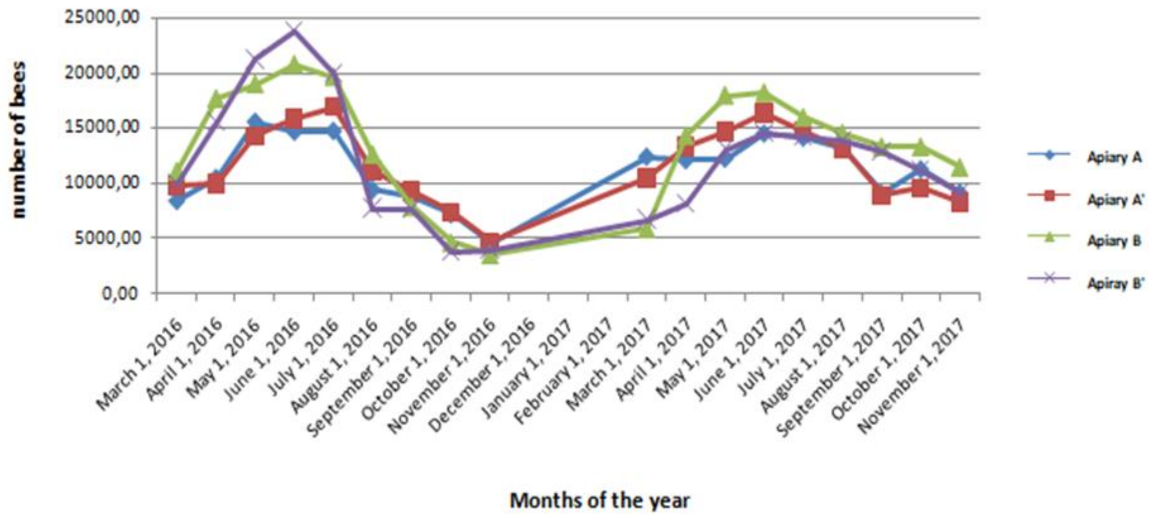

Figure 1. Evaluation of number of cells of the brood capped at the level of the 4 studied apiaries

Dynamics of the varroa population

Brood infestation with *Varroa* shows a very significant difference between the two years of study and between apiaries. However, the highest ICT is recorded in June of 2016 at the B 'Api with an average of 17.43%. However, during the 2017 season, the brood infestation rate is very high in apiary B, with an average of 23.90% registered in July. For apiary A, ICT is very important in June 2016, when an average value of 15.71% was found, while apiary A 'recorded a peak of 9.05% in July of the second year (Figure 2).

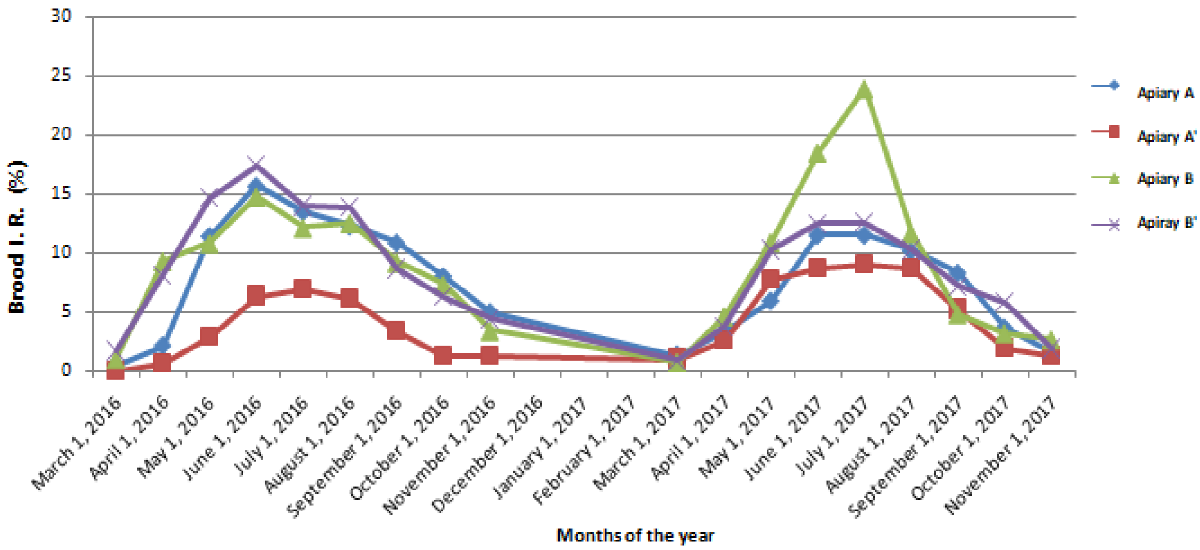

Figure 2. Evaluation of brood infestation rate (TIC) at the four study apiaries

For the adult bee infestation with *varroa*, we notice that the TIA is very high during the year 2016 in all the apiaries. It also shows that bees from apiaries A and B are the most infested and record an average TIA of 11.81% and 10.95% respectively in November 2016. However, in the second year the TIA will decline in the Apiary B and B 'and A with average rates of 8.72%, 7.83% and 6.29%, recorded in September; while at Api A ', the TIA reached its maximum of 5.28% in November (Figure 3).

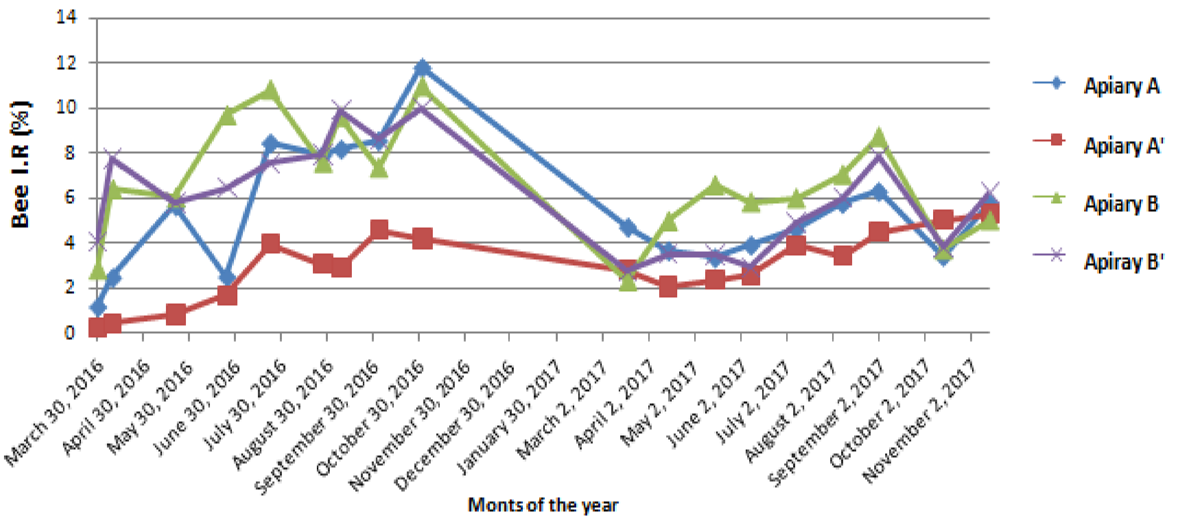

Figure 3. Evaluation of varroa phoretic in the four study apiaries

The comparison of data on changes in natural mortality rates of the *Varroa destructor* during the two years of study shows a gradual increase from March to the September. It also records a highly significant difference between the two years of study and between apiaries. In fact, untreated apiaries A and B record, respectively, an average mortality peak of 711.29 and 890,86 moth in September 2016. In the second year (2017), the mortality rate falls slightly in apiaries A, B and C; while at the level of the treated apiary (A '), the average mortality rates continue to increase to record the maximum of 606 *Varroa* in September (Figure 4).

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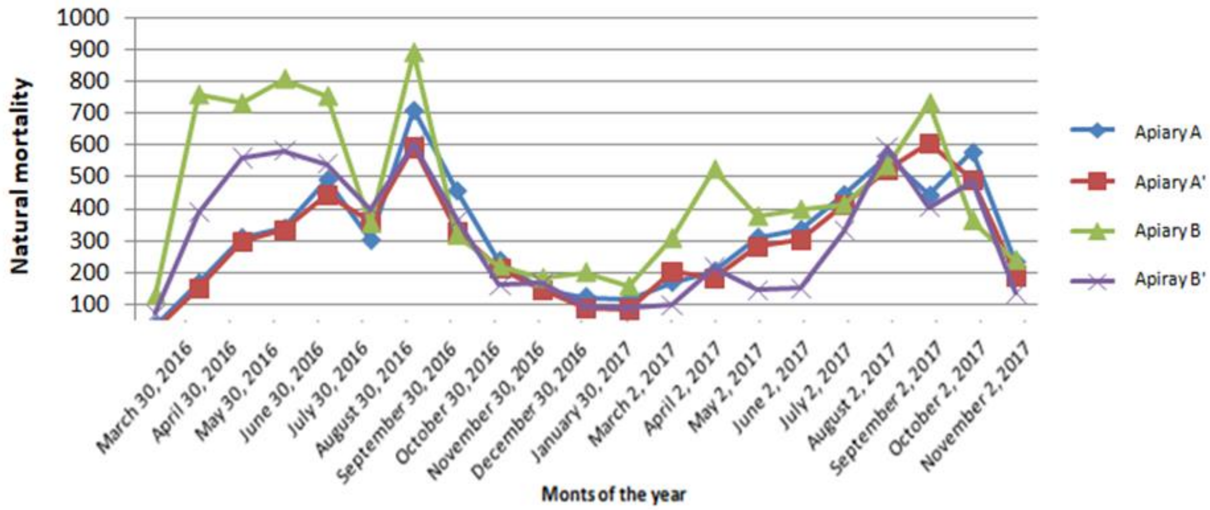

Figure 4. Evaluation of natural mortality in the four study apiaries

In this study, we studied the population dynamics of *varroa* mites in colonies treated against this parasite and colonies that have not been treated. We found that the evolution of the bee population and the *varroa* population differ from one period to another and from one apiary to another.

From the end of March, the queen begins to lay eggs and the colonies resume activity until they reach their peak in June and July in all apiaries. This period coincides with the presence of honey resources (pollen and nectar) food source bees. Then from the end of September, the pollen resources decreases, the queen slowed the laying and the population of bees goes well. The development cycle of the *Apis mellifera intermissa* race is determined by exceptional and seasonal climatic contrasts [6]. Thus, the evolution of the colonies depends on the flowering, the location of the hive and the behavior of the workers as well as the queen [7]. The activity of the colony is also influenced by the climatic conditions [8,9]. Indeed, we found that the colonies studied are more developed during the 2016 season than in 2017. The high temperatures recorded during spring 2017 seem to hinder the activity of the bees. Variable climatic conditions also cause year-to-year differences in colony development [10].

On the other hand, the presence of brood favors the development of the *varroa* population [11]. Indeed, during the first year, the brood is very important which

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favors the entry of the founder into the cells to reproduce. It is also noted that the TIC during the two seasons of our study is at its maxima in June and July. The number of *varroa* in the brood is related to the season and the availability of brood in the hive [12, 13]. Many authors also report that climatic effects on brood production have a significant influence on the growth of brood *varroa* populations [14, 15].

In the Mediterranean climate of California, the growth of parasite populations is not due to a high reproduction rate but to the possibility of *Varroa* breeding continuously in the brood which is present almost all year. [16**]**

However, colonies of untreated apiaries (RA and RB) show significant ICT that differs from one year to another and from one period to another. Indeed, it is higher in June of the first year for the A apiary while at the apiary B, it reaches its maximum in July of the second year. This can be explained by the fact that in a cell we can find more than one individual *Varroa*. A *varroa* female can lay up to seven eggs in the drone cells and six in the worker's alveoli [17]. Nevertheless, during the first year at unprocessed apiaries, the TIA increases each colony is infested at its level according to the factors of tolerance and resistance specific to it [18]. On the other hand, the difference in colony infestation from one year to the next may be due to the fact that workers show much more delousing behavior than other colonies.

The decrease in the *varroa* population during the second year may also be related to high temperatures. reports that experiments have been conducted on the use of heat against *varroa* mites to find the temperature and duration of treatment that can reduce the number of mites without killing bees. He also notes that in some countries, such as Algeria and Morocco, bees manage to cohabit with *varroa* mites. The dynamics of development of the mite is slowed by the temperature of the brood remaining higher than 36 ° C [19].

In Mediterranean climate, a high mortality of *varroa* was recorded; while in the case of semi-arid and arid climates with hot summers, it has been found that high temperatures have a detrimental effect on mites. Climate and phenology are two factors that can control the population dynamics of *Varroa* [2, 20, 21]. However, we note that despite the high infestation rates of the colonies studied, they remain active and rigorous.

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In addition, we have recorded that the fall of mites has continued during the winter, but with low rates, perhaps because the remaining phoretic mites are firmly positioned between the bee segments [22]. We notes that in winter, compared to summer, a smaller number of adult female offspring are recorded, which is due to the high mortality level of male offspring [23]. Nevertheless, in winter, a number of mites continue to leave the colony as they fall with dead bees outside the hive [22].

On the other hand, in the apiaries treated, a reinfestation of the colonies is very remarkable in the apiary B 'which has during the first year preceding the treatment a very high infestation rate compared to the apiary A', at the level of the apiaries treated. of which the development of *varroa* is progressive until reaching the maxima towards the second year. Reinfestation of these two apiaries indicates a decrease in the effectiveness of the Bayvarol® chemical treatment with which they have already been treated.

Conclusion

It appears that the life cycle of *Varroa* is linked to that of its host. It is closely related to the seasonal and internal conditions of each colony. In fact, the population of the parasite increases during the spring period then decreases from September parallel to the decrease in the size of the colony and the amount of the brood of the bee *Apis mellifera intermissa*. In addition, untreated colonies appear to be more resistant to *varroa* mites, since they have not been treated for a long time and do not show signs of weakness or deformations of the wings, which leads us to suppose that our breed is endowed with a certain behavior. considerable hygienic. On the other hand, the weakness of the efficiency of chemical treatment bayvarolis to report, because the already treated colonies are always infested by the *varroa*. Therefore, it is necessary to think about developing an integrated control strategy against varroasis by looking for alternative methods of control that will be economical, do not contaminate the products of the hive and all this to safeguard the honey bee *Apis mellifera.*

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Cezayir'in Merkez Kuzeyindeki *Apis mellifera intermissa* Lokal Arı Kolonilerindeki *Varroa destructor* Populasyon Dinamiği

Öz: *Apis mellifera intermissa* yerel arı kolonilerinde *Varroa destructor* akarlarının populasyon dinamikleri, Akdeniz iklimi olan kuzey Cezayir'deki Tizi-Ouzou bölgesinde yaklaşık iki yıl (Mart 2016 - Aralık 2017) çalışıldı. Varroa akarlarına karşı tedavi edilen kolonilerde aylık olarak gözlemler yapıldı ve herhangi bir akarisit tedavisi uygulanmadı. Varroa populasyonlarının gelişimi, doğal mortalite, yetişkin arı oranı (TIA) ve yavru istilası oranı (TIC) dikkate alınarak izlendi. Elde ettiğimiz sonuçlar, Varroa populasyonunun, ikinci yıl boyunca hafif bir düşüş kaydetmek için iki arı olarak ayrılan işlenmemiş kolonilerde çalışmanın ilk yılında çok önemli olduğunu göstermektedir. Buna karşılık, Ekim 2015'te Bayvarol® ile tedavi edilmesine rağmen RB'de tedavi edilen koloniler yüksek bir istila seviyesine sahiptir. Oysa arı kovanındaki akar miktarı 2017 yılında azami seviyelere ulaşmak için kademeli olarak artmaktadır. koloniler iklimsel (mevsimsel) ve her koloninin iç koşullarına göre değişir.

Anahtar Kelimeler: *Apis mellifera intermissa, Varroa destructor,* dinamik

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R E F E RE N C E S

[1] GARCIA-FERNANDEZ, P., RODRIGUEZ, R .B., & ORANTES-BERMEJO F.J., 1995. Influence du climat sur le développement de la population de *Varroa jacobsoni* Oud. dans des colonies d'*Apis mellifera iberica* (Goetze) dans le sud de l'Espagne. *Apidologie*, 26, 371-380

[2]BERKANI-GHALEM, Z., HAMI, H. et BERKANI, M-L., 2013. Effet du Climat sur l'Évolution des Populations de *Varroa destructor* chez l'Abeille *Apis melliferaintermissa* L. dans les Différents Écosystèmes de l'Algérie. *Silva Lus*. vol.21 no.2 Lisboa dez. 2013.

[3] ADJLANE, N,, DOUMANDJI, S.E., et HADDAD, N., 2012. Situation de l'apiculture en Algérie :facteurs menaçant la survie des colonies d'abeilles locales Apis melliferaintermissa. *CahAgric* 21, 235-41. doi: 10.1684/agr.2012.0566.

[4] BRANCO, M. R., KIDD, N. A. C., & PICKARD, R. S., 2006. A comparative evaluation of sampling methods for Varroa destructor (Acari: Varroidae) population estimation. *Apidologie.* 37, 452-461.

[5] DE JONG, CONCALVES L.S., & MORSE R.A., 1984. Dependence on climate of the virulence of *Varroa jacobsoni*. *Bee World*. 65, 117-121.

[6] PEYVEL, CH., 1994. L'espèce *Apis mellifera*: les grandes races géographiques. *Bull.Tech. Apic*. 21, 129-138P

[7] IMDORF, A., RUOFF, K.et FLURI, P., 2010. Le Développement Des Colonies Chez L'abeille Mellifère. *ALP forum*. 68, 67.

[8] IMDORF, A., RICKLI, P. et FLURI, P., 1996. Dynamique des populations d'abeilles. *Rapport du centre Suisse d'Apiculteur*. 48.

[9] BRANCO, M.R., KIDD, N.A.C. & PICKARD, R.S., 1999. Development of *Varroa jacobsoni* in colonies of *Apis mellifera iberica* and Mediterranean climate. *Apidologie* 30. 491-503

[10] KOKKINIS, K. et LIAKOS, V., 2004. Population dynamics of *Varroa* destructor in colonies of Apis mellifera macedonica in Greece. *Journal of apicultural research* 43(4). 150-154.

[11] DONZE, G., 1995**.** Adaptations comportementales de l'acarien ectoparasite *Varroa jacobsoni* durant sa phase de reproduction dans les alvéoles operculées de l'abeille mellifère *Apis mellifera.* Thèse de doctorat en sciences. *Université de Neuchâtel*, 150.

[12] BOOT, W.J., SCHOENMAKER, J., CALIS, J.N.M., & BEETSMA, J., 1994. Invasion of *Varroa jacobsoni* into drone brood cells of the honey bee, *Apismellifera. Apidologie.* 26, 109-118.

[13] MORETTO, G. & DE MELLO, L.J., 2000. Resistance of Africanised Bees (*Apismellifera*) as a cause of mortality of the mite *Varroa jacobsoni* Oud. in Brazil. *Am. Bee J.* 141, 895-897.

[14] EGUARAS, M., MARCANGELI, J. & FERNANDEZ, N.A., 1994. Influence of parasiticintensity on *Varroa jacobsoni* Oud. reproduction. *J.Apic.Res.* 33, 15-159.

[15] DE JONG, D., DE ANDREA, R. & CONCALVES, L.S., 1982. A comparative analysis of shaking solutions for the detection of *Varroajacobsoni* on adult honey bee. *Apidologie.* 13, 297-306.

[16] KRAUS, B. et PAGE, R.E., 1995. Population growth of *Varroa jacobsoni* Oud in mediterranean climates of California. *Apidologie.* 26(2), 149-157.

[17] IFANTIDIS, M. D., 1997. Ontogenesis of *Varroa jacobsoni* Oud.*Cahiers Options Méditerranéennes.* 21, 13- 21.

[18] FREY, E., SCHNELL, H. & ROSENKRANZ, P., 2011. Invasion of V*arroa destructor* mites into mite- free honey bee colonies under the controlled conditions of a military training area. *Journal of Apicultural Research* 50(2), 138-144.

[19] HOULE, E., 2004. Les méthodes physiques en lutte intégrée. Centre de Référence en agriculture et agroalimentaire. Québec, Canada, 3-4.

[20] ADJLANE, N., BENAZIZA, D. & HADDAD, N., 2015. Population dynamic of *varroa destructor* inthe local honey bee *Apismelliferaintermissa*in Algeria. *Bulletin of Pure and Applied Sciences*. l.34, 25-37.

[21] FRIES, I. PEREZ-ESCALA, S., 2001. Mortality of varroa destructor in honey bee (apis mellifera) colonies during winter. *Apidologie* 32(3), 223-229.

[22] MARTIN, S. J. 2001. The role of *Varroa* and viral pathogens in the collapse of honey bee colonies: a modelling approach. *Journal of Applied Ecology* 38, 1082-1093.

[23] FRIES, I., CAMAZINE, S. & SNEYED, J., 1994. Population dynamics of *Varroa jacobsoni* : a model and a review. *Bee Word* 75, 5-28.

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