Short Communication

Prevalence and Epizootical Aspects of Varroasis in Golestan Province, Northern Iran

Saeid Bokaie 1, *Laleh Sharifi 2, Majid Mehrabadi 3

1Department of Epidemiology, Veterinary Medicine Faculty, University of Tehran, Tehran, Iran
2Immunology, Asthma and Allergy Research Institute, Tehran University of Medical Sciences, Tehran, Iran
3Graduated from Azad Islamic University, Garmsar Branch, Garmsar, Iran

(Received 20 Nov 2011; accepted 15 May 2013)

Abstract

Background: The Varroa destructor mite is considered as a major pest of honey bees Apis mellifera. The rapid spread of Varroa mites among bee colonies may be due to several factors, including drifting of infested bees, movement of bee swarms, and robbing of weakened colonies. Disease spread and predisposing the infested bees to other diseases lead to high economic losses in beekeeping industries. The aim of this study was to determine the prevalence of and evaluate some managing factors in Golestan Province in Iran in 2008.

Methods: According to the records of Agricultural Research Center, 80 infested beekeeping centers identified and a questionnaire consisting of managing factors for each center has been designed. All data were recorded and analyzed by SPSS software to calculate χ² test.

Results: Among 80 apiculture centers, 72 centers (92%) were infested to Varroa and hive density of 90.6% of the centers was 31–60 hives in one center (P=0.324). All of the apiculture centers had more than 6 km distance to nearest beekeeping center (P=0.687). Amongst bee keepers 15(93.8%) had low literacy level (P=0.479) and 26(89.7%) had 5–10 years experience in beekeeping (P=0.953).

Conclusion: We can conclude that because of the high prevalence of the disease, the usual methods of prevention are not effective. This high prevalence emphasizes that we are very far from a solution for Varroa infestation and extra researches on mite biology, tolerance breeding, and Varroa treatment is immediately required.

Keywords: Apis mellifera, Varroa destructor, Honey bee, Iran

Introduction

The new worldwide distributed and hemophagous mite Varroa destructor is considered as a main pest of honey bees Apis mellifera. Before year 2000, V. destructor was understood to be Varroa jacobsoni (Anderson and Trueman 2000) which successfully shifted from the original host, A. cerana to the Western honey bee, A. mellifera. (Rath 1999). The details of the host shifting phenomenon are unclear. Varroa destructor acts as a vector of different bee viruses. Until now 18 different viruses have been identified in honey bees (Chen and Siede 2007). Numerous of bee viruses can be transmitted by V. destructor such as Acute Bee Paralysis Virus (ABPV), Israeli Acute Paralysis Virus (IAPV), Kashmir Bee Virus (KBV), Sacbrood Virus (SBV), and Deformed Wing Virus (DWV) (Boecking and Genersch 2008). Before the appearance of Varroa mites in A. mellifera, viral diseases were minor troubles for honey bee health (Allen et al. 1986, Bailey and Ball 1991, Bowen-Walker et al. 1999, Yue and Genersch 2005). At a short time V. destructor has worldwide geographical distribution and we can not find a country free of this disease rather than Australia. The economic burden of this ectoparasite is high. Disease...
distribution and predisposing the infested bees to other diseases lead to high economic losses in beekeeping industries. In addition, *Varroa* mite may intensify the problems of pollination in future time (De la Rua et al. 2009).

*Varroa* females start to reproduce by entering the brood cells of last-stage worker or drone larvae, normally within 20–40 hours before the cells are sealed (Boot et al. 1992). About 60 h after the bee cell is capped; the adult female mite puts her first egg and can produce over 10 progeny (Sammataro et al. 2000). The adult female mite and progeny feed on the hemolymph of pupae from a single feeding site (Kanbar and Engels 2003). All reproduction of *Varroa* occurs in the brood cells, and only the adult females survive after the bee emerges. Some immature females, eggs (rarely), and males are left and removed by the nurse bees when the bee emerges. *Varroa* mites suck the hemolymph from adults and developing pupae of honey bees, thereby weakening the bees and reducing their life length. The rapid spread of *Varroa* mites among bee colonies is due to a number of factors such as drifting of diseased bees, movement of bee swarms, and robbing of weakened colonies (de Jong 1997). In addition, migratory beekeeping practices and the importation of infested bees lead to rapid distribution of *Varroa* mites (Sammataro et al. 2000).

Application of synthetic acaricides has been the main way for controlling the pest. But the intensive use of many chemical substances against the mites resulted in the increase of resistance and decrease of their efficiency (Milani 1999) and contamination of products such as honey and beeswax (Wallner 1999). The problems of chemical acaricides encourage the scientists to find new and safer ways control of *Varroa*. Natural products such as essential oils offer a highly desirable alternative to synthetic products. These substances are used increasingly because they are generally inexpensive and have fewer health hazards to both man and honeybees (Isman 2000). Various alternative ways for managing the mite have been investigated (Imdorf et al. 1995, Fries 1997, Thomas 1997, Calderone 2005). Most of them are suggesting non-chemical methods for reducing occurrence of mite infestation in beehives (Imdorf et al. 1999). One of these non-chemical methods is use of formic acid that has received great consideration because of its activity against *V. destructor* (Calderone 2000, Currie and Gatien 2006).

Based on the veterinary organization protocol in Iran the bee hives with ≤5% infestation of *V. destructor* must be treated with standard treatments such as Formic Acid®, Api Life Var®, Apiguard®, Apistan® and Apivar®.

The objectives of this study were to determine the prevalence of *V. destructor* and evaluating the effect of the hygienic factors in infestation rate in Golestan Province of Iran. This province with temperate and wet macro climate is one of the most important sites of beekeeping industry in Iran.

**Materials and Methods**

All beekeeping centers were identified in Golestan Province according to the information of the Agricultural Research Center. Due to protocol of the Iranian Veterinary Organization, *Varroa* sampling was done every season and 5% of hives in each beekeeping center were investigated. Beehives with less than 5 honey-combs were excluded from sampling. A questionnaire consisted of managing and hygienic factors were filled for each beekeeping center. Questions included distance to the nearest apiculture center, altitude of apiculture center from the sea level, use of guard wall around the beekeeping center, migration situation, numbers of hives, the height of hives from the ground, distance between hives, disinfection procedures, and
methods to provision of pollen, wax, apiculture equipments, queen and water supplying. Literacy and experience levels of bee keepers were asked also.

All data were recorded and analyzed by SPSS software version 15 to calculate χ2 test and fisher exact test. P values less than 0.05 were considered as significant level.

Results

Among 80 apiculture centers, 72 centers (92%) were infested by Varroa mite. The hive density of 90.6% of centers was 31–60 hives/center (P = 0.324). All of the apiculture centers had more than 6 km distance to nearest beekeeping center (P = 0.687). Fire have been used to disinfect the equipments in 54 (90%) of studied centers (P= 1.000). Fifty eight infected centers (90.6%) had migrated beehives (P= 0.657).

Amongst beekeepers 15(93.8%) had low literacy level (P = 0.479) and 26(89.7%) had 5–10 years experience in beekeeping (P= 0.953).

In Table 1 the association between Varroa infestation of beekeeping centers and the altitude of apiculture center from the sea level, the height of beehives from the ground, distance between beehives and use of guard wall around the beekeeping center, have shown.

The methods for provision of pollen, wax, apiculture equipments, queen and water supply have been shown in Table 2 and their relations with varroasis are in the same table.

Table 1. The relations between varroasis and the altitude of apiculture center, the height of hives, distance between hives and use of guard wall

| Varroasis                   | Variables                              | Positive | Negative | P value |
|-----------------------------|----------------------------------------|----------|----------|---------|
|                             | Altitude of apiculture center           | ≤800m    | 47 (90.4%) | 5 (9.6%) | P = 1.000 |
|                             |                                       | >800m    | 25 (89.2%) | 3 (10.8%) |
|                             | Height of hives from the ground surface | 10–25cm  | 69 (89.6%) | 8 (10.4%) | P = 0.0284* |
|                             |                                       | 26–40cm  | 3 (100%)   | 0 (0%)    |
|                             | Distance between hives                 | ≤50cm    | 63 (90%)   | 7 (10%)   | P = 1.000 |
|                             |                                       | >50cm    | 9 (90%)    | 1 (10%)   |
|                             | Use of guard wall                      | Yes      | 19 (79.2%) | 5 (20.8%) | P = 0.0485* |
|                             |                                       | No       | 53 (95%)   | 3 (5%)    |

*P< 0.05 is significant

Table 2. The relation between varroasis and the use of pollen in apiculture, source of pollen, water, wax, equipments, and queen

| Variables                              | Varroasis       | Positive n (%) | Negative n (%) | P value |
|----------------------------------------|-----------------|----------------|----------------|---------|
| Use of additional pollen               | Yes             | 62 (89.8)      | 7 (10.2)       | P= 0.00011* |
|                                        | No              | 10 (91)        | 1 (9)          |
| Purchase pollen from other apiculture  | Yes             | 65 (91.5)      | 6 (8.5)        | P= 0.2201 |
| centers                                | No              | 7 (77.7)       | 2 (22.3)       |
| Purchase wax from other apiculture     | Yes             | 58 (89.2)      | 7 (10.8)       | P= 1.000 |
| centers                                | No              | 14 (93.3)      | 1 (6.7)        |
| Purchase second hand equipments from   | Yes             | 24 (92.3)      | 2 (7.7)        | P= 1.000 |
| other apiculture centers               | No              | 48 (88.9)      | 6 (11.1)       |
| Purchase queen from other apiculture   | Yes             | 32 (84.2)      | 6 (15.8)       | P= 0.1414 |
| centers                                | No              | 40 (95.2)      | 2 (4.8)        |
| Source of water                        | River           | 63 (88.7)      | 8 (11.3)       | P= 0.0008* |
|                                        | Non river       | 9 (100)        | 0 (0)          |

*P< 0.05 is significant
Discussion

According to the results, this high prevalence of infestation shows the high spread of *V. destructor* in beekeeping centers in Golestan Province. This occurrence is similar to other sites of the world that had reported, the eastern coastal region of the USSR in 1952, Pakistan in 1955, Japan in 1958, China in 1959, Bulgaria in 1967, Paraguay in 1971, Germany in 1977 (Ruttner and Ritter 1980), United States in 1987 (De Guzman and Rinderer 1999). Today, *V. destructor* has global distribution, but according to the reports published by Australian Government (http://www.daff.gov.au/qis/quarantine/pests-diseases/honeybees) it has not yet been found in Australia.

In this study we showed that heights of hive from the ground level associated to varroasis prevalence. Distance from the ground surface can affect the humidity of brood cells and influence the mite reproduction. We found a significant relation between varroasis and use of additional pollen for hives in beekeeping centers. In addition we found that the infestation rate of bee-keeping centers that supply their water from the river are less than centers which provide water from other routs also use of guard wall around the apiculture center was related to lower infestation rate of *Varroa*. The micro-climatic conditions inside the colony are affected by outside factors including temperature, humidity or the accessibility of pollen and nectar. This may influence the proportion of non-reproducing mites (Eguaras et al. 1994, Garcia-Fernandez et al. 1995, Kraus and Velthuis 1997, Moretto et al. 1997).

According to the non-significant results of the effect of bee-keepers’ literacy and experience level in prevention of disease, inefficiency of hygienic factors such as having suitable distance to other beekeeping centers and decreasing hive density in a center (number of hives), the altitude of apiculture center from the sea level and distance between bee-hives, it can be concluded that the usual methods of *Varroa* prevention are not effective. However the ways to provision pollen, bee wax, equipments, and queen had not any influence on *Varroa* infestation rate.

Use of *Varroa* tolerant honey bees and chemical and biological methods of *Varroa* treatments are suggested as important controlling ways. The control of mite reproduction is considered the most effective tool for the host to prevent the growth of a *Varroa* population within the colony (Fries et al. 1994).

However further exploration of mite biology in preparing control measures as well as using tolerant types and treatment especially by non-chemical substances are instantly needed.

Conclusion

Because of the high prevalence of the disease (92%), the usual methods of prevention are not effective and we should consider the new methods for *Varroa* control.

Acknowledgements

We would like to thank Mr. Gholam Abbas Badrkhani, for providing helpful comments to carry out this research project. The authors declare that there is no conflict of interest.

References

Allen MF, Ball BV, White RF, Antoniw JF (1986) The detection of acute paralysis virus in *Varroa jacobsoni* by the use of a simple indirect ELISA. J Apicult Res. 25: 100–105.

Anderson DL, Trueman JWH (2000) *Varroa*
*jacobsoni* (Acari: Varroidae) is more than one species. Exp Appl Acarol. 24: 165–189.

Bailey L, Ball BV (1991) Honey Bee Pathology. Academic Press, London.

Boecking O, Genersch E (2008) Varroosis – the ongoing crisis in bee keeping. J Consum Protect Food Safety. 3(2): 221–228.

Boot WJ, Calis NM, Beetsma J (1992) Differential periods of varroa mite invasion into worker and drone brood cells of honey bees. Exp Appl Acarol. 6: 295–301.

Bowen-Walker PL, Martin SJ, Gunn A (1999) The transmission of deformed wing virus between honeybees (Apis mellifera) by the ectoparasitic mite *Varroa jacobsoni* Oud. J Invertebr Pathol. 73: 101–106.

Calderone NW (2000) Effective fall treatment of *Varroa jacobsoni* (Acari: Varroidae) in colonies of the honey bee (Hymenoptera: Apidae) with formic acid in a northern climate. J Econ Entomol. 93: 1065–1075.

Calderone NW (2005) Evaluation of drone brood removal for the management of *Varroa destructor* (Acari: Varroidae) in colonies of the honey bee Apis mellifera L. (Hymenoptera: Apidae) in the northeastern USA. J Econ Entomol. 98: 645–650.

Chen YP, Siede R (2007) Honey bee viruses. Adv. Virus Res. 70: 33–80.

Currie RW, Gatien P (2006) Timing acaricide treatments to prevent *Varroa destructor* (Acari: Varroidae) from causing economic damage to honey bee colonies. Can Entomol. 138: 238–252.

De Guzman LI, Rinderer TE (1999) Identification and comparison of *Varroa* species infesting honey bees. Apidologie. 30: 85–95.

de Jong D (1997) Mites: varroa and other parasites of brood. In: Morse RM, Flottum PK (Eds.), Honey Bees Pests, Predators, and Diseases, 3rd ed. The A. I Root Company, Medina, OH, pp. 281–327.

De la Rua P, Jaffe R, Dall’Olio R, Muñoz I, Serrano J (2009) Biodiversity, conservation and current threats to European honeybees. Apidologie. 40: 263–284.

Eguaras M, Marcangeli J, Oppedisano M, Fernández N (1994) Seasonal changes in *Varroa jacobsoni* reproduction in temperate climates of Argentina. Bee Sci. 3: 120–123.

Fries I, Camazine S, Sneyd J (1994) Population dynamics of *Varroa jacobsoni*: a model and a review. Bee World. 75: 5–28.

Fries I (1997) Organic control of *Varroa*. In: Munn P, Jones R (Eds) *Varroa! Fight the mite*. IBRA, Cardiff.

Garcia-Fernandez P, Rodriguez RB, Orantesbermejo FJ (1995) Influence of climate on the evolution of the population-dynamics of the Varroa mite on honeybees in the south of Spain. Apidologie. 26(5): 371–380.

Imdorf A, Bogdanov S, Ibáñez Ochoa R, Calderone N (1999) Use of essential oils for the control of *Varroa Jacobsoni* Oud. in honey bee colonies. Apidologie. 30: 209–228.

Imdorf A, Charriere JD, Maquelin C, Kitchenmann V, Bachofen B (1995) Alternative varroa control. Federal Dairy Research Institute, Apicultural Department, Liebefeld.

Isman MB (2000) Plant essential oils for pest and disease management. Crop Prot. 19: 603–608.

Kanbar G, Engels W (2003) Ultrastructure and bacterial infection of wounds in honey bee (Apis mellifera) pupae punctured by *Varroa* mites. Parasitol Res. 90: 349–354.

Kraus B, Velthuis HHW (1997) High humidity in the honey bee (Apis mellifera L.) brood nest limits reproduction of...
the parasitic mite *Varroa jacobsoni* Oud. Naturwissenschaften. 84: 217–218.

Milani N (1999) The resistance of *Varroa jacobsoni* Oud. to acaricides. Apidologie. 30: 229–234.

Moretto G, Gonçalves LS, De Jong D (1997) Relationship between food availability and the reproductive ability of the mite *Varroa jacobsoni* in Africanized bee colonies. Am Bee J. 137: 67–69.

Rath W (1999) Co-adaptation of *Apis cerana* Fabr. and *Varroa jacobsoni* Oud. Apidologie. 1999. 30: 97–110.

Ruttner F, Ritter W (1980) Das Eindringen von *Varroa jacobsoni* nach Europa im Rückblick. Allg Deut Imkerz. 14: 130–134.

Sammataro D, Gerson U, Needham G (2000) Parasitic mites of honey bees: Life History, Implications, and Impact. Annu Rev Entomol. 45:519–548

Thomas HU (1997) Practical aspects of alternative Varroa control methods. In: Munn P, Jones R (eds) *Varroa! fight the mite*. IBRA, Cardiff, pp. 22–30.

Wallner K (1999) Varroacides and their residues in bee products. Apidologie. 30: 235–248.

Yue C, Genersch E (2005) RT-PCR analysis of deformed wing virus in honeybees (*Apis mellifera*) and mites (*Varroa destructor*). J Gen Virol. 86: 3419–3424.