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Prevalence of *Varroa destructor* on honey bees hives in district Karak, Khyber Pakhtunkhwa, Pakistan

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Abstract
The parasitic mite *Varroa destructor* is responsible for heavy losses in honeybee hives, colonies and is a major threat to the beekeeping industry. *Varroa destructor* the ectoparasitic honey bee mite are known to be capable of infesting and successfully reproducing in *Apis mellifera* colonies worldwide. Varroosis has not been thoroughly investigated in the Khyber Pakhtunkhwa province of Pakistan, so the aim of the present study was to observe the current status of *V. destructor* in beekeeping industry in District Karak. Total 14 hives of honey bees were examined. Almost 308 specimens were collected from different localities of the studied area from November 2016 to May 2017.The overall prevalence of *V. destructor* was in honey bee hives was 0.64%. The parasites were more prevalent during the month of April and November. The infection was higher in larvae, pupae as compared to adults. To control *Varroa* mite oxalic acid concentration are very effective and can be used without any side effect.

Keywords: prevalence, *Varroa destructor*, honey bees, hives

Introduction
Bees of all kinds belong to the insect order Hymenoptera comprising about 100,000 species. There are almost 25,000 described species of bees worldwide. About 26 sub species and numerous ecotypes of *A. mellifera* have been described based upon behavior, morphology, and molecular evidence [1]. Ten species of honeybees belonging to the genus *Apis* are generally recognized [2]. There are four species of *Apis* in Pakistan i.e *A. mellifera, A. dorsata, A. cerana, A. florea* [3]. *Varroa destructor* is the world's most devastating pest of Western honey bees, *Apis mellifera*. Though the *Varroa* complex includes multiple species, *Varroa destructor* is the species dependable of the enormous common of the injure accredited to mites from this genus. However, taxonomic work available in 2000 indicated that a previously-unidentified species of *Varroa destructor* were accountable for the harm, while *Varroa jacobsoni* was given away to be only reasonably harmful to western honey bees [4]. The parasitic bee mite is one of the common severe honey bee pests in the world extensive but most common in Pakistan. Without chemical intervention by the beekeeper honey bees colonies will typically die within 6-18 months due to *Varroa* infestation [5]. The ectoparasitic mite *V. destructor* parasitizes only honeybees [6]. Since they get in touch with *Varroa* and *A. mellifera*, severe troubles have been experienced worldwide in apiculture. The effects of the parasite on honey bees range from weakening to death of parasitized colonies. The *Varroa* mite is measured a critical factor in the declining numbers of beekeepers and honey bee colonies in Europe together with the worldwide decline of natural pollinators, the *Varroa* mite may make worse expectations harms for pollination [7]. Beekeepers are bearing heavy financial losses due to the *Varroa* mite attack on honeybees and their resistance against acaricides populations. So it is very essential to find other non-toxic and effective methods to suppress mite populations. Many beekeepers use unregistered products including chlorobenzilate, phenothiazine, sulfur, different pyrethroids for controlling the mite infestation because no approved miticides are available [8]. Oxalic Acid is a natural constituent of honey and very effective against the *Varroa* mite. Uses of OA for the control of *Varroa* have been increasing in recent years [9]. Contamination of bee products with pesticides has been widely documented for many years. Beekeepers either loose a great amount of their colonies in the winter or they start with a weak colony population in the spring season. The level of *Varroa* infestation and the use of old queens could be the main reason for the loss of colonies in the winter [10]. Several causes of these large-scale losses have been reported, including honey bee parasites (*Varroa destructor*) pathogens pesticides,

contaminated water, use of antibiotics, poor nutrition, and migratory beekeeping practices [11]. The objective of the current study was to investigate the prevalence of *Varroa destructor* in honey bee farms present in District Karak, Khyber Pakhtunkhwa (Pakistan).

Materials and Methods

Study area

District Karak is situated on the south of Peshawar. It is 123 km from the Peshawar capital of KPK. This area is mainly separated into two main zones on the basis of rainfall, temperature and soil texture. Thall zone (Thall Area) which is comparatively hot and annual rainfall is less than 500 mm. *Triticum aestivum* (wheat), *Avena sativa* (barly), Jove, *Ziziphus jujuba* (beri), *Acacia Arabica* (kicker), *Dalberjaseso* (shawa) are commonly found in this region. *Ziziphus jujuba* (beri) is the common fruit of the region, which attract honey bees. The temperature reaches up to 42-46 ◦C in summer while in the winter season it reaches up to 19–20 ◦C. The second zone ischontra. Annual rainfall is in between 500 to 750 mm. The common fruits, wild plant is founded such as *Ziziphus jujuba* (beri), *Arabica* (kicker), peanuts (*Arachis hypogea).*

Sample collection and processing

The study was carried out seasonally, started from November 2016 to May 2017 in the studied region. Total 308 specimen was collected in different region of the district Karak. Specimens were collected from Tahti-e-Nasrati, Chokara, Bogarra, Miankibunda, Ahmed Abad, Warana, Latember, and Shah slim. Total 14 hive were observed in different timings. After examination these specimens were deposited in the entomology laboratory Department of Zoology.

Results and Discussion

In the present study *Varroa destructor* parasite was analyzed particularly in the honey bee's species *Apis mellifera* in district Karak from November 2016 to May 2017. To check the prevalence of *V. destructor*, 14 hives were inspected to collect honey bee specimen in district Karak. And the total number of infected hives prevalence of *V. destructor* was 0.64% (table 1.1). Total 308 samples of honey bee's species *Apis mellifera* were collected. The overall month's wise prevalence of *Varroa destructor* was 5.19% (table 1.2). The highest prevalence of *Varroa destructor* was found in the month of April 7.5% and November 5% the lowest number was found February 1.2% and December 3.3%.

Table 3.1: Total number of hives prevalence *V. destructor* in honeybees (*Apis mellifera*)

Parameter	Total number of hives	Number of infected hives	Prevalence in percentage (%)
Hives	14	2	0.64 %

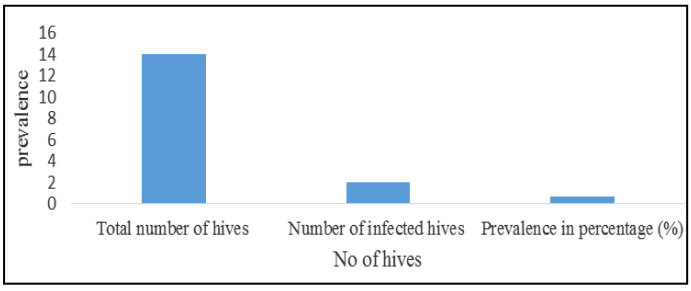

Fig 3.1: Total number of hives prevalence *V. destructor* in honeybees (*Apis mellifera*)

Table 3.2: Month wise prevalence of *V. destructor* in honeybees (*Apis mellifera*).

Months wise prevalence	Number of samples collected	Number of infected samples	Total percentage
Nov 2016	40	05	12.5%
Dec 2016	30	01	3.3%
Jan 2017	43	02	4.6%
Feb 2017	80	01	1.2%
Mar 2017	40	02	5%
Apr 2017	40	03	7.5%
May 2017	35	01	2.8%
Total	308	16	5.19%

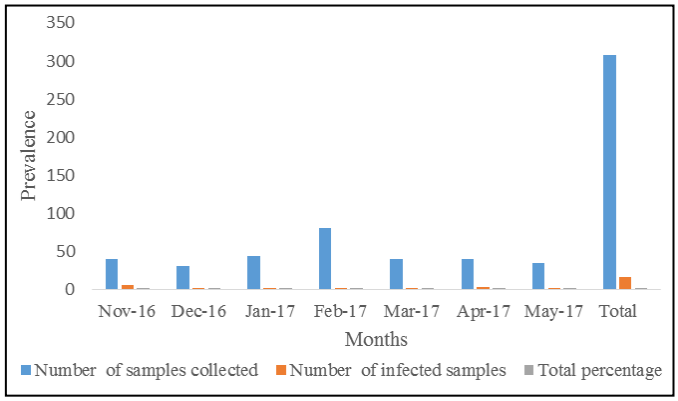

Fig 3.2: Month wise prevalence of *V. destructor* in honey bees (*Apis mellifera*).

According to Anandan *et al*, (2009) [12] the obtained results for the severity of mite infestation before treatment among the studied region 1980 colonies in the districts of Karak, Kohat and Bannu were uneven 73.26%, 60.90% and 53.47%, respectively. But the current result shows that *Varroa destructor* attack on the *Apis mellifera* in districts Karak, the total number of infected hives were 0.64%. Which indicate that the highest prevalence of *Varroa destructor* was found in the month of April, 7.5% and November 5%. This indicated that the presence of *Varroa* is a major problem for beekeepers in these areas. The number of mites that fell on the sticky board during the first collection period was significantly higher than that observed during the second and third collection periods [12].

The mean value of monthly collected three years data indicated that adult *Varroa* mites are present in all the experimental bee colonies throughout the years. However, the adult *Varroa* mite population is slightly higher during dry seasons of January, April and June, December. However, in the months of January, March and July the population of *Varroa* mites recovered was low and this might be accredited to low brood rearing in these dry months. In the arid period, there is a low, threatening propensity and this hide the growth reduces mite population growth and bee colonies during the honey flow season are more likely to be infested with *Varroa* mites. In fact, this is despite the killing nature and historical records the mite in causing be colony collapse on European honey bees if not chemically treated. The results also confirm that the 3.2% OA for normal sized colonies can be used for mite control with good results without any obvious adverse effects on bee colonies over winter [13].

Conclusion

Varroa destructor was not properly studied in District Karak, Khyber Pakhtunkhwa Pakistan. This study has evaluated the prevalence of Varroosis in honey bee hives in District Karak.

It was concluded that the parasite is prevalent in District Karak and the intermediate host's i.e larval brood, pupa. To control the parasitic attack of *Varroa destructor*, beekeepers must use biological and biotechnical methods to prevent their hives from *V. destructor*.

The use of different organic acids and essential. i.e. *F*ormic and oxalic acids, geranium and basil or through an IPM (Integrated Pest Management) program to control *Varroa* mites. These materials are inexpensive, labor-efficient and relatively less toxic compared to very expensive and toxic acaricides, randomly used in overdoses, by beekeepers. It is agreed that there is no danger of contamination if the treatment is carried out properly outside the period of production or storage of honey in the hives. In spite of reduced brood rearing in some cases, colonies could restore their normal strength gradually again. It is worth mentioning that formic acid should not be conducted with weak colonies, however the present results showed that such colonies are severely damaged and could be collapsed.

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