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Distribution of Varroatosis and Mixed Infections in Beekeeping Farms of Khorezm and Bukhara Regions

Suyunov Rashid Uktamovich
Independent Researcher, Samarkand State University of Veterinary Medicine, Livestock and Biotechnology

Yunusov Khudaynazar Beknazarovich
Doctor of Biological Sciences, Professor, Samarkand State University of Veterinary Medicine, Livestock and Biotechnology

Ibragimov Furqat Buriyevich
Candidate of Veterinary Sciences, Associate Professor, Samarkand State University of Veterinary Medicine, Livestock and Biotechnology

Mirzakarimova Kumushkhon
Master's Degree Student, Samarkand State University of Veterinary Medicine, Livestock and Biotechnology

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Annotation: This article examines the epizootic situation of honey bee varroatosis in beekeeping farms of the Khorezm and Bukhara regions, assessing the prevalence (extensiveness) and intensity of infestation. Additionally, cases of mixed parasitic infections involving Varroa destructor, Tropilaelaps spp., and Nosema spp. were analyzed. The results revealed regional patterns in the distribution of varroatosis and identified the influence of climatic conditions and management practices on disease development. The study scientifically substantiates the necessity of implementing integrated pest management strategies.

Keywords: honey bee, bee colony, beekeeping, varroatosis, Varroa destructor, Tropilaelaps clareae, Nosema apis, ectoparasites, infestation prevalence, infestation intensity, epizootology, honey bee biology, honey quality, entomological monitoring, parasitological analysis, mixed parasitic infections, integrated

pest management (IPM), environmental factors.

Relevance of the Study: In recent years, parasitic diseases in beekeeping farms, particularly varroatosis, have become widely prevalent, exerting a serious impact on honey bee health and the efficiency of honey production. Varroatosis is caused by the ectoparasitic mite *Varroa destructor*. This parasite attaches to the external surface of honey bees, primarily on the abdominal segments, and feeds on their hemolymph. As a result, bees become weakened, brood mortality increases within colonies, their biological productivity declines, and susceptibility to secondary viral and bacterial infections rises. Furthermore, the development and spread of the disease are directly influenced by the climatic conditions, vegetation cover, management practices, and acaricidal preventive measures specific to each region.

From this perspective, investigating the epizootic status of varroatosis in beekeeping farms of the Khorezm and Bukhara regions, determining the prevalence and intensity of invasion, as well as evaluating cases of mixed infections, holds significant scientific and practical relevance and remains an urgent research issue.

Degree of Problem Study: From a morphological perspective, the causative agent of varroatosis belongs to the phylum Arthropoda, subphylum Chelicerata, class Arachnida, order Acarina, suborder Parasitiformes, family Varroidae, genus *Varroa*, and is classified as *Varroa jacobsoni*. In addition, the genus *Varroa* includes two other species: *Varroa underwoodi* and *Varroa destructor* [7].

The life cycle proceeds through complete metamorphosis and includes the following stages: egg → larva → protonymph → deutonymph → imago. Development occurs inside brood cells (i.e., capped pupal cells of honey bees), which enhances the ecological adaptability of the parasite [4; 5; 8].

Scientific studies conducted on *Varroa destructor* emphasize the importance of implementing standardized methodologies. The proposed systematic approaches recommend internationally applicable methods for parasite detection, quantification, and monitoring. Notably, these studies suggest that regional and climatic differences should be considered when selecting control strategies [2].

Research conducted on local honey bee colonies in Ethiopia revealed the seasonal dynamics of *Varroa destructor* infestation, demonstrating that peak infestation rates occur during periods when bee colonies are weakened and exposed to abrupt environmental changes. According to these findings, varroatosis management strategies should be seasonally adapted. Observations across the African region, particularly in Ethiopia, indicate that seasonal surges in varroatosis coincide with the summer and dry periods [3].

Varroatosis manifests not only as an independent disease but also as part of complex infections associated with multiple viruses, especially IAPV (Israeli Acute Paralysis Virus) and DWV (Deformed Wing Virus). Such co-infections may lead to the complete collapse of honey bee colonies [6].

Among the most effective monitoring methods for varroatosis are alcohol wash, powdered sugar dusting, and bee shaking techniques. These methods provide a high level of accuracy in determining infestation rates [1].

Materials and Methods: The scientific research was conducted during 2023–2025 at the Department of Veterinary Sanitary Expertise of Samarkand State University of Veterinary Medicine, Livestock and Biotechnologies. The laboratory analyses were carried out in the laboratories of the Departments of “Veterinary-Sanitary Expertise” and “Diseases of Fish, Bees, and Fur-Bearing Animals,” while field experiments were performed in beekeeping farms including “Qudrat Masharipov Asalari” in Khiva district and “Asadbek Toza Asal” in Gurlan

district of the Khorezm region, as well as “Fayzullo Polvon Toza Asal” in Jondor district and “Umurbek Asalari Boli” in Olot district of the Bukhara region.

The study was conducted on Carpathian breed honey bee colonies, with 15 colonies examined from each farm. Epizootological, parasitological, and organoleptic methods were used in the research.

Bukhara region is located in the central-western part of Uzbekistan, in the lower reaches of the Zarafshan River. It borders Navoi region to the north, Kashkadarya region to the east, and Turkmenistan to the south and west. Horticulture, melon-growing, vegetable cultivation, and cotton farming are developed in irrigated areas of the region. Although the region’s hot and arid climate to some extent slows the development of varroatosis, the humid microclimate formed in irrigated lands maintains the risk of disease transmission.

Khorezm region is situated in the far west of Uzbekistan, in the lower reaches of the Amu Darya River, and borders the Republic of Karakalpakstan, Turkmenistan, and Bukhara region. Cotton, wheat, alfalfa, and vegetable–melon crops, as well as orchards, are widely cultivated in irrigated lands, serving as an important year-round nectar source for bees. The long vegetation period and successive flowering of plants extend the nectar-gathering season, enabling multiple honey harvests per year. Khorezm honey is distinguished by its unique composition, combining nectar from cotton, alfalfa, fruit trees, and desert flora.Although the hot and arid climate of the region limits the development of varroatosis, a potential risk of disease persists in microareas with high humidity, particularly in irrigated zones. Therefore, preventive and monitoring measures against varroatosis must be implemented with consideration of local climatic conditions.

To detect the ectoparasite *Varroa destructor*, the causative agent of varroatosis in honey bees, and to assess its prevalence and epizootic characteristics, parasitological methods were employed. Worker bee samples were collected in special containers and washed in an alcohol solution to isolate the parasites. According to the alcohol wash method, 300–500 worker bees were collected from each colony and placed in 70% ethanol solution. The solution was then passed through a double-layer sieve, after which the parasites retained in the lower sieve were separated by shaking and examined under a microscope (MIC D30 trinocular microscope, 10×100/1.25 objective lens). Based on their morphological features (shape, size, color, and body structure), *Varroa destructor* mites were identified. Subsequently, the level of infestation in each colony was determined by calculating the ratio of the number of mites to the number of bees.

Results of the Study: The results of the study conducted to determine the prevalence (extensiveness) and intensity of varroatosis in Carpathian breed honey bee colonies in the Bukhara and Khorezm regions revealed significant regional variability in the distribution of the disease.

In the “Fayzullo Polvon Toza Asal” apiary located in Jondor district of Bukhara region, the infestation prevalence was recorded at 26.7%, indicating a relatively low level of disease spread. The infestation intensity ranged from 8 to 17 mites per 300 worker bees, which corresponds to a moderate level of infestation.

In the “Umurbek Asalari Boli” apiary located in Olot district, infestation prevalence was 20%, which is slightly lower compared to that in Jondor district. The infestation intensity ranged from 3 to 13 mites, reflecting a low level of varroatosis in this area. On average, the infestation prevalence of varroatosis in Bukhara region was 23.3%. These findings are presented in Table 1 below.

Table 1. Indicators of Infestation Prevalence and Infestation Intensity of Varroatosis in Carpathian Breed Honey Bees in Bukhara and Khorezm Regions

№	Region	District	Name of Apiary	Number of Colonies Examined (n)	Number of Infested Colonies	Invasion extensiveness		Infestation Intensity (per 300 worker bees)
						by farm	By region	
1.	Bukhara	Jondor	“Fayzullo polvon toza asal”	15	4	26,7	23,3	8-17
2.	Bukhara	Olot	“Umurbek Asalari boli”	15	3	20		3-13
3.	Khorezm	Khiva	“Qudrat Masharipo v asallari”	15	5	33,3	30	23-34
4.	Khorezm	Gurlan	“Asadbek toza asal”	15	4	26,7		19-35
Total / Average				60	14	26,7	26,7	13,2-24,7

Invasion indicators in the Khorezm region were higher compared to the Bukhara region. In particular, in the “Qudrat Masharipov asallari” beekeeping farm located in the Khiva district, the invasion extensiveness was 33.3%, which is significantly higher than the indicators recorded in the farms of the Bukhara region. The invasion intensiveness was recorded in the range of 23–34 mites per 300 worker bees, indicating a high level of infestation.

In the “Asadbek toza asal” farm of the Gurlan district, the invasion extensiveness was 26.7%, while the invasion intensiveness ranged between 19–35 mites per 300 bees, which indicates a high parasitic pressure. On average, the invasion extensiveness of varroatosis among bees in the Khorezm region accounted for 23.3%.

In general, the average invasion extensiveness in beekeeping farms of the Bukhara and Khorezm regions was 26.7%, and the invasion intensiveness ranged from 14.3 to 24.7 mites per 300 bees. These results show that Carpathian honey bee colonies exhibit varying susceptibility to varroatosis depending on regional conditions and management practices. The higher invasion extensiveness and intensiveness indicators observed in the Khorezm region compared to other regions indicate a higher risk of *Varroa destructor* invasion in this area.

This situation can be explained by several factors. Firstly, the climatic conditions of the region—with long and hot summers and relatively mild winters—create favorable conditions for year-round activity of the parasitic mites and enable uninterrupted continuation of their reproductive cycle. Secondly, irregular and unsystematic acaricide prophylaxis practices in local beekeeping, as well as improper dosage or untimely application of chemical treatments, contribute to the persistence of the parasite population.

In addition, the lack of control over colony replacement and inter-colony contact in some farms increases the rate of disease transmission. *Varroa* mites develop not only on adult bees but also in capped brood, which contributes to the long-term persistence of the infection focus. High invasion intensiveness (19–35 mites per 300 worker bees) adversely affects the physiological

condition of bee colonies, leading to weakened immunity in worker bees and the occurrence of secondary viral co-infections.

Therefore, the implementation of Integrated Pest Management (IPM) strategies is of great importance in controlling varroatosis in the Khorezm region. These strategies include biological methods (organic acids such as oxalic and formic acids), mechanical methods, as well as the use of effective and rotational acaricide preparations (Bipin-T, amitraz, flumethrin, and others). In addition, conducting invasion monitoring at least three times a year and determining treatment measures according to the infestation level help reduce the regional endemic status of the disease.

During the examinations, the presence of mixed parasitic infestations in the samples taken from bee colonies was also detected. At the regional level, it was found that infestation with *Varroa destructor* mites along with other detected infections causes significant damage to bee colonies, leading to the death of a large number of bees in hives and a decrease in honey productivity.

According to the results of the investigations, in some districts of the Samarkand region, infestation only with *Varroa destructor* mites accounted for 33.3%. Mixed infestation with *Varroa* and *Tropilaelaps* mites was detected in 28.3%, while triple infestation with three parasites — *Varroa*, *Tropilaelaps*, and *Nosema* — was recorded in 22.7% of cases. Infestation only with *Nosema* accounted for 11.3%, which is higher compared to other regions. In some districts of the Kashkadarya region, infestation only with *Varroa destructor* mites was 40%, which is the highest rate among the four regions. Mixed infestation with *Varroa* and *Tropilaelaps* mites was recorded at 26.7%, triple infestation at 19.6%, and infestation only with *Nosema* was found in 9.1% of cases.

In the Bukhara region, infestation only with *Varroa destructor* mites accounted for 23.3%, which is one of the lowest rates. However, mixed infestation with *Varroa* and *Tropilaelaps* mites was observed in 33.8% of cases, placing the region among the leading areas in this regard. Triple infestation was recorded in 21.1%, while infestation only with *Nosema* accounted for 5.6%.

In the Khorezm region, infestation only with *Varroa destructor* mites was 30%, mixed infestation with *Varroa* and *Tropilaelaps* mites was 32.4%, triple parasitic invasion amounted to 20.5%, and infestation only with *Nosema* was detected in 7.8% of cases.

These results indicate that pure varroatosis is most widespread in the Kashkadarya region, while mixed invasions (*Varroa* + *Tropilaelaps*) are more common in the Bukhara and Khorezm regions. In the Samarkand region, the high level of complex infestation involving three parasites poses a serious threat to the overall health of bee colonies in the area.

Table 2. Indicators of mixed infestation of bees with varroatosis and other diseases in beekeeping farms of the Samarkand, Kashkadarya, Bukhara and Khorezm regions (%).

Region name	Only Varroa mites, %	Varroa mites + Tropilaelaps, %	Varroa mites + Tropilaelaps + Nosema, %	Only Nosema, %
Samarkand	33,3	28,3	22,7	11,3
Kashkadarya	40	26,7	19,6	9,1
Bukhara	23,3	33,8	21,1	5,6
Khorezm	30	32,4	20,5	7,8

As a result, honey obtained in such regions is more likely to have lower indicators in terms of organoleptic properties, chemical composition, and veterinary-sanitary requirements.

Conclusions:

1. In the Khorezm and Bukhara regions, the invasion extensiveness of varroatosis averaged 26.7%, while the invasion intensity ranged from 14.3 to 24.7 mites per 300 worker bees. The

disease level was higher in the Khorezm region, indicating a greater risk of active parasite spread in this area.

2. Mixed infestations of *Varroa destructor*, *Tropilaelaps*, and *Nosema* parasites are widespread among honeybee colonies. Such conditions reduce the immune status of bee families and negatively affect productivity and honey quality. Therefore, it is necessary to implement Integrated Pest Management (IPM) systems that take into account climatic and management conditions, combining biological (organic acids), mechanical, and chemical methods in a harmonized manner.

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