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Dispersion type of *Varroa* mite (Acari, Varroidae) Among the Bee hives in Kurdistan Province, Iran

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ABSTRACT: Samples of bees were collected from different apiaries of Kurdistan province. The samplings were done in spring, summer and fall of 2011 from twelve bee apiaries. Results demonstrated that maximum infestation of bees to *Varroa* mites was in the apiaries sampled in Saghez (32%) and minimum infestation was observed in samples of Marivan (5%). Dispersion in most of sampled locations was of homogenous type (Binomial), while in Marivan was of random type (Poisson). Statistically speaking the results showed that the number of *Varroa* mites in every single bee and in each of sampling times were significantly different from other bees and other samplings. In the third sampling we observed the maximum of significant difference between number of *Varroa* mites infesting bees but in the first sampling the difference between population of *Varroa* mites in individual bees was minimum.

***Keywords*:** *Varroa* mites, infestation percentage, Kurdistan province, Iran

INTRODUCTION

Nowadays *Varroa* mites are one of the most important ectoparasites of honey bees in bee keeping industry throughout the world. In 1904 the mite was determined as *Varroa jacobsoni* by Oudemans and in 1951 was redescribed as *Mymozercon reidi* Gunther (Delfinado, 1963). In 2000, Anderson and Trueman declared that the species name of *Varroa* mites which live in Asia and specially those living in the middle east is *Varroa destructor*. Some Iranian researchers, after their findings in bee hives announced that the species name for Iranian specimens was *Varroa destructor* (Rahmani, 2006). The *Varroa* mites has a world distribution, (except of Australia) and probably has the most expanded distribution in Asia (Bahrini, 2006). The principal host for this mite is *Apis cerana*, and the *Varroa* mite despite of living on the host's integument do no damage but cause the maximum damage in colonies of *Apis mellifera*. In its' early years of appearance *Varroa destructor* caused vanish of 100000 bee colonies in Bulgaria and 55000 bee colonies in Russia (Mossadegh and Komili Birjandi, 1991). Due to the high transport rates of bees worldwide the *Varroa* mite has acquired a high dispersion rate in different countries of the world and in the summer 1984 the mite was observed between bee colonies in northern, north eastern and central provinces of Iran and now are present in most bee colonies throughout the country. De jong, (1982) after revisions of the literature about *Varroa* mites had announced that this mite has a widespread dispersion in all continents of the world except Australia and every day would expand its dispersion territories more than before. Ruttner and Ritter (1980) expressed that the *Varroa* mites have an annual rate of expansion of 2-5 Kilometers in Germany. Otis (1981) reported that the expansion rate of *Varroa* mites among African races of *Apis mellifera* in south American countries is very high, because these bees have an annual displacement of 131 kilometers. Ritter and Ruttner (1981) reported that the infestation to *Varroa* mites among the larvae and pupae of the drones are more than other castes of honey bees because the egg laying mites prefer to lay eggs on larvae destined to be drones rather than

laying eggs on worker's larvae. So, determination of infested colonies easily could be done by observing larvae and pupae of the future drones. De Jong, (1982) reported that the females finished their complete life cycle in 8-10 days but males had a life cycle of 6-7 days. Rahmani, (2010) pointed out the importance of gathering data about intensity of infestation and kind of dispersion of the *Varroa* mites in different locations, they believed this may lead to better control of the pest. To study the population density of insects and mites it is mandatory to do analysis of population's spatial dispersion which lead to acquisition of the preliminary data which can be used to interpret any spatial dispersion and design of different sampling programs which shall be used in evaluation of mites population density and its' management and control (Kuno, 1991). We have calculated the *Varroa* mites spatial density in different regions of Kurdistan province to have an evaluation on spatial dispersion patterns of the mites there as well as calculating the rate of infestation in bees in different parts of that province.

MATERIALS AND METHODS

Samplings form beekeeping apiaries were done throughout Spring, Summer and Fall of 2011. Twelve apiaries (three sites from each of the cities Sanandaj, Saghez, Marivan and Baneh) of Kurdistan province were chosen for sampling. Ten colonies of bees were randomly chosen from each of apiaries, and from each colony, ten adult bees were chosen and put in a small glass tube with water and few droplets of hand washing liquid soap, after one hour the mites were separated from the bees and counted. The samplings were repeated three times with an interval of three months. All the samplings were done from apiaries in which no acaricides of any kind were used, and by use of dispersion index, type and percentage of infestation were calculated. For calculating the Index of dispersion(=ID) the following formula was used:

ID is equal to $\chi^2 = \frac{(n-1)}{\bar{x}} S^2$,in which S^2= variance, n= number of samples , $\bar{x}$= mean number of mites in samples, ID= dispersion index.

the χ^2 table was used and with (n-1) degree of freedom, we got the χ^2 value in the table considering α=0.05 and 0.95. If the value of calculated ID was not between these two limits of 0.05 and 0.95 i.e. 0.95≥ID≥0.05, therefore Z index was calculated and used to determine the type of dispersion. $Z = \sqrt{2v} - 1 - \sqrt{2x^2}$

when V= n- 1

In this formular; Z=dispersion index, V=n-1, n=number of samples.

If -1.96≤Z ≤ +1.96, therefore the spatial dispersion is of random type(Poisson), if Z≤ -1.96, the dispersion is of (Binomial) type, and if Z≥+1.96 the dispersion is of (Negative Binomial) type(Patil & Stiteler, 1974).

RESULTS AND DISCUSSION

Maximum infestation to *Varroa* mites was seen and calculated in Saghez (32%), and the minimum in Marivan (5%), besides the maximum of the mean number of *Varroa* mite per every honey bee was seen in Saghez and the minimum in Marivan. The dispersion indices of χ^2 are shown in Table 1. Calculated Z= dispersion index for *Varroa* mites in Marivan was of random type (Poisson) but in other places was of homogenous type(Binomial).

Table.2 shows that the mean infestation rate of *Varroa* mites Sampled from different apiaries in different cities was significantly different. The general trend of density of *Varroa* mite population was the same in four cities studied, in Spring the mites begin to increase their population size, in Summer they have an average population size and in Fall the maximum size of population was reached(Figures.1, 2, 3, 4.)

Table 1. Percentage of infestation to *Varroa* mites and it's dispersion indices in different apiaries in Kurdistan province

Parameter	percent of infestation	Means plus standard deviation	ID index	Z index	type of dispersion
Saghez	32	2.88 ± 0.16	13.67	-4.1	Binomial
Baneh	13	2.3 ± 0.75	3.78	-2.67	Binomial
Marivan	5	1.6 ± 0.32	2.64	-1.19	Random
Sanandaj	16	2.49 ± 0.56	4.72	-3.2	Binomial

Table 2. Mean rate of infestation to *Varroa* in different samples collected in different cities in Kurdistan province

Samplings	1st (16.4.2011)	2nd(13.7.2011)	3rd (8.10.2011)	F	P
Mean ± Standard deviation	1.87 [a]± 0.24	2.22[b]± 0.54	2.9[c]± 0.11	3.22	0.04

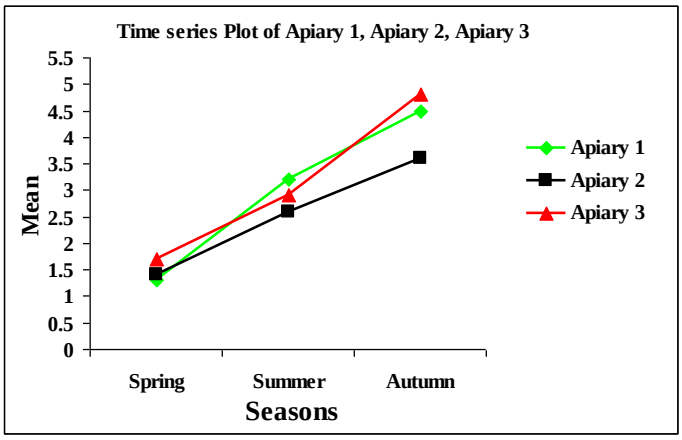

Figure 1. Infestation to *Varroa* mites in apiaries in Saghez

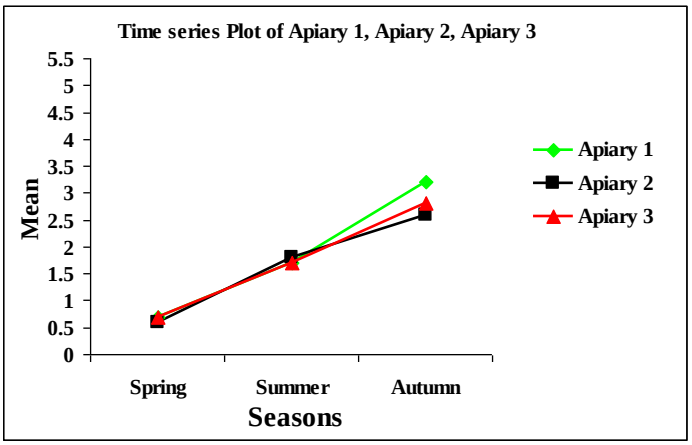

Figure 2. Infestation to *Varroa* mites in apiaries in Marivan

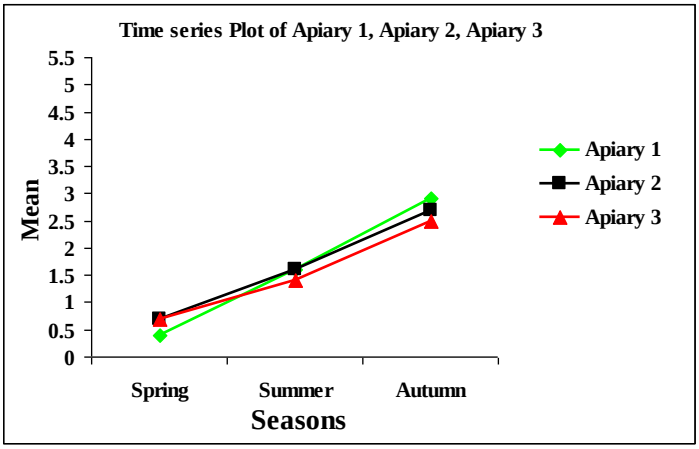

Figure 3. Infestation to *Varroa* mites in apiaries in Baneh

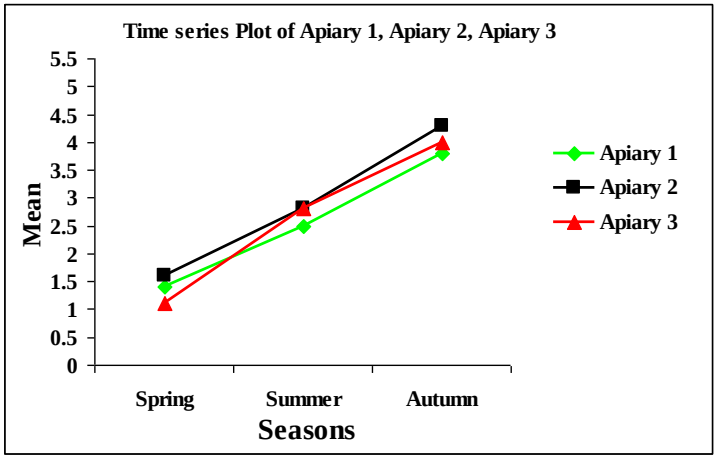

Figure 4. Infestation to *Varroa* mites in apiaries in Sanandaj

The results obtained by us showed that the maximum of infestation to Varroa mites was encountered in Saghez and the minimum of infestation was seen in Marivan. In Saghez beekeepers are used to displace and transport their hives to other provinces which cause more contact of their bees with bees living in other regions, when winter arrives the beekeepers of Saghez carry over their bee hives to Dezful, a city in south Iran and as winter in Dezful contrary to Saghez is mild, so even in winter the queen does continue to lay eggs and the Varroa mites reproduce in pupae cells, so there are a rise in population number of the Varroa mites throughout the year. In Marivan, as the quantity of natural plantations and pollen and nectar of flowers are suitable to meet the bees food requirements, so the beekeepers don't displace their hives to other provinces and because of very cold winter governing there the queens stop egg laying and as there are not any pupae in their hives during the cold periods of the year, so Varroa mites population number in apiaries of Marivan would decline. As Varroa mite dispersion was of random type(Poisson) in Marivan only, but in other locations of Binomial type and as there was a high population of Varroa mites in Saghez apiaries, so our advice for beekeepers there is to undertake preventive and control measures. Besides as there are similar levels of infestation to Varroa mites in most apiaries of the Kurdistan province this fact could provide us enough evidence to do the future ecological researches with lower number of samplings and thus economizing the cost of samplings for evaluation of the correct number of population of Varroa mite in different apiaries of cities in that province. Donzé. 1996,found that Varroa jacobsoni has an aggregated distribution, and their distribution is not of random type.

Salvy, (1999) showed that spatial dispersion pattern of Varroa mites between larvae of worker bees is not of the geometric type, his studies revealed that neither between the individuals of one colony, nor among the apiaries of each city the spatial dispersion of Varroa mites is of the geometric type. In accordance to results obtained by Salvy and co-workers, we found in our researches that the spatial dispersion of Varroa mites was not of geometric type. Fries, (2006) found the increase of mortality rate of 76% in winter colonies of honeybees due to Varroa destructur in Gotland, a nordic island of Baltic sea in the first year and was dropped to 19% in the 6th year of bee brood, they named it a co- adaptation between bees and mites, comparing their results with our results, although we have seen in our experiment the fall of population of bees due to mite infestation in winter but as we have not continued our research for six years so we can neither confirm nor reject the finding of these authors. We have also found the maximum growth of Varroa mites in end of the Fall, begin of the Winter, with maximum mortality in bee populations which is in accord with the results obtained by Fries and co-workers. In 2003, Moretto (2003) in Brazil studied the growth rate of Varroa destructor in Department of Natural Sciences, Regional University of Blumenau, State of Santa Catarina, Brazil, at 17 m altitude and 26◦55’ latitude south, and found the favorable climatic condition there has played a role that the infestation rates of apiaries to rest low after five years of intial infestation, they have found 724 ± 419 mites per colony and 2.33 ± 0.83% mites per hundred honeybees. Puc (2011) in Yucatan, Mexico have collected 76 bee samples between June and September 2006 and between 26 managed colonies infestation rate was 1.70 ± 0.26 mites/ 100 bees, but among 49 colonies of wild swarms the infestation rate was 1.96 ± 0.44 mites/100 bees. We have seen the mite infestation rate 5% in Marivan,1286 masl., 32% in Sghez,1493 masl.,successively having the lowest and the highest percent of rate of Varroa mite infestation. According to Moretto, (2003) have attributed the mite infestation to climatic conditions we think that elevation could be a factor facilitating the high infestation rate of Varroa mites on bees of Saghez as Saghez has higher elevation than Marivan, so we confirm the findings of Moretto and co-workers that the climatic condition could be a factor

influencing the high rate of infestation of Varroa mites in Saghez, because by increasing of the height of a location the air pressure there should be decreased by a certain rate, and as the Saghez city is 207m more high than Marivan ,probably the lower air pressure in Saghez should have an effect on the increase of rate of infestation of Varroa mites in that city. we have found in our studies that the size of drone's brood has a role on infestation rate of Varroa mites, but contrary to our findings, Martin,1998 in U.K., studied Varroa mites and analysed the data obtained by using software (model maker ®) and has concluded that there is not any direct relationship between the mites number and host colony development, in other words, the feeding activities of the mites on bees do not prevent the normal development of the bee colony In Denmark , Brodsgaard and Brodsgaard,1998 in accordance with Martin, stated that the distribution of Varroa mites on broods and equally on adult bees had not a direct and clear relationship between them and the fit of a linear model was only 40%.

CONCLUSION

Our study showed that by calculating spatial density and rate of infestation of Varroa mites we had obtained an evaluation on spatial dispersion pattern of the mite in different regions of Kurdistan province. We have observed different spatial types of distributions of Varroa jacobsoni in different cities of Kurdistan province, in Saghez, Baneh and Sanandaj the spatial type of distribution was of binomial type and in Marivan was of random type. As the apiaries of Saghez city compared to other cities of Kudistan province had the highest infestation rate of Varroa jacobsoni , we suggest that the causing factors probably should be;

1- The beekeepers in Saghez transported their hives more than other beekeepers to infested areas located out of the Kurdistan province and thus their bees had more risk of contact with infested bees in such an areas.

2- Compared to other cities studied in Kurdistan province, higher elevation of Saghez city could be a climatic factor which induce higher reproduction rate of mites and thus the higher infestation rate of the Varroa mites.

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