

STUDY OF THE VARROASIS INFESTATION RATE IN THE CENTRAL AREA OF ECUADOR

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Received: 25 Jan 2020, Revised and Accepted: 23 Mar 2020

ABSTRACT

Objective: To study the Varroasis Infestation rate in the central area of Ecuador.

Methods: The experimental phase was developed in four apiaries distributed in the provinces: Bolívar, Tungurahua, Chimborazo and Los Ríos (12 hives), the experimentation lasted 65 d. A DCA design was applied. Three different systems were used for the identification of varroa: soapy water (SW), honeycomb cut (HC) and the cardboard with semi-solid petrolatum (CSP).

Results: With the SW method, it was obtained that Chimborazo has 23.14%; followed by Tungurahua (7.99%); Los Ríos (3.24%) and finally Bolívar with (0.51%); with the HC method, it was determined that Chimborazo has the highest incidence with 9.13%; followed by Bolívar and finally Los Ríos; with the CSP method, the province of Chimborazo presents the highest infestation (26250 individuals); followed by Bolívar, Tungurahua, and Los Ríos. Regarding the production of eggs for each frame, 3 frames taken from the brood chamber were used in each of the apiaries under study; Chimborazo being where there is less quantity of eggs for each frame, followed by Bolívar, Tungurahua and finally Los Ríos.

Conclusion: The higher the geographical height, the greater the Varroa infestation.

Keywords: Varroajacobsoni, SW, HC, CSP, Bees

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INTRODUCTION

The parasite *Varroa jacobsoni* (*Oudemans*) is a mite, which feeds on the honey bee (*Apis mellifera* L.), on the hemolymph and reproduces within the sealed cells of the brood of bees [1]. The FAO in 2004 unveiled the infested countries, North China and the East coast of the Former Soviet Union in (1950), Japan and the rest of Asia until reaching European Russia, Eastern Europe (1970). In America, the largest infestations of this pest occurred in Paraguay 1969, Argentina 1976, Peru 1985 [2], the United States 1987, Mexico 1992, Guatemala 1996.

This disease is known throughout the world and has been documented in the vast majority of countries, however, in Ecuador there is little information, the only work that stands out is that carried out by Cherez Neacato *et al.* [3], who located an identification of *Varroa destructor* in 100%, the only data that exists from the province of Bolívar, the Chimboracanton, in which a study was carried out, because the complete hives of some beekeepers were lost.

The *Varroa jacobsoni* was apparently introduced to Ecuador by transhumant beekeepers; There is another version that, due to its proximity to Brazil, due to the Amazon, it is believed that this infestation occurred as stated [4, 5].

After this event it was determined that in Ecuador there is the varroa that produces the varroasis [6], 14.5% in Bolívar. In this study it was observed that this disease is present but with low pathogenicity, compared to other places. In practice, varroa spreads only with live bees [1], although it has also been observed in wasp nests [7].

In colonies with young offspring, bees are infested more than older bees [8]. The mite absorbs the hemolymph of the insect, decreasing its body mass (weight). In the larval stage, it is more critical because adults are born with less than 30% of the weight of an unparasitized adult.

Given this situation, it is considered necessary to investigate how to mitigate the expansion of this parasite that causes so much damage to the provincial and national economy that is why it was proposed to Study the Varroasis Infestation Rate in the central zone of Ecuador (Bolívar, Chimborazo, Tungurahua and Los Ríos).

MATERIALS AND METHODS

Location and duration of the experiment

It was developed in four apiaries distributed and/or located in the provinces: Bolívar, Tungurahua, Chimborazo and Los Ríos: in Bolívar (Faculty of Agricultural Sciences of the Bolívar State University); in Tungurahua (Beekeeping program of the Luis A. Martínez Institute); in Chimborazo (Beekeeping program of the Puruha Institute, of the Quimiag Parish); in Los Ríos (Beekeeping projects of the Provincial Government of the province of Los Ríos). The duration of the experimental phase was 65 d, from June 10 to August 14, during this period, 2 visits were made to each of the apiaries.

Experimental units

Twelve hives distributed over 3 hives in each province were studied. In which 3 different systems were used for the identification of varroa: soapy water (SW), honeycomb samples (HC) and the cardboard with semi-solid petrolatum (CSP).

Mathematical model

$$S_{ij} = \mu + \pi_i + m_j + e_{ij}$$

Where:

S_{ij} = Observation; μ = Population Mean; π_i = effect of the province; m_j = Effect of the identification method, visits, altitude, temperature, size; e_{ij} = Effect of error Likewise, the Tukey test was applied with a significance of 0.05% in order to determine homogeneous groups. In addition, interactions between factors have been carried out. All these methods were processed with the Stat Graphic Statistical program.

RESULTS AND DISCUSSION

Number of varroas in each of the methods

Table 1: Number of varroas found, using the soapy water method (SW)

Provinces	Altitude	Visit/apiary	Number of individuals analyzed	Number of varroas found	Number of varroas per 100 individuals	Porcentaje	Average percentage
Bolivar	2460	1	130	0	0.00	0	0.51
		2	98	1	1.02	1.02	
Tungurahua	2640	1	91	8	8.79	8.79	7.99
		2	153	11	7.19	7.19	
Chimborazo	2650	1	60	18	30.00	30.00	23.14
		2	86	14	16.28	16.28	
Los Rios	40	1	118	4	3.39	3.39	3.24
		2	97	3	3.09	3.09	

Regarding the quantity and percentage of varroas found, with the soapy water (SW) method, it was determined that the province of Chimborazo is the one where varroas are most found, both on the first and second visits, followed by Tungurahua and Los Rivers finally Bolivar. So if the data obtained in the research, we use it to transfer to the formula of [9], to determine the percentage of infestation; and when two visits are made, it gives us the opportunity that there is more certainty, therefore we obtain an average of both the individuals analyzed and the varroa detected.

$$\% \text{ of infestation of adult bees} = \frac{\text{number of mites}}{\text{number of bees}} \times 100$$

Furthermore, as a percentage, we can find that the concentration of varroas in the prov. Chimborazo exceeds 20%, while in the other provinces, they are less than 10%. When these data are compared with those found by Lin *et al.* [1], which states that data of less than 10 varroas per 100 individuals are not lethal for the colony and above this, immediate measures must be taken.

Quantity and percentages of varroas found, with the honeycomb cut method (HC).

With respect to the number and percentage of varroas found, with the honeycomb method (HC), it follows that the province of Chimborazo is the one where varroas are found the most (4.8-14.29%), both in the first as in the second visit respectively, followed by Bolivar (7% and 0.5%) and then followed by Tungurahua (2-0%) and finally Los Rios (0%). When comparing with Águila [6], who used the honeycomb method, we can state that in 1997 there was an infestation rate of 14.5% in Bolivar, and currently, it is 7%. That is, it has reduced, this is probably due to the little transhumance that takes place in this province. So, if we use the data obtained in the research to transfer to the Flores *et al.* [10]. To determine the percentage of infestation; it gives us reliability to the data obtained; therefore, we obtain an average of both the analyzed individuals and the detected varroa.

Number of varroas found, using the semi-solid petroleum jelly (SP) method.

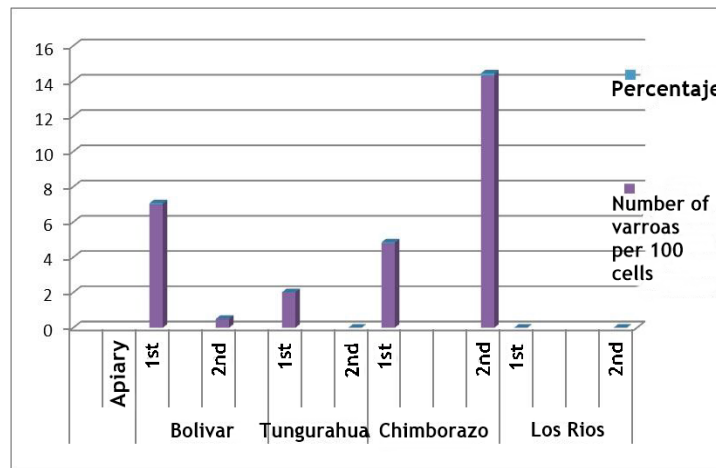


Fig. 1: Quantity and percentages of varroa found, with the honeycomb method

Regarding the quantity and percentage of varroas found, with the Semisolid Vaseline (SP) method, it was determined that the province of Chimborazo is the one where varroas are most found with a percentage of (0.692-0.2291%), both in the first and in the second visit, respectively, with an average population of 26250 individuals; followed by Bolivar (0.051-0.0225%) with an estimated population of 37,500 individuals, then followed by Tungurahua (0.0224-0, 0135%) with an estimated population of

55,000 individuals and finally Los Rios (0.0093% 0,0118% 0%), with an estimated population of 80,000 individuals per hive, there being an inversely proportional relationship between the percentage of varroa infestation with the semi-solid petrolatum method and the population; in other words, the larger the population, the lower the infestation. The population was estimated following the synergy rule of Farrar, [11] where 1Kg of bees equals 10,000 individuals.

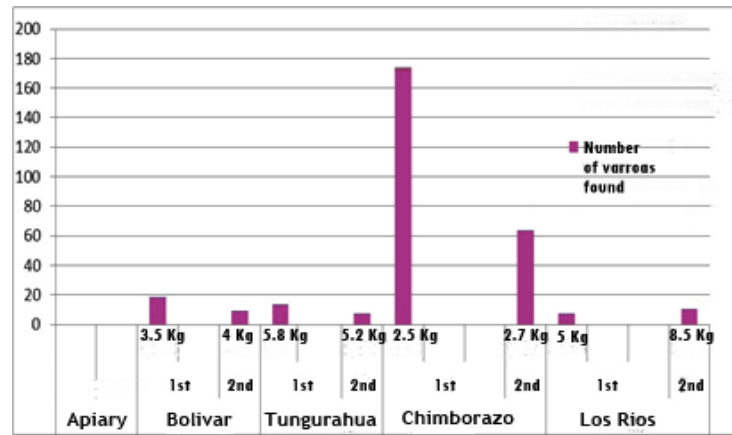


Fig. 2: Number of varroas found, using the semi-solid petroleum jelly (SP) method based on the estimated population of the hive. (1 kg: 10000 individuals)

Table 2: Egg production per frame

Visit	Revised frames	Egg production in each frame reviewed prov bolivar	Egg production in each frame reviewed prov tungurahua	Egg production in each frame reviewed prov chimborazo	Egg production in each frame reviewed prov. los rios
1	1st	70	140	100	140
	2nd	80	180	80	100
	3rd	108	120	60	120
2	1st	120	70	60	130
	2nd	100	100	80	80
	3rd	120	108	80	160
Mean		99.66	119.66	76.66	121.66

When observing table 2, of egg production per frame, the average number of offspring of three frames taken from the brood chamber is demonstrated in each of the apiaries under study; being concordant with the degree of the infestation, that is, the greater the infestation, the lower the production of one-day eggs; Chimborazo being where there are fewer eggs laid by the queens for each frame); followed by Bolivar, Tungurahua and finally Los Rios. The behavior of the hives and the production of eggs by their queens, may also be due to the season, since this study was carried out in the months of low flowering (June-August); in times of summer and strong winds

in the Ecuadorian highlands; and on the coast it is similar and it is even the time when winter crops are produced.

The results found are related to other authors such as Guzman, [12], who mentions that an infested bee lives half the time that a healthy bee due to the reduction of the protein content in the hemolymph. The decrease becomes 22 to 50%, depending on whether the bee is infested by one or two mites. When the degree of infestation in the young is high, the bees present deformations in wings, legs, thorax or abdomen [13].

Table 3: Interactions between the numbers of varroas with each of the methods

	Province				Method			Significance			
	Bolivar	Tungurahua	Chimborazo	Los rios	SW	HC	CSP	Prov.	Method	Visit	Inter
Varroas	1.43 c	3b	11.05 a	1.08 d	8.72 a	3.57 b	0.13 c	*	*	NS	

Soapy water (SW); Honeycomb Cut (HC); Cardboard plus Semisolid Petroleum (CSP)

Table 4: Interactions between the percentage of varroas, the average environmental temperature and visits

Temperature		Visits		Interactions			Significance				
13.9	14	14.5	24	1	2	A	B	AB	Temperatura	visita	Interacciones
3B	11A	1.43C	1.08D	4.73	3.56	8.27	131.4	0.87	***	NS	A B AB NS * **

NS: Non-significant statistical difference; *: Significant statistical difference; **, ***: highly significant statistical difference.

When submitting the study to variance tests, that is, the ANOVA, it can be mentioned that Chimborazo is where the greatest significance is found (11.05), with respect to the other provinces; the method that most helps to determine the percentage of varroa infestation in this study is soapy water with the method of De Jong et al. [5], with a significance of (8.72), in relation to the other methods.

Regarding the honeycomb cutting method, Flores et al. [10], states that the main drawback of this method is due to the fact that some

varroas will remain in the cells, causing a certain error, but that is compensated by the ease of application.

According to table 4, we can show that the behavior of varroas against environmental temperature is inversely proportional, the higher the temperature (24 °C), the lower the incidence of varroa, so that the tropical province of Los Rios proved to be non-significant to the variance test, while at low temperatures (14 °C) higher incidence as occurs in the Andean provinces of Bolivar, Chimborazo and

Tungurahua, giving us a high significance of the presence of varroas especially in Chimborazo.

Our results turned out to be similar when compared with those obtained in Brazil by Moretto and Gonçalves [4], where it was shown that the infestation rates in the temperate regions were higher than those in the tropical regions, although they had a high infestation, they were not destroyed as in Europe. Various studies have shown differences in infestation levels. In cold climates it reaches 76% and in the tropics 43% [11]. The correlation of infestation in the seasons of the year coincides with the correlations of the localities, in spring it was 71.9% and in autumn it was 55.8% [11]. Likewise, De Jong *et al.* [5], states that infestation in some of the colonies of the cold region is high enough to retard their development and limit their production.

Finally, the size of the varroas is related to the degree of infestation and, according to the data found and verified, it can be seen that the vast majority of mites are female due to the dimensions found 950X1300 μ maximum; 700x1250 μ minimum; Media 858x1143 μ that belong to the Puruha Institute of the City of Riobamba, province of Chimborazo.

FUNDING

Nil

AUTHORS CONTRIBUTIONS

All the authors have contributed equally.

CONFLICT OF INTERESTS

Declare none

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