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Preliminary study on the prevalence of *Varroa* sp. in honeybee colonies in the village of Mondon (Burkina Faso)

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In Burkina Faso, beekeeping is practised throughout the country. It has many potentialities, but it faced many constraints. Sanitary constraints are less investigated and need to be elucidate for a better management of bee colonies and improvement of beekeeping. A descriptive study was conducted in Cascades region to assess the prevalence and the density of Varroa mite infestation. The method of sugar shake on adult bees was used. The overall prevalence found was 91.7% [95% CI: 83.8% - 99.5%] and the density varied from 0.3 mite/100 bees to 12.3 mites/100 bees. These results show that the Varroa mite is widespread in bee colonies and its monitoring should be considered for bee health management, which is essential for sustainable beekeeping. Advanced research is needed in a large sample area to further investigate the epidemiological aspects and the potential impact of the mite on honeybee production.

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Introduction

Beekeeping is a livelihood for many people around the world (Bradbear, 2005). It contributes to the maintenance of biodiversity, increasing agricultural production and provision of products used in apitherapy (Paterson, 2006). Initially practised in a traditional way, modern beekeeping was introduced in Burkina Faso around 1973 and nowadays three production systems coexist including the traditional

beekeeping, the modern beekeeping, and a mixture of the two (Kaboré, 2022). More than 16,000 beekeepers (28% women) are noted in Burkina Faso with an average annual production higher than 1,000 tonnes of honey in 2018 (MRAH, 2019).

Certainly, beekeeping has potentialities in Burkina Faso as availability of melliferous resources (Nombré *et al*., 2009), but it faces technical, financial, and sanitary constraints (MRAH, 2019). The literature on bee health shows that the small beetle, the varroa mite and the wax moth have been identified in bee colonies in the country (Aebi *et al*., 2016; Kaboré *et al*., 2021). However, specific investigations allow better understanding of the diseases for their better management. Varroa mite, considered as part of bee colony collapse (Lee *et al*., 2015) is known to infest bee colonies in Burkina Faso, but what would be its prevalence and density? This study aims to determine the prevalence and density level of Varroa sp. in the western part of the country and to serve as a basis for studying the epidemiology of the infestation.

Materials and Methods

Study area and period

The investigation took place in the village of Mondon, in the Cascades regions of Burkina Faso. This region of Burkina Faso is a part of the a humid sudanian zone with rainfall average between 900 and 1,200 mm/year. It has a strong melliferous potential and contributes to the national production with more than 60 tons of honey (MRAH, 2019). The study was conducted during the dry season from January to February, and the sampling took place in the evening from 6 to 8 pm.

Data collection

Forty-eight colonies were sampled from two apiaries through a random sampling. The method used for *Varroa* sp. detection is as described by Macedo *et al*. (2002) and Lee *et al*. (2010). We used a jar from the trade with a lid of which the centre part is replaced by a around 2mm hardware cloth. After opening each selected hive, around 300 bees from the brood chamber were collected in the jar. After closing it, a heaping of ice sugar was added through the mesh or cloth. Then, the jar was rolled gently to cover all the bees with sugar for one minute. The jar was turned upside down in a slide bag to collect the sugar and any varroa mites. The bees remained alive in the jar and were returned to the colony. The samples were placed in a humidified cooler until returned to the laboratory. In the laboratory, the contents of the bags were spilled on white paper and the brown varroa mites were isolated as they can be easily identified seen by the naked eye. For the confirmation of eye identification, a microscopic method based on Dietemann *et al.* (2013) identification key was used. After their isolation the mites were kept in 70% ethanol to be cleaned. Then, each specimen was mounted on microscope slides and observed at 40X magnifying. The observed images were compared to the Varroa appearance according to Dietemann *et al.* (2013).

Data analysis

All data were recorded in Excel and transferred to R software version 4.0.4. In first time, descriptive analysis was performed. The sample infestation was calculated using the following formula (Schubnel *et al*., 2020):

$$\text{Sample infestation density} = \frac{\text{Number of Varroa sp. counted}}{3}$$

and the density at the colony level was estimated by considering a mean of 50,000 bees per colony. Student's t test was used to compare infestation densities between the two apiaries.

Results and Discussion

All beekeepers were men of 40-60 years old that reached the primary school level. They received training in beekeeping and have an average of 5.5 years of experience. Kenyan beehives were the only used hives in selected apiaries. During the hives installation, the preparation of the hive was done by embossing the bars with wax. The colonization rate was 93% and 83% respectively for apiaries 1 and 2.

Beekeeping is a traditional practice in Burkina Faso, and it has many melliferous potentialities as availability of manpower, endogenous knowledge, melliferous plants, etc. (Nombré *et al*., 2003; MRAH, 2019). The practice of beekeeping by adult persons found in this study is similar to the results of national census of beekeepers (MRAH, 2019). It could be explained by their possession of endogenous knowledge and know-how that generally allows them to start in a traditional way while waiting to evolve towards modern beekeeping (Kaboré, 2022). The use of embossed wax to bait hives is already reported and seems to be the common way of colonization of bar and frame hives (Paterson, 2006). The colonization rate found is higher than the result (53%) from Kaboré *et al*. (2021) in Sudano-Sahelian zone. Indeed, hives colonization is still dependant to the attraction of the wild bee colonies or swarms and their availability would depend on melliferous resources (vegetation, water, shelters, etc.). Our study area is in the humid sudanian zone with forests which constitute an important source of nectar and water resources to host many bee colonies. The difference between the colonization rate could be due to this agroecological contrast. These current results showed an availability of bee colonies and beekeeping knowledge, but could beekeepers manage bees and beekeeping challenges to optimize the production level?

Table 1: Classification of colony infestation densities (number of Varroa mites/colony), the frequencies represent the proportion of each class in the study area

Class	Colony infestation densities*	Numbers	Frequencies (%) and 95%CI
Low	< 1,500	25	52.1 [38.0-66.2]
Medium	1,500 – 2,500	8	16.7 [6.1-27.2]
High	>2,500	11	22.9 [11.0-34.8]
Negative	0	4	8.3 [0.5-16.2]
Total		48	100.0

*Colony infestation density = number of Varroa mites per estimated colony of 50,000 bees

Bee diseases and parasites are known through the world to be a constraint for sustainable development of beekeeping. Varroa mite is known as an important threat for bees and is incriminated in the bee colony collapse in the world (vanEngelsdorp *et al*., 2009). The Sugar shake method used has a high sensitivity, reliability and is cheapest (Goodwin & Eaton, 2001; Dietemann *et al*., 2013). It is also a more bee-friendly alternative as the method does not kill the bees. The use of microscopy allowed the identification of Varroa mite. The overall prevalence of varroa mite found was 91.7% [95% CI: 83.8% - 99.5%]. There was no significant difference between the apiaries (p-value = 0.2). In Burkina Faso, the presence of *Varroa* sp. was indicated without a formal study carried until the confirmation by Aebi *et al*. (2016). Despite these results, *Varroa* sp. infestation density was not determined in previous studies. Our result on the prevalence is lower than the 100% found by Aebi *et al*. (2016) and slightly higher than the result (89%) of Llorens-Picher *et al*. (2017) in Ghana. This high level of infestation rate means that the parasite entered and spread in the country and could be due to the beekeeping characteristics in Burkina. Indeed, the activity is dependent on the availability of natural resources. The hives colonization depends on swarming of established colonies. The beekeeping management could be a factor of spreading of the mite (Chemurot *et al*., 2016). Furthermore, during the dispersal phase of Varroa life cycle, it parasitises adult bees which contributes to the spread of Varroa mite (OIE, 2021).

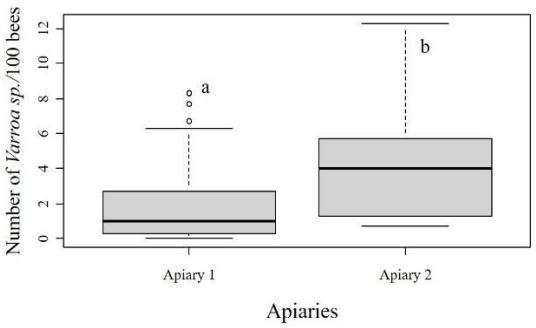

Figure 2: Density of *Varroa* sp./100 bees for apiaries 1 and 2 (different letters indicate significant difference (p<0.05)

Beyond the prevalence, the infestation density mean was 2.8 mites/100 bees with a minimum of 0.3 Varroa/100 bees and maximum of 12.3 Varroa/100 bees. This density was significantly higher in apiary 2 (Figure 3). This density allowed the determination of infestation classes (Table 1).

The determination of infestation density in the apiaries allows a decision-making about treatment (Schubnel *et al*., 2020). Indeed, density is a parameter for estimating the severity of the infestation and the need for control actions. The density found is less than the result of Akinwande *et al*. (2012) in Nigeria (2 to 55 mites per 100 bees). This difference could be linked to agroclimatic parameters and apiaries management. More than 50% of the colonies are in the low infestation class and this would reflect a certain resistance of the bees to Varroa. It could be due to the adaptation and/or behaviour of African bees to the mites. Indeed, Gebremedhn *et al*. (2019) found in Ethiopia that the infestation level was lower when colonies were started up from swarm catching (when compared to colony splitting). However, our results would raise many questions and further investigations should be carried out for a better management of bee health.

In conclusion, the presence of Varroa mite is confirmed in Burkina Faso with high prevalence. For the first time, the infestation density was studied and showed variable infestation densities which are useful for measuring the severity of infestation during bee colony health monitoring. Nevertheless, there is a threat on bee health as *Varroa* sp. is also a vector for bee viruses. This threat would require prevention and/or treatment. The results could be useful for further research and serve as a starting point for investigations by animal production and health authorities and researchers.

Conflict of interest

The authors declare that there is no conflict of interest.

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