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Research Application Summary

Prevalence of varroa mite infestations among honey bee colonies in Uganda

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Abstract

Honey bees (*Apis mellifera*) are well adapted insects with great economic importance as pollinators and honey producers. However, their health is being threatened by various diseases and pests among which is the Varroa mite (*Varroa destructor*). In Uganda, prevalence of *V. destructor* infestations among honey bee colonies was not known though there were anecdotal reports of its presence. This study was conducted to establish the incidence and severity of *V. destructor* among domesticated honey bee colonies in Uganda. It was conducted in nine districts (Masaka, Luwero, Bushenyi, Kabarole, Kyenjojo, Mbale, Kapchorwa, Lira and Kitgum) representing four of the ten agroecological zones in the country that is Lake Victoria Crescent, Mid North, Western Highlands and Eastern. Between 100-300 worker bees were sampled from each hive and placed in 100 ml of 70% ethanol. A total of 81 honey bee colonies were randomly sampled and screened for Varroa, 61 of these tested positive. All the surveyed districts tested positive for Varroa with infection levels ranging from 50% to 100%. This is probably because of the high swarming rates, robbing among colonies and continuous movement of bee colonies to different parts of the country through bee colony marketing. As such, beekeepers need to be trained on good apiary hygiene practices so that colony marketing is limited to only those areas that are disease and pest free. Policy should also be geared towards the control of spread of this dangerous mite, including introduction of quarantine in the most affected regions.

Key words: *Apis mellifera*, incidence, severity, Uganda, *Varroa destructor*.

Résumé

Les abeilles (*Apis mellifera*) sont des insectes bien adaptés à la pollinisation et à la production de miel avec une grande importance économique. Cependant, leur santé est menacée par diverses maladies et ravageurs parmi lesquels l'acarien Varroa (V*arroa destructor*). En Ouganda, la prévalence des infestations de V. destructor parmi les colonies d'abeilles n'a pas été connue malgré qu'il y ait des rapports anecdotiques de sa présence. Cette étude a été menée pour établir l'incidence et la sévérité de *V. destructor* chez les colonies d'abeilles domestiques en Ouganda. Elle a été menée dans neuf districts (Masaka, Luwero, Bushenyi, Kabarole, Kyenjojo, Mbale, Kapchorwa, Lira et Kitgum) représentant quatre des dix zones agroécologiques du pays à savoir le lac Victoria Crescent, Mid North, Western, Highlands et de l'Est. Entre 100 -300 abeilles ouvrières

ont été échantillonnés dans chaque ruche et placés dans 100 ml d'éthanol à 70%. Un total de 81 colonies d'abeilles était échantillonné au hasard et évalué pour l'infection par Varroa, et 61 d'entre eux ont été testés positifs. Tous les districts ayant fait objet de l'enquête se sont révélées positifs pour l'infection du Varroa avec des taux d'infection allant de 50 à 100%. C'est probablement à cause des taux d'essaimage élevés, volant entre les colonies et le mouvement continu des colonies d'abeilles dans différentes régions du pays à travers la commercialisation des colonies d'abeilles. A cet effet, les apiculteurs doivent être formés sur les bonnes pratiques d'hygiène apicoles de sorte que la commercialisation de colonie soit limitée aux seules zones qui sont exempt de maladie et d'organismes nuisibles. La politique devrait également être orientée vers le contrôle de la propagation de ce dangereux acarien, y compris l'introduction de quarantaine dans les régions les plus touchées.

Mots clés : Apis melifera, incidence, sévérité, Uganda, *Varroa destructeur*

Background

The honey bee, *Apis mellifera* L., is a well adapted insect with great economic importance and exists in different ecological conditions of the world (Ivanova *et al,* 2010). It is a valuable insect, known for its importance as a pollinator and honey producer (Strauss *et al.,* 2014).

The beekeeping industry is an important component of agriculture and economic enterprise worldwide, generating employment and income in the rural areas. In addition to the products from apiculture such as honey and beeswax, the most important aspect of honey bees is the vital role they play in the environment by pollinating both wild flowers and many agricultural crops as they forage for nectar and pollen. By doing so, honeybees contribute to food security and biodiversity conservation (Chemurot *et al.,* 2016). The essential and valuable activities of bees are possible only with a healthy population of honey bees. Honey bee populations are under threat largely because like other insects and livestock, they are subject to many diseases and pests (FAO, 2006). Several factors have been shown to negatively impact the longevity of honey bee colonies, including parasites, pathogens, pesticide exposure, poor nutrition, reduced genetic diversity and management practices (Muli *et al.*, 2014).

More than 100 species of mites are associated with the honey bee, and several species of pollen feeding mites are occasionally found in hives or attached to foragers (FAO, 2006). These phoretic mites are mostly innocuous to beekeeping. There are however three species of parasitic mites, *Varroa destructor* (Varroa mite), *Acarapis woodi* (Tracheal mite) and the *Tropilaelaps* spp that are capable of producing devastating effects on honey bee colonies and have had a significant and deleterious impact on beekeeping worldwide (FAO, 2006).

Varroa destructor, Anderson and Trueman (Acari:Varroidae) is the most serious parasite threatening the beekeeping industry all over the globe (Begna, 2015). Relatively harmless to its natural host, the Eastern honey bee *Apis cerana,* the Varroa mite crossed

onto the Western honey bee *Apis mellifera* and spread from its Asian origins throughout most of the world (Allsopp, 2006). Colonies infested by *V. destructor* will eventually suffer debilitating effects. Feeding by mites on bee pupae can reduce the resulting adult bees' body weights, suppress their immune systems, and reduce their life spans (Lee *et al.,* 2010; Ghada, 2011). Mites also can transmit viruses during feeding, which can have devastating effects on colony health (Lee *et al.,* 2010). In regions of the world where the varroa mite is well established, such as Europe and the USA, wild honeybee populations have all but disappeared as a result of varroa mortality and commercial beekeeping is only possible with the liberal use of anti-varroa pesticides.

Varroa mites in honey bee colonies in East Africa were identified for the first time in 2009 (Muli *et al.,* 2014). In Uganda, there are anecdotal reports on the presence of Varroa and little data is available on the pathology and impacts on productivity of honey bees. The purpose of this study therefore was to establish the incidence and severity of Varroa mites infestations in selected districts of Uganda.

Study description

The study was conducted in nine districts spread in four agro-ecological zones (AEZs) of Uganda namely Eastern (Mbale and Kapchorwa), Lake Victoria Crescent (Luwero and Masaka), Mid Northern (Lira and Kitgum) and Western Highlands (Kabarole, Bushenyi and Kyenjojo). With the participation of district entomologists, three apiaries were selected in each of the nine districts. The apiaries were selected in such a way that they were in different subcounties or at least 3.5 km apart to minimize sampling honey bees foraging within the same area (Chemurot *et al.*, 2016). Three colonies randomly selected from each apiary were inspected for presence of *Varroa destructor*. All sites from which sample collection was done were geo-referenced using a GPS.

Between 100 -300 worker bees were sampled from each hive and placed in 100 ml of 70% ethanol. A total of 81 honey bee samples were collected from 29 sites (apiaries) across nine districts. *V. destructor* attached to the bees were washed off into the alcohol and thereafter counted. The number of bees sampled was also counted. The number of varroa mites per bee was then calculated as a measure of the severity of varroa infestation.

Results

The survey showed that all the sampled districts tested positive for varroa mites with 100% incidence. From the 81 bee colonies diagnosed, varroa mites were found in 61 colonies (75.3%). An average of 235±21.89 bees per colony was examined through adult bee colonies and an average of 4±0.69 (range 1-8) varroa mites recovered from the colonies. Infestation rates were found to be high (100%) in Masaka and Kitgum. However, in terms of per colony recovered, the average number of varroa mites was highest for Bushenyi and lowest for Luwero districts as indicated in Table 1 below.

Table 1: Sampled districts in Uganda with percentage of colonies tested positive for Varroa mites

District	Number of sampled sites	Number of sites positive for varroa	Total Number of bee colonies sampled	Number found postive to varroa mite	Percentage Infestation	Average bees sampled per colony	Average varroa recovered per colony
Masaka	3	3	9	9	100	250	5
Bushenyi	3	3	9	8	88.9	347	8
Kabarole	3	3	9	6	66.7	170	3
Kyenjojo	2	2	6	5	83.3	228	3
Luwero	6	5	16	8	50	332	1
Mbale	3	2	8	4	50	169	3
Kapchorwa	3	3	7	5	71.4	192	3
Lira	3	3	9	8	88.9	239	3
Kitgum	3	3	8	8	100	192	6
Total	29	27	81	61	699.2	2119	35
Average	3.2	3	9	6.8	77.7	235.4	3.9
STDEV				2		66	2
SEM				0.59		21.89	0.69

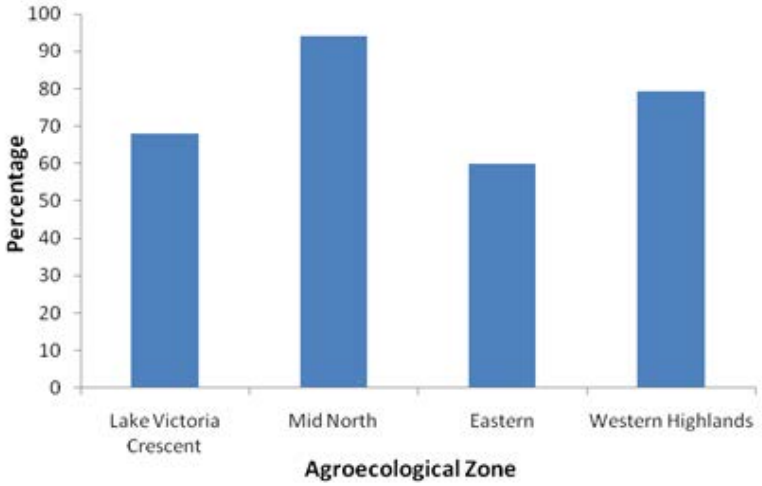

Figure 1: Percentage infestation by *Varroa destructor* per Agroecological zone

It was also observed that varroa was present in all the agro-ecological zones in this study but with varying levels of incidence (Fig.1). For all the zones, percentage infestation was above 50% with the mid north scoring highest (91%). However, the severity across districts and agro-ecological zones which is indicated as number of varroa mites per 100 bees was generally low across the board (Table 2), basing on the recommended threshold of usually 5 mites per 100 bees for an infestation to be considered alarming.

Table 2: Severity of *Varroa destructor* infestations among districts and agro-ecological zones

Agro-ecological Zone	District	Mites/100 bees
Lake Victoria Crescent	Masaka	2.2
	Luwero	2.4
Eastern	Mbale	1.5
	Kapchorwa	1.2
Mid-North	Kitgum	0.4
	Lira	1.5
Western Highlands	Bushenyi	1.4
	Kabarole	1.2
	Kyenjojo	2.9

Discussion

The 100% incidence of Varroa mites in all the sampled districts is an indicator that the Varroa problem has spread to almost the entire country except perhaps for the island ecosystems where extensive research on the subject has not been done. However, on further examination of the average number of varroa mites recovered per colony (4±0.59), it's infestation level is still quite low and not yet alarming. This may be due to the fact that African bee sub species have a tendency to abscond and swarm more readily than the European bees thereby causing breaks in brood rearing and thus reducing Varroa loads (Muli *et al*., 2014).

The mid-north and the western highlands agro-ecological zones are some of the major honey producing areas in Uganda and many locals have embraced beekeeping as a business. As such, it is assumed that there could be a lot of silent bee colony marketing that is not regulated and this has facilitated the high spread and incidence of the mite across colonies. For the eastern agro-ecological zone, low mite numbers were recorded and this could be due to beekeepers there being quite geographically scattered and far from each other. Also, majority of the beekeepers in this area are rearing honey bees at a subsistence level in their backyards. For Kapchorwa in particular temperatures are generally very low and this affects honey bee movement and activity. This reduces the levels of colony mobility and translates into low rates of Varroa mite distribution.

Conclusion

From the findings of this research, it is evident that the Varroa mite problem is expanding in Uganda. There is need to promote better beekeeping practices among beekeepers to avoid deliberate spread of the Varroa mite as well as organizing beekeepers in groups for continuous training on Varroa management.

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