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Occurrences and Distributions of Honeybee (*Apis mellifera Jemenetica*) Varroa Mite (*Varroa destructor*) in Tigray Region, Ethiopia

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Abstract

One of the key steps in successful beekeeping depends on the ability to identify encountering problems as early as possible. Widespread losses of honeybee colonies have been reported from Tigray region, Ethiopia due to unknown factor(s). With objective of identifying possible reasons for the honeybee colony death and dwindling, diagnostic survey was conducted in 10 districts of Tigray region in October and November, 2010. Totally 200 honeybee colonies were randomly sampled and inspected internally and externally for adult bee brood diseases and pests. All the surveyed areas tested positive to *varroa* mite with infection levels ranging 37.5% to 100%. With no clues on how and when the mite introduced, high bee colony mobility (marketing), ranches to and from which bee colonies collected and redistributed.

Natural bee colony swarm and migration are regarded as causing high rates of *varroa* mite distributions in the region. The first testimonial for the existence (occurrence) of *varroa* mite was considered to be extensive loss of honeybee colonies. But what are less certain are the magnitudes of its effects on honeybees and their products in the region. For the region with special white honey and with high government focus on beekeeping, the occurrence of *varroa* mite is a great threat to the subsector. This study reported, for the first time, the presence of *varroa* mite and indicated the most likely occurrence of *varroa* mite attendant disease called DWV in the country. Therefore, parallel to setting up of control experiments in identifying the mite species and its effects on honeybees and their products, special apiculture extension should be designed to curtail factors enhancing intra and inter apiaries disseminations of the mite. Beside the investigation of varroa mite, for the first time, this study unveiled the newly added genetic material to biodiversity of the country.

Keywords: Apiculture; Extension; Occurrence; Tigray; *Varroa*

Introduction

Varroa destructor, Anderson and Truman (*Acari:Varroidae*), is the most serious pest mainly threatening beekeeping industry development all over the globe [1-5]. After switching from its original host *Apis cerana*, to *Apis mellifera* the mite spreads throughout most of the world [4] and has been causing huge honeybee colony mortalities [1,4,6,7]. On top of the ability to replicate only in a honeybee colony, *varroa destructor* is an external parasitic mite that can be attached on (to) the external body of the bee and suck Hemolymph that results in a disease called varroatosis [5]. Through repeated feeding, the mite shortens the life span of the honeybees and causes the ultimate perishing of colonies [8]. Generally, the mite is potentially the vector of honeybee viruses [9-12] and particularly the transmitter of Israeli acute paralysis virus, a virus that is a significant marker of honeybee colony collapse disorder [5], devastating honeybee colonies across the USA [13,14] and around the world [15]. The existence of *Varroa destructor* in Africa has been reported for the first time in 1997 in South Africa [16]. Subsequently, a positive test report has been produced in Kenya, Tanzania, Uganda and Ghana in 2009 [4].

Ethiopia, being the with the largest honeybee colony population and the leading honey and beeswax producers in Africa, it has not yet been demonstrated if this mite could exist and interacted with local honeybees. Recently, report on the unknown honeybee colony death and dwindling has been received from Tigray regional state bureau of Agriculture. Based on the received case report, extensive diagnostic surveillances were conducted in different districts of the region to identify the plausible causes behind the honeybee colonies death and dwindling in the region.

Materials and Methods

Diagnostic survey and collections of adult bees and brood samples were conducted in 10 districts of Tigray Regional State (northern Ethiopia) from 14th of October to 2nd of November 2010 in the areas indicated in Figure 1. Sample collections were done from bee colonies (*Apis mellifera Jemenetica*) hived in Zander frame beehives. Two sites from each district and 10 bee colonies from each site, in total 20 sites; and 200 and 73 bee colonies were diagnosed for adult bees and for brood bees respectively. From each bee colony, 150 to 200 adult honeybees were brushed off from the brood comb directly into a wide mouth plastic container. The collected adult bees were killed using hot water and placed in 10 ml of 1% detergent-water solution (10 ml detergent in 1000 ml water) and vigorously shaked for 1 minute to dislodge mites. The mites were collected filtering the solution through a ladle (8- to 12-mesh) that hold the bees and let out the mites with the solutions. Then, wire gauze (less than 8 mm mesh) was used to hold the mites and discharge the solutions. The wire gauze was turned down and collided with the white paper on which the presence/absence of the mite were examined. Subsequently counting was done on diagnosed adult bees and recovered *varroa* mites. Furthermore, brood examinations were done by cutting 5 cm×5 cm brood comb areas from drone and/or worker pupae broods. A minimum of 100-200 pupae were uncapped and pulled out of their cells, examined for *varroa* mites and pictures taken. Similarly, counting was done on the pupae pulled out and *varroa* mites recovered.

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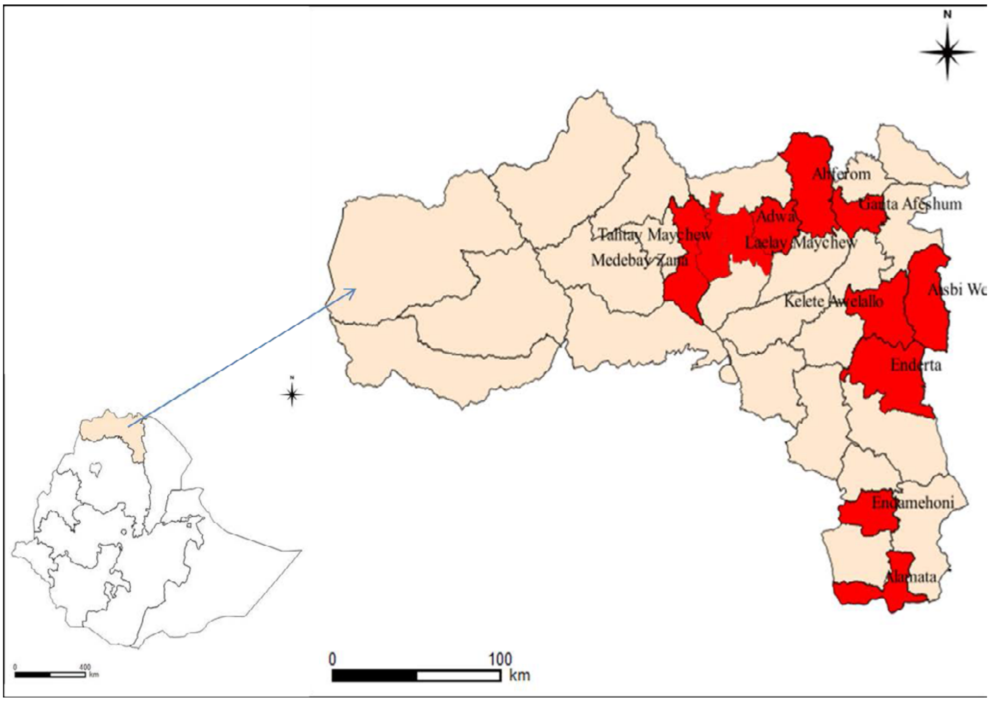

Figure 1: Adult bees and brood bee sampling localities.

District	Number of sampled sites	Number of sites positive to varroa	Total Number of bee colonies sampled	Number found positive to varroa mite	% infestation	Average number of bees sampled per colony	Average number of varroa recovered per colony
Alamata	2	2	20	20	100	150	9
Endamehoni	2	2	20	17	85	199	8
Enderta	2	2	20	16	80	205	11
Kilete Awulallo	2	2	20	20	100	200	12
Atsbi	2	2	20	15	75	184	18
Ganta Afshum	2	2	20	20	100	196	20
Aferom	2	2	20	17	85	236	27
Adwa	2	2	20	14	70	213	25
Axum	2	2	20	17	85	193	15
Shire Endasilase	2	2	20	8	40	187	4
Total	20	20	200	164	820	1963	146.5
Average	2	2	20	16.4	82	196.3	15
STDEV				3.63		21.97	7.45

Table 1: Adult bees sampling districts with percentage bee colonies tested positive for varroa mites.

Results

Adult bee diagnosis

This study showed that all the sampled districts and sites were tested positive to *varroa* mites with 100% infestation rate. From the total 200 bee colonies diagnosed, *varroa* mites were detected in 164 ones with overall infestation rate of 82%. An average of 196 ± 22 bees per colony was examined through adult bee colonies and an average of 15 ± 7.45 (ranging from 4-27) *varroa* mites were recovered. Although there is no apparent difference, infestation rates were high for Alamata, Kilete Awulalo and Ganta Afeshum with 100%. However, per colony recovered the average number of *varroa* mites was high for Enticho and low for Shire Endasilasie districts (Table 1).

Brood bee diagnosis

From the total of 73 bee colonies diagnosed for brood, 47 bee colonies accounting 64% of the diagnosed brood were tested positive for *varroa* mites. The result from the diagnosed brood showed that all the sampling localities were 100% infested with *varroa* mites with the infestation rate ranging from 33% to 100%. On the average 7 ± 1.42 bee colonies were sampled for brood diagnosis from each district and an average of five bee colonies were found positive to *varroa* mite. Likewise, on the average 96 ± 11.84 brood cells were opened from each bee colony with an average of 10 ± 5.75 *varroa* mite detection. Through the brood analysis, Aferom and Endamehoni districts were found with high and low *varroa* mite infestation rates respectively (Table 2).

Furthermore, varroa mites on drone pupae as well as dead pupae with discolored, shrunken, decreased body size were detected during the laboratory diagnosis (Figure 2).

Discussions

The major finding of the diagnostic survey disclosed *varroa* mite caused mainly honeybee death and dwindling in different parts of the region through feeding on haemolymph [17] and producing immune

District	Total number of bee colonies sampled	Number found positive to varroa mite	% infestation	Average number of opened brood per colony	Average number of varroa recovered per colony
Alamata	5	2	40	97	4
Endamehoni	6	2	33	94	5
Enderta	8	4	50	87	4
Kilete Awulallo	10	6	60	73	7
Atsbi	7	6	86	108	14
Ganta Afshum	9	8	89	102	15
Aferom	7	7	100	114	18
Adwa	7	5	71	88	16
Axum	7	4	57	96	14
Shire Endasilase	7	3	43	105	5
Total	73	47		964	102
Average	7.3	4.7	64	96.4	10
STDEV	1.42	2.06		11.84	5.75

Table 2: Total number of sampled bee colonies per district and obtained results through brood diagnosis.

Figure 2: Varroa mite on pupae (Left) and dead pupae with discolored, shrunken, decreased body size (Right).

suppression [18,19] and caused the colony collapse [20] in different parts of the region. It is also an established fact that *varroa* mite through repeated feeding can cause bee body perforation in which bacteria can develop and prevent the healing through repeated feeding on the same perforation [17,20]. Therefore, the bee colony death caused in the region might be due to the combined effects of the *varroa* mite and the *Varroa* mite infestation caused viruses [21]. On the other hand, the wide distribution of the *varroa* mites in all the surveyed areas and in all inspected bee colonies indicates longtime introduction explaining high levels of bee colony losses [22,23]. The varied number of *varroa* mites recovered through adult bees and brood bees between districts suggests different mite levels associated with different levels of bee colony death and dwindling phenomenon [24]. The average number of *varroa* mites recovered from a single bee colony through adults and broods analyses were 15 and 10 mites, respectively suggesting the colonies are close to collapse concurring with the finding that established more 10 mites natural drop per day can cause colony collapse [25]. However, the causes of variations in infestation rates among the studied districts might be attributed to the service level of the places as bee colony marketing points. Although there is no a place where bee colony can't be marketed in Tigray region, Alamata, Kilete Awulallo, Ganta Afshum and Aferom districts were principally identified as bee colony market points to which bee colonies from neighboring districts are collected and redistributed (resoled) to different parts of the region. Being with traditionally established bee colony market in Enticho town, Aferom district followed by Ganta Afeshum district were found with highest infestation levels through the brood diagnosis. Moreover, the number of varroa mites recovered through both adults and brood sample diagnoses were also very high in these two districts validating the big role of high bee colony mobility for high rates of *varroa* mite distribution [26]. On the other hand, the low infestation registered in Shire Endasilase probably indicates either the recent introduction of the varroa mite into the place or the low level of beekeeping that didn't so far require high bee colony mobility.

Furthermore, the positive testing of the diagnosed dead pupae with discolored, shrunken and decreased body size during the laboratory diagnoses were the manifestations of the disease caused by DWV infection associated with infestations of the parasitic mite, *Varroa destructor* [27,28]. This is because, *varroa* mite is effective Deformed Wing Virus (DWV) vector and bees as well as brood parasitized by *Varroa* are nearly 100% infested by Deformed Wing Virus (DWV) [28,29].

Conclusions

Although, it is difficult to trace how and when it was introduced, Ethiopia has been tested positive to *varroa* mite. The presence of *varroa* mite in the country is highly significant and market oriented high bee colony mobility coupled with lack of awareness neither from the beekeepers nor from the experts enhanced its high rate of distributions. This study for first time reported the presence of *varroa* mite in Ethiopia and indicated the most likely occurrence of *varroa* mite attendant disease called DWV in the country. Furthermore, it advanced our understanding of the existences and virulence of *varroa* mite implicated in the phenomenon of honeybee losses in the county and the current cosmopolitan nature of the mite.

Recommendations

The presence of this mite in the country is highly significant.

If honeybee colonies in the country succumb to *Varroa* as they are in other parts of the world, the results could be devastating to both beekeeping industry and agricultural production. Unfortunately there is a fear that the presence of *varroa* mite in the country could jeopardize bee products export and causes big setback on commercial beekeeping development of the country.

Hence, both policy and technical measures must be in place as soon as possible to contain the pest and minimize the threat posed to the market and the sector growth. Also, there should be strong national and/or regional quarantine between borders that regulate bee colony and bee products movement and marketing. More importantly, there should be awareness creation using public mass-media and other possible means to advise all actors in the value chain to cautiously while performing bee colony purchasing, swarm catching, and transporting from doubtful sources. The awareness creation should also include the right ways of varroa mite diagnosis, its economic impact, and means of avoiding intra colonies and inter apiariess mite spread. Furthermore, a manual that clearly indicates accurate and right ways of diagnosing bee colonies for *varroa* mites and its associated DWV should be developed. Although there is chemical way of treating the mite, the current level of beekeeping in the country can't allow appropriate medication. Hence, for the apiculture subsector to continue playing its purposive roles, there should be a paradigm shift from the current 90% traditional system to improved ways of beekeeping that enables the beekeepers easily diagnose and medicate to subdue the effects of *varroa* mite and other emerging diseases of honeybee. Finally, immediate research should be launched to define *varroa* infested and free areas of the country as a whole with parallel setting up of controlled experiment to estimate the economic impacts of *varroa* mite on local bees with developing its control means.

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