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– A Study of Galleria mellonella and Achroia grisella

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Independent project • 15 hec
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Abstract

The bee wax moth is a problematic pest that has been a problem to Kenyan bee farmers for some time now. This study has tried to answer if the observed factors affected the infestation rate of the pest.

The bee wax moth is nocturnal and can during the late hours freely enter the hive even if the colony is strong, however, it is only a problem in weak colonies that cannot fend them off. The moth is often not the first disturbance, stress from another pest, scarcity of food, heat etc. can leave the hive open too an attack.

There are many options for control of the bee wax moth e.g. heat or cold treatment of the stored combs, breeding programs for more effective bees, biological control and insecticides. These control methods are sometimes difficult to implement due to different prerequisites in different countries, in Kenya for example they do not profit from the cold winter that could kill the bee wax moth, but instead benefit from harvesting honey all year round. This also means that they do not have the same need for storage of their frames and boxes and some methods of control are therefore unsuitable. A preferable solution would be to be able to lessen the infestation rate from the start to make up for the lack of available control methods.

Out of the five different factors hypothesized to have an effect on infestation rate, hive type, number of hives in one location, type of suspension, placed in shadow or sun exposed and clearing of the ground, none proved to be significant. However, both hive type and type of suspension showed that there is the inclination of a trend. The subject could use further study since there are many other factors that could affect the infestation rate that are not taken into consideration in this project.

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1. Introduction

Man has been using honey for a long time and it has become easier to collect through the years. Nowadays, stationary colonies are preferred, that we can move around as we please and that fill up with honey quickly after each harvest. This can sometimes fall through by the bees swarming or absconding, leaving the hive without honey (Ellis, 2012).

Beekeeping in Kenya differs from beekeeping in, for example, Sweden. In Sweden, where domesticated bees are used, colonies are often bought or new queens are introduced to an already active colony whereas in Kenya, hives or catcher boxes with baits are put out where wild bees enter and begin reproducing, thus, hives start out with fewer individuals than in Sweden (FAO, 2011). This way of keeping bees favors the wild bee population unlike most of beekeeping in European countries (Richardson, 2019). Honey has for a long time been a valuable resource for the bees themselves, other animals and humans. It is an important source of income and food and could be very valuable to poor families with otherwise limited earnings, but there are a lot of factors that can stand between the farmer and a successful honey harvest.

Embu County was the location for this project. It is a small town in northwestern Kenya where many farmers have picked up on beekeeping as an additional activity to farming due to its importance. This study focused on one of the most severe pests of honey bees in Embu County, the bee wax moth.

There are two different species of bee wax moth, the lesser and the greater (*Galleria mellonella* and *Achroia grisella*). There will not be a differentiation between the two in this study since the damage they do is very similar. The moth is one of the local bee farmers biggest threat to their honey production together with safari ants (*Dorylus*), though the latter will not be discussed here (Johansson, 2019). The goal was to evaluate the extent of the problem and if the type of hive and placement of the hives has influence on the rate of infestation. More specifically the study assessed the effects of three types of hives, if the hives were sun-exposed, type of suspension, the number of hives close to each other and if there were debris or not on the ground. This empirical study was combined with a small literature study about the African honey bee, the bee wax moth and different ways to control it.

2. The Honey bee

Apis mellifera, more commonly known as the honey bee, is special among the different bee species in that they form a colony where many individual bees work together to keep the colony clean and well fed. Each colony has one queen and her purpose is reproduction. Before the queen lays eggs she walks around the combs looking for suitable places to lay them. A productive queen can lay 2000-3000 eggs a day during her busiest season. When the queen gets older and she needs to be replaced she is either discarded by the other bees in the colony or leaves when it is time for swarming. Before the old queen leaves the colony, the bees need to produce a new queen. The worker bees build a cell that is larger than a regular cell that becomes the queen cell when an egg is laid inside it. It is tenderly cared for by the worker bees and the larva that hatches is fed with what is called queen jelly that causes the growing larva to develop into a larger bee with fully developed reproductive organs (Mattson and Lang, 2009).

About a week after the queen emerges, she leaves the hive to mate with drones. This is when she will attain all the sperm necessary to produce fertilized eggs for the rest of her lifespan, around 500,000 of them. Drones are adult bees stemming from unfertilized eggs, which are always male and carries only the queen´s DNA (Mattson and Lang, 2009).

The worker bees develop from fertilized eggs. During their lifetime they have many different tasks to perform. They often start out with cleaning the cell they emerged from so that it can be used anew. After they start feeding, they start to produce bee milk, which they use to feed larvae as nursery bees. This is usually followed by helping to receive pollen and nectar brought in by the other bees. After the bees´ wax glands are fully developed they can also help, if necessary, to build new combs. They may serve a shorter time as guard or cleaning bees before serving as field bees for the remaining part of their life, gathering nectar, pollen and water. This schedule is flexible and can vary depending on what is needed at the time (Mattson and Lang, 2009).

Figure 1 One of the bees at a farm in Embu County (Johansson, 2019).

The bee used in many parts of Africa is a wild subspecies of *Apis mellifera* called *Apis mellifera scutellata* or the African honey bee. The African honey bee is a subspecies of honey bees that have a shorter tongue and body and are known for being more aggressive than other subspecies. It is one of the few remaining wild subspecies of honey bees and are more resistant against pests than their European kin and therefore more fit for a life without human interference. Since they do well in the wild, they can sometimes compete for food with domesticated bees (Ellis, 2012).

The African honey bee has a stronger tendency to swarm and to abscond from the nest than the European honey bee (Winston, 1991). African bees are able to produce drones in all seasons of the year, which is one of the reasons they can swarm 6-12 times a year. In their wild state, their temperate relatives only produce drones between the months of March to October and swarm 1-3 times a year during spring and summer (McNally and Schneider, 1992). The strong tendency of the African honey bee to abscond from its nest sometimes makes it hard to work with. Absconding from the nest can be triggered for different reasons, e.g., through, a decrease in colony quality brought about by disturbance such as pests and overheating. Another reason is seasonal, but why they abscond seasonally is not well understood since colonies that have the same conditions in food supply do not always exhibit the same absconding behavior. Nevertheless, the main theory is that the seasonal absconding is connected to food supply and access to water (McNally and Schneider, 1992).

2.1 The Bee Wax Moth

One pest that is a large reason to why the honey bees abscond, is the bee wax moth (*Galleria mellonella* and *Achroia grisella*). The female moth lays eggs that have a rounded shape and have a color resembling that of bone (Smith, 1965). In the hive the eggs hatch into larvae that start to eat from the comb. They are initially a shade of cream white but that deepens with each instar stage (Kwadha et. al, 2017). As the larva eats through the combs, they may damage the brood since the brood combs are more attractive as food because of the pollen and cast larval skins (Hood, 2010). The larvae continuously spin a web while feasting on the comb and this is the same material later used for the cocoon. During the process of spinning the cocoon, available debris are used as camouflage to remain undetected (Smith, 1965). The larvae then pupate after eight to nine instar stages (Kwadha et. al, 2017).

Figure 2 The larva of a bee wax moth found in a traditional hive.

When the adults emerge from the pupae, they have a clever way of avoiding the wrath of the bees. Since moths are nocturnal creatures and bees are active during the day, they can wait without entering the hive until the bees are no longer active and leave again just before sunrise. This way they can enter strong hives that during the day would have been able to fight the moth off (Nielsen and Brister, 1977). The adult moth does not consume any food, so it has only one purpose, reproduction (Smith, 1965). Expectant wax moth females prefer strong colonies in comparison to weakened and small ones where she lays the eggs in narrow areas of the hive inaccessible to the bees (Kwadha et. al, 2017). The wax moth is not a threat to strong colonies that are healthy and has a large bee count, but weakened and small colonies can suffer significant damage if infested where the bees die or abscond. This can cause a total loss in honey production for that colony (Martin et. al, 1980).

2.1.1 Methods of control of the bee wax moth

There are several different methods of control of wax moths with different success rates and varying difficulties to implement (Hood 2010). First of all, it is important to have a good queen that can effectively regulate the amount of bees to keep an optimal bee-to-comb ratio. A second important strategy is keeping the stress level of the bees low. For example, when manipulating the hives, you risk stressing the bees, leaving the colony open for attack. Other stressful factors include swarming, starving or the presence of other pests. The beekeeper should also be aware of the right number of supers (the box where the honey comb is built that is put on top of the box with the brood) in relation to the number of bees. Too large an area for a small number of bees can make it hard for them to defend against intruders. The depressions made by the wax moth larvae in the wooden frames can provide shelter for other pests which is why the frames should be inspected regularly. If they are damaged, they should be disposed of and replaced, other damaged surfaces in the hives should be repaired. Together with these observations and actions, good hygiene is important to keep the hive clear of pests (Hood, 2010).

In Embu County, it was found that the farmers try to keep the ground clear from debris such as leaves since they experience that the moth hides beneath it (Johansson, 2019). Many farmers interviewed by Johansson mentioned cleaning the ground as a key method, but they did not specify how often they practice it.

Combs taken from the hive that are no longer protected by the bees have a greater risk of suffering damage from the bee wax moth (U.S. department of agriculture, 1972). Many of the methods mentioned for fighting wax moth damage are, therefore related to storage of the combs. Heat and cold treatment are options to exterminate wax moths present in or around the combs, when storing frames and honey. Cold treatment can also be used on separate frames on a still active colony but is seldom the solution in the long run. An additional treatment for combs that are to be stored is to use carbon dioxide to suffocate all the life stages.

In recent years a new product for biological control of the bee wax moth has appeared on the market. The product is called B401® but is not yet permitted on the Kenyan market (Pest Control Products Board, 2018). B401® contains a subspecies of *Bacillus thuringiensis* (Bt) that is formulated to target bee wax moth larvae. It is used on stored honeycombs as a preventive method (Hood, 2010). The use of the product has been proven effective in reducing the damages made by the moth but not eliminating it (Ellis and Hayes, 2009).

As a last resort the farmers, when all else fails, can use insecticides such as paradichlorobenzene also known as PDB and aluminum phosphide. Aluminum phosphide is used to protect drawn honey but is only allowed to be used by licensed professionals since it is highly flammable and toxic to humans. PDB can be used without a license but only on stored combs since honey absorbs the substance and becomes unfit for human consumption (Hood, 2010). PDB is not available for usage in Kenya unlike aluminium phosphide that can be purchased but is classified as restricted (Pest Control Products Board, 2018). Even though insecticides are supposed to be used as a last option it is common that they are used before all other options have been explored.

3. Materials and Method

A field survey was conducted to determine the extent of the problem with bee wax moths in the different areas in Embu County, and if factors such as type and placement of hives affects infestation rates. Contact was established with the Chairman of a local bee group that helped to get in touch with beekeepers in the group that comprised the majority of farmers included in this study. Four of the farmers were contacted through one of the supervisors of this project.

All the data was collected by examining each hive between the hours of 10 a.m. and 3 p.m. with usually one farmer in the morning and one in the afternoon. A total of 20 farmers were visited.

A car with driver was used as a means of transportation to the different areas. That driver was also acting as a translator. On arrival, the farmers were asked for permission to look into their hives in search of the bee wax moth. Protective gear was put on before walking closer to the hives and a smoker was used to decrease the aggressiveness of the bees prior to opening the lids of the hives.

Most of the farmers had less than ten individual hives. In cases where they had more than ten, to save time, ten of those were chosen for observation leaving the rest unchecked. The exception was one farm where eleven hives were checked. If there were less than ten hives all of them were observed, if there were more than ten, ten were purposefully selected. This often meant choosing to look in the ones that were colonized when the number of hives were far greater than ten and many of the hives were not colonized. An empty, not yet colonized hive does not attract the moth. Farms with a number of hives above, but close to ten could therefore end up having empty hives observed if not enough of them were colonized.

The status inside of each hive was documented with photos and the distance to other hives was determined visually in the field. If there was more than 100 meters between the hives, they were counted as separate from each other. Sun exposure of the hives was determined during the day when the sun was at or close to its highest point. If the hives were shadowed during this time of day, they were categorized as shaded, and if it was sunny, they were categorized as sun exposed. It was also noted if the hives were hung from a tree or put on a stand and if the ground underneath was cleaned or not.

To avoid interfering with the bees to a large extent there were some limitations with the study. If there was risk of ruining combs, both brood and honey, observations were made without lifting the frames. When looking inside the hives it was noted which type of hive it was (Langstroth, top bar or traditional), if the hive had bees and if it was infested with bee wax moth. It was also noted which life stage was observed (egg, larva, pupa or adult) as well as the presence of cocoons. An infestation that had already terminated but had left behind visible traces that had yet to be cleaned and gotten rid of, was also counted as an infestation in the analysis. During the observation it was only noted if a hive was infested or not, not to what degree.

This data was then used for a statistic analysis to see if any of these factors significantly affected the likelihood of infestation. To analyze how five independent variables, related to environmental conditions and management, affected the incidence of the pest, a logistic regression was conducted in R 3.4.2 using the glmer function in the lme4 package. The five tested variables were:

1) Type of hive (categorical variable, three levels)
2) Number of hives close by (continuous variable)
3) Whether a hive was placed on a stand or in a tree (categorical variable, two levels)
4) If a hive was placed in shadow or sun-exposed (categorical variable, two levels)
5) If debris had recently been removed from the ground underneath the hive (categorical variable, two levels)

Only main effects of these variables were considered. The farmer was added as a random factor to the model.

4. Results

The findings from the visits to the beekeepers and the data gathering at the different locations in Embu County are presented here. For a detailed overview, please confer the Appendix.

A total of 110 beehives at 20 different sites were examined, where 39 of them had an infestation of bee wax moth of different severity. An additional 18 had traces of bee wax moth from previous infestations. The moth egg, larvae and pupae were often found in places that were hard for the bees to reach, the space between the lid and the frames, in the spaces between two frames close together, between the frame and the hive walls and in cracks in the hive itself. When the level of infestation increased, they even made their way out into the open spaces of the hive. Those hives were often abandoned or had a small colony. The infestation often took place before the bees had time to begin building the combs containing honey or had just started. If the infestation went uncontrolled, by both the farmer and the bees, significant damage was observed.

Many of the beehives inspected were located in farmland, except for two that were located in Mount Kenya forest. Farmland in Embu County has a narrow range of crops most commonly consisting of avocado trees, macadamia, mango, coffee, tea and corn. In Mount Kenya forest, many of the trees are indigenous so there is a clear distinction between the different vegetation in the farmlands and in this particular forest.

All the beekeepers had hives made from wood with aluminum plate roofing, except for a few that were traditional that were missing the plate roof. Three different models are used, they are listed in the order from most common, Langstroth, top bar and traditional.

Figure 3 L. Langstroth hive, M. Top bar hive, R. Traditional hive (Johansson, 2019).

None of the hives and supers are stored since they are in use all year round. After harvest, the honey is placed in buckets, then everything is cleaned and put back in place. Sometimes, using the Langstroth hive, the farmer had put a super on the brood box right from the start before the colony was large enough, which lead to fewer bees protecting a larger area.

The stages most often observed were larvae and pupae, they were also the most easily observed stages since the eggs are very small and the adults are mostly active at night. Adults were only observed in two hives at two different farms. In addition to the moth, other pests were also observed in the hives such as spiders, ants, beetles, geckos and rodents, though these were not the pest of interest.

Figure 4 Damage from grown wax moth larva (Johansson, 2019)

Of the 84 Langstroth hives, 26 had an active infestation, compared to 10 out of 20 top bars and 3 out of 6 traditional (Fig. 3). However, there was no significant difference in infestation rate between the three hive types.

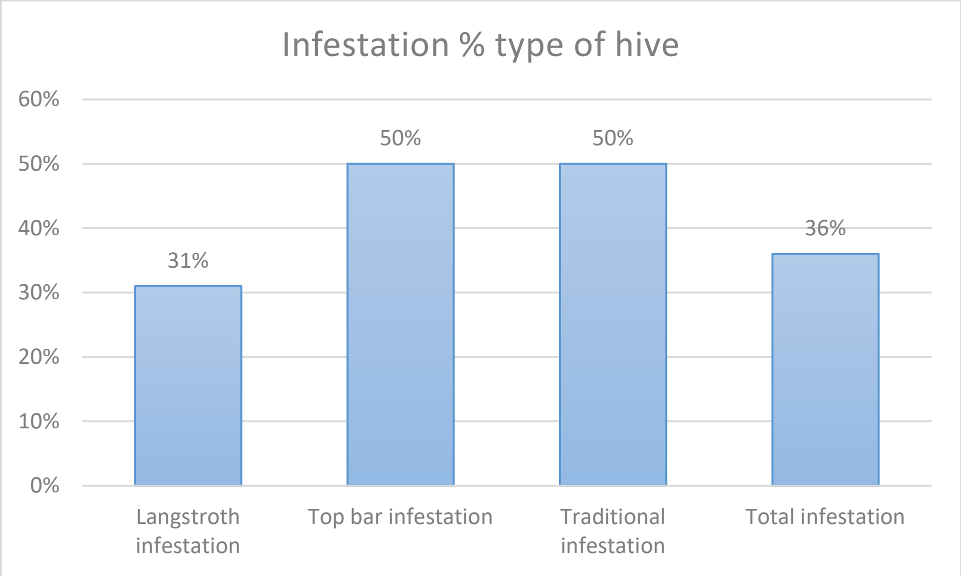

Figure 5 Diagram of occurrence of bee wax moth in each type of hive together with the total percentage

The hives often stood in close proximity to each other (closer than 100 meters), but the number varied greatly between the different farms which is why it was chosen as a variable. The number ranged from two hives in close proximity to 108 (Fig. 4). The statistical analysis did however not show any significant effect on the rate of infestation.

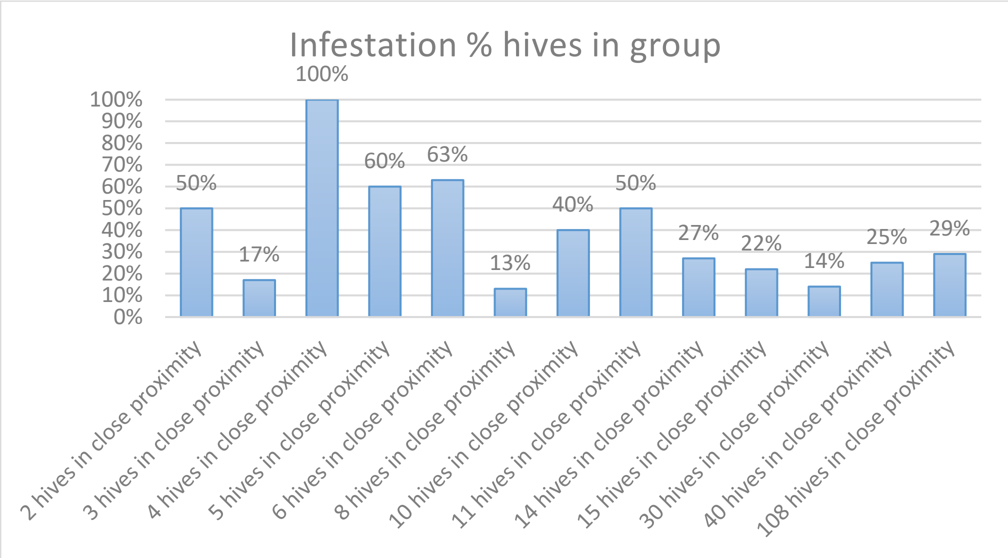

Figure 6 Percentage of infestation based on the number of hives near each other

All the hives were placed in two ways across all the farms, on stands or hung in trees, either to aid in the colonization of the hive or, according to the farmers beliefs, work as an additional protection against pests. This was the next variable chosen for analysis. There were 12 hives hanging in trees and 98 put on stands. Once again, the statistical analysis of infestation rates failed to indicate significant effects of this variable, yet there seems to be a trend if looking at Figure 7.

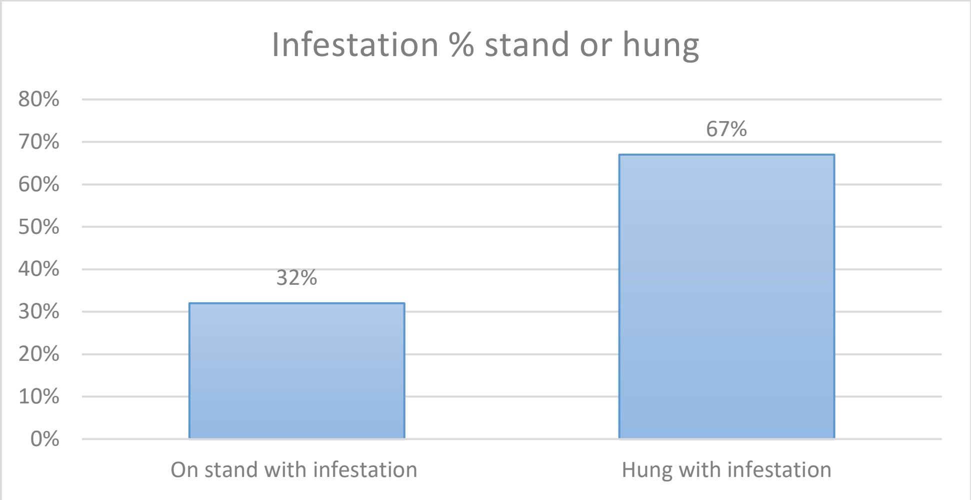

Figure 7 Frequency of occurrence of bee wax moth depending on whether it was put on a stand or hung in a tree

The second to last variable chosen for analysis was whether the hives were placed in shadow or sun. Thirty-two hives were placed in the sun and 78 in shadow. As previously mentioned, overheating can affect a colony and cause them to weaken or abscond. This is an important factor for the bee wax moth and this variable was chosen for this reason. However, there was no indication of an effect of this variable either which is consistent with the results in Figure 8.

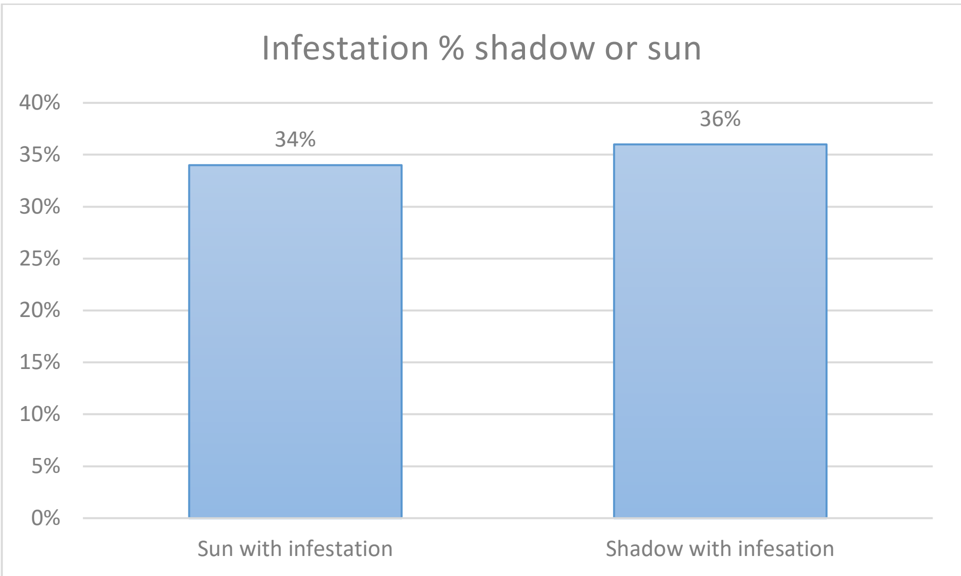

Figure 8 Percentage of hives infested whether they were in sun or shadow

Few of the farmers said that they had actively kept up with keeping the ground free from debris. During the observations it was confirmed that only a few appeared to have cleaned recently, namely four farmers, adding up to twenty hives, leaving ninety not cleaned. There was no significant difference in infestation rates between those who had recently cleaned the ground underneath and those who had not, this result supports the outcome in Figure 9.

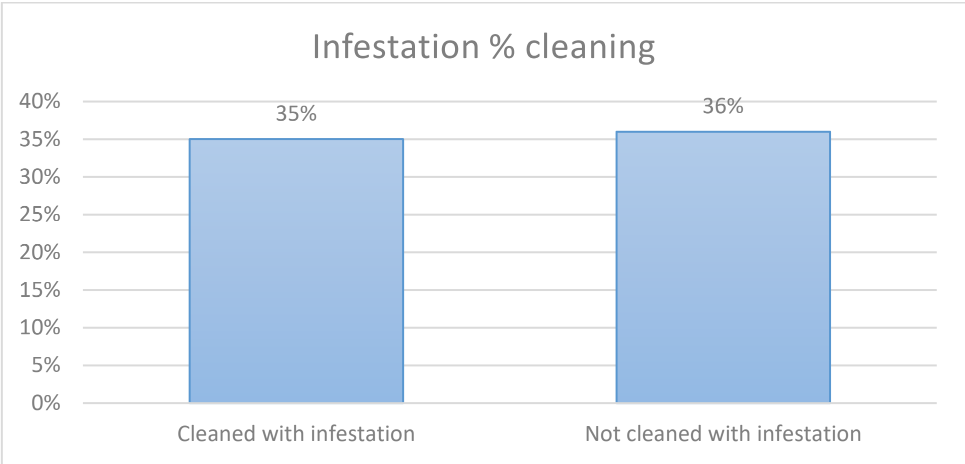

Figure 9 Occurrence of bee wax moth in hives that had and had not, had the ground cleaned recently

Many of the farmers mentioned frequenting the area around the hives, but seldom, if ever, looked inside the hives. They often hired someone to harvest for them and to look after the colonies, which meant rare visits up to two months apart.

5. Discussion

The results clearly show that the bee wax moth is a frequent problem for the bee farmers in the Embu County area with 35.5 % or 39 out of 110 hives infested. An uncontrolled infestation can take over and force the bees to leave, leaving the farmer with no honey to harvest.

Type of hive, number of hives close to each other, if the hive was on a stand or hung in a tree, if it was placed in shadow or sun and if the ground was cleared of debris, had no influence on the occurrence of the moth. This could be because there are so many other factors contributing to whether or not the moth enters the hive and becomes a problem. Factors including, the presence of other pests, the farmers own involvement when opening the hive, vegetation etc. These were not taken into consideration during this project but could be interesting observations for future studies. It is possible that a more controlled study of cleaning debris of the ground could produce different results as only a few of the farmers had done it recently.

There was a trend towards a difference between the different type of hives and the occurrence of bee wax moth, but no significant difference was detected in the statistical analysis. If a larger sample size of the traditional and top bar would have been available, it is possible that a difference could have been detected since they both had a higher percentage of infestations than the Langstroth type. This is also true for if the hive was put on a stand or hung from a tree where it appears like putting the hive on a stand could lessen the risk of infestation. The reason we see a difference that favors the hives on stands could simply be because they are easier to reach and maybe therefore gets checked more often than the ones in trees. This is of course speculation, and the subject, as mentioned earlier, requires further study while limiting other affecting factors.

Then what can the farmer do to fight the moth and help the bees?

As indicated under methods of control there are several ways to fight the bee wax moth. Although many of the control methods are for storage of combs and frames which has not been necessary in this region since they do not store either, though there are some that can still be useful. The importance of having an efficient queen that is good at regulating the number of bees in the colony is mentioned among the methods. This one is hard to implement in Embu County considering that they use wild bees in their colonies, so obtaining a good queen is left to chance. Next option is to avoid stressing the bees in various ways, making sure that other pests do not enter the hive and that the hive has a good temperature. It can be beneficial to regularly check if there are pests or temperature changes in the hives that could weaken the colony and make it vulnerable for attack. However, opening the hives too often could stress the bees and make them vulnerable, or even worse, make them abscond, leaving the farmer with nothing. Further study is needed on how often one can open the hives before disturbing the African honey bees to that extent.

It was found that some beekeepers in Embu County put supers on top of the brood boxes, before they were colonized, when placing the hives in the different locations. This could be because of a lack of knowledge or an attempt of efficiency to limit the number of visits to the site. Whatever the motive, it is not a good strategy for limiting infestation of the bee wax moth since there will be too much area for the bees to protect until they have a higher number of workers. This gives the moth an advantage when it can slip in unseen and lay its eggs undisturbed.

Hygiene is an important part of keeping the colony healthy and pest free where the bee farmer can lend a helping hand in removing waste and making sure the hive is cleaned when harvesting or between housing colonies.

One type of control that is already implemented here is keeping the ground clean, though the ground was often covered with leaves and other debris, which made it hard to say how often they cleared the ground. However, clearing the ground below the hives seemed to do little in way of keeping the moth away. This method is not studied as a way of control of the bee wax moth and could use more research to find out if it has an effect, so far, the only source are the farmers. It would probably be beneficial to perform a more controlled study where you have a specific area that is cleaned, decided beforehand, or a study where different sized areas are cleared to get a good look if the dimensions of the cleaned area is of significance.

Since the infestation seems often to take place in the early stages of colonization of the hive when the bees are fewer, it should be recommended to keep an eye out for pests during this most sensitive stage. Observation and inspection should of course continue even after the colonies have come out of this stage.

The wax moth is a force to be reckoned with and with only preventive measures and observations there is not much to be done when the moth is in the hive except for removing it by hand. Which in the worst case scenario means, clean up and start again.

Sources of error

Difficulties defining if a hive is mostly in shadow or sun during the daylight hours from just one time of day. To get an accurate reading one would need to observe the whole day.

When looking through the photos it was sometimes challenging to determine when a photo depicted a new hive or if it was still the same hive as in the previous photo which can contribute to misinterpreting the results if the photos were misjudged.

Sometimes a hive could not be properly inspected since doing so could ruin the farmers harvest which could mean missing an infestation.

It was sometimes difficult to determine if the bee wax moth was the reason for the bees absconding or if they came after the bees had left and ate what was left behind.

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Appendix

Table 1 Results from statistical analysis

	Estimate	Std. Error	z value	Pr(>│z│)
(intercept)	0.451170	0.872611	0.517	0.605
Hive type Top	0.720263	0.533702	1.350	0.177
Hive type Traditional	-0.197834	1.088740	-0.182	0.856
Cleaned Yes	-0.062492	0.588361	-0.106	0.915
Number of hives nearby	-0.006415	0.009780	-0.656	0.512
Shadow Yes	-0.028336	0.503988	-0.056	0.955
Stand Yes	-1.186122	0.800445	-1.482	0.138

List of findings at each beekeeper with degree of infestation of the bee wax moth:

Farmer 1; 8/4

1:st Langstroth: Bees, larvae of the bee wax moth, traces of spiders

2:nd Langstroth: No bees, bees absconded but no bee wax moth

3:rd Langstroth: Bees, no bee wax moth

4:th Langstroth: Bees, no bee wax moth

5:th Langstroth: Bees, no bee wax moth

6:th Langstroth: Bees, no bee wax moth

7:th Langstroth: Bees, no bee wax moth

1:st Top bar: Bees, traces of bee wax moth

Farmer 2; 9/4

1:st Langstroth: Bees, traces of bee wax moth

2:nd Langstroth: Bees, damage from ant attack, pupae from bee wax moth

3:rd Langstroth: No bees, severe infestation from bee wax moth

4:th Langstroth: Bees, no bee wax moth

5:th Langstroth: No bees, traces of rodents, bee wax moth and unidentified moth

6:th Langstroth: Bees, traces of rodents and bee wax moth

7:th Langstroth: Bees, traces of bee wax moth and spiders

8:th Langstroth: Bees, traces of bee wax moth and spiders

1:st Top bar: Bees, larvae of bee wax moth and damage to the combs

1:st Traditional: Bees, no bee wax moth

2:nd Traditional: Bees, no bee wax moth

Farmer 3; 9/4

1:st Langstroth: Bees, traces of bee wax moth

2:nd Langstroth: No bees, infestation from bee wax moth

3:rd Langstroth: Bees, traces of bee wax moth and ants

4:th Langstroth: Bees, no bee wax moth

5:th Langstroth: No bees, traces of bee wax moth

6:th Langstroth: Bees, no bee wax moth

7:th Langstroth: Bees, never looked in bottom section

8:th Langstroth: No bees, severe infestation from bee wax moth, found both pupae and cocoons, was colonized before attack, spiders were also found

9:th Langstroth: Bees, no bee wax moth

Farmer 4; 10/4

1:st Top bar: Bees, no bee wax moth

2:nd Top bar: Bees, no bee wax moth

3:rd Top bar: Bees, traces of bee wax moth

4:th Top bar: Bees, no bee wax moth

5:th Top bar: Bees, smaller bee wax moth infestation, found larvae

1:st Langstroth: Bees, traces of bee wax moth, cocoon

2:nd Langstroth: Bees, varroa mites, no bee wax moth

3:rd Langstroth: Bees, no bee wax moth

Farmer 5; 10/4

1:st Top bar: Bees, traces of bee wax moth

1:st Langstroth: Bees, traces of bee wax moth

2:nd Langstroth: Bees, traces of bee wax moth in the lid

Farmer 6; 11/4

1:st Traditional: Bees, found pupae and cocoons

2:nd Traditional: Bees, cocoons on the outside, nothing on the inside

1:st Langstroth: Bees, no bee wax moth, placed in a small house with net around the hive

2:nd Langstroth: Bees, cocoons on the underside

3:rd Langstroth: Bees, cocoons on the underside, pupae, large infestation, larvae and one snail found

Farmer 7; 11/4

1:st Langstroth: Bees, pupae (not from bee wax moth), traces of spiders

2:nd Langstroth: No bees, spiders, one lizard and wasps found

3:rd Langstroth: No bees, large infestation of bee wax moth, larvae, pupae

4:th Langstroth: Bees, pupae found, together with traces from previous infestations

Farmer 8; 12/4

1:st Langstroth: Bees, no bee wax moth

2:nd Langstroth: Bees, cocoons on the underside of the hive together with a lot of traces from previous infestations

3:rd Langstroth: Bees, pupae on the underside and inside of the hive

4:th Langstroth: Bees, traces of the bee wax moth, cocoons

Farmer 9; 12/4

1:st Langstroth: Bees, pupa from the praying mantis, no bee wax moth

2:nd Langstroth: No bees, large infestation of bee wax moth, pupae, larvae, cocoons and eaten wax comb

3:rd Langstroth: No bees, never colonized, gekko found

4:th Langstroth: Bees, no bee wax moth

5:th Langstroth: Bees, traces of bee wax moth, pupae found

6:th Langstroth: No bees, large infestation of bee wax moth, cocoons and eaten wax comb

Farmer 10; 16/4:

1:st Top bar: Bees, no bee wax moth

1:st Langstroth: Bees, traces from bee wax moth together with pupae and larvae that had eaten from the wax comb, varroa mites were also found, the colony had made a lot of queen cells

2:nd Top bar: No bees, a lot of traces from bee wax moth, severe infestation in the company of a mouse nest

3:rd Top bar: No bees, severe bee wax moth infestation

Farmer 11; 16/4

1:st Top bar: No bees, cocoon from bee wax moth

2:nd Top bar: Bees, no bee wax moth

3:rd Top bar: Bees, no bee wax moth, traces of spiders

Farmer 12; 17/4

1:st Langstroth: Bees, pupae by the putside of the lid, nothing inside the hive

2:nd Langstroth: Bees, pupae and larvae of the bee wax moth

3:rd Langstroth: No bees, pupae and traces of bee wax mothinga bin

4:th Langstroth: Bees, no bee wax moth

5:th Langstroth: Bees, no bee wax moth

Farmer 13; 17/4

1:st Langstroth: Bees, no bee wax moth

2:nd Langstroth: Bees, old traces of bee wax moth in the lid

Farmer 14; 22/4

1:st Traditional: Bees, cocoons, larvae and pupae

Farmer 15; 22/4

1:st Traditional: Bees, no bee wax moth, one spider

Farmer 16; 23/4

1:st Langstroth: Bees, no bee wax moth, spider found

2:nd Langstroth: Bees, traces of bee wax moth
3:rd Langstroth: Bees, no bee wax moth
4:th Langstroth: Bees, no bee wax moth
5:th Langstroth: Bees, old pupa, uncertain if bee wax moth
1:st Top bar: No bees, no bee wax moth, rodents’ nest and big spider infestation
2:nd Top bar: Bees, found pupae in between the frames

Farmer 17; 23/4
1:st Langstroth: Bees, no bee wax moth
2:nd Langstroth: Bees, large infestation
3:rd Langstroth: No bees, webbing found
4:th Langstroth: No bees, large infestation of bee wax moth and ants, a lot of bee wax moth was in between the lid and the frames
5:th Langstroth: Bees, large infestation of bee wax moth
6:th Langstroth: No bees, spiders
7:th Langstroth: No bees, spiders
8:th Langstroth: No bees, spiders
9:th Langstroth: No bees, bee wax moth in between the lid and frames, ants
10:th Langstroth: Bees, traces of bee wax moth by lid and bottom

Farmer 18; 24/4:
1:st Top bar: No bees, cocoons from bee wax moth
2:nd Top bar: Bees, spiders, reptile eggs, pupae
3:rd Top bar: No bees, grown moths, many pupae, cocoons, dead bees covering the bottom of the hive
4:th Top bar: No bees, cocoons and pupae

Farmer 19; 30/4
1:st Langstroth: Bees, no bee wax moth
2:nd Langstroth: Bees, possible wasp nest
3:rd Langstroth: Bees, found traces of bee wax moth on the frames that came from the catcher box
4:th Langstroth: Bees, no bee wax moth

5:th Langstroth: Bees, no bee wax moth, noticed one ant

6:th Langstroth: Bees, cocoons, larvae and pupae, possible full-grown moth

7:th Langstroth (Catcher box): Bees, traces of bee wax moth

8:th Langstroth: Bees, no bee wax moth

Farmer 20; 30/4

1:st Langstroth: No bees, no bee wax moth, never colonized

2:nd Langstroth: Bees, large infestation of bee wax moth

3:rd Langstroth: Bees, no bee wax moth

4:th Langstroth: Bees, no bee wax moth

5:th Langstroth: Bees, no bee wax moth

6:th Langstroth: Bees, larvae found

7:th Langstroth: Bees, no bee wax moth