International Journal of Advanced Research in Biological Sciences
ISSN: 2348-8069
www.ijarbs.com
DOI: 10.22192/ijarbs Coden: IJARQG (USA) Volume 8, Issue 11 -2021

Research Article

DOI: http://dx.doi.org/10.22192/ijarbs.2021.08.11.009

Study on the prevalence and associated risk factor of large hive beetle on honey bee in and around Holeta

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Abstract

A cross-sectional study was conducted with the purpose of determining the current prevalence of large hive beetle of honey bee infestation and to identifies the associated risk factor in and around Holeta, which is in Oromiya regional state c. For this purpose a total of 100 farmers were interviewed with an average hive of 400 in and around Holeta. In this study result showed that overall prevalence of LHB infestation is 4%.the highest prevalence. However this prevalence differs within types of hive 58% of the hive infested by large hive beetle is tradition 26% transition and 16% were modern. According to the survey done in and around Holeta comb destruction is the most common effect of LHB beetles as about 41% of respondents state it as the prior effect of these beetles on honey bees followed by the brood destruction. The majority of LHB beetle infestation was reported to be occurred during a period from September to November following lasting of the summer and reduction of rainfall. That is during this autumn period as much as 53% of infestation occurs. In conclusion the study revealed that medium prevalence of large hive beetle infestation in the study area and this result show large hive beetle became considerable pest in our country, so it need to develop further research strategy in promoting modern beekeeping.

Keywords: Large hive beetle, Holeta, Prevalence, Risk factor

Introduction

Bee keeping is an important component of agriculture and rural developmentprogram in many countries (FAO, 1990); useful small scale efforts have been made to encourage beekeeping intervention throughout the world (Brabear, 2003). Beekeeping plays a role in providing nutritional, economic and ecological security. The business almost requires no land, capital and does not take much lands and of the farmers' time. Young and old people can be involved without gender restriction. It does not compete for other component of farming system for resource (FAO, 1990). The direct contribution of beekeeping include the value of outputs produced including honey, bee wax, queen and bee colonies, and other product such as pollen, royal jelly, bee venom and propolis in cosmetics and medicine (ARSD, 2000 and Gezahegn, 2001).

Ethiopia has the largest bee population in Africa with over 10 million bees colony, out of these 4.6 million are confined in the hives and the remaining exists in the forest. Currently bee colony in Ethiopia is grouped in to five different honeybee populations occupying different ecological area (Spiegel,M, 1988).

Like any animal honey bee are exposing to disease like parasite, pests, bacteria and predators (Desalegn and Amssalu 2006) many organism make their living home in the hive honey bees some are parasites that directly affect the bees while, other utilize the bee hive as a shelter purpose without producing significant effects on the bees life or activity. But mostly they attack by honey pests. The effect of these pests lose bee life damage and feed the products (Thomas, 1989).There are many insects that are making their feed source by collecting plant pollen other than honey bees among them large pollen competent beetle one to be mentioned (Purcell and Boucias, 2007)

Beetleis any of an order (Coleoptera) of insects having four wings of which the outer pair are modified into stiff elytra that protect the inner pair when at rest. Pollen competent beetle collects pollen for feeding itself and to feed the young. It is black in color with red to yellow patch on its thorax. This beetle lives in the wood hole, under the house, trees, and buildingand even in the hive bees. Hence, it interact bees not only by computing the pollen but also by producing mechanical damage on their hive. By collecting pollen it make the so called pollen honey on which children consume by inserting stick through its hole and withdrawing its honey (Skinner, 2002).

The second one is the large hive beetle oplostomus fuliginous**,** this beetle enter the hive for the purpose of eating the honey. This beetle is called the large and black beetle and it causes much damage to combs and comb contents, but it doesn't breed in the hive its highly more than 20mm long the bee couldn't pierce its strong integument to sting it and its integument is very hard (Sanford, 2003).

This large oplostomus beetle is distributed mostly in low to mid altitude area of the country where maize and sorghum crops are farming is practiced at large. The beetles has shown high preference for sweet food items, but some literature indicate as it eats brood and pollen too it also observed that it damage the combs in the process of taking honey, pollen too. It is also observed that it damage the combs in the process of taking honey, pollen and brood. It enters the bee hive and mostly fails to get out so the bee couldn't able sting it found embalmed in propolis probably after it has passed due to aging (Desalegn and Amssalu, 2006). Therefore the objectives of this study were [1] To determine the prevalence of large hive beetle [2] To assess assosciated risk factors for the occurrence of large hive beetle in and around Holeta

Materials and Methods

Study area

The study was conducted at Holeta from october 2013 to april 2014 G.Cin and around Holeta.which is located west shoa of oromia region around addis abeba,stuated at latitude of 9^0 3'N and longitude of 38^0 30'E. the altitude of the area is 2400mm (annex.2) above sea level. The area receive an annual rainfall of 1060mm of which 70% of rain (long rain) fall from june to september,and 30%(short rain) fall from february to aprill the monthly mean minimum and maximum temprature are 50.4%(range 39%-58%) and 43.4mm. the soil type of the area is vertisoil and nitrosoil.

The agricultural scenario is dominated by mixed crop livestock farming system in which crop production system dominates.there are about 137019 cattle,75,850 sheep,13,237goats,6349 horses,135 mule,11,767 dokeys and 94,804 poultry.the apiculure is modern and tradational production system. However,allmost all the farmer are not beneficiary from honey production eventhough there are farmer successefull in honey production.

Study population

The study animal will comprises more than 400 honey bee colony and beetles found in and around Holeta and Bakoapiaries under Holeta honey bee research center the honey bee species that found in the study area are all *A. M bandansi*(amssalu,Dr).This apiary uses modern type of hive i.e. Zander and Langstroth

Study design

on the study area a crossectional type of study design is conducted from october to april to determine the prevalence of large hive beetle purposily examined all the honey bee colony found in the apiary and within the farmer in and aroud Holeta by distributing a questionaire to determine the prevalence of these large beetle.LHB also captured from the sarroundig and their speies and colony types will be studied when hive is opened containing beetle thyey can bee seen running across the comb to find hiding place adults were detecting under top cover or on the bottom board Cabanillas and Elzen (2006). Then the adult beetle describes morphologically small about one third of the size of bee redish brown or black in color and covered in fine hair where are the larvae are small and elongated cream colored and have three

sests of leg just behind the head and pupae are whitish brown (Delaware *et al.,2000)* if the infestation is heavy ,both adult and masses of larvae will seeing on the comb and bottom board dammaged comb classified into moderate and sever based on the no of combs dammaged by beetle if the number of dammaged combs is one to three it can be say moderate However , if the number of dammaged comb more than four it can be say sever study area can classified into low to high land(annex.2).

Sampling method and sample size determination

The sample size required for the study wiil determined based on sample size determination in random sampling for infinite population using expected prevalence of beetle and 5 percent desired absolute precision according to thrusfield as follows

$$n = \frac{1.96^2 p_{exp}(1-p_{exp})}{d^2}$$

where n= required sample size
pexp=expected prevalence
d= desired absolute precision

By using 50 percent expected prevalence with 95 percent confidence interval at 5 percent absolute precision (Thrusfield, 2005). the nomber of hive required to estimate the prevalence bee louse was calculated to be 384 and 385 will be collected.the site of collection of sample will focus at addis alem ,goliliben, Holeta,jaldu, muger,sebeta and suba.

Questionnaire survey

A structural questinnaire was administered in individual involving a total of 200 respondant farmer. The major emphasis was to asses prevalence and associated risk factor of large hive beetle on honey bee and honey bee production in and around Holeta town.by this questionnare I were capable identified the season of infestaton , economical impact and the effect of LHB on honey and honey bee production.

Data analysis

Data obtained in the study will stored in Microsoft (excel spreadsheet program) and subjected to SPSS version 15.0 (Spiegel, 1988) software for chi-square x^2 statistical analysis for possible significant different between prevalence among apiary (ecology) status of bees and other risk factor.in all cases statistical significance was set at $p<0.05$ for questionnaire survey descriptive statistics was applied and analyzed using percentage. Prevalence of LHB was expressed as percentage by dividing total number of respondents to the total number of LHB positive respondents individual.

Results

A total of 100 honey bee owner keeps more than 400 colonies were interviewed for the presence of large hive beetle. The prevalence of large hive beetle in the area is 4%. The highest prevalence is 4% and the lowest prevalence is 1%. There is association between prevalence of beetle with the type of hive ($p<0.05$, x^2 =16.498).

Types of hives and LHB beetle infestation

The majority of the respondents interviewed claimed that infestation of LHB beetle is greater on traditional types of hives followed by transitional types of hives whereas the modern types of hives were found less prone to LHB infestation (table 1).

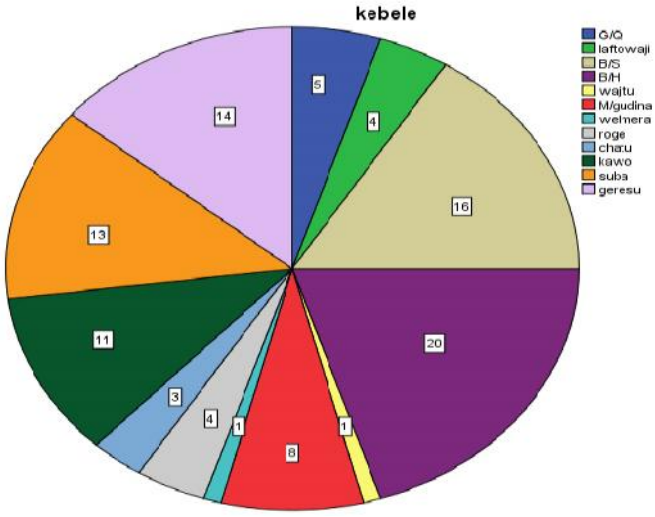
Table1. Degree of LHB infestation on different hive types

Type of hive	Frequency of infested	Per cent
Traditional	58	58.0
Transitional	26	26.0
Modern	16	16.0

Distribution of LHB beetles within the study area

The survey indicated that a high level of infestation (20%) was found in burka harbu followed by wajitu(16%) whereas the degree of infestation is the least and equal in birbirsasiba androge (1%).

Fig 3: The distribution of large hive beetle prevalence within the study area



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Season of LHB beetle infestation

The majority of LHB beetle infestation was reported to be occurred during a period from September to November following lasting of the summer and reduction of rainfall. That is during this autumn period as much as 53% of infestation occurs. During winter (8%) and spring (6%) periods low levels of infestations are reported to be encounter (table 1).

Table 2. Seasonal variation of LHB beetle infestation

Month	Frequency	Percent
september-november	53	53.0
december-february	8	8.0
march-may	6	6.0
june-august	33	33.0

Financial impacts of LHB beetle

According to the survey comb destruction is the most common effect of LHB beetles as about 41% of respondents state it as the prior effect of these beetles on honey bees followed by the brood destruction (table 3).

‘Table 3. The effect of LHB beetles on honey and honey bee

Effect of LHB	Frequency	Percent
comb destruction	41	41.0
Absconding	6	6.0
Death of honey bees	14	14.0
Consumption of honey	9	9.0
brood destruction	20	20.0
infected not yielded	3	3.0
Infected yielded	1	1.0

Table 4: Prevalence of LHB in bees categorized based on the different risk factor

Risk factor	No of farmer interviewed	Positive (prevalence)	P value
Hive type			
modern	100	26(100)	
Transitional	100	16(100)	0.001
tradational	100	58(100)	
Types of management			
backyard	100	41	0.019
Under the eaves of the house	100	59	
Colony status			
Weak	100	80	
Medium	100	13	0.956
strong	100	7	

Figure 1: Large hive beetle infestation of the honey bee.

- **Bee pests – Large hive beetles** *Oplostomus species* (Coleoptera: *Scarabaeidae: Cetoninae*)
- (Oval in shape, with 8 legs – 4 pairs, 1.1 -1.8 cm long, 0.7 -1.2 cm wide)
- Native to Africa (*Apiscerana*)
- Restricted to Africa
- Damage brood, pollen and honey by adults

Discussion

In this cross sectional study of large hive beetle, overall prevalence of 4% was observed. This level of prevalence is somewhat less than when compared with the work of Fombong(2003) who reported large hive beetle with prevalence of 9% and 10% in comb and brood respectively in Kenya, of large hive beetles *Oplostomus species*(*Coleoptera: Scarabaeidae: Cetoninae*). It was also lower than the work of Donaldson(1989) who reported large hive beetle with prevalence of 12%in South Africa. The difference in prevalence of large hive beetle in current and other previous studies might be associated with the difference method followed in the examination of large hive beetle or and due to difference in the occurrence of large hive beetle in the different study areas may related to environmental factor affecting occurrence of large hive beetle. LHB causes serious damage when it occurs unlike small hive beetle. The overall prevalence of large hive beetle differs among types of hive. The highest prevalence of large hive beetle observed in traditional types of hives 58% might associate with the management under taken (like temperature, moisture, space etc.) and hygiene between the traditional and between the other two types of hive which might suit for entrance and to stay in. maintaining high level of hygiene in all beekeeping practices and good husbandry contribute greatly to overall colony behavior and health, thereby avoiding conditions in which disease can flourish. Eggs may be deposited in various places in a hives in a hive in empty cells, on brood cell capping or on wax dirt on the floor of the colony (EAMBA, 2009).

According to the survey done in and around Holeta comb destruction is the most common effect of LHB beetles as about 41% of respondents state it as the prior effect of these beetles on honey bees followed by the brood destruction. But as Donaldson (1989) says LHB are generally considered more serious and destructive pests when they occur. Adult LHB occur more frequently on frames rather than bottom boards, where they consume uncapped and capped brood as well as pollen and honey stores. Since they are about as big as a honey bee, it's probably much more difficult for bees to deter them off of the frames but bees will attack by biting at them. Ms. Turner said bees will also cover these beetles in propolis occasionally. Probably most importantly, the presence of LHB may cause honey bee colonies to abscond (abandon) from the hive. They may reach peak numbers of 6 to 20 per frame for *O. fuligineus* and *O. haroldi*, respectively. Unlike SHB, larvae of both LHB species do not seem to occur in the honey bee colony and typically live and pupate in decomposing plant matter or dung of cows or donkeys. Neither species of LHB have been documented outside of Africa (Donaldson, 1989).

The majority of LHB beetle infestation was reported to be occurred during a period from September to November following lasting of the summer and reduction of rainfall. That is during this autumn period as much as 53% of infestation occurs. During winter (8%) and spring (6%) period's low levels of infestations are reported to be encounter. But(Wojcik et al., 1978). Proved that the prevalence of large hive beetle(*Coleoptera: Scarabaeidae: Cetoninae*)in Florida were determined February and october, but the main flight period extended from May through September. The peak flight period of (*Coleoptera: Scarabaeidae: Cetoninae* occurred in June and July with almost continuous flights from May until October, and additional flights occurred in warm periods during the winter. No correlation was found between flight periods, air or soil temperatures, or rainfall. Also, no correlation was apparent between beetle flights (Wojcik *et al*., 1998).

.Large hive beetles have been documented pests of managed bee hives in South Africa since the early 1900's, though they have likely associated with honey bees on the continent for much longer. Both species of LHB currently are documented only from Africa including Botswana, Kenya, Namibia, Nigeria, Senegal, South Africa, Tanzania and Zimbabwe. There is evidence that *O. haroldi* is more frequent in coastal areas vs. inland areas so local environmental conditions may affect their prevalence. Moreover, very important basic features like the number of beetle offspring per colony in the US and Africa and levels of infestation of African and European host populations have not been rigorously quantified The number of beetle generations per year in temperate regions is likely to be smaller than in South Africa (five generations; Lundie, 1940) because temperature has an effect on beetle developmental time(Neumann et al., 200). Thus, pest severity may be less too due to smaller beetle population sizes. However, this has not been investigated yet. Very dry conditions may also limit beetle reproduction in its new ranges (Njau *et al*., 2009). In order to evaluate exact prevalence and associated risk factor further study should be conducted.

Conclusion and Recommendations

The present study indicates infestation of large hive beetle medium in Holeta and in its surrounding. The study also revealed that types of management and system and types of hive are found as a risk factor as to large hive beetle infestation in honey bee colonies, but colony types and agro climate type have no significance difference in large hive beetle infestation. Large hive beetle in beekeeping industry have great economic importance. When the colony infested with large hive beetle there is reduction in yield 4-5kg of honey this is estimated 400-500 Ethiopian birr per hive,this result showsthat large hive beetle become considerable pest in our country and this level of infestation might causes significant effect on honey production. Based on the conclusive remarks, the following points are forwarded:

- Reducing colony stress conditions and maintaining strong productive colonies especially in areas where beetles are problematic.
- Any practice which helps to maintain wellpopulated honey bee colonies that reduces the comb-to-bee ratio and excludesbeetles from the brood area.
- Good sanitation is recommended around honey houses to prevent large hive beetle damage to stored comb.
- Beekeepers should remove wax capping's, other wax materials and equipment containing bee pollen. Pollen traps should not be left on colonies over extended periods of time because the unprotected pollen will provide the beetles with needed protein for regeneration.
- Selecting apiary sites that have drier soil conditions is recommended for large hive beetle control; open, sunny sites are recommended.
- In commercial agricultural settings where fields are often irrigated, beekeepers should place bee colonies several meters from irrigated areas to minimize beetle regeneration because moist soil conditions promote regeneration.

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DOI:10.22192/ijarbs.2021.08.11.009	

How to cite this article:
Mammo Belayneh, Amssalu Bezabeh, Jirata Shiferaw and Yacob Hailu Tolossa. (2021). Study on the prevalence and associated risk factor of large hive beetle on honey bee in and around Holeta. Int. J. Adv. Res. Biol. Sci. 8(11): 80-87.
DOI: http://dx.doi.org/10.22192/ijarbs.2021.08.11.009