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Honey bee production common disease and pests in Ethiopia – A review

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Abstract

This paper is mainly focused on the assessment of honey production system, diseases and pests in Ethiopia. Ethiopia is one of the countries in the continent which possess huge honey production potential. Beekeeping in Ethiopia is a long-standing agricultural practice. It has been exercised as a sideline activity by many of the rural farming communities for its honey and beeswax production that contributes to income generation. Beekeeping is a major integral component in agricultural economy of developing countries. The most important and available insect in the world today is the honeybee. There are several species of honeybees existing, but Apismellifera is country famous. It is a wonderful and popular bee type for There are four different types of beekeeping practices in Ethiopia namely, traditional forest, traditional backyard, transitional and improved or modern beekeeping. Beekeeping is a very long-standing practice in the farming communities in different regions of Ethiopia and it plays a significant role as source of additional cash income and nutrition for many subsistence farmers. The major constraints that affect beekeeping sub-sector in Ethiopia are; lack of beekeeping knowledge, shortage of skills man power, shortage of bee equipments, pests and predators, pesticide threat, poor infrastructure development, shortage of bee forage and lack of research extension Low and productivity and quality of bee products are the major economic impacts.

Keywords: Honeybee production, Honeybee diseases, Honeybee pests, Ethiopia

1. Introduction

1.1. Background

Ethiopia is the honey producer in Africa and 10th largest honey producer all over the world. In addition, there is a considerable amount of bee wax production having the highest number of bee colony. The total honey production in the country is estimated to be more than 13000 metric tons per year (CSA, 1995). However, the total honey produced in the country only small amounts is marketed (EEPD, 2006).

Ethiopia is known for its tremendous variation of agro-climatic conditions and biodiversity which favored the existence of diversified honeybee flora and huge number of honeybee colonies (Adgaba, 2007). The diversified agro climatic conditions of the country create environmental conditions conducive for the growth of over 7000 species of flowering plants of which most are bee plants (Nuru, 2002). It has the largest bee population in Africa with over 10 million bee colonies, out of which about 5 to 7.5 million are estimated to be hived while the remaining exist in the wild (MoARD, 2007; CSA, 2009).

Apiculture is a promising off-farm enterprise, which directly and indirectly contributes to smallholder's income in particular and nation's economy in general. It has significant role in generating and diversifying the income of subsistence Ethiopian smallholder farmers mainly the small land holders and landless (Gezahegn, 2001).

Honey bees play a vital role in the environment by pollinating both wild flowers and many agricultural crops as they forage for nectar and pollen, in addition to producing honey and beeswax. The essential and valuable activities of bees depend upon beekeepers maintaining a healthy population of honey bees, because like other insects and livestock, honey bees are subject to many diseases and pests. The apiculture industry plays an important role in generating employment and in increasing family income in the rural areas of the world. Many developing countries are trying to improve the quality of their honey products but they frequently encounter the main obstacle in apiculture; control of diseases and pests of honey bees. The principal resources base for beekeeping has become seriously advantaged in the course of time. The potential of the Ethiopia land scope for honey production does now, undoubtedly, only for small fraction of its former wealth. Moreover, the destruction of the remaining resource base can be observed going on at steadily accelerating pace (Girma, 1998). Since the late 1970's attempts have been made to improve the productivity of beekeeping of the country through introduction of improved beekeeping technologies (Edessa, 2005).

Recent investigation indicated that the number of honeybee colonies in the country has been declining (Gezahegne, 2001) and consequently the honey and honey bee wax production as well as export earnings fall down because of honey bee disease and enemies (Tesfaye, 2007).

Different disease and enemies found in Ethiopia have significant influences on honey production capacity of bees. From those disease like Adult bee diseases (Nosema, Amoeba, Chalk brood and poisoning plants) and from enemies like Ants, Waxmoth, Birds, Spider, Termite etc) are found (Morse and Flutten, 2005).

However, the success of apicultural activity depends on the biotic and environmental factors proffered by the ecosystem. Honeybee pests have been identified as one of the major biotic factors standing in way of successful beekeeping practice (Oyerinde and Ande, 2009).

1.2. General objective

To Review the common honey bee diseases and pests in Ethiopia.

1.2.1. Specific objective

To review honey bee production system.

To assess the common honey bee diseases and pests in Ethiopia.

2. Literature Review

2.1. Honey bee production systems in Ethiopia

It has significant role in generating and diversifying the income of subsistence Ethiopian smallholder farmers mainly the small land holders and landless (Gezahegne T, 2001). Ethiopia is known for its tremendous variation of agro-climatic conditions and biodiversity which favored the existence of diversified honeybee flora and huge number of honeybee colonies (Adgaba N, 2007). Currently Ethiopia is listed as a third country to export honey by European commission. Ethiopia is blessed with adequate water resources and various honeybee floras, which create fertile ground for the development of beekeeping. Honey hunting and beekeeping have been practiced in the country for the exploitation of honey. In places where wild colonies of bees living in hollow trees and caves are found, honey hunting is still a common practice in Ethiopia. According to Holeta bee research center (2004) there are four different types of beekeeping practices in Ethiopia namely, traditional forest, traditional backyard, transitional and improved or modern beekeeping.

2.1.1. Traditional Forest Beekeeping

In Ethiopia, traditional beekeeping is the oldest and the richest practice, which has been carried out by the people for thousands of years. Several million Honeybee colonies are managed with the same old traditional beekeeping methods in almost all parts of the country (Fichtl R *et al*., 1994). Traditional beekeeping is of two types: forest beekeeping and backyard beekeeping. In some places, especially in the western and southern parts of the country, forest

beekeeping by hanging a number of traditional hives on trees is widely practiced. In other most parts of the country backyard beekeeping with relatively better management is common (Nuru, 2002).

2.1.2. Traditional Back yard Beekeeping

It is undertaken in safeguarded area for honeybees mostly at homestead. The advantages of such practices are: construction is very simple, it does not require improved beekeeping equipment; it does not also require skilled manpower; whereas its disadvantages are inconvenience to undertake internal inspection and feeding, in some places the size is too small and causes swarming, it has no possibilities of supering, there is no partition to differentiate brood chamber and honey chamber (Hackett, 2004).

2.1.3. Transitional System of Beekeeping

It is a type of beekeeping intermediate between traditional and modern beekeeping methods. Generally, top-bar hive is a single story long box with slopping sidewalls inward toward the bottom (forming an angle of 115 of with the floor) and covered with bars of fixed width, 32 mm for east African honeybees (Adjareand Nicola, 2002). IBRA suggested that for technical and economic reasons, most African countries are not yet in the International Bee Research Association (1997) position to use movable-frame hives, and for them top-bar hive represents a satisfactory compromise.

2.1.4. Modern (improved) System of Beekeeping

Modern beekeeping methods aim to obtain the maximum honey crop, season after season, without harming bees (Nicola, 2002). Movable frame beehives allow common bee management practices such as migratory beekeeping, supers adding or reducing, regular inspection, quality honey harvest, swarm control, feeding during dearth periods, stimulating early colony growth, and pest and disease control. These are valuable assets that enhance honey production both in quantity and quality. Moveable frame beehive beekeeping was introduced to the country in 1978, through the Ethiopian Rural Development Extension program. Since then, thousands of box hives, along with the necessary accessories, were distributed throughout the country (MoARD, 2007). Although frame beehives were introduced to Ethiopia more than forty years ago and are known to have advantages in the production of honey, their adoption rate is very low (only about 2.7%), mainly attributing to lack or unavailability and expense of accompanying accessory equipments (mainly casting mold and honey extractor), lack of appropriate training, lack of assisting experts ortechnicians, etc. However, lately some regional states have paid significant attention to the demand the recent distribution status of frame beehives is increasing (Belets Gebremicheal and Berhanu Gebremedhin, 2014).

2.2. Economic Importance of Honey bee in Ethiopia

2.2.1. Honey production

Honey, the natural product of honeybee is an excellent energy source because it contains simple sugars that are ready for assimilation immediately on reaching the intestine. Currently Ethiopia is listed as a third country to export honey by European commission. To export to European Union a number of requirements must be met the primary and the secondary requirements. The primary requirements listed were: viable offer to the market, listed in the EU inventory of third countries eligible to export honey to EU and clean honey. The secondary requirements s comprised of: Business relation with the buyer, a traceability system for quality control and Hazard analysis and critical control points concept (Amsalu Belay, 2001).

2.2.2. Beeswax production

In several regions of the country, beeswax collection is not significant and the beeswax produced by bees, which could be harvested by beekeepers, is wasted. The wax is mostly left or thrown away because beekeepers do not bother to collect it since it is of little practical value for beekeepers (Admasu ,1994) and the people do not know the local beeswax is generating attractive money. Nevertheless, the annual beeswax production of the country is estimated at about 3,658 tones. This makes Ethiopia the fourth largest beeswax producing country in the world after China, Mexico and Turkey. Beeswax supports the national Economy through foreign exchange earnings. Presently, beeswax is one of the major exportable agricultural products. Ethiopia is the third largest beeswax exporter in Africa and the annual average value of beeswax is estimated at about 125 million Birr Like honey, beeswax is also a multipurpose natural bee product, which is used in the manufacture of more than 300 commodities. Honey and beeswax also play a big role in the cultural and religious life of the people of the country.

2.2.3. Crop pollination

Bees are essential parts of the agricultural system. Although the value of honeybees in crop pollination is under estimated, it has a significant role in increasing national food production and regeneration of plant species. Honeybees are the prime pollinating agents in the world. Their service in pollination is estimated to be worth over 15 times the value of all hive products together, although it is much more difficult to quantify their benefit Hackett (Roubik.1989).Honeybee is also believed to play a significant role in the economy of Ethiopia through pollination services. Pollination is one of the most important factors that affect seed production in agricultural crops. In Ethiopia, an experiment was conducted to determine the effect of pollination on Niger (Guizotia Abyssinia) and the result showed that honeybees increased the seed yield of Niger by about 43% (Admasu and Nuru, 2002) and Onion (Allume Cepa) by two fold (Admasu *et a*., 2008).

2.2.4. Source of Immediate Cash Income

Source of immediate cash income: Beekeeping is believed to play a significant role and one of the possible options to the smallholder farmers in order to sustain their livelihood. In Tigray, the price of one established bee colony in a traditional hive ranged from 300-800 Birr Nuru AM (2002) which was worth enough to buy about 3-5 sheep and goats or a heifer, On the other hand, some beekeepers in Amhara region that are involved in beekeeping technology packages, were reported to earn up to 3000 birr annually from sale of honey Bureau of Agriculture, Amhara National Regional State (2003a) making up for the large portion of their annual income for the rural communities.

2.3. Constraints of Honey bee Production in Ethiopia

Ethiopia has enormous untapped potential for promoting beekeeping; both for local use and for export purpose. However, like any other livestock sector, this sub sector has been ceased by complicated constraints. The prevailing production constraints in the beekeeping sub sector of the country would vary depending on the agro ecology of the areas where the activities is carried out (Edessa, 2005). According to different researchers like HBRC Holeta Bee Research Center Ayalew, 2001 and Edessa 2005 among the major constraints in the beekeeping sub sector are related with honeybee diseases and pests:

2.3.1. Pests and predators

Ethiopia, as one of the sub-tropical countries, the land is not only favorable to bees, but also for different kinds of honey bee pests and predators that are interacting with the life of honey bees (Desalegn, 2001). Pests and predators cause a serious devastating damage on honeybee colonies with in short period of time and even overnight. The major bee pests and predators in Ethiopia are wax moth, spider, ants, bee-eater birds, honey badger and beetles are the most serious problems to beekeeping development. Those pasts and predators are the most harmful in order to decreasing importance of beekeeping in Ethiopia.

2.3.2. Diseases

Bee colonies can be attacked by several diseases. Those diseases have causative agent like bacteria, protozoa, fungus, and virus. Generally, from those diseases Nosema, Amoeba, poisoning plants and chalk brood are found in Ethiopia (HBRC, 2005).

2.4. Major Honey Bee Diseases in Ethiopia

2.4.1. Chalk Brood Diseases

The brood of the honeybee is susceptible to fungal infection by a wide variety of pathogens, including *Ascosphaera apis*, *Paenibacillus larvae* and *Melissococcus plutonius*, the causative agents of some of the most important diseases affecting bees (Shimanuki and David, 2000). The fungus *Ascosphaera apis* is responsible for chalk brood disease, in which larvae are infected by ingesting fungal spores that then germinate in the digestive tract (Garrido-Bailon *et al*., 2013). *Ascosphaera apis* is responsible for larg combination with other pathogens such as *Nosema apis* (Aydi *et al*., 2006), *Nosema ceranae* and *Varroa destructor* (Hedtke *et al*., 2011).

Chalk brood as its name implies, it affects honey bee brood. Infection by spores of the fungus is usually observed in larvae that is three to four days old. The spores are absorbed either via food or the body surface. Initially, the dead larvae swell to the size of the cell and are cover with the whitish mycelia of the fungus. Subsequently, the dead larvae mummify, harden, shrink and appear chalklike. The color of the dead larvae varies with the stage of growth of the mycelia: first white, then grey and finally, when the fruiting bodies are formed, black. When infestation is heavy, much of the sealed brood dies and dries out

within their cells. When such combs are shaken the mummified larvae make a rattling sound (FAO, 2006, Hornitzky, 2009). The *Ascosphaera apis* sticky spores are commonly present on adult bees and all surfaces within occupied hives, suggesting its speedy distribution from place to place& from apiaries to apiary. The disease develops only if the brood is physiologically stressed in some way like chilling and it is documented that diseases of fungal origin are more prevalent in dump and cool conditions (Desalegn Begna, 2006).

In Asia, chalk brood is rarely considered to be a serious honey bee disease; although in Japan the disease has been reported to cause problems to beekeepers. In temperate America and Europe, however, cases have occurred in which chalk brood has caused serious damage to beekeeping (FAO, 2006).

2.4.2. Nosematosis

Nosema honeybee disease is the most wide spread of adult bee disease and occurs worldwide wherever bee colonies exists (Matheson, 1993; Ellis and Munn, 2005; OIE, 2008a). It is caused by the spore of *microspordian* parasite *Nosema apis* that infect the epithelial cell of adult honeybee *ventriculus* (Shimanuki and David, 2000; Coffey, 2007; FAO, 2012). Spores germinate in the mid gut and infect the cells of the mid gut epithelium where they vigorously proliferate to produce new environmental spores which are released into the gut lumen (Friesand Camazine, 2001). *Nosema apis* is an important pathogenic agent of hives which is influenced by climatic conditions and management factors, deeply causing losses which are undetectable to beekeepers (Bermejo and Fernandez, 1997). The infection is transmitted by food, water, and faeces (Sokh *et al*., 2007). Old comb has been associated with increased incidence of Nosema (Fries, 1988).

Poor management and external factors such as coldness, bad diet, and hive humidity can increase sensitivity of bees to nosema (Razmarajii and Karimi, 2010). Adult bees become infected by ingesting Nosema spores which are present in faeces but can also be found in12pollen (Higes *et al*., 2008). It has been regarded as a serious obstacle for profitable beekeeping in temperate climates (Fries, 1993).

2.4.3. Amoeba

Amoeba caused by a single cell parasite called *Malpighamoeba mellificae*. The parasite affects the malpitubules of the adult honey bee. The disease shortens the life cycle of bees. The disease is transmitted by feeding on contaminate food of honey bees. Diagnosis can be made only by removing and microscope examining the tubules for the presence of amoeba cysts. The disease is common in Ethiopia including Addis Ababa with high prevalence rate (Haylegebriel, 2014).

2.4.4. Poisoning plants

Number plant species are poisonous pest to honey bees. A recently emerged red color flower locally called Ababbo Diima (Abiyu, 2011) was reported to kill worker bees during their flowering stages. Plant species belongs to families of *Ranuculaceae, Solanaceae, Acanthacae, Euphorbiaceae and Phytolacaceae* were reported to poisons to bees (Nuru, 2002). Similarly the nectar or pollen of poisonous plants such as *Cassia siamea, Crotonm acrostachyus, Aloe brahana, Zizyphus mucronata, Phytolacca dodecandra* and Susbania species was reported to be toxic to the bees themselves and those in which the honey produced from their nectar are toxic to humans (E. Kerealem, *et al.*, 2005). Similarly honey from *Daturaarborea*is reported irritates human beings when eating and *Euphorbia cottinifolia* is known to kill honeybees (G. Awraris *et al*., 2012).

2.5. Common honeybee pests in Ethiopia

2.5.1. Honeybees Pests

Honeybee colonies are subject to a number of natural stress inducers and enemies including weather, natural disasters, pests, predators, parasites and diseases (Lawal and Banjo, 2008). Honeybee pests comprise nowadays a major concern for local beekeepers (Al-Ghzawi *et al*., 2009).

The presence of a numerous of pests on the colonies confirmed that pest infestation is a problem in beekeeping in the tropics. The pests are responsible for the destruction of the colony and decline in its establishment. Pests and predators cause devastating damage on honeybee colonies and at most time cause swarming, abscond or colony collapse. The honeybee pests interact with the life of honeybees by

synchronizing their activity with the beekeeping cycle in Nigeria (Oyerinde and Ande, 2009).

Ethiopia is one of the sub-tropical countries; the land is not only favorable to bees, but also for different kinds of honeybee pests and predators that were interfering with the life of honeybees (Desalegn Begna, 2001).

2.5.2. Small hive Beetle (Aethinatumida)

Originally, this beetle *(Aethina tumida),* was only found in Africa, south of the Sahara. Ellis (2004) reported that the African countries reported to have the beetle include: South Africa, Botswana, Ethiopia, Kenya, Namibia, Eritrea, Angola, Central African Republic, Senegal,16 Ghana, Republic of Congo, Nigeria, Uganda, Zimbabwe, Guinea- Bissau, Congo Republic, Zambia and Tanzania. It first appeared in the southern United States of America in 1998 and has continued to spread north as far as Canada. Since 2002, this beetle has been found in parts of Australia (Hood, 2004; FAO, 2006,).

In Africa, the beetle's original range, only weak colonies or storage combs are affected. However, in America or Australia, colonies of ordinary strength can be affected. This might indicate the introduced European bee races are lack of defense behavioral mechanisms (FAO, 2006). A minor infestation is difficult to recognize because the beetles immediately hide in the dark (FAO, 2006; Coffey, 2007).

Economic damage from SHB occurs when the bee population is insufficient to protect the honeycombs from the scavenging beetle larvae. When large numbers of adult beetles defecate in the honey, they introduce yeasts, causing the honey to ferment and run out of the cells. Honey contaminated by small hive beetles can be rejected by bees, is entirely unfit for human consumption and should never be bottled or mixed with other honey for packing (Hood, 2004).

Beetles feed on honey, pollen and brood in bee colonies and have been implicated often in both colony mortality and increased absconding rates. The estimated losses to small hive beetles experienced by beekeepers in the USA in 1998 were US$3 million. Losses were in the form of colony destruction and damage to stored honey supers in honey houses. Some commercial beekeepers in the USA reported losing thousands of bee colonies and associated equipment to beetles (Ellis, 2004; Hood, 2004). In Ethiopia the small hive beetle was recognized as local honey bee parasite in different periods and locations of the country (Desalegn Begna and Amssalu Bezabeh, 2006; Amssalu Bezabeh *et al*., 2010).

2.5.3. Bee lice

Lice are known to infect honey bees in hive. Bee louse are wingless ectoparasite fly which causes significant damage in colony bees. Bee lice larvae feed on honey and pollen by tunneling under the cell capping (R. Morse, and R. Nowogrodzki, 1990). The adult lice feed on nectar directly from the mouth of honey bees: this reduces food availability of queen and reduce egg-lying are widely distributed in Africa, Asia, and North America and southern of Africa. In Ethiopian infestation of lice in honey bees was reported from the western region of Shewa, Oromia regional state with overall prevalence rate of 42% with highest prevalence rate 70.8% in Gemechis, 50% in Holeta and 17.1% in Jaldu (G. Gizachew *et. al*., 2007).

2.5.4. Ants (*Dorylus fulvus*)

Ants are highly social insects which attack the hive in mass, take and use different contents of the hive: dead or alive adult bees, the brood and honey. They are also nuisance for beekeepers and can bite them which are painful. Those colonies under Ant attack become aggressive and difficult to manage and sometimes the colony will be abscond (Deslegn, 2001).

Both the traditional and modern hive can be attacked by ants. Some of the most common species of antwhich attack bee colonies are the weaver ant (*Decophylla smaragdina),* the black ant *(Monomorium indicum*) and the fire ant (*solenopsis spp.*).The best way to control ants is to systematically search the ants' nests and when found destroy them by burning and generally avoid nesting sites of ants by eliminating brush, rotten wood and cutting thgrasses around apiaries (Shimanuk and David, 2000).

2.5.5. Wax Moth

Wax moth is one of the most important pests of the honeybee colony with worldwide distributions. It is more active and spread rapidly in warmer climates with rare exception in high elevations (Crane, 2000). The greater wax moth (*Galleria mellonella*) and lesser wax moth (*Achroia grisella*) are major pests of stored or unattended combs (Ellis *et al*., 2013).

The greater wax moth causes the heaviest losses to beekeepers throughout the world; however, the lesser wax moth is generally more common, and can also cause significant damage. The two species tend to coexist, and are frequently found in the same location (Shimanuki and David, 2000). It lives in long silken tunnels and after hatching; it feeds on honey, nectar and pollen. Larva makes tunnels in combs and extends it to the midrib of comb. Depending on availability of food, temperature, habitat of pests, several overlapping generations can be produced in a year (William 1997; Sanford, 2003; Rachna and Kaushik, 2004; FAO, 2006).

Wax moth causes significance damage in colony of honey bees in several countries such as: Algeria, Egypt, Kenya, Tanzania, Uganda, Sudan, Ghana, Nigeria and Senegal (Husein, 2001).

Wax moth is one of the most important pests of honeybee colony with worldwide distributions is also identified as one of the serious local honeybee pest in Ethiopia (Desalegn Begna, 2001).

2.6. Prevention and control

Beekeepers practice different prevention methods but are not totally efficient which requires developing suitable prevention methods. For honey badger they use mechanical barriers putting like thorny woods around the tree; fixing smooth iron sheet on the trunks of a tree where hives are hanged; hanging hives on ficus trees which has very smooth bark which is not suitable for honey badgers to climb on it and tying of thorny branches (G. Awraris *et al*., 2012).

Different types of pest and predators control methods are employed in different bee keeping areas of the countries. These numbers of traditional control methods are either used individually combination with other methods in all types of bee keeping practice and in all hive types. A number of preventive or control management practices to minimize the effect honey bee pests are practiced in the country. For example strengthening honey bee colonies via feeding, removing unoccupied suppers and combs, trapping adult wax moths were tested against wax moths and results in reduction of infestation level of wax moths by 82.3%and increasing honey bee. Three different ant protection methods such as inner tube, smooth iron sheet (B. Amssalu *et al*., 2012).

3. Conclusion and Recommendations

Ethiopia is one of the countries in the continent which possess huge honey production potential. Beekeeping is a major integral component in agricultural economy of developing countries. Apiculture is a promising off-farm enterprise, which directly and indirectly contributes to smallholder's income in particular and nation's economy in general. It has significant role in generating and diversifying the income of subsistence Ethiopian smallholder farmers mainly the small land holders and landless. In Ethiopia, traditional forest, traditional back yard, transitional and modern systems of types of honey production are common.

Direct contribution of beekeeping includes the value of the outputs produced such as honey, bee wax, queen and bee colonies, and other products such as pollen, royal jelly, bee venom, and propolis in cosmetics and medicine.

Among The major constraints that affect beekeeping sub-sector in Ethiopia are: diseases, pests and predators, pesticide threat, shortage of bee forage and lack of research extension from those the most common are diseases and parasites that make low quantity and quality product.

Generally, there are some control mechanisms where recommended to improving productivity of honey bee and their health such as;

- During introducing colony bee providing health stock of bee educated bee keepers the risk of buying infected colony.
- Good hive management techniques are reduced the effect of different honey bee disease and parasites like maintain a strong bee in each hive, inspects hive at least one month and move hive to disrupt the life cycle of honey bee parasites.
- Providing educational delivery training through extension services to beekeepers on detection of diseases in bee and how to manage the problem.

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