ZIBELINE INTERNATIONAL PUBLISHING

Sustainability in Food and Agriculture (SFNA)

DOI: http://doi.org/10.26480/sfna.02.2020.38.41

REVIEW ARTICLE

HONEYBEE PESTS AND DISEASES IN NEPAL: A REVIEW

Rakshya Aryal*, Ananta Dhakal

Faculty of Agriculture, Agriculture and Forestry University Rampur Chitwan Nepal.
Corresponding Author Email: rakoaryal123@gmail.com

ARTICLE DETAILS

Article History:

Received 26 April 2020
Accepted 27 May 2020
Available online 02 June 2020

ABSTRACT

Apiculture has been in practice since ancient times in Nepal and is one of the most potential countries for beekeeping. Despite having diverse bee species mostly, Apis mellifera occupies prominent position in beekeeping. Beekeeping in Nepal also faces the problem of several disease and pests that attack adults and brood bees. This condition lays a fundamental practice among all to identify the major disease and pest commonly occurring. This helps in applying the best possible control measures for profitable and prosperous beekeeping in Nepal.

KEYWORDS

Apiculture, Control, Diverse, Identify, Problem

1. INTRODUCTION

Bees are one of the insects in the world that can produce something that is beneficial to all of us. Apiculture is the scientific method of rearing honey bee. The Latin word *'Apis'* refers to bee. So, apiculture/beekeeping is the rearing and maintenance of honey bees for the purpose of honey, wax, bee venom propolis, royal jelly production (National Organic Standards Board, 2010). Since the ancient times beekeeping has been in practice in Nepal and is one of the major source of livelihood to many farmers in Tropical and Subtropical belts of Nepal (Aryal et al., 2015). In context of Nepal about 37% of the land of is filled with forest area with diverse flora and fauna. This situation imparts increasing potential to beekeeping in Nepal (Federation of Beekeeping Nepal, 2015). About 55,000 hives are owned by about 5,700 commercial beekeepers in Nepal (Beekeepers' Association, 2016). *Apis laboriosa, A. dorsata, A. cerana, A. florae* are native bee species among all, but *Apis mellifera* was introduced in 1994 and has occupied a prominent position on commercial bee keeping. Despite all above species diversity two of them are famous among beekeepers, i.e. *Apis cerana* and *Apis mellifera.*

However, Beekeeping in Nepal encounters many problems of disease and pests as that the Beekeepers worldwide are facing. Some of the diseases are so devastating while some can be controlled to some extent. Beekeepers need to recognize those pests and diseases so that the extent of damage can be known, and proven control measures can be applied. The broods are attacked by American foulbrood, European Foulbrood, Chalk brood, Stone brood, Sac brood disease while adults are attacked by Nosema disease and the predators like Mites, wax moths, ant's, birds, bear, lizard, frogs etc., attack the bees.

2. PESTS OF HONEY BEES

2.1 Wax moths

Wax Moths are considered as one of the destructive and devastating pest of honey bee worldwide (Kwadha et al., 2019). (*Achroia grisella*)Lesser and (*Galleria mellonella*) Greater wax moths are the two types of wax moths found (Marc, 2014). Both species feed on bees wax, mainly unprocessed wax, and even pollen of mainly already diseased colonies (Bee Aware, 2014). The greater wax moth is worldwide in distribution and its occurrences have been noted from the very early days of Aristotle (TNAU Agritech Portal, 2014). In Nepal it is seen causing severe damage in the plains regions such as Chitwan, Dang and lower altitudes but is rare in high altitudes. But it is more common and severe from July to October and November to December although it is most observed throughout the year. Combs of all the species of Apis are attacked. The caterpillars feed on the propolis, pollen and wax in the combs and live in silken tunnels made by them. When they penetrate the combs, the wax particles are displaced and fall into the hive. This is the first symptom of attack. At later stages black fecal materials are seen in the comb. Weaker bee colonies and colonies with cracks and that are not covered completely are damaged. Due to this some bees drift away from the colony (MG, 2019). *Achroia grisella* are abundant on higher altitudes (TNAU Agritech Portal, 2014).

2.1.1 Control

The insect can be controlled by careful and periodic examination of all the cracks and crevices of the hive and discarding of all wax debris. The hives that are extra and are not filled by the bees must be removed and stored after fumigation with ethylene bromide. In the storerooms the spare hives should be stored in tightly closed containers.

2.2 Ants

Ants are manageable and controllable predators of honey bees and are considered not that serious ones. Some ant species that attack honey bees are:

- Black ant *Camponotus compressus,*
- Red ant, *Dorylus labiams*
- Monomorium spp.

They mostly attack weak colonies for the honey, pollen and the brood. Strong colonies recover the ant's damage, but in weak colonies may completely be destroyed (TNAU Agritech Portal, 2014).

Quick Response Code	Access this article online	
	Website: www.sfna.org.my	**DOI:** 10.26480/sfna.02.2020.38.41

Cite The Article: Rakshya Aryal, Ananta Dhakal(2020).Honeybee Pests And Diseases In Nepal; A Review.
Sustainability In Food And Agriculture, 1(2): 38-41.

2.2.1 Control

By providing water bowls (ant traps) around the bases of the stand or oil bands over the stands, ants can be kept away. Methyl parathion or carbaryl or 0.1% chlorpyriphos solutions are the chemical control measures.

2.3 Wasps

The yellow-banded hornet, *Vespa cincta* F., is a large and invasive predatory pest. Due to its aggressive and effective predation of the European honey bees and wild bees, hornets have been seen as a significant problem for beekeepers. It is a social insect that constructs papery nests in hollow spaces. It captures bees on the hive entrance and kills them for feeding their young ones.

It captures bee in the field also. By reducing the width of the alighting board of the hive, the wasps can be prevented from sitting near the entrance (Bee Aware, 2014). As a result they have a direct impact on honey bee colonies. Hive health is affected so, adversely as the bees have to spend much time on defense to avoid attack of hornets and have limited time for foraging activities. This leads to very less pollen and honey collection and reserves making the colonies susceptible to attack.

2.3.1 Control

Wasp nests should be destroyed by burning them. They even can be controlled by reducing hive entrance.

2.4 Small Hive beetles

(*Athina tumida*) is a small hive beetle that is about one-third size of bee is the minor pest of honey bee. They lay eggs on the comb that hatch into small larvae. They consume pollen, comb and larvae in their larval stage. With the rapid development adults start feeding on eggs of the honey bee (Gulati and Kaushik, 2004).

2.4.1 Control

Cleanliness of hive and regular examination is one of the better options. Hive entrance size reduction also checks the entry of beetles in hives (Gulati and Kaushik, 2004).

2.5 Birds

The bird species that capture bees and devour them are:

- Dicrucus sp. King Crow and
- Merops spp. bee cavers

2.6 Tracheal Mites

Acarapis woodi, the tracheal mite, causes Acarine disease of adults. They reside inside the tracheae and air sacs of adult bees. The adult mites first attack and infest the prothoracic and complete their life cycle there (Sammataro et al., 2000). Piercing type mouthparts are the basic features of these mites that are ingested through wall of trachea (Fouks and Wagoner, 2019). These mites survive feeding the blood hemolymph. The K shaped winged situation arises on bee that creates difficulty for bees to fly. As bees are unable to fly they can be observed crawling nearby the hives (Fouks and Wagoner, 2019). They are responsible for significant colony losses throughout the world. When more in number they are found to diminish brood area, cause smaller bee populations, winter clusters become loose, increases honey consumption, and lowers honey yields (Sammataro et al., 2000).

2.6.1 Control

Menthol crystals are found to be effective against them. Also rearing of resistant bees is even a better solution.

2.7 Varroa mites

Varroa jacobson, commonly known as varrora mite is one of the major pests of honey bees in many parts of the world (Calderón et al., 2012). These mites are ectoparasites that feed on the early stage of larva and prepupa. Due to this nature the mites are regarded as problematic and are very difficult to control. The adult mites are broader in their shape and lay the eggs after the drone cell is sealed. The emerging drones are deformed adults that may lack wings or legs and are unable to mate with queen. These drones are generally seen on the entrance of hives, with uneasy posture and feel difficulty to reach to hive (Sammataro et al., 2000).

2.7.1 Control

Spraying sulfur on the frames or fumigating inside hive is the control measure. These mites can even be managed a cloth or cotton balls saturated with formic acid. (65%) (MG, 2019).

2.8 Tropilaelaps mites

Tropilaelaps mites are also honey bee parasites that feed externally. They generally feed on young broods. These mites invasion leads to reduced brood number and colony collapse too (Pettis et al., 2017). Four species of *Tropilaelaps* that are recognized are:

- *Tropilaelaps clareae* (Delfinado and Baker),
- *T. mercedesae* (Anderson and Morgan),
- *T. thaii* (Anderson and Morgan) and
- *T. koenigerium* (Anderson and Morgan) (Collectively referred to as *Tropilaelaps*).

Tropilaelaps mites have been attacking *A. mellifera* as it was introduced into Asia. *Apis dorsata* F. is thought to be the original host of *Tropilaelaps*. These mites are proven to be problematic to A. mellifera. Due to their rapid reproduction rate, Varrora mites are rarely seen in colonies where these mites are present.

2.8.1 Control

These mites can be controlled by using Apistan, Formic acid, spraying of botanicals like lemongrass oil.

2.9 Other enemies

- Toads, Lizards and frogs capture bees at hive entrances.
- Cockroaches enter weak colonies which impart a foul smell to the hive.
- Bears damage the hives and eat upon honey, pollen, brood and the bees.
- Termites damage wooden parts of the hive
- *Acherontia styx* ('death's head' moth,) enters hive and consumes honey.

3. DISEASES OF HONEY BEES

Several diseases affect the honeybee worldwide and in Nepal. Some of the diseases of economic importance are:

3.1 Nosema Disease

This disease is a protozoan disease whose causative agent is *Nosema apis*. The protozoon produces spores that cause contamination of food. When these spores are ingested they germinate inside the gut (Wikipedia, 2009). The pathogen then penetrates cells of the stomach lining and continues to grow and multiply rapidly, using the cell contents as its food supply. Uncountable spores are generated in short period which is the major factor to tranmitt further infection. The healthy cells become infected by the spores transmission (Agriculture Victoria, 2019). The bees are unable to fly and void loose excreta on the combs, frames and ground in front of the hive. During cold weather the flight is mostly affected.

3.1.1 Control

Microbial supplements *(bifidobacteria* and *lactobacilli)* and fumigation are found to be effective on control of this disease (Burnham, 2019).

3.2 European foul-brood disease

This disease is caused by Streptococcus pluton (previously known as Melissococcus pluton). This disease is now causes larvae death along with the presence of bacteria along with secondary infection. After introduction of A. mellifera this disease spread worldwide (Rie, et al., 2012). EFBD affects the larvae of all castes (Agri learner, 2020). The bacterium contaminates the food and when young broods/ larvae ingest them the bacteria enter into the gut and reproduces there. The larvae dies after the infection and the cells are not capped by the workers. In some cases the infected larvae dies only when the cell are sealed. The worker bees then after tries t clean the cells and this leads to formation of sunken and perforated capping (Food and Agriculture Organization, 2011). The infested larvae turn watery, yellow then brown and lastly dark-colored. There after the larvae dies which is coiled shape and a distinct unwanted foul odor is emitted (TNAU Agritech Portal, 2014).

3.2.1 Control

The use of antibiotic Terramycin @100mg in a liter of sugar syrup is most effective in treating the disease which is fed at every seventh-day interval. Fumigation with ethylene oxide is also one of the control measures (Ohio State Beekeepers Association, 2020). Quarantine is also crucial to prevent the entry of any of the bee diseases on the hive.

3.3 American Foul Brood

American Foul Brood is a bacterial disease. By name it is a brood disease that is widespread worldwide. Its causative agent is *Paenibacillus larvae*

which is rod shaped flagellated and motile bacteria, resistant to desiccation and heat (Wikipedia, 2009). This disease also infests young brood/ larvae of all castes. The main source of infection is contamination of food with spores of the bacteria and their ingestion. The ingested spores then multiply in huge number when they reach hemolymph penetrating the gut wall (MG, 2019).

Youngest larvae are the most susceptible among all broods. The nurse bee removes and rejects the diseased larvae. Those larvae which are not thus removed die at the prepupal or pupal stage after they have spun their cocoons. The diseased cell capping becomes dark in color and moist which later becomes concave when the larvae shrink (Bee Research Laboratory, 2016). They putrefy emitting unwanted fishy odor. Now the adult bees repair the damaged cells. The infection mostly is spread by the nurse bees engaged in cleaning the cells. Larvae that get nourished on those previously infected cells are also prone to infection. The chance of colony of recovery during honey flow period is high but is very less during dearth period (Rural Industries Research and Development Corporation, 2015).

3.3.1 Control

There is no best control measure rather than the complete destruction of honey bee hives. In some cases 0.1% sodium hypochlorite is even used for hive decontamination (Agriculture and Food division , 2016).

3.4 Sac-brood disease (SBV)

Sac-brood is a viral disease mainly attacking Apis mellifera. The causative agent is *Morator aetotulas*, that renders the larvae to form pupae and the appearance become sac like that names the disease Sac brood (Food and Agriculture Organization, 2011).

3.4.1 Control

Keeping colonies strong and ensuring the availability of food is to be done as the disease mostly develops on the stress condition.

3.5 Thai sac brood disease (TSBV)

The causative agent of the Thai sac brood disease is Thai Sac-brood virus which was reported about 50 years ago. *Apis cerena indica* is found to be the major host of this virus. The dead brood is found in a pre-pupal but sealed stage. When they are about to form pupae the symptoms appear. The pupae turn into sac-like structures at the posterior end filled with ecdysial fluid (Bailey, 1968). Later, the larvae change their color from yellowish to brownish to black color. The larvae then after dies and no distinct foul odor are emitted. This disease has been problematic for many beekeepers in Nepal.

3.5.1 Control

Isolation of diseased colony is the best proven control measure for it (Bizencyclopedia, 2019).

Diseased colonies combs should not be used for any other purpose and dequeening the colony for a few days followed by requeening with a healthy queen from a strong colony is an effective measure (TNAU Agritech Portal, 2014).

3.6 Chalk brood disease

Chalk brood disease is a fungal disease whose causative agent is Ascosphaera *apis*. The disease seems more problemetic in workers and drone but in some cases queens can also be seen infected. The damage symptom is produced as it attacks the gut of larvae (Mumoki et al., 2014). The disease is more prevalent at commencement of spring when colonies multiply and are volumized. The effect of infestation start to decrease when the temperature and disappears with higher summer temperature (Burlew, 2020). The spores germinate when ingested and mycelia grow through the body penetrating the epidermis and covering the pre-pupa in a short time-span. The diseased larvae are mummified.

3.6.1 Control

Maintaining good and strong colony and stimulating good hygienic behavior are the best manage-mental practices that can be applied.

3.7 Stone brood

It is one of the infectious diseases, which is caused byfungus of same genus but different species; Aspergillus fumigatus, Aspergillus flavus, and Aspergillus niger (Stamets, 2014). Aspergillus flavus is considered as the main pathogen causing the stone brood disease. A. flavus spores might be present within a beehive without showing damage symptoms. The brood of honey bee colonies is mummified. The disease is spread outside the hive by drifting, robbing or swarming honey bees. The major routes of transmission are; swarming, robbing and drifting of bees. This is even transmitted with Aspergillus spp. spores contaminated beekeeping equipments (Sarwar and Gupta, 2016).

The spores when ingested the follow the process of hatching in the gut and forms a collar like ring shaped structure nearby head. The mycelium of fungus grows out from the outer skin, i.e. integument and the false outer layer is generated. The rapid spore production covers the whole body of fungus. The dead larvae become hard and crushing them becomes very difficult, this names the disease stone brood (Muhammad, 2016). Worker bees have some sort of genetic trait, i.e. hygienic behavior that removes the dead and diseased broods. The recovery rate of hive from the damage depends upon their hygienic behavior, colony strength and the degree of infection (BCS Bees, 2019).

3.7.1 Control

No specific treatments are available so the best management is the way for prevention of it. Sterilization of hive tools and management of good location for honey bees is one of the better practices that can be followed.

4. CONCLUSION

Beekeeping in Nepal got to a rising phase after the introduction of exotic honey bee, (Apis mellifera). Along with further advancement and commercialization attack of disease and pest is a real issue. So the need to identify all the disease pest and predators is major concern. This is essential to apply the proven control measures for the control of those disease and pests. The timely identification of those pest and diseases leads to better income, profit and prosperity.

REFERENCES

Agri Learner. 2020. Agri learner. Retrieved April 13, 2020, from http://www.agrilearner.com/apiculture/

Agriculture and Food division. 2016. Government of Western Australia, Department of Primary Industries and Regional Development. Retrieved from Agriculture and Food division website: Bee Research Laboratory

Agriculture Victoria. 2019. Agriculture Victoria. Retrieved 10 4, 2020, from griculture.vic.gov.au/agriculture/pests-diseases-and-weeds/animal-diseases/bees/nosema-disease-of-honey-bees

Aryal, S., Thapa, R., Jung, C., 2015. An overview of Beekeeping Economy and Its Constraints in Nepal. Journal of Apiculture, 30, Pp. 135-142.

Bailey, L., 1968. Honey Bee Pathology. Annu. Rev. Entomol., Pp. 191-212.

BCS Bees. 2019. Retrieved 4 10, 2020, from http://www.bcsbees.com/: http://www.bcsbees.com/stonebrood.html

Bee Aware. 2014. Plant Health Australia. Retrieved 4 10, 2020, from https://beeaware.org.au/pests/

Bee Research Laboratory. 2016. Agriculture Research Service. Retrieved 4 10, 2020, from U.S Department of Agriculture Website: https://www.ars.usda.gov/northeast-area/beltsville-md-barc/beltsville-agricultural-research-center/bee-research-laboratory/docs/american-foulbrood-disease/
Beekeepers' Association. 2016.

Bizencyclopedia. 2019. Retrieved 4 13, 2020, from https://www.bizencyclopedia.com/articles/view/6882/141

Burlew, R., 2020. Honeybeesuite. Retrieved 4 11, 2020, from HoneyBeeSuite.com: https://www.honeybeesuite.com/chalkbrood-disease-of-honey-bees/

Burnham, A.J., 2019. Scientific Advances in Controlling Nosema ceranae (Microsporidia) Infections in Honey Bees (Apis mellifera). Frontiers in veterinary Science.

Calderón, R.A., Chaves, G., Sánchez, L.A., Calderón, R., 2012. Observation of

Varroa destructor behavior in capped worker brood of Africanized honey bees. Experimental and Applied Acarology, 58(3), Pp. 279-290.

Federation of Beekeeping Nepal. 2015. Nepalese Wild Honey. Retrieved 4 12, 2020, from http://www.fnbk.org.np/index.php/91-news-and-event/127-honey-news1

Food and Agriculture Organization. 2011. http://www.fao.org/3/T0104E/T0104E0d.htm. Rome,Italy: Food and Agriculture Organization of the United Nations.

Fouks, B., Wagoner, K.M., 2019. Pollinator parasites and the evolution of floral traits. Ecology and Evolution, Pp. 6722-6737.

Gulati, R., Kaushik, H., 2004. Enemies of Honeybees and Their Management - A Review. Agricultural review, Pp. 189 - 200.

Kwadha, C., Mutunga, J., Irungu, J., Ongamo, G., 2019. Decanal as a major component of larval aggregation pheromone of the greater wax moth, Galleria mellonella. Journal of Applied Entomology.

Marc, N., 2014. Feasibility study on the value of honeybees for sustainable livelihood and biodiversity conservation: Case of Nyungwe landscape. Critical Ecosystem.

MG, S., 2019. Free Feeds. Retrieved 4 10, 2020, from feedsfree.com: https://feedsfree.com/apiculture/

Muhammad, S., 2016. Fungal diseases of honeybees (Hymenoptera: Apidae) that induce considerable losses to colonies and protocol for treatment. International Journal of Zoology Studies, 1(1), Pp. 08-13.

Mumoki, F., Fombong, A., Muli, E., Muigai, A., Masiga, D., 2014. An Inventory of Documented Diseases of African Honeybees. African Entomology, 22, Pp. 473-487.

National Organic Standards Board. 2010. Formal Recommendation by the National Organic Standards Board to the National Organic Program. National Organic Standards Board, Livestock Committee.

Ohio State Beekeepers Association. 2020. Antibiotics for American And European Foulbrood Disease. Reynoldsburg, Ohio: Ohio Department of Agriculture.

Pettis, J.S., Chaimanee, V., 2017. Chemical and cultural control of Tropilaelaps mercedesae mites in honeybee (Apis mellifera) colonies in Northern Thailand. PLoS ONE.

Pettis, J.S., Rose, R., Chaimanee, V., 2017. Chemical and cultural control of Tropilaelaps mercedesae mites in honeybee (Apis mellifera) colonies in Northern Thailand. (N. A. Xiao-Yue Hong, Ed.) PLos ONE.

Rie, A., Kiyoshi, T., Meihua, W., Masatoshi, O., Kazutomo, I., Naomi, O., 2012. Diversity of Melissococcus plutonius from Honeybee Larvae in Japan and Experimental Reproduction of European Foulbrood with Cultured Atypical Isolates. PLoS ONE.

Rural Industries Research and Development Corporation. 2015. Australian Beekeeping Guide.

Sammataro, D., Gerson, U., Needham, G., 2000. Parasitic Mites of Honeybees: Life History, Implications, and Impact. Annu. Rev. Entomol, Pp. 519-548.

Sarwar, M., Gupta, P., 2016. Fungal diseases of honeybees (Hymenoptera: Apidae) that induce considerable losses to colonies and protocol for treatment. International Journal of Zoology Studies, Pp. 08-13.

Stamets, P.E., 2014, 08 07. Patent No. US20140220150A1. USA.

TNAU Agritech Portal. 2014. Tnau Agritech Portal Farm Enterprises. Retrieved 4 10, 2020, from http://agritech.tnau.ac.in/farm_enterprises/fe_api_pestanddiseases.html

Wikipedia. 2009. wikipedia. Retrieved 4 2020, from https://en.wikipedia.org/: https://en.wikipedia.org/wiki/Nosema_apis.