



Enemies Threatening Honeybee Colonies: Identifications and Management Strategies.

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Abstract

In India, because of different climatic conditions different flora is there which helps in potential bee keeping. About 1.5 million bee colonies are there which produce 55,000 tons of honey annually. The apiculture is one of the profitable industries among all the industries and honeybee enemies are major limiting factors amongst all others. Various pests harm the honeybee in different ways. In this article we will discuss about different honeybee enemies and their effective management as poor management weakens the honeybee colonies and they are susceptible to enemy's attacks. Understanding how to recognize and combat these pests is essential for safeguarding honeybee populations and ensuring the stability of pollination services as they play a crucial role in pollination and are vital component of agricultural ecosystem.

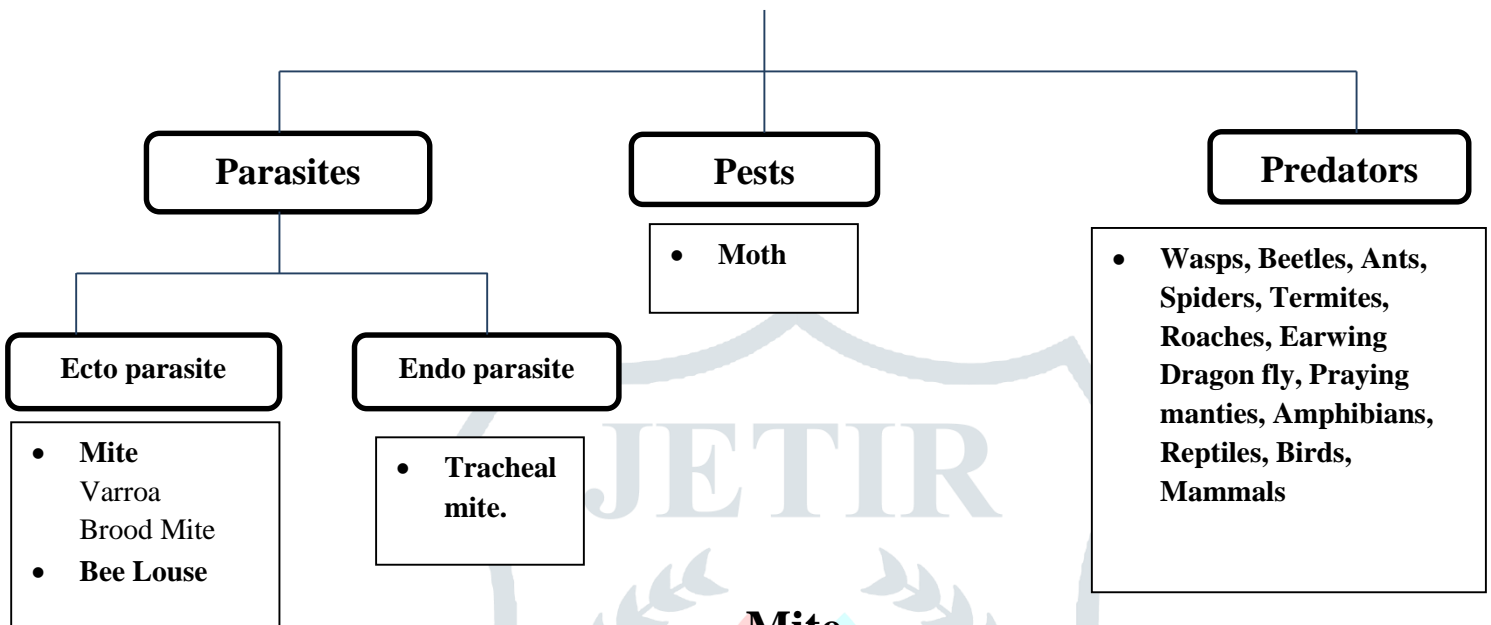
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Introduction

As the flowers start to bloom, the honeybee colonies start to collect pollen & nectar to rear the brood & side by side the enemies like pest, parasites & predators of honeybee start to feed on the bees & also on their bee brood for proteins etc. The honeybee plays a vital role in environment as a pollinator as well as their cherished products such as honey, and other products like bee wax, propolis, bee venom etc. These products have their widespread use in different small or large-scale industries. The apiculture industry play an important role in generating employment as well as livelihood of rural area of the world. Many apiculturists of developing countries are trying to improve the quality & quantity of the products of honeybee by maintaining the healthy populations of honeybees. As like other livestock's they are susceptible to many diseases and enemies. The attack of these enemies causes great harm & loss to the life of honeybees & result in dissipation of the hive by the bees. So, to protect the honeybees, an apiculturist needs to study about them to flourish their bee keeping industries. Apiculturist can use various methods to manage or control these enemies. India is one of the honey exporting countries. The major market of Indian honey is Germany, Japan, France, Spain & Italy (Tej et.al 2017).

The bee enemies can be classified as: parasite, pest & predators depending on the nature of their damage and interdependence with bees.

Classification of Bee Enemies



Mite

Parasitic mites are the most serious enemy of honeybees. The complete eradication of the mites from the apiary is impossible as the feral nests of the native bees are infested by the parasites serve as a reservoir of mite. Many species of mites have been reported from *A. mellifera* & *A. cerana* colonies throughout Asia. Two types of mites depending upon their mode of action i.e. ectoparasitic mite & endoparasitic mite. Ectoparasitic mite which attack on the outer body of the honeybee. Endoparasitic mite which attack on the internal body of the honeybee.

Ectoparasite e.g. *Varroa destructor*, *V. Jacobsoni* disease caused by this mite is called Varroosis. This parasite is found throughout the world except Australia & New Zealand. Mite is a tiny, oval bodied with four pairs of legs. Shiny reddish-brown colour, body covered with short hairs. Individual mites are often seen clinging tightly to the body of adult bees, mostly on thorax or between thorax & abdomen. Immature mites are bright white, adult females are brown while males are smaller than females & creamish in colour & pear shaped.

This attacks on adult bees and developing brood, attacks *A. cerana* & *A. mellifera*. Mite hangs on bee's body & feed on bee's haemolymph.

Varroa Mite:

This mite reproduces only in honeybee colony. It is transported from colony to colony by drifting or robbing bees. *V. Jacobsoni* multiplies faster in *A. cerana* while *V. destructor* is more serious problem of *A. mellifera*.

Symptoms on bee colony or sign of infestation: Reduced weight of emerging bees, deformed wings & legs, shrunken abdomen, restlessness in bees.

Symptoms of infestation of Varroa mite: It directly feed on honeybee if more than one parasitic female mite infest the brood cell, the brood delays & adult deformations occur leads to shortened abdomen & deformed wings. Varroa mite is also a carrier of deformed wing virus which causes shortened & twisting of wings. Unfavourable climatic conditions or insufficient stocks of pollen & nectar lead to collapse of colonies as well as disintegration of the colonies. If only one mite infests a cell symptom may not be visible but the life span of honeybee shortened & the behaviour of bee may be disturbed.

Treatment or Prevention:

1. **Control by hive manipulation:** Varroa mite prefer drone brood for completing its developmental cycle. The frames with drone brood are removed & put into freezer for one to two days to kill the mites i.e. occasional removal of A. cerana male brood combs & keeping the hive in healthy conditions are the ways of prevention of varroasis in A. cerana colonies.
2. **Chemical control:** It is the most popular method of Varroa control for the Asian apiarist. But the chemical treatment should be started after honey harvest. Few chemicals which are used for mite control are natural & synthetic. Natural chemicals are formic acid, oxalic acid, lactic acid, etheric oil like thymol. Synthetic chemicals are Apistan strips, Amitraz.
 - i. **Formic acid:** Kills the mite even in the sealed brood cells. A solution of 3-5 ml of 60% formic acid is applied onto the sponge tissue per comb. The quantity can be increased or decreased according to the size of comb. Treatment can be done 3 to 4 times at the interval of at least 7 days.
 - ii. **Oxalic acid:** It does not act via evaporation like that of formic acid, but it is used through the direct contact with the bees. 42 gm of Oxalic acid crystal is diluted into 1 litre of sugar water. 5ml of this acid solution is trickled in between every 2 combs late in the evening. The treatment should be repeated two times at the interval of 7 days.
 - iii. **Lactic acid:** It is better tolerated by bees. The disadvantage of this acid is that every single comb is taken out of the hive to lactic acid spray. 8 ml of 15 % acid is the dosage of this acid. This treatment is repeated several times at the intervals of 7 days.
 - iv. **Thymol:** It is only etheric oil, can be applied as a readymade preparation or in crystal form 0.5 mg thymol is kept into a gauge bag & deposited on the frames for some weeks which will kill the mites.
 - v. **Apistan Strips (fluvalinate):** It is a synthetic parathyroid applied as a contact miticide. They are in the form of strips. It is highly effective for the mites & has low toxicity to bees. It is suspended between brood frames for two weeks. They are highly effective, but the mites develop resistance to them rapidly.
 - vi. **Amitraz:** It can be used as hive fumigant; fumigation should take place in the evening. When the foragers have returned to the hive.

Brood Mite (Tropilaelaps clareae):

This mite is a native parasite of the giant/rock honeybee (*A. dorsata*) & widely distributed throughout tropical Asia. The population of *Tropilaelaps clareae* often being greater than that of *Varroa* mite. Parasitism of *A. mellifera* colonies simultaneously by both the parasitic mites occurs rarely.

It is smaller than *Varroa* mite, adult female mite is light reddish brown in colour. With an oval shaped body mite body is covered with the short setae seen by microscope only. They are rarely found on adult bees; they are generally observed walking rapidly in the surface of the comb & on the brims of cells. In immature stage this mite lives within the brood cells of the bees & feed on the brood's haemolymph.

Stages of development of egg:

Eggs → Six-Legged Larva → Proto-nymph → Deuto-nymph → Adult.

Adult males of *Tropilaelaps* do not feed because of their Chelicerae (the organs originally used for piercing the bee's integument) have been modified into the organs which transfer sperm. Life cycle of mite is well synchronised with the host bee.

Symptoms of attack of *Tropilaelaps*: The damage caused to colonies by *Tropilaelaps* infestation is like that caused by *Varroa* mite.

The injuries inflicted on individual bees & bee brood are essentially the same. The infected bee has reduced abdomen & having a short life span than the healthy bees. Heavily infested colonies bees have deformed wings & crawl in the vicinity of hive entrance & on the comb surfaces & the pieces of the dead bee comb (brood) are thrown out from the hive by the house bees can be seen in front of the entrance. Hives severely infested with *Tropilaelaps* shows an irregular pattern of sealed & unsealed brood.

Treatment or Prevention:

1. **Control:** The *A. mellifera* colonies catch the mite infestation from *A. dorsata*. When the *A. dorsata* rob the *A. mellifera* bee colonies. Prevent the robbing & drifting of the *A. dorsata* among the colonies in an apiary to check the spread of the mite.
2. **Chemical Control:**
 - i. Dusting of sulphur powder per comb, sulphur should be dusted directly on the top bars of combs.
 - ii. Use of formic acid (while the use of formic acid the user should wear acid proof gloves & protective goggles).
 - iii. Application of Amitraz is very effective when used either as a liquid spray on the surface of the brood comb & hive walls.
 - iv. Treatment is required, 3 to 4 applications at every 4-day intervals.

Precautions during treatment: All chemical treatments must be suspended for at least 8 weeks before the onset of honey flow. Amitraz must not be used in spray form in the presence of open brood.

Bee Louse (*Braula Coeca*)

A small wingless, reddish brown colour insect found on the head, thorax, abdomen of all adult caste bees.

The louse sucks the blood (haemolymph) of bee by its powerful sucking & piercing mouth parts till the host bees dies. When it attacks the queen, cause the death of queen resulting in disturbance of whole colony. It is usually observed in the comb of Indian honeybee *A. cerana*.

Symptoms of attack of Bee Louse: Reduced working capacity of infected bee, restlessness, nervousness in infected bee.

Treatment or Prevention:

1. Controlled mechanically.
2. Controlled by smoking of tobacco.
3. Controlled by use of naphthalene & camphor.

Endoparasite: Tracheal mite (*Acarapis woodi*)

Mites infest the tracheal system of adult honeybee of all the three castes.

Mode of Infection: Infection level highest during winter & spring. It generally penetrates through the spiracles into the first tracheal pair of thorax & feed on haemolymph. Mite lives, breeds & lays the eggs in the tracheal system of honeybee. Male offspring emerge after 12 days & female after 13-16 days. Due to disruption in respiration the infected bee dies. Honey production reduced when 30% of bee population infected with tracheal mites.

Symptoms of attack of Tracheal Mites:

- i. Infested bee comes outside the hive they try to take off but fall down & keep crawling around the hive. Close observation of these flies reveals K shaped winged condition i.e. forewing & hindwing are not coupled (disjointed) & due to these reasons the bees are unable to fly. Infestation shortens the life span of the individual bees.
- ii. Abdomen gets swollen.
- iii. Bees undergoes abscond.

Treatment or Prevention:

1. Use of menthol or Thymol (Ethereic oil): As the bee's breath the vapour of menthol or thymol desiccates the mites located in the tracheal system.
2. Use of mixture of Saffron oil, nitrobenzene & petrol in 1:2:2 ratio is very effective.
3. Cotton soaked in Methyl salicylate placed under the hive is also effective in killing the mite.

4. Use of formic acid: The conc. Of 20 ml of 65% formic acid is applied on the cloth gives a good result. This treatment is done 4 times at an interval of 7 days.
5. Treatment with formic acid is done during low humidity & temperature range is not more than 30 degrees Celsius.

Moth

Several moths are hazardous to honeycomb & honeybees. The most common are:

- Greater wax moth (*Galleria mellonella*)
 - Lesser wax moth (*Achoria grisella*)
 - *Plodia interpunctella*.
 - *Acherontia atropos*
1. **Greater wax moth (*Galleria mellonella*):** Most common & most damaging & serious pest of honeybee. This damage the honeybee colonies & bee products in Asia. They also cause damage to empty combs, rendered wax, comb foundation & bee collected pollens if they are not properly stored by the apiculturist. This moth is the major predator or pest of *A. cerana* & often causing the honeybee colonies to abscond. Adult moth is brownish grey in colour, 10-18mm in length, wing expanse is 25-40 mm from side to side, male is smaller than females. About 50-150 eggs are laid in each batch and they are glued together & adhere firmly to the surface on which they are laid. Development time of *Galleria* larvae depends upon food availability & temperature. When the weak colonies are infested then the symptom of *Galleriasis* (a disease caused by *Galleria*) is observed.
 2. **Lesser wax moth (*Achoria grisella*):** It is smaller than greater wax moth i.e. adult, larvae, pupa of this moth are smaller. Colour of adult moth is silver grey which have a distinct yellow head. Insect is quite small with a slender body. Size of female moth (13 mm) is larger than the male moth (10mm). Life span of adult female is about 7 days which can lay 250 to 300 eggs.

Both the moth lays eggs in combs which hatch on small larvae. Other moth species are also seen in association with bee & bee products(honey). e.g. *Plodia interpunctella*, *Acherontia atropos*, *Acherontia Styx*. *Acherontia atropos* is known as Death head hawk moth because of the thorax region there is a face of a dead & it is also included one of the lesser wax moths as its size is smaller & apiculturist consider them minor pests. All these moths found dead on the bottom boards of bee hives.

Mode of Infestation: Both the moth enters the hives at night & drink the honey, attack on weak colonies where the number of bees is not sufficient to cover all the combs. But in strong colony they are driven out & the bee protect the hive. Both the species lays eggs directly on the comb which hatch into small larvae. Caterpillars of moth live in silken tunnels made by them feed on propolis, pollen, wax (all found in the combs). As the caterpillars penetrate the wax layers, the particles of wax are dislodged & fall into the cells & in the hive & weaken the comb. When the infestation is large the comb is seen covered with silken webs with numerous black faecal particles of the caterpillars.

Large scale infestation of colonies by larvae of moth leads to colony loss. Absconding & reduction in the size of migratory bee swarm. While feeding, they also excrete minute elongated black striated pellets such feedings weaken the comb. The heavy infestation reduces the comb into web mass containing comb pieces, silken galleries & excreta.

The wax moth does not attack on the bees as such. Its full development to adult requires access to used older combs or cell capping, which contain proteins essential for the larval development.

Wax moth infestation is higher in hot & humid conditions & is more serious in weaker honeybee colonies.

This pest is more serious on Asiatic bee species than European honeybees. The surplus wax combs stored in super chambers is also infested by the wax moth.

A strong honeybee colony generally needs no treatment against the wax moth. The bee kill & clean out the moth larvae & their webs. The following conditions (Control measures) is to be done which help in checking the wax moth infestation:

A. Cultural control: i.e. maintaining good sanitation.

- Keeping the colony strong with adequate food sources and by uniting two or three weak colonies into single strong colony.
- Sealing the cracks & crevices of colony.
- Removing all the debris.
- Frequent cleaning of floorboard helps in checking the wax moth infestation.
- Minimum use of pesticide.
- Replace defected or infected combs regularly.
- Destroy infested combs showing the sign of gallerias is.
- Expose the equipment & combs at high or low temperature for few days.
- By removing the extra/surplus combs from the honeybee colonies.
- Storing the surplus combs in cold storage followed by their exposure to the sun is also helpful in checking the moth infestation.
- If the combs are heated at 48 degrees Celsius for 3 hours, then the development of wax moths can be checked.

B. Chemical Control: Fumigants are effective against all the stages of wax moth like sulphur, acetic acid, ethylene bromide, calcium cyanide, methyl bromide, phosphine, Paradichlorobenzene (PDB) naphthalene, Carbon dioxide, Aluminium phosphide fumigation is also helpful in the control of their pest in the stored empty combs. And after fumigation, the combs must be well aired out for several days before their use.

The use of Naphthalene balls is not preferred because it accumulates in the wax, kills bees & contaminates honey. After chemical treatment the combs must be well dried out for several days before their use. No chemical treatment should be done against wax moth is recommended in the live healthy colony of bees.

C. Biological Control: Many biological agents & bio products are very effective like Bacillus thuringiensis, Bracon hebetor, Trichogramma species, fire ant, Solenopsis species. It is an effective biological control agent & has an excellent safety record. A watery suspension of Bacillus thuringiensis is sprayed onto the combs.

Wasps

It is a common & highly destructive predator of honeybee in all the Asian countries, who attack the bee at hive entrance & also on flowers. Wasps take away the adult bees or brood bees to feed their own young ones in their wasp's nests. They are active in hot & humid environment, during monsoon & autumn (July-October) the wasps attack on apiaries reaches to peak.

As both are the social insect, they also build nest in the cavities of different sites like tree walls & in cracks. They catch the bees from blossom or even at the entrance of the hive. Wasps are very bold to enter inside the hive & catch the bees directly from the comb of the weak colonies, sometimes finishing off the entire colony. Most frequently reported genus is Vespa, among many wasps & among them the most frequently reported species are listed in the table. They are widely distributed throughout the world.

Zoological Name	Distribution
Vespa orientali.	India, Pakistan
Vespa mandarina.	India, Burma, Japan, Republic of Korea, Tropical Asia.
Vespa tropica.	Tropical Asia.
Vespa velutina.	Tropical Asia.
Vespa cincta.	Tropical Asia.
Vespa affinis.	Tropical Asia & Sub Tropical Asia.
Vespa crabro.	Japan & Temperate Asia.
Vespa mongolica.	Japan & Temperate Asia.
Vespa lewisii.	Japan
Vespa vulgaris.	Republic of Korea.

Colonies of both *A. cerana* & *A. mellifera* are frequently attacked by these predators in Asia.

Apiaries situated near foothills & tropical forests suffer more acutely than those in plains. The attack of wasp occurs in various phase. In the hunting phase when a few wasps capture & kill slow-flying bees one at a time near the entrance of a weak hive. Later, in another phase called slaughtering phase is set in. In this phase some 20 & 30 wasps attack a weak colony in a group (all together) with their strong jaws to maul (physically attack or badly hurt) the bees. The dying & dead bees are dropped to ground. Finally, this phase has continued long enough & have lost most of its defender workers. The wasp enters in the hive & eat away honey & brood nest.

Management of Wasps:

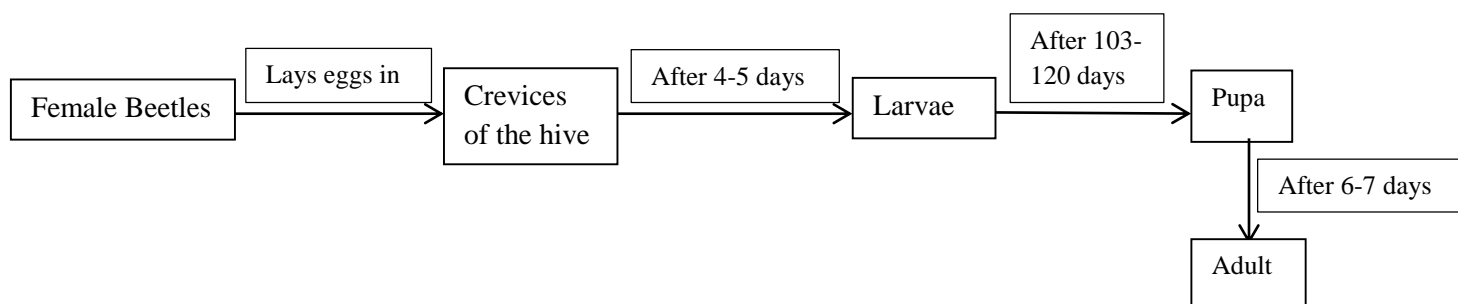
- 1) Chemical control: Burning their nest & them by spraying insecticide like 5% benzene hexachloride emulsion. By blowing 10% DDT dust in underground nest. Locate & destruct the wasp nest by fumigation with calcium cyanide or aluminium phosphide or spray carbaryl on their nest.
- 2) Poison Baits: Use of wasp bait in the apiary is also useful in minimising the damage. The poisoned jaggery packed in gelatin capsule are glued to the thorax of the trapped predators & reaching to their nest the poised jaggery would be shared by nest mates & this help in killing the entire wasp colony. To kill the wasp at the entrance of the hive various poison baits are made up of meat, fish or chemicals can be kept but these baits may attract the honeybee & kill them, so this method is not much effective.
- 3) Other methods:
 - Placing the bushes/screens in front of the hive entrance also reduces the damage from these wasps to some extent as their exit & entrance becomes difficult & the wasps are kept away from the hive gate.
 - Collect & kill the adult wasps during active predation.
 - Killing the gravid females during the spring season reduces the wasp population in the coming season.
 - It is very helpful to locate the nests of wasps by following flight passes of individual wasps back to their nests & then destroying the nests.
 - Capturing & killing the individual wasps foraging in the vicinity of the apiaries is very useful in controlling the problem of wasps.
 - The wasps can be killed by using fly flappers or broom in front of the bee hives particularly during noon time, when wasps are the most active.
 - In case of heavy attack relocating the apiary in safer place is advised.

Beetle

There are several different beetles live in honeybee colonies, two species are more common first in Indian beetle *Platybolium alvearium* & second is African beetle *Aethina tumida*. Indian beetles enter the beehive to get the honey while African beetle enter the hive for breeding purpose. Both are considered as minor pest.

Mode of Infestation: The beetle invades the colony during the management activities like during honey extraction etc.

Life Cycle of Tumida Beetle: Female lays eggs within & outside the bee colonies i.e. lays eggs within & outside the bee colonies i.e. lays eggs within a colony, in fissures or cracks & they are outreach of the bees.



Total life cycle is completed in 113-132 days.

Symptoms of attack of Beetle: The larvae & adult of beetle infest the brood & honeycombs in the apiary. They form eating canals & destroy the cell caps. Beetle larvae & faeces change the colour & taste of honey & combs appear to be mucilaginous. Minor infestation is difficult to recognise as they hide in dark. Larva are found among the debris of bottom board or nibbling piece of an empty old combs in weak colonies. The best way to identify the infestation of beetle is after chemical treatment when the dead beetles come in bottom board of hive. The beetles are responsible for the unhygienic conditions in the hive, so regular cleaning in the hive so regular cleaning of the bottom board & through the inspection of the empty comb will keep bee colony from these minor nuisance beetle pests. The beetle is a quick moving & can fly so it spreads easily in colonies & apiaries.

Control:

- Keep the strong colonies & remove the weak colonies from an apiary.
- Honeycombs should be stored at less than 10 degrees Celsius or in dry environment having less than 50% relative air humidity before use.
- Use of checkmate only in strongly affected bee colonies.
- Paradichlorobenzene (PDB) is protective for combs in storage of them.

Structure of Adult: It is dark brown to black in colour 5mm long, 3mm wide.

Structure of Larvae: It is white in colour 11mm long, found in combs only.

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Ants

They are the most common predators of honeybee in tropical & sub-tropical Asia. Most frequently recorded species of ant is weaver ant (*Oecophylla smaragdina*) & black ant (*Monomorium destructor* *Monomorium indicum*), red ant (*Dorylus spp*) *D. labiatus*, Carpenter ant (large black ant), *Componotus compressus*, fire ants (*Solenopsis spp*) and *Formica spp*. They are social insects and attack the hives in mass and take away honey, brood, pollen, dead bees and other debris particularly from weak colonies but strong colonies (due to large no.).

In addition to the destruction of beehives they can also be a nuisance to the beekeepers and cause pain from their bites to beekeepers. The apiary of 2 bee species i.e. *A. mellifera* and *A. cerana* under the ant attack become aggressive and difficult to manage. Sometimes weak colonies abscond against frequent ant invasion.

Control: Bee colonies can be saved from intrusion of ants by following these precautions or measures which must be followed up by the beekeepers.

- Keep the apiary clean by eliminating the rotten wood, bushes from the apiary & cutting the grasses is the general requirement to eradicate the ant nesting sites.
- Bee hives should be placed on stands with a 30-50 cm height above the ground & whose legs should be kept in earthen bowls which are filled with water or engine oils or tar.
- A black ant lives in underground nests, destruction of ant nest in the vicinity of the bee hives & apiaries when found & destroy them by burning.
- Sealing the underground nest of ant by mud.
- Ants can be controlled by fumigant CS₂ or by insecticide like 0.2% BHC suspension or by 0.1% calcium emulsion.

Spiders

There are several types of spiders that may eat bees. The large web spinning spider eat a bee that it can capture in its web.

Roaches, Earwings

They live inside a hive or inside the inner cover of a beehive for short or longer period. They may eat bees or honey or for shelter only.

Control:

- The stored, stacked equipment should be fumigated with PDB which will keep the most of these insects out of the reach of stored equipment.

Dragon Fly

In some sites the large sized adult dragon fly is numerous & they feed on the bee excessively. In some areas queen mating has been seriously disrupted due to adult dragon fly which feed on queen bees flying to mate in & around the apiary.

Control:

Movement of the apiary site is the only control measure.

Praying Mantis

Sometimes in particular area these insects are abundant & they do not usually selectively feed on the honeybee, but they destroy some bees not to the whole colony.

Control:

Movement of the apiary site.

Termites

They are listed as a hive pest. Since termites are wood infesting creatures & most bee hives are made up of wood. As the termites are only after the wood not bees or honey but the hives are placed on the ground or bee equipment left lying on the ground are get infested by the termite. They destroy the bottom boards & the bees could not move i.e. enter or leave.

Control:

The beekeeper should not keep the wooden equipment in direct contact with the ground.

Amphibians

The following amphibians damage the apiary in tropical climates.

- Toad named *Bufo melanostictus*, *Kaloula pulchra*.
- Frog named *Rana limnocrasis* & *Rana tigrana*.

They can be detected only by close observation. The heaviest attack by these amphibians occurs in the night & after a substantial fall in the colony population the problems done by them is recognised.

When the apiary is invaded by large number of these predators then the dark brown droppings are found scattered in front of the hive entrance. The dry faecal matter & remains of the dead part of bees can be seen in front of the hive entrance. They are very harmful to the bee colonies if their entrance is not prevented then there must be a great loss of colony strength. Strong colonies can withstand the predation & subsequently recover their full strength with time, but weaker colonies are at risk.

Mode of action of Amphibians:

Toads & frogs have similar attacking patterns.

- Near the vicinity of the hive entrance, they wait & prey on the passing bees.
- Colonies which are close to ground provide an easy access to them & guard bees at the hive entrance are easily preyed.
- If they are of small size, then the attacker enter the hive by squeezing their body through the hive entrance & prey on the bees.

Control Of Amphibians:

- Place the hive on stands which are usually 40 to 60 cm in height.
- Fence the apiary with fine mesh chicken wire.
- Other methods like chemical control etc. have not been advised for amphibians.

Reptiles

Most of the reptiles like Gecko gecko, Calotes Spp, Acanthosaura Spp & Skink Sphenomorphus Spp are mostly insectivorous & feed on bees also & commonly found in tropical Asian jungles, grasslands, urban areas & in wood logs. They are expert in capturing the bees & less affected by the bee stings & venom.

Lizards: They are occasional predators of honeybee colonies & eat both brood & adult bees. They often devour bees from hive entrance as well as when foragers are visiting blossoms, this results in the reduction of the colony strength. Smaller lizards such as gecko Hemidactylus frenatus often hide in the empty space between the outer or inner covers of the hive. Arboreal reptiles like many geckos & spinks (a type of lizard belonging to the family scincidae) can attack bees either near the hive entrance or on the limbs of the trees which is often visited by the forager bees.

Management of Reptiles:

- 1) Protection against these reptiles can be done by keeping the hive about 40-60 cm high from the ground.
- 2) Use of beehives free from cracks & crevices & also maintaining the colonies with the hygienic conditions & would prevent the reptiles problem.
- 3) Hive stands should be coated with engine oil, grease to prevent the entry of them into the hive.

Birds

Birds prey upon the various insect's species & honeybee is one of them. Certain species of birds visit apiaries during season & mostly visit on the cloudy days & prey upon the bees.

All the birds do much harm & help in keeping down the insect population of a locality. They are well adapted to catch the bees easily during flight. These birds sit on trees, on telegraph wire near an apiary & picks the bees on their wings. They can manipulate the prey, dislodge the sting & remove the poison sac of the bees.

The level of damage caused by honeybee eater birds varies. An attack by a single bird or by few together rarely do a serious problem but when a large flock attack simultaneously upon a bee colony of an apiary caused a decline in the population of bee colonies. The degree of damage to the commercial apiaries caused by the predatory birds & depends largely on the number of predators & intensity of attack. But the presence of only a few predators causes a serious loss to the apiaries which are engaged in queen rearing. List of different predatory birds of honeybee:

- 1) Blue bearded: *Nyctyornis athertoni*.
- 2) Blue cheeked: *Merops persicus*.
- 3) Green bee eater: *Merops orientalis*.
- 4) Blue tailed: *Merops philippinus*.
- 5) Chestnut headed: *Merops Leschenaulti*
- 6) Red-black Shrike: *Lanius collurio*.
- 7) Brown Shrike: *Lanius cristatus*
- 8) Lesser Yellow nape: *Picus Chlorolophus*
- 9) Greater Yellow nape: *Chrysophlegma flavinucha*
- 10) Streak-throated swallow: *Petrochelidon flarvicola*.
- 11) Yellow rumped: *Setophaga coronata*.
- 12) Common swift: *Apus apus*.

Most honeybee eater birds belong to *merops* spp, *cypselus* spp, *apus* spp, *dicurus* spp, *Lanius* spp & *picus* spp.

Bee-eaters: - Bird predators, Certain species of birds visit apiaries during season.

- Green bee eaters: *Merops orientalis*, *Merops superciliosus*.
- Blue bearded bee eater: *Nyctyornis athertoni*.

These birds sit on trees, on telegraph wire near an apiary & picks the bees on wing.

- Drongo: *Dicurus leucophaeus*.
- King crow: *Dicurus macrocercus*

They visit apiaries on cloudy days & prey upon bees. They are the most common bird predators of bee colonies. All the birds do much harm & help in keeping down insect population of a locality. The birds are well adapted to catch the bees easily during the flight. They can manipulate the prey, dislodge the sting & remove the poison sac of the bees. Such type of birds feed exclusively on bees & their allies, so they are of great concern to the beekeepers.

- 1) Black drongo (*Dicurus macrocercus*): A small Asian drongo (king crow), They occasionally visit the apiaries on cloudy days & prey upon bees. It is an aerial predator of insects & prey upon grasshoppers, cicadas, wasps, dragonflies & honeybees. Nesting of this bird is done during April to August. It is a common resident breeder in the tropical southern Asia.
- 2) Green bee eater (*Merops orientalis*): They do much harm to the apiaries distributed in the Indian subcontinent except Eastern Assam. A migratory bird which come in swarms & predate on honeybees during brood rearing season. Breeding is usually in sandy soils making shallow tunnels to the length of 8 meters. Besides common perching sites, the bee eaters sit on the bee hives waiting for foragers of *A. mellifera*. A flock of 60 birds consume about 709 bees per day from an apiary of 40 colonies. This predator usually active for 10-13 hrs. The species of Green bee eater keep watch on passing the insects from a vantage point like a bush, fence, post, electric post, iron telephone wire, & catch the worker bees on the foraging. They feed on *A. cerana*, *A. indica*, *A. mellifera* & *A. dorsata*. The swarm of these birds can be managed by scaring.

Management of Birds:

- The apiarist regard insectivorous birds as predator but the agriculturist do not consider them as predator. Insect birds that prey on insects are beneficial to the farmers as they help in control of the insect pests. The problems come during the migration season of birds when the heavy predation is done by them. & this problem can be solved by careful site selection of apiary or by temporary reallocation of the apiaries at least until the migration period is over. The following management measurements are considered by the apiculturist for controlling bird problems in bee keeping.
- Making noise by beating drum & scaring & producing distress voice at a high volume.
- By using red reflective ribbons around the apiary.
- Apiary should be installed away from the bird perching object such as telephone wire, electric poles, other wires, building, trees etc.

- Covering apiaries with strong mesh, prevent the entry & attack of the bird.
- The swarm of these birds can be managed by scaring (use of 0.22 bore rifle is advised to beekeeper for shooting these birds.).

Mammals

Many groups of mammals are the enemies of the honeybee. In general, they prey on the colonies of honeybee or brood cell or attack accidentally all this is possible when apiaries are placed in or near the forests & are not protected properly. The name of mammals that have been reported as the predator of honeybee species in Asia are as under who acts as predators of honeybee.

- 1) Pine Martens
- 2) Raccoons
- 3) Bears & Badgers
- 4) Skunks
- 5) Monkey
- 6) Rodents (mice& Rats)
- 7) Man
- 8) Small Mammals.

1. **Pine Martens:** They are tree dwelling animal of weasel family, destroy the combs of domesticated as well as wild bee for honey in mostly hill areas.

Management & Control: Fencing the apiary may reduce the attack of pine marten.

2. **Raccoons:** They harm the apiary by pulling & squeezing the hive & drink the honey.

Management & Control: They can be trapped by using red reflective ribbons around the apiary.

3. **Bear & Badgers:** Honeybee hives have often been found attacked by the bear & badgers. They are the most honey loving wild animals, once a bear tasted the honey & brood it is impossible to keep it away from the apiaries. These animals climb on tree & squeeze the hive & eat the honey. i.e. they flat out & destroy the hives in minutes & consume the honey & brood & destroy the whole colony.

Management & Control:

- Placing the apiary in location away of the bear's path so that its attacks are reduced.
- Electrified wire fences are often used when they cause severe problems.
- Shooting & trapping them are temporary control measures.
- Place the hives closer to human habitation i.e. away from the forests.

4. **Skunks:** They scratch the bottom board of modern beehive equipment & eat the bees coming out of the hive. They visit the apiary in the evening time & dark hours.

Management & Control:

- Raising the beehive 18 to 20 inches above the ground.
- Use of wire netting around the hive is effective to prevent them.

5. **Monkey:** They remove the adult bees from the combs & feed on honey & brood. Monkeys generally in troops jump on to bee hives & carry away both super & brood combs by shocking the bees to fly away.

Management & Control:

- Construction of strong fence/solar fence around the apiary prevents damage of bee hives.
- Scaring monkeys away from the apiaries using loud noise & tying bee boxes with the strong wire would reduce the monkey's penance.

6. **Rodents:** Mice & rats are the common predators of honeybee. They build their nest in the hive boxes & destroy the comb in the frames & make hole in the equipment's. Also unclean the hive by leaving the dropping.

Management & Control:

- To keep the mice out of hives, a mouse trap can be placed at the entrance of hive.
- The entrance door of the hive should be of one fourth of an inch, so that only bees will be able to come & go & mice & rat will not be able to enter.
- Rat & mice have similar diets so their traps can be baited similarly so peanut butter & hazelnut spread, dry fruit, soft cheese are the best options for them.

7. **Man:** Protection of honey can be provided against many mammals like monkey, bear, badgers but man cannot be prevented from depredation of the bee colonies both for honey & wax. Among all the mammal's man are the most destructive. Honey may be stolen, or brood & combs are consumed on the spot. Areas where modern agriculture is practiced misuse of the pesticide is probably greater than the loss from all other organisms done together.
8. **Small Mammals:** Like skunks, opossum or raccoon etc. found the bee colonies as an easy food source. These animals sit outside the hive & when the guard bees come at the hive entrance to investigate the disturbance then they are caught by the animal's paw & then eaten.

Management & Control:

- Make the entrance of beehive to less accessible to these animals.
- Elevate the hive stand/hive entrance so that it became outreach of these animals.
- Large mesh wire or chicken wire should be screened near the entrance of hive.



Conclusion

The bee keeping industries in developing countries is a low cost means of improving diet, also to earn a livelihood and diversifying sources of foreign exchange and now it is going to increase as a good rural industry example so it can be said that apiculture is an ideal agro based subsidiary enterprise providing supplementary and sometime major income to the people in rural area along with giving a nature's miraculous food.

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