

Penang Sangam High School
P.O. Box 44, Rakiraki
Year 12 Agriculture Lesson Notes Week 17

Strand	AS 12.4 Livestock Production
Sub-Strand	AS 12.4.1: Apiculture
Content Learning Outcome	Research and elaborate on the history and importance of honey bees

Lesson 1: Overview of Apiculture

Lesson Outcome: At the end of this lesson the student will distinguish between honey bees, wasps and mud daubers and discuss their role in agriculture.

Bees, wasps and hornets are eusocial insects belonging to Hymenoptera insect classification. They live in well-organized colonies with very specific hierarchy and all three help mankind in their own way.

Common name	Honey bee	Wasp [includes hornets]	Mud dauber
Scientific name	<i>Apis mellifera</i>	<i>Vespula species</i>	<i>Sceliphron aementarium</i>
Live in	Nest of wax [hive]	Nest of paper	Nest of mud
No# species	Seven	Hundreds of thousands	Thirty
Feed on	Pollen and nectar	Other insects	Other insects and spiders
Advantage to Agriculture	-Produces honey, wax and propolis -Pollinates crops	Pest control	Pest control

Melittology - a branch of entomology concerning the scientific study of bees

2018 - MC No. 15

Lesson 2: History of Apiculture

Lesson Outcome: At the end of this lesson the student will outline the history of apiculture.

- Simple hives and smoke were used to extract honey from wild hives and honey was stored in jars.
- Europeans constructed moveable comb hive so honey is harvested without destroying entire colony. So began apiculture.
- European missionaries probably first introduced honey bees to Pacific in mid-19th century, for production of honey and wax and to pollinate their crops.

Lesson 3: Advantages and Disadvantages of Apiculture

Lesson Outcome: At the end of this lesson the student will discuss the advantages and disadvantages of apiculture.

Advantages of beekeeping in the Pacific:

1. relatively low technology requirements
2. bee keeping basics are easy to master
3. low initial costs for set up
4. men, women, elderly and youth can participate
5. provides employment

2018 – Essay Question No. 5

- ✓ **Advantages of beekeeping in Fiji (3 marks)**
- ✓ **Disadvantages of beekeeping in Fiji (3 marks)**
- ✓ **Factors to consider when choosing a site to establish apiary (3 marks)**

Disadvantages of bee keeping in the Pacific:

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1. Allergies to stings can be fatal. Antihistamines can be taken to alleviate allergy symptoms
2. Land ownership issue as bees may become a nuisance
3. Weak hives are often subjected to “theft”
4. Bee diseases are a concern as many bee diseases are contagious (none affect humans)
5. Predation from wasps, birds and toads which result in weak hives

Lesson 1: Breeds of Honey Bees

Lesson Outcome: At the end of this lesson, the student will identify and describe the characteristics of four breeds of honey bees.

Breeds	Characteristics	Pros	Cons
Italian bee	-produces good comb -has large brood	-great beginner bee -good honey producer	-swarms easily
Carnolian bee	-originally from Austria -swarms readily	-quick buildup -good comb producers	-rob other hives -drift between hives
Caucasian bee	-adaptable -like to rob honey	-large & strong population -use more nectar sources	-produces lot of propolis -do not calm down easily
Russian bee	-originally from Russia	-resistant to Varroa mites -resistant to tracheal mites	-prone to swarming -can be very expensive

Swarm - a group of worker bees and a queen that leave the hive to establish a new colony.

2019 - MC No. 18

Comb - a back-to-back arrangement of a series of hexagonal wax cells in a bee hive.

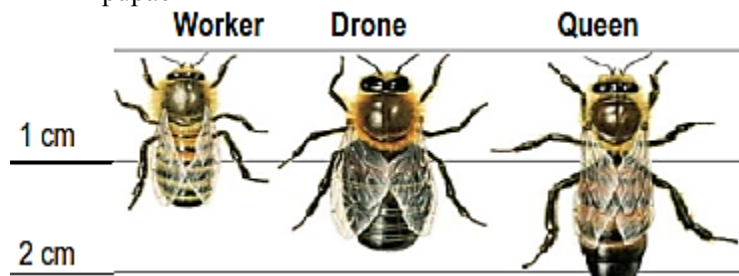
Temperament - disposition of an animal.

Lesson 2: Castes of Honey Bees

Lesson Outcome: At the end of this lesson the student will identify and discuss the different castes of honey bees.

Honey bees are social insects that live in colonies which consist of:

- a single queen
- hundreds of male drones
- 20,000 to 80,000 female worker bees
- eggs
- larvae
- pupae



Three castes of bees live in a hive: queen, worker and drone

Caste	Function
Queen	<ul style="list-style-type: none"> -reproductive female -created by feeding larva only royal jelly throughout its development -produced in oversized cells and develop in only 16 days -has a functional set of ovaries, and a spermatheca -lack the glands that produce beeswax -once mated, may lay up to 1 million eggs; [2,000 eggs per day for 5 to 6 years] -produces a variety of pheromones, called the queen substance, which regulates behavior of workers and helps a swarm track the queen's location during the migratory phase <div> 2018 – Name the variety of hormones which queen bees produce to regulate the behavior of worker bees. </div>
Drone	<ul style="list-style-type: none"> -produced by queen if she chooses not to fertilize an egg; or by an unfertilized laying worker -takes 24 days to develop and do not have a sting -have large eyes used to locate queens during mating flights -serve only one purpose: fertilize queens from other hives -about a week after emerging from their cells, they are ready to mate -once they have fulfilled that purpose, they die <div> 2017 – Identify the main role of drone in an apiary. </div> <div> 2018 – Explain how a drone develops in a honey bee hive. </div>

Spermatheca - a specialized bag on the queen bee which stores sperm after mating

Corbiculum - pollen basket

2017 – State one use of the corbiculum in a honey bee.

Caste	Function
Workers	<ul style="list-style-type: none"> -female bees produced from eggs that the queen has fertilized from stored sperm ✓ develop in 21 days ✓ 60,000 in a typical colony ✓ duties change with their age: <p>Day 1-2: Cell cleaning - brood cells must be cleaned before the next use to the queens satisfaction because she will inspect</p> <div> 2017 – MC No. 17 </div> <p>Day 3-11: Nurse bee - feed the worker larvae with worker jelly</p> <p>Day 6-11: Advanced nurse bees - feed royal jelly to queen larva while drone larvae receive worker jelly for 1 to 3 days then honey and pollen</p>

Worker	<p>Days 12-17:</p> <p><u>Wax producers</u> - bees use wax to build cells, repair old cells and to store nectar and pollen brought in by other workers.</p> <p><u>Nectar receivers</u> - receive nectar from the foraging bees for storage</p> <p><u>Pollen packers</u> - pollen brought into the hive for feeding the brood is packed firmly into comb cells and mixed with a small amount of honey so that it will not spoil.</p> <p><u>Honey sealing</u> - mature honey, sufficiently dried, is sealed tightly with wax to prevent absorption of moisture from the air</p> <p><u>Cleaners</u> - clean the hive of waste and debris</p> <p><u>Propolizers</u> - the walls of the hive are covered with a thin coating of propolis, a resinous substance obtained from plants in combination with enzymes added by the worker.</p> <p><i>Propolis has antibacterial and antifungal properties and is used to aid with ventilation and at the entrances of hives.</i></p> <p><u>Temperature controllers</u> - ensure the hive temperature is maintained at 33°C.</p> <p><i>When the hive is cold, they cluster around the queen, insulating her from the outside cold. If the hive is too hot, they fan the air within the hive with their wings, keeping the queen and brood from overheating.</i></p> <p><u>Queen's attendant workers</u> - bathe and feed her</p> <p><u>Construction workers</u> - soften the wax flakes in their mouths into a workable construction material for building the comb in which the queen lays eggs and the workers store honey and pollen</p> <p><u>Guards</u> - protect the hive from predators and thieves</p> <p><u>Foragers</u> - collect and carry water and pollen back to the hive in their corbiculum to feed the entire colony</p> <p><u>Undertakers</u> - carry the dead from the hive</p> <p>A worker may develop ovaries and lay eggs that produce drones if the hive is queen-less</p>
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Lesson 1: Role of Honey Bees in Agriculture

Lesson Outcome: At the end of this lesson the student will discuss the role which honey bees play in agriculture.

1. Pollinate flowers which are vital to our food chain, genetic biodiversity and sustainability.
2. Bees are a source of food for predators including toads, birds, spiders and lizards.
3. Limbs and mouthparts have been studied and concepts used to develop many tools and machines.
4. Produce honey, pollen, wax and propolis for nutritional, craft, manufacturing and medical applications.

Sting - bee's chief weapon; venom is injected through the modified ovipositor resulting in a burning, itching, swollen lesion

Carbon sinks - anything that absorbs more carbon than it releases

Lesson 1: Requirements of Honey Bees

Lesson Outcome: At the end of this lesson the student will discuss the requirements of honey bees.

Water	To dilute honey and to cool the hive during hot weather *If water is nearby, bees spend more time gathering nectar and less time collecting water 2018 – MC No. 17
Correct temperature	Bees work best at a temperature of 33°C *Worker bees do this by fanning when hive is hot and clustering when hive is cold *They rarely work when the temperature is below 14°C or above 38°C
Windbreak	Provide protection from cold winter winds *Bees eat more and are more susceptible to dysentery when hive receives cold winds *Strong winds blow honey bees away from their path home
Sunlight	Place hives where they will get morning sun but are shaded when day heats up *Field bees usually fly from mid-morning to mid-afternoon *Keep hive entrance away from prevailing winds, which can cool the hives
Security	Locate the colony in a hive beyond reach of toads, lizards and spiders Keep away dogs and goats which will eat honey comb and honey
Food source	Nectar, mixed with enzymes in stomach is stored in wax cells and evaporated into honey *Try to locate hives close to various food sources; not across rivers or creeks *Locate hives where bee flight paths do not interfere with people and animals

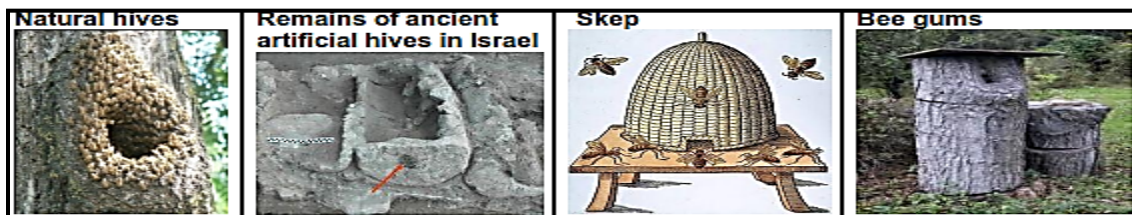
Clustering - bees cling together after swarming or during cold weather

Dysentery - a condition in adult bees resulting from an accumulation of faeces

Lesson 2: Identify the Major Models of Honey Bees Hives

Lesson Outcome: At the end of this lesson the student will discuss some ancient, traditional and modern honey bee hives.

1. Natural hives - colonies of bees use caves, rock cavities and bee trees as natural nesting sites.
2. Ancient artificial hives - are made of straw and unbaked clay.
3. Traditional artificial hives - hollow containers like logs, skeps and pots (fixed frame hives).
*Honey was extracted by squeezing wax, resulting in destruction of comb, which was a source of wax.
4. Bee gums - sections of hollow gum logs, with a wooden 'roof' set up in 'bee yards'.



5. Modern artificial hives - provide a box with removable lid and base. Some examples are:

(a) Langstroth hives - supers with four sided frames that support foundation wax are provided. Honey bees build comb on the foundation wax for the storage of honey, pollen, propolis and brood. Frames are removed and taken for extraction of honey, then replaced, as combs are hardly destroyed.

(b) Top bar hive - bars are placed across the top of the supers for the bees to develop their combs. Bars of comb are removed for the extraction of honey, which usually destroys the wax.

(c) Flow hives - where the comb is provided for the bees. Once filled with honey, a metal bar is inserted into the frame and twisted, causing the wax walls to realign, allowing the honey to flow down into collection tubes and out of the hive.



2017 – Differentiate between a Langstroth hive and a Long hive in relation to the placement of supers.

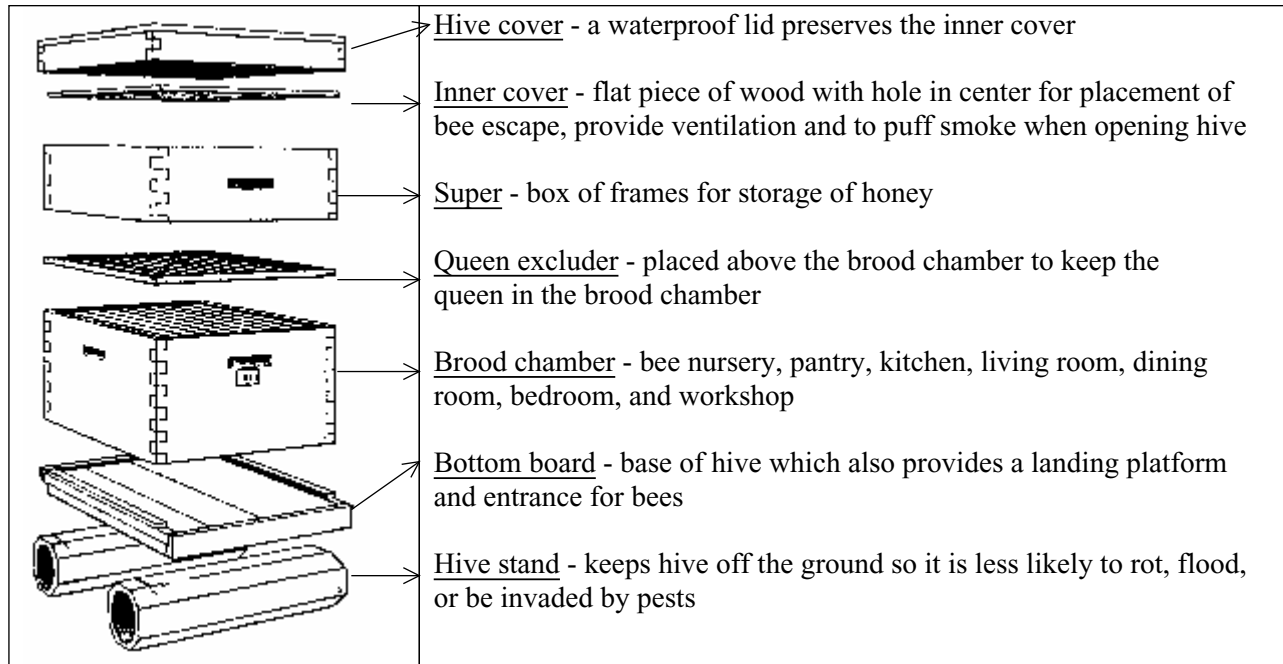
Lesson 3: Identify the Tools and Equipment Needed for Raising Honey Bees.

Lesson Outcome: At the end of this lesson the student will identify and discuss the type and use of apiculture equipment.

The tools and equipment used by apiculturists are aimed at reducing challenges faced when raising bees and extracting honey.

1. **Challenge** - accessibility to honey

Solution - the modern hive - [the Langstroth hive is being used as an example]



2. **Challenge** - destruction of comb during extraction of honey

Solution - the frame which supports the comb



3. **Challenge** - angry bees defending hive

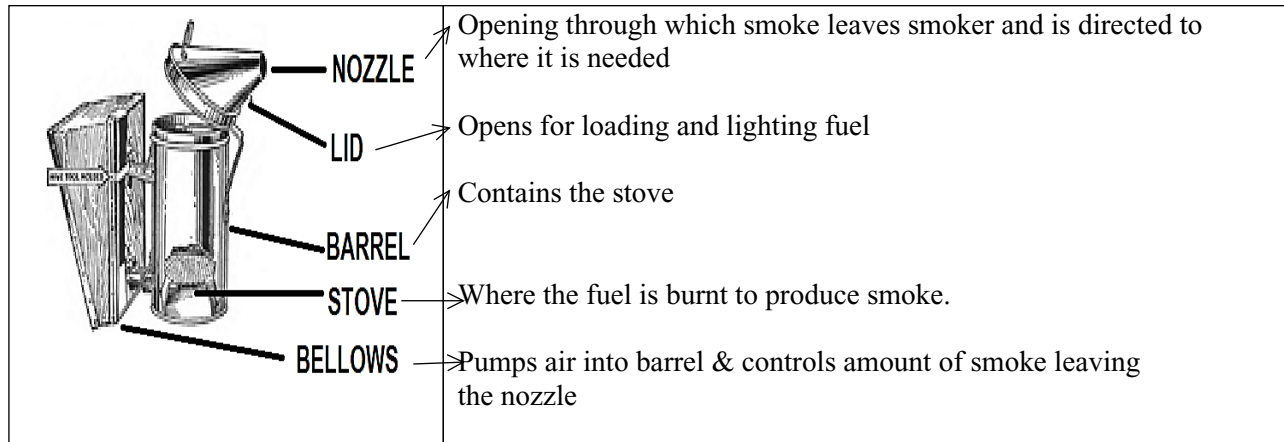
Solutions - work early in the morning when the bees are foraging so fewer bees are in the hive.
- working on calm, warm days when bees are foraging

Apply cool, clean smoke inside the hive to distract the bees as smoke:

- ✓ causes the bees to think there is a fire nearby so they gorge honey and nectar
- ✓ disrupts the pheromone which warns the bees of intruders

2017 – Why farmers use smoke to calm bees?

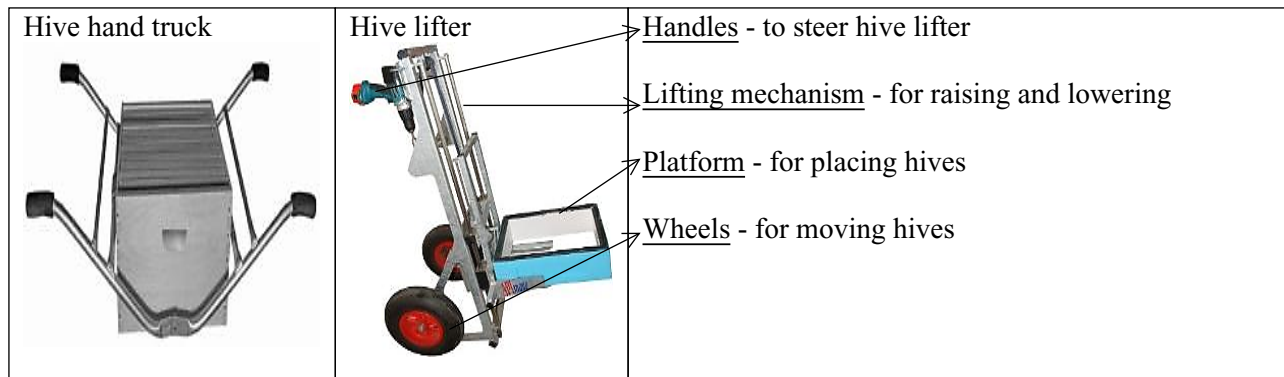
Smoke is produced by a bee smoker.



4. **Challenge** - weight of hive supers

Solutions

- (i) Using hive hand truck - which allows two people to carry the boxes
- (ii) Using hive lifters - which can raise and lower boxes and also transport boxes



Bee space – is crawl space (between 6mm and 9 mm) that bees create in a natural hive to enable them to pass freely around their nest.

2018 – Why honey bees create bee space in their hives?

Propolis - bee glue; a reddish brown resinous material collected by bees from tree buds and used to seal unwanted open spaces and crevices in the hive and to varnish honey comb.

5. **Challenge:** Access to bee supers - hive may be 3 or more supers high; access to supers is difficult.

Solutions

- (i) maintain two super hives
- (ii) use specially made ladders to reach top boxes
- (iii) use the long hive - components of the hive are arranged horizontally



6. Challenge: bees on the comb or frames being removed for extraction

Solutions

- (i) shaking frames - bees fall into hive
- (ii) bees escape board - bees can pass through only one way
- (iii) brush bees into hive - brush gently upwards to minimize injury

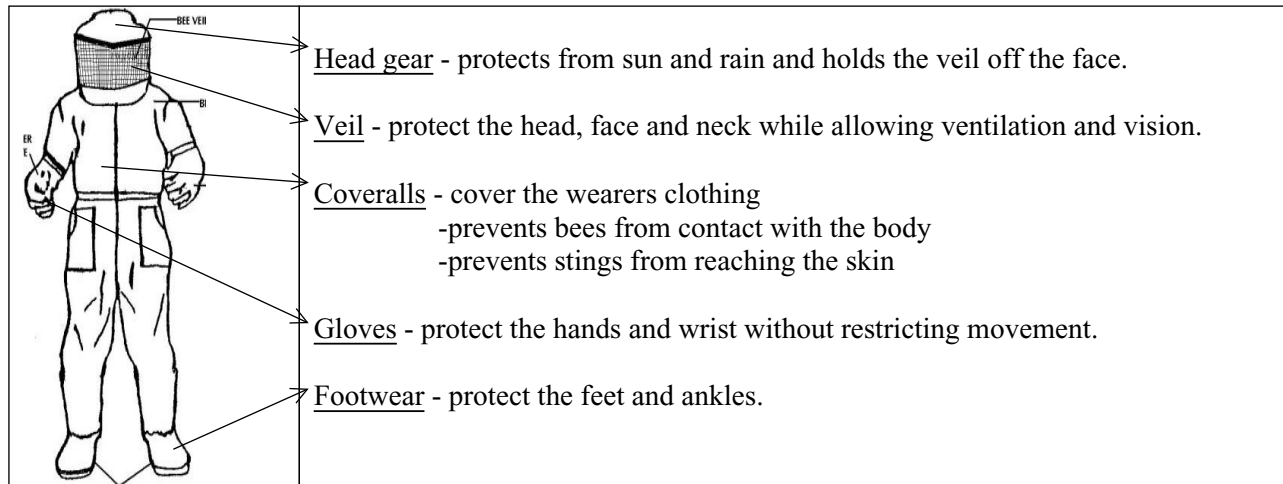
2019 – One method used by farmers to remove honey bees from frames which are taken from a hive for honey extraction.

7. Challenge: angry bees

Solutions:

- (i) wear white or light colored clothes - bees will be less aggressive
- (ii) wear less shiny jewelry and accessories - shiny articles attract bees
- (iii) wear clean clothing and avoid perfume as bees have a keen sense of smell
- (iv) gentle movement – so bees are not alarmed and threatened
- (v) less noise - keep noise from vehicle engines, music, talking etc. low, calm and to a minimum
- (vi) less disturbance to hives - do not leave a hive open unless working in it
- (vii) protective clothing - worn by beekeepers to minimize the effect of stings

2018 – One method used to keep honey bees calm while beekeepers are inspecting the hives.

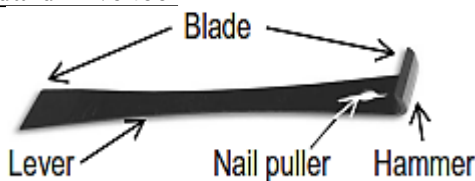


8. Challenge: hive components stuck together with wax, comb and propolis.

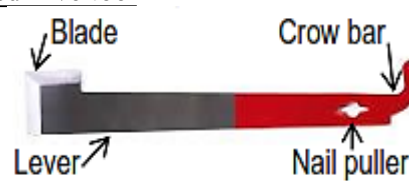
Solutions:

- (i) bee space - providing a hive which closely resembles the dimensions found in natural hives.
- (ii) hive tool
 - ✓ designed for working in hives
 - ✓ used to open hives and lever frames out of boxes
 - ✓ hammer wood and nails into place
 - ✓ kill pests
 - ✓ remove burning fuel from bee smokers
 - ✓ remove stingers and scrape off propolis and comb

Standard hive tool



J shaped hive tool

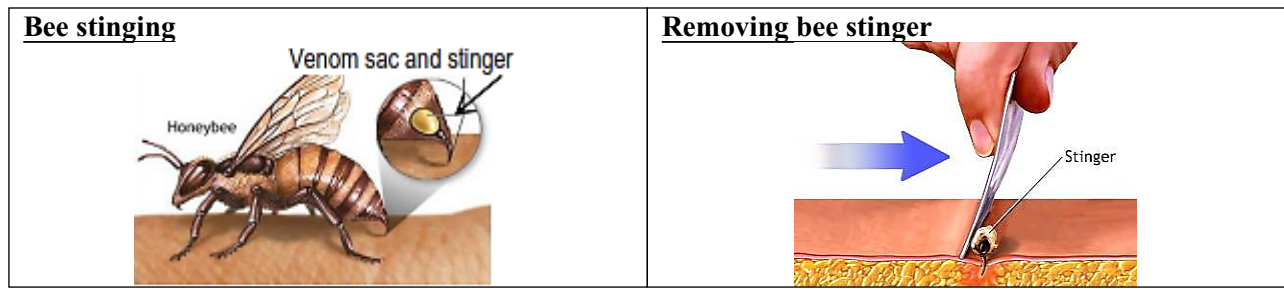


9. Challenge: bee sting - when bees sting, the stinger lodges and pumps venom into the skin, causing swelling, pain and redness. As they sting, worker bees release an alarm pheromone which causes other bees to attack and sting the same site.

2018 – Why farmer must remove the stinger as soon as a honey bee stings

Solutions:

- (i) remove the stinger as soon as possible and apply smoke to the site to camouflage pheromone.
 - (ii) wash sting site with soap and water to remove the alarm pheromone.
 - iii) apply ice to the site to slow down the swelling.
- ***If swelling persists, visit a doctor for antihistamine.



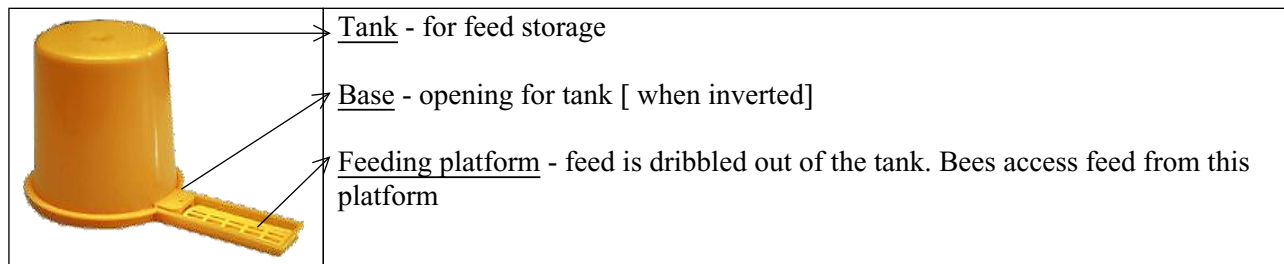
10. Challenge: theft from hives.

Solutions:

- (i) provide fenced compounds with locked gates
- (ii) arrange hives on stands which can be locked

11. Challenge: starving colonies

Solution: Feeding - honey bees store honey for their food supply when food is scarce. A colony may need feeding if too much honey is extracted, there is no pollen and nectar available and the hive is new or is weak due to swarming or disease.
Honey, sugar and water syrup or dry sugar is placed in feeders within hives for bees to eat.



Feeding often encourages swarming in response to pests like ants and mice; bees drown if feed is too deep; bees from other colonies are attracted to the feed and rob the hive, often killing colony members.

12. Challenge: Space for storage of materials, equipment, records and honey as well as extraction area which is bee safe.

Solution: Construct a stand-alone, bee proof structure with adequate storage space, extraction area, loading ramp, road access, water and power source, some distance from the apiary to discourage robbing.