

Penang Sangam High School
P.O. Box 44, Rakiraki
Year 12 Agriculture Lesson Notes Week 18

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

Content Learning Outcome: AS 12.4.1.3 Raising Honey Bees in Apiaries

Lesson 1: Setting Up

Lesson Outcome: At the end of this lesson the student will discuss how a new hive is established.

The following are necessary when establishing an apiary:

1. Choose, clear and fence a suitable site to locate hives.
2. Choose and purchase equipment, tools and materials needed for farm.
3. Set up bee house to store records, tools, equipment and materials as well as extract and store honey.
4. Construct a hive and frames and place it on stand in apiary.
5. Secure colonies and introduce them to the hive by one of the following methods:
 - (a) Buy two established colonies from a reputable beekeeper which:
 - ✓ are housed in clean supers and have no symptoms of disease or damage
 - ✓ have calm bees between combs [indicating that a queen is present]
 - (b) Capture a swarm of honey bees
 - ✓ locate swarm, spread white sheet on ground below it & spray mixture of sugar and water on bees
 - ✓ place container around swarm and encourage bees to transfer into container
 - (c) Buy a nucleus colony of bees [nuc] from a reputed supplier
 - ✓ contains 4 to 5 frames of brood, honey and bees, plus an actively laying queen in a nuc box
 - ✓ transfer the frames (bees and all) from nucleus box into your own hive
 - (d) Established beekeepers may split a strong colony into two
 - ✓ this means introducing a new queen into one of the colonies



Lesson 2: Hive Care

Lesson Outcome: At the end of this lesson the student will discuss the care of an established hive.

1. **Weed control** - weeds growing around the hives may harbor pests like mice and toads.

- ✓ just before day break, close entrance to hives using rolled up newspaper
- ✓ use cane knife or push mower to trim weeds
- ✓ brush cutter is only used if apiary is large or other equipment is not available
- ✓ remove part of the newspaper and allow the bees out

2. **Inspection** - although hives are inspected at regular intervals, entrance has to be observed to ensure that the hive is healthy. A busy but calm hive indicates a strong colony.

The beekeeper is looking for evidence of:

(i) **Brood**

- ✓ queen brood indicates that hive needs a new queen
- ✓ viable worker brood of different stages of development indicates queen is laying eggs
- ✓ drone brood indicates queen is growing old and needs replacement or worker bee has taken the role of queen, in her absence

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(ii) **Honey and pollen stores**

- ✓ presence of honey in brood chamber and supers shows that bees are foraging
- ✓ lack of honey may indicate problems like disease, robbing, swarming and queen problems



(iii) **Pests** - pests can enter hive, damage comb, steal honey and may cause bees to swarm in search of a new home.

The apiculturist may find:

- (a) Mummified pests - bees cover the pests in propolis, so the dead carcass does not taint the hive.
 (b) Presence of pests - pests may be found in or near hive



3. **Maintenance of hives and surroundings**

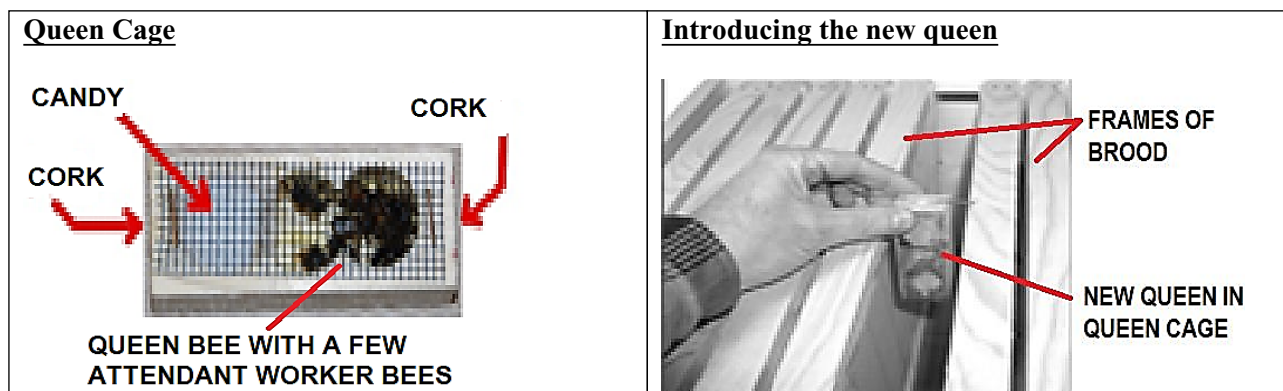
- ✓ repair or change rotten hive components
- ✓ feed starving bees
- ✓ mend fences and access roads
- ✓ control weeds

4. **Re-queening** - there are three reasons why a hive is re-queened:

(i) **Old queen** - although queen can live for 5 years, her laying capacity decreases over time. Most beekeepers change queen every second year to ensure hive has healthy, young and productive queen.

(ii) **No queen** - if queen cannot be seen and there is lack of eggs and larvae, a new queen needs to be introduced before a worker begins laying drone brood.

(iii) **Poorly laying queen** – if hive is weak and brood is not consistent, then the queen may be diseased or of poor quality.



Often the three situations above will manifest as:

- ✓ aggressive bees
- ✓ diseases such as chalk brood and stone brood
- ✓ unhygienic behavior
- ✓ poor productivity
- ✓ formation of new queen cells
- ✓ swarming since a colony headed by a young queen is less likely to swarm

Re-queening

1. Find and kill old queen to make sure hive is queenless and destroy any queen cells present in brood chamber - worker bees will kill new queen if the old queen is still around.
2. Remove cork plug and place new queen cage between two frames of brood to allow nurse bees to get used to new queen's pheromones before they chew through candy and release her from cage.
3. Check the hive after 10 days for signs that queen has been released from cage and is laying.

2019 – Discuss the process of re-queening a bee hive. (3 marks)

Student Activity

1. Discuss ways in which honey bees deal with pests.
2. Discuss the challenges associated with capturing a swarm of bees.
3. Discuss the relationship between honey bees and biodiversity.
4. Imagine that you were a queen bee and had to relocate your colony within the school compound. Discuss the place you would choose.
5. Honey bees set up hives in hollow logs. Differentiate between a natural hive and a bee gum.

Lesson 3: Pests of Honey Bees

Lesson Outcome: At the end of this lesson the student will discuss the main pests of apiaries.

Some pests are attracted to honey:

Pest	Solution
1. <u>Robber bees</u> - bees from other hives often raid weaker hives and steal honey.	-Ensure all hives are strong and healthy.
2. <u>Ants</u> - enter and taint the hive as well as steal honey.	-Paint kerosene around foot of hive stand to repel the ants.
3. <u>Mice</u> - enter hive and destroy comb as well as taint and build nests inside the hive.	-Ensure entrance is small enough for bees to guard. -Place rodenticide near hive to poison rats. -Keep apiary clear of weeds.

Some pests are attracted to honey, wax and pollen

1. **Wax moths** - come in two main types

(i) Grater wax moth (*Galleria mellonella*) - which is pale brown to grey, 20mm long with grey wings. Lay pinkish white eggs in clusters in hive.

(ii) Lesser wax moth (*Achroia grisella*) - which is silver grey to yellow, slender 13 mm long. Lays solitary eggs in the hive.

These notorious pests enter the hives at night and lay eggs near wax combs. The larvae hatch and begin burrowing through the combs to eat honey, pollen, beeswax and debris in the cells. Moth larvae ruin combs and plaster them with webbing and faeces.

2019 – Describe one symptom which a farmer would observe in a bee hive that is infested with wax moth.

Some pests are attracted to bees:

Pest	Symptoms	Prevention
<u>Tracheal mites</u> (<i>Acarapis woodi</i>) -enter the tracheae of young bees, block air exchange and pierce the walls of the tubes to suck blood.	-bees become weak -colony death rates are high during winter	-treated with Miticur -special formulations of menthol
<u>Varroa mites</u> (<i>Varroa destructor</i>) -size of pin head and copper in color -cling to adult bees and suck their blood <div style="border: 1px solid black; padding: 2px; display: inline-block;">2017 – MC No. 16</div>	-infested colonies die within three to four years	-treated with Apistana -formulation of fluvalinate
<u>Toads, lizards and birds</u> -usually wait outside the hive and eat bees at the entrance	-presence of toads	-raise hives knee height off the soil. -fence & keep apiary free of weeds

Some pests are curious

1. **Cattle, goats, horses and pigs** - are either attracted to the smell of honey, use the hives to scratch against or are just plain curious. They knock over the hives especially if stung, causing the bees to swarm. These pests will sometimes return to the abandoned hive and eat the comb.

2. **Children** - play games which anger the bees and will often end in stings and unnecessary stress for the bees. Education, fences and experience helps.

Content Learning Outcome: AS 12.4.1.4 Describe the Harvesting, Post Harvest Treatment and Use of the Products and By-Products of Apiculture

Lesson 1: Extracting Honey

Lesson Outcome: At the end of this lesson the student will discuss when honey is ready for harvesting.

Curing honey - reducing the moisture content of nectar from 80% to 18% or less to produce honey

Honey is cured nectar and is made by worker bees.

Worker honeybees visit thousands of flowers, and collect nectar from them, storing it inside their bodies in a special “honey stomach”. When inside the bees, the nectar mix with a number of proteins and enzymes produced by the bees, starting the honey-making process. When the worker honeybees return to the hive, they transfer the nectar into the beeswax comb, and repeat the process until the combs are full.

The bees then fan the air around the stored nectar with their wings, drying the moisture out of it and preparing it for long-term storage: during this process the nectar thickens and eventually transforms into what we recognize as honey. When this is done, the bees cap the honeycomb with wax and move on to the next empty combs, beginning all over again.

Honey is harvested from hives which are strong. Harvesting honey from weak hives results in starvation of the colony members.

Honey can be harvested from the honey supers if:



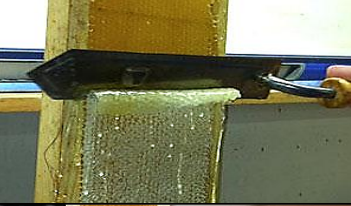




1. **Combs are capped** - this honey has been cured and stored by bees for future use, so is ready for extraction.
2. **Uncapped honey is cured** - turn frame so uncapped cells of honey are facing ground and tap gently.
 - ✓ Cured honey will not leak out and can be harvested
 - ✓ If content of cell leak out, it is nectar that hasn’t been cured (water content is too high)
 - ✓ Attempting to bottle this nectar results in watery syrup that is likely to ferment and spoil

2017 – Predict a problem which may result if a honey bee farmer extracts the content of uncapped frames.

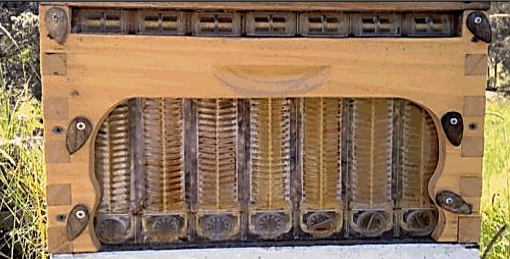

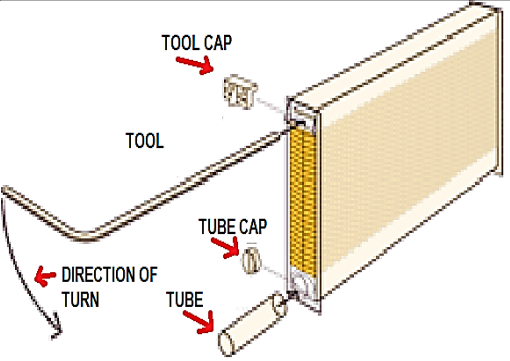

Harvesting honey from capped combs


1. Open the Hive

- first step in honey harvest process is to open beehive
- use smoker around entrance of beehive to subdue bees
- remove top of hive and smokes bees down to lower end of hive

<p>-this results in fewer bees on frames of honey</p>	
<p>2. <u>Choose capped frames and remove bees</u></p> <ul style="list-style-type: none"> -inspect each frame in honey super -brush frames of capped honey and placed in an empty super -uncapped honey and frames from brood chamber are left untouched 	
<p>3. <u>Uncap the honeycomb</u></p> <ul style="list-style-type: none"> -super of selected frames are taken to honey house for extraction -honeycomb is uncapped using a sharp knife or electric knife -wax is stored separately -honey is removed by squeezing the wax 	
<p>4. <u>Extract honey from honeycomb</u></p> <ul style="list-style-type: none"> -uncapped frames of honeycomb are placed in baskets in an extractor -frames are spun using centrifugal force, removing honey from combs -honey is thrown against walls of extractor, where it runs down and collects at bottom of extractor -frame baskets are turned and then spun again so all honey is removed <p>2019 – Explain how the honey extractor removes honey from the honey comb.</p>	
<p>5. <u>Filter honey</u></p> <ul style="list-style-type: none"> -most extractors have spigot at bottom for draining honey -honey is strained to remove debris, such as wax and bee parts <p>2019 – One method used by farmers to separate raw honey from debris, like wax, during the extraction process.</p>	
<p>6. <u>Stand extracted honey</u></p> <ul style="list-style-type: none"> -leave honey in closed container for around 12 hours to expel air bubbles before bottling. <p>2018 – Why farmers stand extracted honey for 12 hours before bottling?</p>	
<p>7. <u>Bottling honey</u></p> <ul style="list-style-type: none"> -honey is filled into sterilized containers which are closed, labeled and packed ready for use or sale. 	
<p>8. <u>Return frames to hives</u></p> <ul style="list-style-type: none"> -frames are returned to the honey supers from which they were taken. 	

Harvesting honey from flow hives

<p>1. <u>Determine which frames are ready for extraction</u> -view frames through glass window to determine which frames are ready for extraction. [N.B. frames are not removed from hives]</p>	
<p>2. <u>Attach the tube</u> -remove tube cap from flow frame and insert one end of the tube with the other end placed in collection container.</p>	
<p>3. <u>Insert the tool</u> -remove tool cap from flow frame which is inside the hive. -insert tool into slot</p> <p>2018 – MC No. 16</p>	
<p>4. <u>Adjust flow frame to release honey</u> -tool is turned 90°, causing comb to realign and allowing honey to flow down the center of comb and out of the pipe, into collection container.</p>	
<p>5. <u>Honey is collected</u> -collected honey can now be taken for settling to remove air bubbles and for bottling.</p>	

	
<p>6. <u>Flow frame is readjusted</u></p> <p>-tool is turned back so that comb is returned to its original shape.</p> <p>-bees can now uncap the combs and begin to refill it with honey.</p>	

Lesson 4: Products and By-Products of Apiculture

Lesson Outcome: At the end of this lesson the student will discuss the uses of the products and by-products of apiculture.

Beekeeping produces many primary products with the main one being honey. The lower the water contents of honey, the higher its quality.

1. Honey

- ✓ rich source of natural sugars (contains 80% fructose and glucose)
- ✓ lasts for long period of time (honey with water content of 18% or less will not ferment)
- ✓ contains 2% minerals, vitamins, proteins and pollen
- ✓ contains the minerals Ca, Cu, Fe, Mg, Mn, P, K, Na and Zn
- ✓ contains no fat nor cholesterol

Honey is used for:

- ❖ food and as food ingredient and preservative
- ❖ medicine and as a medicine ingredient
- ❖ improving and preserving the aroma and humidity of tobacco
- ❖ cosmetics as skin treatment, moisturizer, softener; in creams, soaps, shampoos and lipsticks

2. Beeswax - a natural secretion from wax glands on the undersides of body of honey bees.

* used primarily as a building block for the bees' honeycomb cells in which the young are raised and honey and pollen are stored.

* to stimulate production of beeswax, honey bees eat honey and huddle together to raise the temperature of the cluster.

After honey is extracted, beeswax is collected and cleaned and used for many purposes including:

- ✓ making candle cosmetics and hygiene items
- ✓ food processing including coatings on cheese
- ✓ lubricants on zips, hinges, metal and wood joints
- ✓ varnishes and polish for granite, metals, leather and wood surfaces
- ✓ preventing metals rusting and tarnishing
- ✓ coating nails and screws to prevent wood splintering
- ✓ printing in fabric [batik] and egg art
- ✓ medicines

- ✓ art supplies including crayons, modeling wax etc.

3. Bee pollen - is male gamete of flower blossom which is collected by honey bees and mixed with bees' digestive enzymes.

It is low in calories but rich in proteins, amino acids, vitamins, minerals, enzymes and carbohydrates.

It is harvested from hives and used in:

- ✓ medicine
- ✓ food supplement
- ✓ hygiene products
- ✓ cosmetics
- ✓ feed supplement

2017 – MC No. 15

4. Propolis - is a resinous mixture that honey bees make by combining sap from trees and flowers with saliva and beeswax.

They use propolis to:

- ❖ reinforce the structural stability of the hive and reduce vibration
- ❖ make the hive more defensible by sealing alternative entrances and cracks
- ❖ prevent diseases and parasites from entering the hive
- ❖ inhibit fungal and bacterial growth

Bees usually carry waste out of hive. However, if small lizard or mouse, for example, finds its way into hive and dies there, bees may be unable to carry it out through hive entrance. In that case, they would attempt instead to seal carcass in propolis, mummifying it and making it odorless and harmless.

Propolis is harvested from the hive and used for:

- ✓ food like propolis chewing gum
- ✓ car wax, local anesthetics and cosmetics
- ✓ varnish for the strings of musical instruments
- ✓ medicine kills bacteria, virus and fungi

2019 – Name the substance which honey bees use to mummify pests, like rats, which enter the hive.

5. Royal jelly - is a milky-white viscous substance which worker bees produce by mixing honey and bee pollen with enzymes in the glands of their throats.

They secrete royal jelly from the pharyngeal glands and feed it to all larvae during their first few days. However, it is continually fed to larvae selected to be queens.

Royal jelly contains high concentration of vitamins B5, B6, and amino acids and is believed to be a potent antioxidant.

Royal jelly is harvested from the hive and used for:

- ✓ medicines and cosmetics
- ✓ energy tonics and food supplements

6. Pollination services - where colonies of bees from beekeepers are hired by farmers for the purpose of pollinating their crops.

7. **Hive stock** - the raising of queens and nuclear colonies for sale.

8. **Apitoxin** - is the bitter colorless honey bee venom, which causes local inflammation and acts as an anticoagulant. Honey bees produce this venom when they sting, as a form of defense.

This venom can be collected and injected to treat rheumatoid arthritis, neuralgia [nerve pain], multiple sclerosis [MS], desensitising against bee stings, tendonitis [swollen tendons], and muscle conditions such as fibromyositis [inflammation] and enthesitis [inflammation of the sites where tendons or ligaments insert into the bone].

2019 Essay Question No. 5

- ✓ **Types of artificial hives used to farm bees (3 marks)**
- ✓ **Items of protective clothing worn by bee-keepers (3 marks)**
- ✓ **Uses of beeswax (3 marks)**