

BEE KEEPING (APICULTURE)

Apis is a Latin word for bees. The honey bee is *Apis mellifera*.

Terms used in bee keeping

Apiary/Bee yard; a place where a number of bee colonies are kept.

Apiculture; the keeping of bees.

Bee keeping; the art and science of managing bees for the production of honey, bee wax, propolis, bee pollen, royal jelly, and bee venom.

IMPORTANCE OF BEES

- Production of nutritious food like honey, pollen and royal jelly.
- Income generation from sale of different bee products and services.
- Pollination of food crops.
- Contribution to biodiversity; bees sustain natural habitats through pollination and aid reproduction of plants in these habitats.
- Bee keeping contributes to agro-tourism.
- Entomological research e.g. in toxicology studies of agricultural and veterinary drugs.
- Bee keeping provides employment.
- Bee products are used for treatment of human diseases (Apitherapy).
- Bee keeping creates relaxing atmosphere (leisure).
- Bees are being used in modern warfare in detection of explosives and narcotics.

LIMITATIONS OF BEE KEEPING

- There is little knowledge on bee management, harvesting, processing.
- Bees are aggressive insects when disturbed
- Bees require special environment with low temperature, free of noise etc.

- Bees are attacked by many enemies which kill them and rob their honey.

The Justification for bee keeping/ Reasons for increasing popularity of bee keeping

- Bees pollinate crops hence boosting crop yields and house hold incomes.
- Bee products generate high income levels.
- Bee keeping requires limited capital to start since bees are got from the wild and equipment are made locally.
- Bee keeping does not use land needed for crops but can be done on waste land areas.
- Bees do not compete for food with other livestock or people.
- local traders benefit from bee keeping industry bee making bee hives, equipment and selling products.
- Bee keepers have a financial reason to Conserve the environment, ensuring that bees are protected.
- Bee keeping can be done by people of all ages since they do not need daily care even the lame.
- Bee keeping is an enterprise that generates income without necessarily destroying the habitat.
- Presence of favourable environmental conditions for bee keeping.
- Bee keeping creates an opportunity for diversification by the farmers.

SYSTEMS OF BEE KEEPING

1. Bee killing or honey hunting

This is where hunters invade nests, kill bees for honey.

Disadvantages of honey hunting

- Nests and bees are destroyed or bees abscond.
- Bees may become aggressive and attack people or animals.
- Access to the colony can be far, difficult and dangerous.

- Combs get mixed during harvesting and this can produce bad quality honey.
- The environment is damaged since trees are cut and fires are set.

2.Bee hiving

This method conserves bees and allows regular harvesting of honey and wax. Honey bees are encouraged to settle into simple or Traditional hives

Advantages of bee hiving

- The fixed combs are cheap and require limited labour costs.
- Less risky than honey hunting.
- Hives can be placed close to home.

Disadvantages

- Combs are fixed and must be broken during harvesting hence cannot be re- used
- Honey yields are modest.

3.Bee keeping

This involves the keeping of bees in specially designed modern hives such as the top bar hive and Langstroth's hive in which combs are movable without disturbing neighbouring combs.

TAXONOMY AND COLONY CYCLE OF HONEY BEES

Kingdom: Animalia

Phylum: Arthropoda

Class: Insecta

Order: Hymenoptera

Family: Apoidea (social bees)

Genera: Apis (Honey bees)

Species: Mellifera (Ugandan honey bee- Apis mellifera scutellata)

HONEY BEE RACES

Distinguishing factors for honey bees include;

- Body size; Apis mellifera scutellata is smaller than Apis mellifera linguistica.
- Colour; the first dorsal segment of the abdomen varies in colour between light yellow and entirely dark.
- length of tongue; 1.7 mm difference between tongues of bees.
- Hair coverage: some races have wiwi and dense tomenta.
- Veins of the wings; Wing veins join and enclose some cells, shape of cells.
- Number of hooks on the wing : Width of the metatarsus.
- Shape and size of wax glands.
- Shape of the chitinous plates of male sexual organs.

MEMBERS OF THE COLONY

1.The queen

- Fully fertile female.
- Largest in size.
- Mainly lays eggs. Workers eggs(fertilized) or drone eggs (unfertilized).

2.The drones

- Male bees in the colony.
- Larger and heavier than workers.
- Have no stings.
- Main function is to mate with the queen.

3.The workers

- Females that lack fully developed reproductive organs of the queen.
- They are the Smallest in size.

Functions of young workers in a hive

- Cleaning cells for re- use.
- Nursing the grubs [Larvae], by feeding them on royal jelly.
- Secretion of bees wax for Comb Construction,
- Receiving nectar which the foragers bring and converting it into honey by evaporating water from the nectar and digesting the sucrose into glucose and fructose.
- Cooling the hive if it gets too hot, by receiving water from foragers and spreading it on the surface of the combs, evaporating it by fanning it with her wings.
- Keeping the hive clean by removing any debris.
- Guarding in front of the hives, ready to sting any intruders.

General duties of workers

- Cell cleaning: Nurse bees remove debris, faecal matter from the hives.
- Brood, queen and drone feeding.
- Building the comb using wax secreted by wax glands of worker bees.
- Food transmission and processing nectar is transmitted from worker to worker, worker to queen or worker to drone.
- Colony defence against strangers.
- Undertaking dead bees 30M away from the hive,
- Regulating temperatures in the hives (thermo regulation).

SOCIAL BEHAVIORS OF BEES

Swarming: It's the movement of bees from one place to another looking for a new bee hive.

Causes of swarming

- Change in the ratio between number of young workers and the brood. As honey occupies many cells, the foragers have to vacate and find a new hive.
- Overcrowding in the hive due to rapid population buildup.
- Emergency of a new queen in the colony makes the workers to vacate.
- Overheating in the hives encourages buildup of new queen cups and queen cells hence swarming.
- Outbreak of pests like mites and ants and diseases in the hives.
- Sick or infertile queen that makes worker bees to vacate the hive.
- Damage of brood combs during honey harvesting or by pests and parasite in the hives.
- Strong bad odour/ smell in the surrounding environment that makes the bees uncomfortable.
- Too much direct light to the hive.
- Shortage of food and water within two miles radius of the hive.
- Annual urge to multiply in New and better environment.

Prevention of swarming

- Adding honey supers on time to increase hive volume.
- Removing artificial swarms from the colony.
- Good ventilation of the hive to reduce temperature rise.
- Controlling pests and disease in and around the hives to make the bees comfortable and reduce damage of the brood.

Migration: it's the process of bees leaving the hives they had colonized over Sometime,

Causes of migration

- Pests and predators.
- Unfavourable weather e.g. overheating.
- Dampness.
- Disturbances by man.
- Shortage of forage.
- Disease attack.

Supersedure: it's a means by which an old queen may be replaced. This is when a colony realizes that the queen is no longer productive, producing more drones than workers'

Absconding: Sudden departure of bees from their hive.

Aggressiveness: tendency of some bees being prone to attacking and defending than others.

Honey flow, it's the collection of nectar in abundance by bees due to favourable conditions.

Dearth period, it's when honey production is at minimum when plants stop flowering.

Field force, it's the total population of a colony that collects nectar, pollen and water.

Reproduction and Mating in Honey Bees

Mating of the queen

On a mating day, a virgin queen comes out of the hive and flies while locating landmarks (tree houses) so that she can recognize her home on return. During her nuptial flight (usually in the afternoon of a bright and clear day. The queen is pursued at speed by many drones whom she has attracted using a characteristic pheromone. Mating takes place in air and may be done by more than one drone. During mating, the sperm mass in the drone's penis bulb is discharged by eversion of the penis into the queen's vagina

pouch.

The mating queen separates herself from the drone, the penis bulb remains in her genital tract, the male organ having been torn apart at its weakest point between the bulb and the penis neck.

The drone bleeds to death and its carcass(body) falls off, giving way for other drones to have a lifetime chance to mate with the queen .

The spermatozoa discharged by the drone are first stored in the distended lateral oviducts. As soon as the remains of the male organ and the mucus are removed from the vagina by muscular contractions, the female forces the spermatozoa into the vagina.

The spermatozoa are directed into the spermatheca where they retain their viability throughout the reproductive life of the queen (2.5 years).

LIFE CYCLE OF BEES

Egg laying

When an egg is ready to be laid, the lower end of its follicle opens and the egg passes down the oviduct into the vagina. Eggs that produce females are laid in worker comb cells, and because these are small, the queen's abdomen is squeezed together with the spermatheca, hence sperm is released to fertilise them.

The eggs that produce males are not fertilized since they are laid in large cells. The queen lays all the eggs in hexagonal bees wax cells built by workers. Depending on the feeding of the larva, the fertilized egg becomes a queen or worker. Drones develop from unfertilized eggs by a process of parthenogenesis called arhenotoky.

METAMORPHOSIS

The brood (developing young honey bee) go through four (4) stages;

Egg stage.

Larva; the larva feeds on royal jelly during the first three days after hatching. The royal jelly is produced by the worker bee. The drone to be and worker to be larvae feed on nectar and pollen; the queen larvae feed on royal jelly.

The pupa; the antennae, legs and wings are formed, compound eyes and adult mouth parts are present. The pupa sheds its cuticle and does not change further externally.

The adult: emerge from splits of pupal shells. Workers emerge after 16 days,(30 days life span), Drones after 21 days(survive as long as they don't mate),Queen after 24 days (Up to 5years lifespan).

ANATOMY OF HONEY BEES

The head: the center of information gathering.The visual, gustatory and olfactory inputs are received and processed by the head.

Compound eyes; for motion and mosaic imaging.

Simple eyes/ocelli; provide information about light intensity.

Mouth parts; chewing and sucking.

Endocrine glands; produce juvenile hormone for queen- worker differentiation.

Exocrine glands; the mandibular gland produces queen pheromones.

Thorax : divided into prothorax,mesothorax, metathorax and propodeum.

Abdomen has 9. segments, poses wax glands, the scent glands, the sting, the alimentary canal.

COMMUNICATION OF BEES

Honey bee dances

The circular or round dance:

performed when food is 150 meters around the hive.

Waggle dance: performed when food is 150 meters and more away from the hive.

The sickle dance.

PHEROMONES**Worker pheromones**

1. The Nasanov gland produces geraniol, citral 2, citral E, Nerol, Nerolic acid, Geronic acid and Farnesol. These help bees to easily find entrance to the hive during swarming.
2. The Koschevnikov gland: Secretes the alarm pheromone that attracts other bees after a bee stings your body.
3. The Dufour glands: indicate families, colony kinship or nest ownership.
4. Mandibular glands: secrete heptan-2-one for designating an object or attack.

Queen pheromones

Mandibular glands: secrete the queen substance 'queen mandibular pheromone' containing:

- 9-oxodec-2-enoic acid that inhibits workers from constructing emergency queen cells, inhibits ovary development in workers.
- Attracting drones during mating flight.
- Attracting workers to the queen in the hive

The Koschevnikov glands: formation of the clusters of court bees that surround the queen

Drone pheromones:

The mandibular glands secrete a hormone that causes drones to gather together.

BEE KEEPING TOOLS AND EQUIPMENT

Hives: house for bees.

A. Traditional hives: these include the following;

1.Log hive: A tree is felled and cut into cylindrical or truncated conical shape.

2.Basket hive: woven flexible sticks in a cylindrical or truncated conical shape.

3.Grass hive: woven dry grass in a cylindrical form.

4.Clay-pot hives.

5.Gourd hive.

NOTE. The traditional bee hives are cheap and simple.

DISADVANTAGES OF TRADITIONAL BEE HIVES.

- It's not easy to inspect the colony.
- It's not easy to harvest honey.
- They are easily affected by pests.
- They give low yield of honey.
- Don't permit Return Of honey combs.
- Combs affected by diseases can't be identified and removed.

B. Improved hives

1. Langstroth hive: made up of the following: lid, Crown board, Honey super, Queen excluder, Brood chambers, Floor Board as shown in the diagram below :

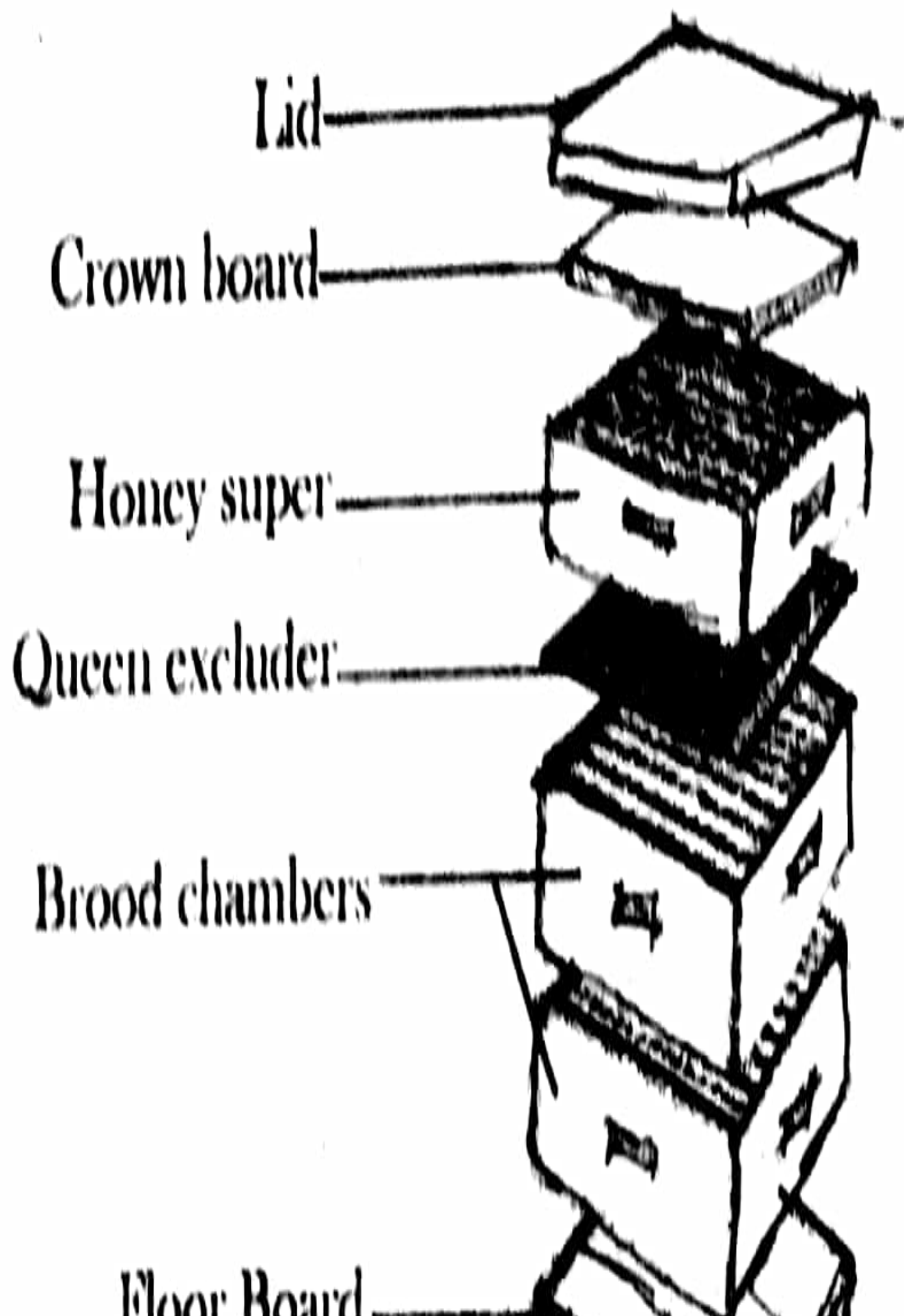
Bottom board: a wooden stand on which the hive rests.

Frames and foundation: wooden frames hold sheets of bees wax.

Hive body/brood chamber: a large wooden body for bees to rear brood and store honey for their own use.

Queen excluder: placed between the brood nest and the honey supers, keeps the queen

confined in the brood nest.



Advantages of using a queen excluder

- The queen bee only lays eggs in the brood chamber.
- The honey chamber contains clean honey.
- Wax from the honey chamber is clean and white.
- When honey is removed, bees are calm as there are fewer disturbances.
- Bee population increases steadily and therefore more honey is produced since there is no disturbance to the queen and the brood.

Honey supers: bees store surplus honey that is harvested.

Inner cover: insulates the hive against temperature changes.

Over cover: provides weather protection.

Feeders: hold sugar syrup that is fed to the bees in prolonged dry season.

Advantages of the langstroth hive

- The comb is firmly fixed to four sides of the frame hence easy to harvest without damaging the comb
- The strength of the built-in comb also allows easy transportation, Honey is extracted using the centrifugal extractor making it possible to remove the honey without damaging the comb.
- Very few bees are crushed during hive manipulation.

- The queen and brood are undisturbed during honey harvesting.
- It is easy to hive a swarm of bees since the bees easily pass through the space between the frames.
- Hive boxes can easily be stacked for storage.
- It is difficult to be stolen.

Disadvantages of the langstroth hive

- It is expensive to purchase.
- A high degree of craftsmanship is required to build the hive.
- The wood for constructing the langstroth frames needs to be seasoned for at least a year, which is hard for local carpenters.
- It requires many equipment to harvest the honey e.g. extractors, de-Capping knives, trays.
- They are heavy and difficult to carry.

- The size of the hive c

- The size of the hive can vary to suit local conditions.
- Every comb is accessible without removing the others.
- The brood can easily be inspected for disease, giving the bee keepers control over the hive.
- The bee keeper can judge the exact time when the combs are ready for harvesting.
- The farmer gathers good quality bee wax which is marketable.
- No lifting is required other than that of the comb.
- There are better management techniques promoted by these hives hence preserving and improving bee populations.

ADVANTAGES OF IMPROVED BEE HIVES.

- The combs can easily be removed from the colony for inspection and replaced.
- Harvesting is easy and possible to select ripe combs.
- The honey combs can be removed from the colony without disturbing the brood nest.
- It leads to high yield of honey and bee wax.
- They have high colonization rate if baited correctly.
- The queen excluded can be fixed to separate the honey comb from the brood.
- It leads to improved honey quality since the pollen and brood combs are not included in the honey.

DISADVANTAGES OF IMPROVED BEE HIVES.

- They are expensive to buy.
- They require lot of skills to make and use.
- They require lot of care and supervision.
- There are high rates of absconding by bees if not well managed.
- They take long time to be colonized if not correctly baited.
- They have many movable parts that pave way for entry of pests into the hive.

CARE OF BEE HIVES.

- painting of external surfaces with preservatives.
- The hive should be put in a leak proof place to prevent deterioration of timber.
- The hives should be raised off the ground to prevent pests and dampness.
- Protect the hives from wild animals and farm animals by fencing.
- Never use fire on the hives as this can damage the hives.

SMOKERS

Produce smoke which calms bees and reduces stinging.

Adaptations of the smoker to its functions;

- Possess a bellow for pumping/ puffing smoke in the hive.
- Possess ignition chamber where dry material is put with fire to produce smoke.
- Narrow outlet/vent for smoke to enter the hive inlets.
- Handle for grip during the operation.

How to use a smoker

- Put burning materials or substances with smoke in the ignition chamber.
- Press the bellow to generate pressure to release smoke out.
- Apply smoke coming out through the vent onto the hive to suffocate the bees and make them docile.

Hive tool (prying tool)

It is sharp at one end and is used in cutting honey combs during harvesting. It's also used in prying i.e Used to separate the top bars

Container; used for placing honey after harvesting

Bee suits, veils, gloves; protect the bee keeper's body, head and arms from stings

Honey tank; for storage of honey.

Honey extractor; extracting honey from the combs. Solar wax extractor melts the comb after honey extraction to recover the wax for further industrial use.

THE APIARY

An apiary is a place where a number of be hives are kept.

FACTORS CONSIDERED WHEN SITING APIARY

- Nearness to water source; place hives besides a river or stream and in areas of no flowing water, provide water in the apiary.
- Proximity to flowering trees and plants; place bee hives within a bushy area rich in flora where different trees bloom at different times,
- Wind direction; the hive should be sheltered from strong winds with hedges.
- Overhead sun; place the hives in shady place since too much sunshine causes overheating in the hives.
- Noise and pollution; site the apiary away from noisy places like roads, Public places etc. and away from Sources of smoke.
- Distance from homesteads and the grazing area the apiary should be at least 100M away from the home dwellings.

Features of a good apiary site

- Should be at least 100- 200 meters away from human dwellings.
- Should be quiet and away from areas where children play or any other source of noise.
- Water should be available at least a mile away .
- Proximity to flowering trees and shrubs and crops that need pollination.
- The hives should be sheltered from strong winds.
- The hive should be sheltered from strong sunshine.
- Dryness of the environment; away from marshy areas since this encourages fungal growth and prevents honey from maturing.
- Should be a way from cattle and other livestock.

- The path to the apiary should not face the entrance to the hives to avoid frightening the bees.

Sources of starter bee colonies

- Buying and moving colonies.
- Catching Swarms clustered on accessible places such as low tree branches.
- Installing packed bees.

PROCEDURE OF STOCKING A BEE HIVE

- Smear a hive with an aromatic old comb or shecp sorrel to attract bees.
- Transfer a swarm cluster to a new hive using a catcher net. Ensure the queen is in the swarm cluster.

Note. Catching of bees is best done in the morning whe the bees are less active,

- Use a catcher box- a small box placed near a bee cluster, when bees collect in it, transfer the box close to the hive and position it conveniently. The bees then move into the hive.
- Place the hive in a convenient site, this increases the chances of a swarm occupying it.

FACTORS THAT ENCOURAGE COLONIZATION OF THE BEE HIVE

- Cool environment.
- Availability of water.
- Availability of flowers.
- Placing hives in a quiet and isolated place
- Place hives in a north- south direction to avoid the sun.
- Placing hives in a cool sheltered place.
- Putting a small bee swarm or queen in a hive.

ROUTINE APIARY MANAGEMENT ACTIVITIES

- Provision of water during dry season
- Provision of security by fencing
- Provision of shade to the hives
- Provision of foraging plants to provide pollen and nectar to bees.
- Pests control in an apiary.
- Re-stocking of empty hives.
- Hive inspection; ensure that the hive does not become dirty or a residence for mice and wasps that keep off the swarm.
- Colony division and unification; splitting the colonies already in the apiary, transfer the brood with the queen into the new hive.
- Annual re-queening; kill and discard the old queen, leave the colony queenless for 24 hours and introduce the new queen in the hive.
- Supplementary feeding; during prolonged dry seasons, provide sugar Syrup
- Apiary cleaning, cut the grass around the hives, remove tree branches touching the hives.
- Record keeping; makes hive inspection easy.

THE FOLLOWING RECORDS ARE KEPT BY A BEE KEEPER.

- Date/time of last inspection,
- forage and weather conditions
- Date of occupation/colonization
- Honey yield per harvest
- Age of queen
- cash flow analysis.
- Date of last harvest

- colony strength and growth
- Amount of honey in store
- Hive characteristics
- Swarming record
- pest incidence and their control.

IMPORTANCE OF RECORDS TO A BEE KEEPER

- They are used in selection of the queen for use in breeding.
- Used during evaluation of the economic viability of the colonies and the apiary.
- They are used during inspection and monitoring of the progress of the colonies in the apiary.
- They are used to time the progress of the hives to ensure timely harvesting of honey
- Used during control of pests in the colony.

HONEY HARVESTING

Precautions taken during honey harvesting

- Harvest when the honey is ready; i.e smells of honey, when bees are more aggressive than usual.
- Harvest in the cool of dusk.
- Do not harvest during rainy weather as water dilutes the honey.
- Use a suitable smoker.
- Harvest combs that are 2/3 full of honey.
- Leave light coloured combs for the bees to use re-build a new honey comb.

- Place the honey combs into a pot or bucket that can be closed to avoid robbing.
- Always carry two clean and dry containers with sealed lids.
- Remove dirt from then honey.
- Avoid propolis and too much pollen in honey.

STEPS OF HARVESTING HONEY

- Be clean and use clean sterilized equipment.
- Wear protective clothing and assemble all the necessary tools at the apiary.
- Place a few embers in a smoker.
- Using a smoker, puff all around the sides on the hive then introduce smoke inside the hive gradually. On sensing danger, the bees inside the hive suck alot of honey and thus become docile and will not sting a lot.
- Remove the hive's top cover.
- Systematically remove the top bars each in turn and check for comb formation.
- Scrape off the bees from the combs with use of a hive tool. If the comb is brightin colour, then it contains honey, but if it is dark colored, then it has brood.
- If the comb has honey, cut it using ahive tool and lea a small length (2.5cm) still attached to the bar and place back. This will serve as a an oricntation line for a new comb.
- Place the cut comb in a clean container.
- Leave some honey combs for the bees.
- Work gently and smoothly not to upset and kill bees.
- After checking all the combs, replace the top cover to its normal position.
- Carry the containers out of reach of bees still buzzing around.

HONEY BEE PRODUCTS

- Composition of honey
- Honey sugars, 95-99% of honey dry matter
- Water content;
- Acids.
- Minerals e.g. chlorine, sodium, calcium,
- magnesium, potassium.
- Hydroxymethylfural.
- Water insoluble solids-suspended wax particles, insects, vegetable debris and
- pollen grains.

USES OF HONEY

- Food to humans as a sweetener or eaten directly.
- Health benefits are derived from feeding on honey e.g. For respiratory diseases , gastric ulcers, skin and wound healing.
- Honey helps with recovering from alcohol intoxication.
- Raw material in baked products, confectionary, milk products.
- Honey is used in tobacco, meat, cosmetic industry.

FACTORS AFFECTING QUALITY OF HONEY

- The method of extraction: direct heating of the honey combs discolors the combs lowering its quality.
- Type of flowers from which the nectar was collected.
- Season of the year; honey formed of dry season tends to be of a lower quality.
- Stage of honey maturity; mature honey is of good quality.
- The method of storage after harvesting.
- The method of handling during harvesting i.e dirty containers results to poor quality honey.

PROCESSING OF HONEY

1. Sieving method: the honey combs are crushed, placed in a muslin cloth put on a container and left for several hours. The honey drips through the muslin cloth into the container leaving the combs with wax on the cloth. The honey is then collected and any scum scooped out,

2. Heat method: the honey combs are put in a container which is then immersed inside another container with water being heated. The combs are heated causing honey to melt. The honey is placed in a clean container and left to cool. After cooling, any wax found floating on the honey is removed.

3. Honey extractor: used in large scale honey extraction. Crushed honey combs are placed in a centrifugal extractor which is operated either manually or mechanically. The high centrifugal force extracts honey from the combs.

Uses of bee venom

Bee venom is a defensive agent against predators. It is water soluble and not fat soluble.

REVISION QNS

- (f) Describe the procedure of harvesting honey from a bee hive.
- (e) What factors affect the quality of honey?
- (h) Describe the procedure of dividing a bee colony.
- (i) Describe the methods of controlling predators in a bee hive