

## STAGE I - BEEKEEPING COURSE

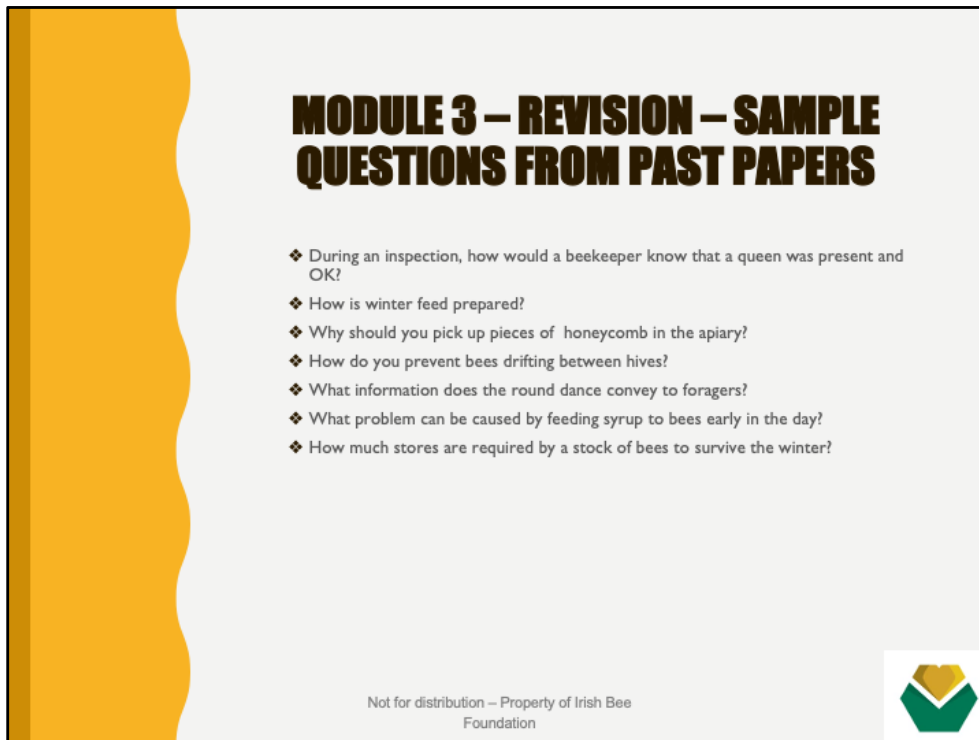


**Irish Bee Foundation**

PROTECTING PRESERVING PROMOTING

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In preparation for Module 4, it's essential to review key concepts, including:

- Recognizing Queen Presence: Look for a consistent brood pattern and new eggs.
- Winter Feed: Typically a 2:1 sugar-to-water mixture.
- Hive Cleanliness: Always collect any pieces of comb to avoid attracting robbers or spreading disease.
- Hive Management: Prevent bee drifting by spacing hives correctly, which helps avoid disease spread.

These foundational questions ensure readiness to identify and manage potential diseases in the apiary.

## **MODULE 4**

### **DISEASES, PESTS AND POISONING**



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## INFORMATION

- ❖ *'The health of honeybees is under threat today from more diseases than at anytime in the history of beekeeping'*
- ❖ This is the rather gloomy opening line from the preface to John McMullan highly recommended book 'Having Healthy Honeybees'. Beginners would be well advised to have this book to hand before acquiring bees
- ❖ It is only by being familiar with the appearance of healthy bees and brood that the beginner learns to recognise that something looks wrong
- ❖ It is partly for this reason that beginners are often advised to start with two colonies for comparison purposes
- ❖ Beginners would do well to 'befriend' an experienced beekeeper for assistance when they are concerned about disease

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Honeybee health faces significant threats, with more diseases impacting bees now than ever before. John McMullan's book, "Having Healthy Honeybees", is recommended for beginners for in-depth knowledge. Recognizing disease requires knowing what healthy bees and brood look like. Beginners should ideally start with two colonies for comparison and have a mentor to guide them.

## HEALTHY BROOD

- ❖ Queen is laying a **good brood pattern** – brood of different ages in concentric circles on a brood comb. Queen laying in virtually every cell, so they will contain an egg, a developing larva or they will be sealed
- ❖ An **egg** should sit upright in the centre of the middle of the base of the cell
- ❖ **Larvae should be pearly white** and lie comfortably, **curled up in the cell**
- ❖ If the comb has been used to rear several generations, the capping will be dark brown. They are lighter on newer comb and just off-white on brand new comb.
- ❖ Healthy sealed worker brood will have **uniform, slightly domed cappings**. Cappings on healthy drone brood will have a more pronounced dome.



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Healthy brood shows a solid pattern, indicating a healthy, laying queen:

- Brood Pattern: Concentric circles of various brood stages.
- Egg Position: Should be centered and upright in each cell.
- Larvae: Should appear pearly white and coiled.
- Cappings: Slightly domed for worker brood, more pronounced for drones, darker as comb ages.

Monitoring these signs helps identify early deviations that could signal disease.

# DISEASES

## Viruses

Chronic Bee Paralysis Virus (CBPV)

Sac Brood Virus (SBV)

Deformed Wing Virus (DWV)

## Queen Disorders

Queenlessness (Test frame)

Laying Workers

Drone Laying Queen

## Other Disorders

Pests (Wax Moths, Mice, Wasps/Hornets/Chemical Poisoning)

Dysentery

Colony Collapse Disorder (CCD)

## Bacteria

American Foul Brood (AFB)

European Foul Brood (EFB)

## Mites / Beetles

Varroa Mites

Small Hive Beetle

Acarine (or tracheal mite)

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# AMERICAN FOUL BROOD (AFB) (1)

- ❖ AFB is caused by the bacterium *Paenibacillus larvae*. This develops in the bee's gut, and kills it after the cell has been capped. **Millions of spores are produced**, which are **ingested by house bees as they clean the brood cells**. They will then pass them on to new larvae in the brood food.
- ❖ The reason this disease is so serious is that the **spores can remain viable and last indefinitely on beekeeping equipment**. It is extremely **contagious** and spreads easily on contaminated equipment, hive tools, and beekeeper's hands. AFB spores are resistant to extreme heat and cold and are unaffected by disinfectants.
- ❖ The beekeeper must be aware that American Foul Brood (AFB) is a **notifiable disease** (to the Department of Agriculture). If it is suspected, the comb containing diseased brood should be tested and all other colonies in the apiary should be examined.

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AFB is a serious bacterial disease caused by *Paenibacillus larvae*, affecting larvae after the cell is capped. It's extremely contagious, with spores that can last indefinitely on equipment and tools, making it a notifiable disease.

- Symptoms: Sunken, perforated cappings, a patchy brood pattern, and a distinct odor.
- Ropiness Test: Use a matchstick to check for a ropery substance in infected cells.
- Response: No treatment exists. Confirmed cases require burning infected bees and equipment and sterilizing the hive with a blowtorch.

# AMERICAN FOUL BROOD (AFB) (2)

## ❖ Signs/Symptoms:

- ❖ Sunken, perforated cappings, which may look greasy
- ❖ 'Pepper-pot' appearance where numerous cells have been uncapped randomly
- ❖ Bad smell (not definitive)
- ❖ **Ropiness Test:** Select what looks like an infected cell and open up the capping. Take a matchstick, poke it into the cell and stir up the larval remains. When you withdraw the matchstick, the cell contents will form a mucous-like 'rope' which can be drawn out to 10-30mm
- ❖ No legally permitted treatment of AFB. If the disease is confirmed, the bees are destroyed. All the frames, bees and honey are **burned** in a deep hole and the remains buried to prevent robber bees visiting the site and taking spores home.



Left: Sunken cappings indicating American foul brood.

Below: The 'pepper-pot' patchy brood pattern.





# AMERICAN FOUL BROOD (AFB) (3)

- ❖ The inside of all wooden parts should be **blow torched to coffee brown** with emphasis on crevices
- ❖ All tools and gloves should be **disinfected/sterilised** and the bee suit washed
- ❖ Early detection and swift action is necessary
- ❖ It is essential that a collective responsibility be adopted by all beekeepers in the vicinity of the outbreak



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# EUROPEAN FOUL BROOD (EFB)

❖ EFB is caused by the bacterium *Melissococcus plutonius*. This infects the gut of a developing larva, competing with it for food, and the larva starves to death usually before the cell is due to be sealed.

❖ **Signs/Symptoms:**

- ❖ Infected larvae lie uncomfortably in awkward positions in the cells
- ❖ Dead larvae can appear 'melted' and they turn yellowish-brown
- ❖ Patchy brood pattern with a severe infection
- ❖ Possibility of unpleasant smell from secondary infections
- ❖ When the larva dies after the cell is sealed the capping may appear sunken or perforated
- ❖ Dried larval remains form a scale that can be removed easily from the cells



Below: Sunken cappings from European foul brood.



National Bee Unit, Fera (crown copyright)

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EFB is caused by *Melissococcus plutonius*, which starves larvae by competing for food, often before cells are capped. Like AFB, EFB is notifiable, requiring swift action if suspected.

- Symptoms: Larvae lie awkwardly, turn yellowish-brown, and dry into a scale that's easily removed.
- Response: For light cases, the "shook swarm" method may be used, while heavy infections often require destruction of the colony.

Early detection and collaboration with nearby beekeepers are essential in controlling the spread.

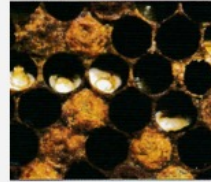
# EUROPEAN FOUL BROOD (EFB)

- ❖ The beekeeper must be aware that European Foul Brood (EFB) is a **notifiable disease** (to the Department of Agriculture). If it is suspected, the comb containing diseased brood should be tested and all other colonies in the apiary should be examined.
- ❖ Confirmed cases require specific and swift action
- ❖ Weak colonies (less than 5 frames of brood) or high infection colonies should be **managed as for AFB**
- ❖ Low infection colonies may be treated by means of a 'shook swarm' however the beekeeper may opt to manage as for AFB
- ❖ An unpleasant odour may indicate a long standing infection
- ❖ All tools and gloves should be **disinfected/sterilised** and the bee suit washed
- ❖ It is essential that a collective responsibility be adopted by all beekeepers in the vicinity of an outbreak



# CHALKBROOD

- ❖ Chalkbrood is caused by a fungus which kills the larva after the cell has been sealed
- ❖ Chalkbrood is widespread, but not considered a serious disease
- ❖ Colonies under thermal stress in early spring or weak colonies exhibit the condition
- ❖ White or grey/black chalky 'mummies' removed by the bees may be seen on the floor of the hive and near the entrance.
- ❖ Chalkbrood is spread by spores sticking to combs and adult bees
- ❖ No specific treatment available
- ❖ In serious cases requeen or move the colony onto new comb



Above and to the left: Chalk brood 'mummies' in the comb.



Left: Chalk brood 'mummies' on the hive floor.

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Chalkbrood is a fungal disease triggered by cool, damp conditions, especially in weaker colonies:

- Symptoms: Infected larvae turn into white or gray “chalky mummies,” often found near the hive entrance.
- Response: While there is no specific treatment, requeening or moving bees onto new comb may help.

Maintaining strong, healthy colonies minimizes the risk.

# NOSEMA

- ❖ Nosema is caused by two microsporidia (single-celled parasites) *Nosema apis* and *Nosema ceranae*
- ❖ House bees clean up the mess in the hive by licking and biting. In doing so, they accidentally ingest the Nosema spores. These multiply in their guts, severely interfering with their ability to digest food.
- ❖ **Signs/Symptoms:**
  - ❖ There are no specific outward sign
  - ❖ A colony affected by Nosema either builds up slowly in the spring, stays the same size or even dwindles and dies
  - ❖ Dysentery, associated with *Nosema apis*, is indicated by brown faecal streaks on the inner cover, the comb, and other surfaces. Dead bees are found outside the hive.
  - ❖ With *Nosema ceranae*, dysentery is normally absent. Bees die away from the hive.
  - ❖ Nosema can only be positively identified using a compound microscope
- ❖ In severe cases, put bees onto clean comb

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Caused by *Nosema apis* and *Nosema ceranae* (microsporidian parasites), this disease disrupts digestion in adult bees:

- Symptoms: Slow colony growth, dysentery (*Nosema apis*), and dead bees outside the hive.
- Diagnosis: Requires a microscope to confirm.
- Response: Severe cases benefit from moving bees onto clean comb to reduce spore buildup.

Proper hive hygiene and regular monitoring help manage Nosema's impact.

# VIRUSES

## ❖ Chronic Bee Paralysis Virus (CBPV)

- ❖ CBPV causes a contagious case of chronic paralysis which can easily spread to other members of a colony
- ❖ Symptoms include trembling of wings and body, loss of flight, loss of hair, and rejection by healthy members of the colony.
- ❖ Bees infected with CBPV die within a few days

## ❖ Deformed Wing Virus (DWV)

- ❖ Affected adults have stunted and deformed wings
- ❖ As they cannot fly, the colony becomes progressively weaker
- ❖ This virus is associated with varroa mite infestations

## ❖ Sac Brood Virus

- ❖ Sac brood is caused by a virus which prevents the larva from making its final moult into an adult
- ❖ The dead larva lies stretched out in the cell in a fluid filled sac

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Several viruses impact bees, often worsened by varroa infestations:

- Chronic Bee Paralysis Virus (CBPV): Causes tremors, hair loss, and bee rejection.
- Deformed Wing Virus (DWV): Linked to varroa, resulting in deformed wings and flightlessness.
- Sac Brood Virus: Larvae fail to molt and die, appearing stretched in fluid-filled sacs.

Reducing varroa mites indirectly helps manage these viral diseases.

# VARROA DESTRUCTOR

- ❖ The mite Varroa destructor is the **most serious threat to bee colonies**. The mite is now pandemic in Ireland, it is in every colony.
- ❖ Both adults and young mites feed on the bee's blood
- ❖ They can only **reproduce in the brood**, and **prefer drone cells**, which are sealed for longer than worker cells
- ❖ Varroa mites are about **1.6mm across** and can be seen with the naked eye
- ❖ **Monitoring for varroa mites** is done using an **open mesh floor (OMF)**, through which mites can fall, but bees can't pass. A removable tray is inserted under the open mesh floor and can be inspected to count the number of mites. (Other monitoring methods include drone brood uncapping, sugar shake and alcohol roll)
- ❖ Treatment is required when the average daily mite drop is more than 1 during the winter broodless period or more than 8 between February and October.



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Varroa destructor is the most significant bee pest in Ireland, feeding on bees' blood and reproducing in brood cells, preferring drone cells due to their longer capping period.

- Symptoms: Mites are visible with the naked eye, particularly on drone brood.
- Monitoring: Use an open mesh floor to collect fallen mites, with regular mite counts.
- Treatment Thresholds: Winter – 1 mite per day; February to October – 8 mites per day.

Managing varroa requires consistent monitoring and targeted treatment.

# VARROA TREATMENT

- ❖ No treatment will kill all the mites within a colony. The treatments are applied when colony numbers reach a level where the health of the colony will be affected.
- ❖ In the case of Varroa there are only four **medications currently licenced** for use in Ireland (Note: 'Animal Remedies Record' of all medications administered must be kept for a period of 5 years). It is imperative to follow **manufacturer's instructions** when using animal medication.
  - ❖ **Bayvarol**
    - ❖ Not recommended because of widespread resistance
  - ❖ **Apiguard**
    - ❖ Normally used in autumn when the supers are taken off
    - ❖ Requires the maximum day temperature to exceed 15 degrees
  - ❖ **Api Bioxal**
    - ❖ Should be used when there is no brood in the colony
  - ❖ **Mite Away Quick Strips (MAQS)**
    - ❖ Suggested treatment times: May or mid-August to allow for natural queen supersedure. There must be a minimum of 6 frames of brood.
    - ❖ Full ventilation is needed

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There are four main treatments for varroa:

- Bayvarol: Not recommended due to resistance.
- Apiguard: Ideal in autumn; requires warm temperatures.
- Apibioxal: Used when colonies are broodless.
- Mite Away Quick Strips (MAQS): Best applied in spring or mid-summer; requires full ventilation.

Follow manufacturer's instructions strictly and record all treatments for five years.



# OTHER MITES & BEETLES

- ❖ **Acarine (Tracheal mite)**
  - ❖ Acarine is an infestation **caused by a mite**. The mite invades the bee's breathing tube (trachea) and breeds therein. This shortens the bees life, which slows colony development. Acarine mites can be seen under a low powered dissecting microscope.
- ❖ **Tropilaelaps Mites**
  - ❖ The Tropilaelaps Mite is a serious pest of honeybees in tropical Asia and other parts of the southern hemisphere and could cause havoc if imported into Europe
  - ❖ Although not found here to-date, the Tropilaelaps mite is a statutory notifiable pest in Ireland.
- ❖ **Small Hive Beetle**
  - ❖ The beetle and its larvae can multiply to huge numbers within an infested colony, where they consume eggs and brood as well as honey and pollen.
  - ❖ This beetle was detected for the first time in apiaries in Europe in South West Italy in September 2014
  - ❖ Although not found here to-date, the Small Hive Beetle is a statutory notifiable pest in Ireland.

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Left: Observing a hive to suspect the presence of Acarine mites. The one is healthy.

Left: This bee has an Acarine mite infestation.



In addition to varroa, beekeepers should be aware of:

- Acarine (Tracheal Mite): Infests bees' breathing tubes, shortening their lifespan.
  - Tropilaelaps Mites: Not yet in Ireland but pose a significant threat.
  - Small Hive Beetle: Not present locally but highly destructive if introduced.
- Early detection and biosecurity are crucial to prevent their spread.

## QUEENLESSNESS

- ❖ When there is no laying queen in the hive, the beekeeper will notice some or all of the following **signs**:
  - ❖ Change in brood pattern/no eggs
  - ❖ Restlessness/aggression
  - ❖ Cells in brood box filled with pollen and nectar
  - ❖ No preparation being made for laying
- ❖ In order to **verify queenlessness**, a tried and tested technique is to introduce a frame of eggs and young larvae from another colony in the middle of the brood nest.
- ❖ If queen cells are being drawn out on this 'test frame' within a few days, queenlessness is indicated.
- ❖ If no queen cell is drawn out on this 'test frame', it may be that a young queen has emerged after a colony has swarmed and is not yet laying
- ❖ OR a queen has been present for a long time but is not laying, in which case she should be found and removed, and a queen cell or laying queen introduced

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A queenless hive can be identified by changes in behavior and brood pattern:

- Signs: Lack of eggs, pollen-stored cells, and restless bees.
- Test Frame Method: Insert a frame with eggs from another colony; if queen cells appear, the hive is queenless.

If no queen cells appear, there may be a young or inactive queen that requires replacement.

# LAYING WORKERS

- ❖ In the absence of queen pheromone, some **workers start to lay eggs**
- ❖ Workers cannot mate, and therefore cannot fertilise eggs – **they only produce drones**
- ❖ **Colony is doomed.** Any attempt to re-queen is likely to result in the introduced queen being killed by the laying workers

## Signs:

- ❖ Multiple eggs in random cells
- ❖ Uneven comb
- ❖ Domed cappings on worker cells
- ❖ Eggs stuck to sides rather than in bottom of cells



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Laying workers develop in queenless colonies, resulting in scattered drone brood:

- Signs: Multiple eggs in cells, domed cappings on worker cells, and uneven comb.
- Response: Such colonies are often doomed, as introducing a new queen is unlikely to succeed.

Managing laying workers can be challenging; replacing the colony or merging with another hive may be the best solution.

## DRONE LAYING QUEENS

- ❖ The **size of the cell dictates whether an egg is fertilised or not** – smaller cells (worker cells) allow the egg to be fertilised, but larger cells (drone cells) don't
- ❖ If a queen runs out of sperm, she will end up laying unfertilised eggs in worker cells
- ❖ This will mimic the laying worker situation with drones being produced in worker cells
- ❖ As the colony is queen right, a **new queen can be introduced successfully**

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If a queen runs out of sperm, she will lay only unfertilized eggs, producing drones:

- Signs: Drone brood in worker cells.
- Response: Introduce a new queen to restore normal colony functions.

This situation mimics a laying worker colony but can be remedied by requeening.

# PESTS

## ❖ Wax Moths

- ❖ Wax moths will eat beeswax and can be a serious pest, especially of stored comb. They can ruin combs and produce copious amounts of webbing and frass.

## ❖ Mice

- ❖ Mice can enter the hives when bees are not active. Once inside, they'll chew wooden parts, eat stores, chew holes in comb and bring in nesting material

## ❖ Wasps

- ❖ Wasps try to rob honey stores from hives in late summer when brood rearing ceases in their own nest until they are killed off by the first frosts

## ❖ Asian Hornets

- ❖ The Asian Hornet hasn't been found in Ireland yet, but it is well established in France, and cases have been confirmed in the UK. If the presence of Asian Hornets is suspected, the Department of Agriculture should be contacted immediately.



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Other common pests include:

- Wax Moths: Damage stored combs, leaving webbing and frass.
- Mice: Enter hives in winter, chewing comb and contaminating the hive.
- Wasps: Attack weaker hives in late summer to steal honey.
- Asian Hornets: Not in Ireland yet but are aggressive predators; any sightings should be reported to authorities.

Maintaining strong, healthy hives with secure entrances reduces pest problems.

# CHEMICAL POISONING

- ❖ Chemical poisoning may be due to natural substances such as toxic nectar, but is more often caused by exposure to fungicides, pesticides and herbicides
- ❖ **Typical Signs/symptoms include**
  - ❖ Large numbers of dead or dying bees suddenly appearing at hive entrance
  - ❖ Bees being ejected from inside or refused entry
  - ❖ Dead bees with tongues extended
  - ❖ Crawling, trembling, confused bees outside the hive

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Bees may encounter chemicals from pesticides, herbicides, or fungicides:

- Symptoms: Large numbers of dead bees at the entrance, crawling or disoriented bees.
- Response: Place hives away from high pesticide use areas, and work with local farmers to reduce chemical exposure.

Bee poisoning can severely impact colony health, particularly during foraging seasons.

## OTHER DISORDERS

- ◆ **Dysentery**
  - ◆ Indicated by **brown faecal streaks** on the outside of the hive, or in more severe cases, inside the hive
  - ◆ Dysentery is the result of **excess water in the intestine**
  - ◆ Causes may include unripe or granulated stores, and long winter confinement
  - ◆ Often associated with Acarine and Nosema
- ◆ **Colony Collapse Disorder (CCD)**
  - ◆ CCD is the term used to describe a phenomenon which was observed and widely reported in North America in the winter 2006/2007.
  - ◆ There was a common set of symptoms:
    - ◆ Rapid loss of adult bees leaving weak or dead colonies with a relatively large amount of food
    - ◆ Lack of dead worker bees around or in the hives
    - ◆ Delayed invasion by hive pests such as wax moths
  - ◆ There is still no consensus as to the cause, but there is an emerging view that CCD involved an interaction between honey bee parasites and other stress factors

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- Dysentery: Caused by excess water in the intestine, marked by brown streaks on the hive.
- Colony Collapse Disorder (CCD): Observed in North America, CCD involves sudden loss of adult bees, leaving food stores intact. The cause remains unclear, with theories suggesting multiple stress factors.

Maintaining good hive conditions and monitoring bee health helps mitigate these issues.

# GOOD PRACTICE

- ❖ **Never transfer combs between colonies**, or divide colonies, without first checking for signs of brood disease
- ❖ Never bring colonies, combs or beekeeping equipment into the apiary unless you are sure they come from a disease-free source. **Never buy old combs**
- ❖ Always **sterilise second-hand hives** by thoroughly scorching with a blowtorch before use
- ❖ **Control robbing** in the apiary. Never leave combs or honey exposed to robbing bees. Never feed honey from another source to your bees
- ❖ If a colony of bees dies out at any time, seal the hive to prevent the remaining stores being robbed out, pending examination of the brood combs for signs of disease
- ❖ **Be suspicious of stray swarms**, hive them on foundation rather than drawn comb. Do not feed for three days. Inspect them for disease once they have become established
- ❖ Regularly and systematically replace old brood combs. **Change at least three brood frames each year**

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Prevent disease spread by adopting safe practices:

- Equipment Control: Only use equipment from known, disease-free sources.
- Regular Inspections: Check for signs of disease before transferring or dividing colonies.
- Robbing Prevention: Avoid leaving combs or honey exposed, and never feed honey from unknown sources.
- Comb Replacement: Regularly replace old brood combs to minimize disease buildup.

Adopting these practices promotes a healthier apiary.



## HONEYBEE DISEASE DIAGNOSTIC SERVICE

❖ Samples for bee disease diagnosis should be sent to:

Dr Mary F Coffey  
Bee Disease Diagnostic Service  
Plant Health laboratory, Blackweston, Celbridge Co Kildare  
W23 X3PH

❖ Send **at least 25 bees** from each hive

❖ Take samples with a matchbox

❖ The sample should be collected from the alighting board or from outer frames in the brood box

❖ The bees should be killed by placing them in the fridge or for an hour in the deep freeze

❖ Even if your bees appear healthy samples should be forwarded **twice a year for examination**

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Samples can be sent to Dr. Mary F. Coffey's Bee Disease Diagnostic Service in Ireland for disease testing:

- Sample Collection: Collect at least 25 bees from each hive, ideally from the alighting board or outer frames.
- Storage: Store samples in a fridge or freezer to preserve them before mailing. Testing twice a year, even when bees appear healthy, helps detect early signs of disease.

*GO RAIBH MAITH AGAIBH*

THANK YOU ALL

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