Management and Caring of Africanized Bees for the Production of Honey In the Vaca Forest Reserve

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Management and Caring of Africanized Bees for the Production of Honey In the Vaca Forest Reserve

SUMMARY

The primary aim of this Beekeeper’s Manual is to provide information to beekeepers on the integrated management of Africanized Bees. The manual describes the basic management of beekeeping from the formation of a new nucleus to the extraction and marketing of honey.

The Vaca Forest Reserve is recognized as an important protected area, particularly as a water catchment area in the Cayo District. Yet this is one of the reserves with major impacts due to the multiple activities occurring in the area ranging from the extraction of timber, farming, cattle ranching and hunting. Today the landscape of the Vaca Forest Reserve is rapidly being transformed. The unsustainable use of the land is annually leading to further deforestation and the loss of wild animals and plants is obvious.

As a result, Friends for Conservation and Development (FCD) together with the Forest Department and with support from the Department of Agriculture launched an initiative to institute a beekeeping program with fifteen (15) farmers in the Reserve. The primary objective is to develop an economic alternative whilst reducing the land degradation in the Vaca Forest Reserve.

This manual contains relevant information based on the request made by participants during the implementation of the first training in the Basic Management of Africanized Bees. We hope that this manual serves as a reference to beekeepers and that the information helps beekeepers improve their knowledge and skills on the integrated management of Africanized Bees.

Thanks to the Global Environmental Facility/Small Grants Program and the United Nations Development Programme (UNDP) for their generous financial contribution; and to the Forest Department for its effort and support to institute a different way of utilizing and managing a forest reserve. We are grateful to Mr. Mario Howe in the Department of Agriculture for his ongoing technical support. To the members of the Cayo Quality Honey Producers Cooperative especially Mr. Eliodoro Perez and Mr. Maximiliano Garcia we are appreciative for their knowledge shared. Thanks to Dr. Roxanna Álvarez for the preparation of this Beekeeper Manual. Finally, our gratitude goes to Arnoldo Melendez, Extension Technician at FCD, for his commitment and enthusiasm for making the apiculture activity a vibrant endeavor among farmers in the Vaca plateau.
INTRODUCTION

For many, apiculture is just a past time, but for others it is a way of life. The management and caring of bees is an art and science. The beekeeper must know the biology of the beehive, the characteristic of each member of the hive and its role inside the hive. The beekeeper should be prepared to deal with the changes in weather pattern, climate change, predators, diseases and other risk factors. He/she must be equipped to deal with the ever changing world of supply and demand, prices per pound of honey, the prices for materials and equipment and many other factors that affects the production of honey.

Beekeepers should always grow in their abilities and strive to increase the number of hives per apiary and quantity of production per hive, while carrying good management practices. He/she should always take into consideration that the product resulting from its work is for human consumption and must, therefore, always be healthy and clean.

Beekeepers in Belize should not only think that the only product in beekeeping is honey. Pollen, propolis, wax, royal jelly and venom, the queen, the beehives and the apicultural materials are other products that capture a good market price.

The Beekeeper’s Manual: Management and Caring of Africanized Bees for the Production of Honey at Vaca Forest Reserve intend to offer general advice to beekeepers on how to manage and take care of Africanized bees. This manual takes into consideration climatic changes experienced over the past 5 years and the response of bees to this factor.

This manual was not designed to replace the knowledge and experience of beekeepers but is intended to serve as a reference guide on how to produce healthy and clean honey.

This manual is dedicated to all beekeepers in Belize. In your hand is the future of this industry and our forests.
**The Queen**

- Easy to recognize for her large abdomen
- Her head is round when you see her from the front
- She is the only one that lays fertile eggs
- During her “nuptial” (wedding) flight she mates with up to 10 drones and stores their sperm for future use
- She lays up to 5,000 eggs per day

**The Drones**

- The only males inside the hive
- Are much wider than the queen and the working bees but smaller than the queen
- Almost rectangular in shape and appears to be fat
- Its eyes touches each other on the head
- They have no sting
  - Collects no food and are fed by the working bees
  - After mating with the queen they die
  - When a hive has many drones it is likely to swarm
→ During drought when there is little food the drones are expelled from the hive by the workers bees
→ The only reason for living is to mate with the queen

**Worker bees**

→ A large colony can have up to 50,000 workers
→ When you look at the workers from the front, they look triangular shaped
→ The tip of its wings touches when resting
→ They transport pollen with their back legs
→ They are the only ones that sting
→ When stinging they die since they leave their abdomen with it
→ If a bee stings you, kill her so that other bees do not smell it and do the same
→ Scratch the stinger with a nail or a sharp object

The young workers carry on the following tasks inside the hive:

1. Clean the cells and remove the bodies of dead bees
2. They feed the queen, the drones and pupae in cells
3. Guard the hive entrance
4. Maintains the temperature of the brood chamber and the brood comb to 35°C
5. Produce wax, build comb and seal the honey and the brood combs
6. They convert the nectar into ripe honey
7. Seal openings with propolis collected from the tips of young plants
Characteristic of Africanized Bees

- Africanized bees are smaller than European bees
- Africanized bees fly faster than European bees
- Africanized bees enter the hive without stopping at the entrance
- They start to work earlier in the morning and finish later in the evening
- They attack weak hives and replace their queens with Africanized queens
- Are more defensive and attack in large groups
- Have a defensive area up to one kilometer of 5/8 of a mile
- Can be angry and attack up to one day
- They adapt easily to differently environments, that is why they can invade areas rapidly and form their own colonies

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>African</th>
<th>European</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size</td>
<td>61 mg/weight</td>
<td>98 mg/weight</td>
</tr>
<tr>
<td>Development Period</td>
<td>18 – 19 days</td>
<td>21 days</td>
</tr>
<tr>
<td>Size of cells</td>
<td>4.8 – 4.9 mm</td>
<td>5.2 – 5.3 mm</td>
</tr>
<tr>
<td>Adult life</td>
<td>12 – 18 days</td>
<td>21 day</td>
</tr>
<tr>
<td>Time to become angry</td>
<td>23 seconds</td>
<td>43 seconds</td>
</tr>
<tr>
<td>Persecution time</td>
<td>160 minutes</td>
<td>40.5 minutes</td>
</tr>
<tr>
<td>Time to become calm</td>
<td>28.5 minutes</td>
<td>2.88 minutes</td>
</tr>
<tr>
<td>Absconding</td>
<td>50 – 100%</td>
<td>0</td>
</tr>
<tr>
<td>Queen egg laying</td>
<td>4000 – 5000 eggs</td>
<td>2000 eggs</td>
</tr>
<tr>
<td>Drones</td>
<td>Less actives</td>
<td>More active</td>
</tr>
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Development of a Honey Bee

- Eggs – the egg emerges after 3 days of being laid. It then turns into a larva.
- Larva – the larva is fed with small amounts of food for 5 days. This is done by nurse bees (young bees).
- The brood (young larva) is sealed with wax by the bees.
- The larvae create a cocoon and later turns into a pupa during the 12 days that they are inside the sealed cell.
- It emerges as a new bee.
- The drones take longer to develop, approximately 22 days.
- The queen emerges approximately in 18 days since she is made 6 days after the beehive has been queenless for 13 days.

Working Pattern of Workers Bees after Emerging

- 1-3 days after a young bee emerges from the cell, she cleans her cell so that the queen can lay her eggs or be used to store honey or pollen.
- 3 – 6 days after leaving the cell they become nurse bees and start to feed old larva with nectar and pollen.
- 6 - 9 days after their glands have developed and are ready to produce milk and royal jelly.
- 9 – 12 days after, they start to build comb and seal cells containing honey and larvae.
- 12 – 15 days after they transfer pollen and nectar to the field bee’s honeycomb that arrives at the entrance of beehive. They fan the honey to evaporate excess moisture to give out the proper storage temperature.
- 15 -18 days they guard the entrance of the hive. They carry out short flight around the hive to locate their exact location. The bees then become field bees and start collecting nectar, pollen, water and propolis.
MATERIALS AND EQUIPMENT USED IN BEEKEEPING

Points to bear in mind:

n Africanized bees are defensive and attack in larger groups so it is necessary to have protective equipment to avoid being stung
n A complete suit is comprised of a overall, veil, gloves, hat and sturdy shoes
n The wax foundation, frames and wire are materials commonly used in beekeeping

management of bees are the smoker and

1) Overall:

n The suit/overalls must always be loose on the body to prevent the stinger from penetrating the suit and the skin. Must have elastic at the wrist and ankles to prevent bees from entering the suit. The overalls should be made from thick materials. The best colour is white to reduce the number of attack.

2) Veil:

n Basically from the same materials except the front wiring gives a perfect view in front and around. It goes together with a hat to cover your head. This is used to reduce the amount of stings in your face.

3) Gloves:

n It should be smooth and soft, long enough to reach your elbow and with an elastic to the end.
4) Footwear:

   n It's better to use a pair of high leather shoes or rubber boots

5) Smoker:

   n The smoker is one of the most important pieces of equipment because it produces smoke that help to keep the bees calm

6) Hive Tool/Spatula:

   n Is used to open difficult supers or to take out frames inside the hive without disturbing the bees

7) Wax Foundation:

   n It is the sheet of wax put on the frame. Here the bees will build their wax.

8) The Frame:

   n It is the wooden frame that supports the wax foundation, the young larva, pollen and the cells filled with honey. They are removed during harvest to extract the honey.
ESTABLISHMENT OF AN APIARY

The Beehive:

- Honeybees can establish their homes in the trunk of trees in the forest
- The wax combs fit inside the cavity/hole
- Modern beehives consist of 9 to 10 movable frames inside the box
- This type of structure gives way to easy handling of bees, expansion of hive and the harvesting of honey, etc.

Keep in mind the following when choosing an apiary site:

- Sources of Nectar and Pollen
- Water source
- Sufficient shade
- Airflow/air circulation
- Wind breaks/barriers
- Vandalism
- Protection of people and animals near the apiary
- Protection against fire and floods
- Easy access for the beekeeper
- Nearby insecticide use

Apiary Location:

- The location of an apiary determines the success of the beekeeper
- The apiary should always be located in an area that has enough food for bees and room for expansion of beehives
- The apiary should be located at least 1.5 miles away from the public, since working bees are very defensive when their hive is being worked
- The apiary must be located at least 200 yards or 600 feet away from the road
- There should be enough bushes between the apiary and the road or populated area
- Some plants can be planted between the beehives to reduce the alarm scent of the bees
- These plants can be cassava, plantain, Annatto, Madre Cacao, sesame and Mexican sunflower, cocoa etc.
Inside the apiary each hive should be on its own “stand” with approximately two yards between each beehive.

In the apiary or in the immediate area there should be clean fresh water. This helps bees not to travel far for water.

The apiary should never be near a landfill due to the possibility of honey contamination.

Water Trough and Stands

Water trough types are many and can be varied.

In our forest environment, it is a good idea to provide some sort of protection to the beehives in the form of a “stand”.

Although water does not stop ants from completely attacking the hive, at least it gives time for the beekeeper to help save the beehive.

Stands vary in shape, size, materials and cost.

The primary objective of the stand is to reduce the incidence of ants invasion, cockroaches, toads, frogs, wild dogs and other predators.

The stand also gives additional height that helps the beehives while moving around in the field.
The nucleus has a queen, eggs, open larvae, closed larva, bees, pollen, nectar or honey.

Obtaining Beehives:
- Can be purchased from well known Beekeepers
- Can be trapped in the forest
- Can be captured using traps in areas where there are plenty of flowers

Beehive Reception:
- The bee nucleus that you receive when purchased is sealed
- When receiving, it should be immediately transferred to the apiary and placed on its stand and then opened
- This should be done before sunrise so that the bees can come out from the hive and get to know their collection area
- Water and food should be immediately available to the beehives
- The entrance to the beehive should be reduced
- The beehive has been through a lot of stress during the trip and should be taken care of in the coming weeks

Food should always be available:
- Citrus
- Mango
- Avocado
- Coconut
- Palms
- Paprika
- All crops that produces flowers
- Madre cacao
- Bukut (Stinking Toe)
- Tambran
- All other vines or shrubs that produces flowers
- Wild flowers/forest flowers
Apiculture Products:

- Wax
- Honey
- Propolis
- Royal Jelly
- Pollen
- Sting/venom
- Beehives
- Queens

INSPECTION AND REVISION OF HIVES

A good beekeeper always knows every one of his beehives. He/she knows when they are happy, when they are working hard, when they are unhappy, when they are stressed, when they are hungry and all other moods they may find themselves in. Apart from knowing its general conditions, he/she should also know the physical state of each hive. To know this, inspection and revision should be done.

Steps for the inspection of beehive:

1. Get close to the hive and spend a few minutes observing the entrance. Look for dead bees, deformed bees, bees with pollen on their hind legs, and pests. Observing bees entering the hive is important to determine pest infestation, food shortage and other things.

2. After doing this for some minutes, walk around the hive to inspect if there are ants, cockroaches and check if water in the trays are clean and that there are no bridges of insects. The hive should be well balanced on the stand and generally the beehive should look good from outside. The inspection is now completed.

Steps for the Revision of Beehives:

1. After the inspection is complete, the beekeeper must now proceed to revise the beehive. Using the hive tool carefully remove the top cover by lifting one corner and puffing some smoke inside.

2. Lower the corner of the cover and leave it for some seconds

3. Now proceed to inspect the hive. Remove the cover and place it on the side of the hive making sure the queen is not on the cover

4. Now you can inspect the frames by using the hive tools to easily remove them. Hold the frames carefully from the corner. Be sure not to damage the honeycombs built by the bees.
What are we looking for when inspecting the frames?

♦ Frames should have fresh eggs, open cells with larva, closed cells with larva, workers, nectar, pollen and honey. If the colony is a single hive it is called the brood chamber and contain a full hive.
♦ When a second super is on top of the main colony this means that the population of the colony is large and requires more space. The second super will have frames with pollen and sealed brood.
♦ When a third super is placed, it is because there is a need for more space because the bees are already producing honey.
♦ The order of the frames in the brood chamber is very important. Fresh eggs should always be at the center with open broods on its side. Around the unsealed broods is the sealed larva with pollen and nectar on the side of the hive. Fresh eggs should be at the center to have the right temperate to continue its life.
♦ The development of a queen inside a peanut (queen cell) should be removed once there is a queen in the hive.

5. After the frames are inspected they are carefully returned inside the hive. The side of the cover is smoked; the top is slightly shaken over the hive or in front of the entrance, smoked and replaced.

* It is extremely important to be very careful when handling the frames as it is easy to kill the queen when frames are handled carelessly.

TIME MANAGEMENT IN APICULTURE

The apiculture calendar is divided into three (3) principal periods. These are pre-harvest, harvest and post harvest. Each period has its own characteristics and specific activities and the beekeeper should be prepared to offer his bees the best condition in order to help the bees pass through hard times without problems. The pre-harvest is from October to December, harvest from January to May and post harvest from June to October.

TECHNIQUES AND PROCEDURES IN PRE-HARVEST

1. Changing old Queens:

   Old queen (more than one year old) should be changed in November to allow time for the queen to reach her full potential before honey starts to flow.
2. Stimulation:

- Consist of 2 things:
  - A) Stimulation of food – up to 2 months before the flow of honey
  - B) Capturing of additional beehives

3. Building up of Hives:

- Up to two months before the flow of honey and harvest, frames and super with wax should be ready when required during the growth of the hive.
- Equipment such as basin, buckets must be reserved, as well as the extractor

4. Cleaning different areas and the equipment

- All areas must be cleaned so that the correct hygienic measures take place during harvest
- These areas are the apiary, extraction house or the area where honey is extracted
- All equipment should be prepared beforehand. Must be carefully washed and disinfected

5. Reverse Brood Nest

- Frames with honey are transferred to the third super
- Brood nests (eggs, young larvae) will be put in the lower supers

6. Small Harvest:

- Small harvest takes place on the last week of December or at the beginning of January
u This is done to stimulate bees to produce more honey

7. Securing Market:

u Market must be identified and secured before the harvest season
u This is to avoid having to find a market when everyone else is

8. Strengthening of the beehive:

♦ Ensure that before harvesting honey, the beehives are strong and fully prepared for the stress of when their honey is being harvested

HARVESTING EQUIPMENT AND ITS USES

Basic Harvesting Equipment:

v Protective Gears
v Hive Tool
v Smoker
v Sharp knife with stainless steel 9” to 12” blade or uncapping knife
v Basin or uncapping tank
v Sieve/Strainer
v Buckets
v Extractor
v Sealed empty boxes

Protective Gears:

v During harvest is when bees become extremely defensive and the use of protective gear is important
v All protective gears must be used and ensure that you are protected – veil, hat, overall, boots and gloves

Hive Tools/Spatula:

v The hive tool/spatula is used to open the hive
v It is also used to separate and help lift the frames
Smoker:

- The smoker is used to keep the bees calm.
- A constant but not excessive supply helps to keep the bees calm during this stressful time.
- Excessive smoke or too little can cause the bees to be aggressive.
- The smoke that comes from corn husk or from cohune is good since it gives a good aroma.

Stainless Steel Uncapping Knife:

- This knife is used to cut the sealed cells full of honey.
- Should be strong and very sharp.
- For easy use the blade must be sharpened and have a length of 9” to 12”.
- It is best if the blade is from stainless steel.

Uncapping Tank or Basin:

- The basin or tank is used as a container to hold the covering of uncapped cells.
- A large stainless steel basin or uncapping tank can be used.

Sieve/Strainer:

- Are used to remove large pieces of wax and other impurities from the honey harvested.
- These strainers come in different shapes and size.
- Must be strong and durable since honey is a thick and heavy substance.
- When it is not possible to get a stainless steel strainer it is preferable to used a piece of clean cloth and place it on the mouth of the bucket.

Buckets:

- Bucket are needed for the extraction and it is preferable to use stainless steel buckets.
- To store, you need dry and clean five gallons plastic food grade buckets.
- These buckets should not smell or have any traces of anything in it.
Extractor:

- There are different types and sizes of honey extractors
- The most commonly used in Belize are 4-frame extractors
- The uncapped frames are placed into the space inside the extractor and the handle is turned
- Honey is extracted by the centrifugal force

Sealed Empty Hive:

- Empty sealed boxes are used to transport frames full with honey
- Transport all frames with honey from the apiary to the house where it will be extracted
- The box should have a cover so that the bees don’t smell the honey

**TECHNIQUES AND PROCEDURES AT HARVEST TIME**

- Harvest time is from January to May

1. Control of Beehives:
   - The beehives must be controlled in order to prepare them for the actual harvest of honey
   - It should not be stressed out or swarming at harvest time

2. Timely Addition of Space and Other:
   - The beehive should carefully be monitored to determine when they need additional space for development
   - We must pay careful attention to the beehives to determine when the honey is sealed and ready for harvest
3. Inter-location of Frames:

- This simply means that all frames with honey should be in the third super
- Cells with young larva should be placed in the brood chamber and should not be damage when harvesting

4. Understanding the botanical cycle of your apiary:

- Always keep in mind that different flowers will serve as food for the bees at the apiary
- Always keep in mind that certain plants (trees, shrubs) will bloom in different seasons
- Also, there will be times of shortage and these are the times when the bees must be fed with supplemental feeding

5. Suitable time for Extraction:

- Sealed honey cells are an indication that soon it will be time for extraction
- Once there is sufficient honey to harvest, preparations must be made
- The extractor must be procured along with all other equipment, disinfected and ready for use

**POST HARVEST TECHNIQUES**

- Post Harvest time is from June to October

1. Reduction of Excessive Equipment

   - Empty frames and super can be removed now
   - This is so that the beehives have more ease in starting to recover

2. Preservation of Wax and Honeycomb

   - The wax cut during the uncapping of frames can be preserved for candles or wax sheets
   - This must be kept clean and carefully processed so that all honey is extracted before it is actually processed for use or storage
   - The comb can be preserved for use as honeycomb
   - This is when the uncapped honeycomb is sold inside the honey harvested
3. Take Inventory of old Queens
   - All beehives should be checked to identify old queens
   - All queens over one year old should be replaced with a new queen
   - After a year, the queen starts to decline in production

4. Sustainable Feeding
   - This is done during the period of scarcity or “Dearth”
   - This is when the hive is recovering after harvest and when there is little pollen and nectar to harvest
   - Generally it consists of two parts of sugar and one part of water
   - It is used to control the hive

5. Control of Varroa Mites
   - This also takes place in the post-harvest period to avoid affecting the quality of honey and for the beehives to become stronger during the difficult period of recovery after harvesting

6. Division and Expansion of Beehives
   - During this time, bees are working hard
   - This is when the division and expansion can occur
   - Expansion takes place during this time because it is when the hives are growing
   - Eventually when the beehive is strong and can bear the division this can be done

DIVISION OF BEEHIVES

Nature has created the reproduction of all natural species, thus guaranteeing its existence. With the bees this is called swarming. This division is called Artificial Division since it is a technical division of bees by the beekeeper for the growth of his apiary.

If the hive presents the following characteristics the division can be carried out:

(a) A good Queen
(b) A strong hive
(c) The existence of abundant honey and pollen
(d) Appropriate period for division to take place (October to December depending on the climate)
Steps to follow in the division of beehives:

- If you have a strong hive with abundant honey and pollen you can divide your beehive. That hive we call it A and the new one we call it B.

- Move hive A from its original place. It should not be less than 8 feet from its original place.

- In the old place where hive A was, place hive B for bees that are out in the field.

- In beehive A, find the queen and make sure she is in. Once this is done, proceed now to distribute the materials.

- The queen stays in hive A with young bees, frames with sealed larva and approximately with half honey and pollen. A queen is introduced and the empty space is filled with new frames with wax sheets.

- Hive B remains with the adult bees, all frames with egg and larva’s, a frame with sealed larva to ensure young workers bees with half of the honey and pollen. A queen is introduced and the empty space is filled with frames with new wax sheets.

- It is recommended to reduce the entrance of the new hive to prevent stealing.

**FEEDING**

There are two instances when you do this. One is when you need to stimulate for expansion and growth of hives and the other when the supplement is necessary during the period of food shortage or “dearth”.

Feeding can be done with a variety of feedstuffs. Commonly used food is sugar. Other food used is Incaparina, patties from Soy milk and pastry sugar. The type of food used is generally decided by the beekeeper within his/her financial possibilities and the purpose of feeding.

Stimulation Feeding: This is given in the months of October to November and is prepared as follows: 2 pounds of sugar dissolved in 1 liter of boiled or purified water. It is put in a plastic bag from which the bees will drink little by little. This type of feeding is given when you need a fast growth and when climate does not allows bees to come out to collect food or if the bees are not making the most of the available flowers.

Supplemental Feeding: Is given during the months when there is little pollen and nectar available and is prepared as follows: 2 pounds of sugar dissolved in
half a liter of boiled or purified water. It is only done when there is a shortage of pollen and nectar and when flowers are not readily available. It is given in the same way as the stimulation feeding.

INCAPARINA and pastry sugar are mixed together with water or dry and given to the hives as well. When mixed with water they are administered in the same way as the sugar syrup. When given dry, it is placed in an open container in the shade. The bees will pick it up as if it was pollen.

The patties of soy milk are placed on top of the frames within the super. The bees eat these slowly.

PESTS AND THEIR CONTROL

Ants:

Ants can be the fastest and deadliest enemies. Normally they enter the hive, kill the bees and steal their honey. The bees normally abandon the beehive when the beehive is weak and attacked by ants.

Prevention:

Basically there are several ways to prevent this type of attacks. It could be a good idea to apply burnt oil or grease at the foot of each stand and the apiary kept clean of grass. This can be done in post harvest time when the beehives are weak and when the oil or grease does not interfere with the quality of honey. In many apiaries a tire cut in half can be used around the base and filled with water. This method requires constant monitoring because if it is dry or if there is garbage inside it no longer serves its purpose and ants will pass. Ants can sacrifice themselves and build ant bridges to cross over water. These troughs should always have clean and fresh water or worms or tadpoles will live in it.

Moths:

This is a moth of gray colour that enters the beehive easily. The adults lay their eggs in the frames and when they emerge, the larvae eat the wax cells destroying them. They eat the stored pollen and can force a hive to abscond if the beehive is weak. If the moth or larvae is seen during inspection it is easy to destroy it and should be done.

Prevention:

It is important to maintain the base and the cover clean since these are perfect sites to find moths. The super should be packed exactly with no openings for moths to gets in. The burning of sulphur near the base of the beehives could
eliminate moths and its larvae but this can only be done during post harvest period.

**Birds**

Birds are real threats since they eat the bees as they leave and enter the hive or when they are working in the field. There is no effective treatment for birds except for manual elimination.

**DISEASES**

The Varroa mite causes varroasis, a disease that affects the Africanized bees.

**Symptoms:**

- The mites are visible on bees
- Deformed bees inside the hive
- Dead bees or deformed bees on the ground in front of the entrance
- Unproductive beehive
- Mites visible in cells of drones
- High mortality on broods

**Treatment:**

First determine the infestation level. Constant monitoring helps beekeepers to maintain the level of infestation at a tolerable level without damaging the beehive. The infestation level can be determined easily. Put a collecting tray on the base with 1/8 wire to catch the mites. White sheet or white Bristol board can be put with white lard. The mites accumulate there. The average mite determines the infestation level.

<table>
<thead>
<tr>
<th>Amount of mites</th>
<th>Infestation Level</th>
<th>Control Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 5</td>
<td>Low</td>
<td>Not required</td>
</tr>
<tr>
<td>5 – 7</td>
<td>Medium</td>
<td>Biological Control</td>
</tr>
<tr>
<td>More than 10</td>
<td>High</td>
<td>Chemical Control</td>
</tr>
</tbody>
</table>

**Biological Control:**

The biological control is recommended to reduce the speed of resistance that the mites develop. The first method is to exclude the queen to a frame with drones with two queen excluders. This is done at the center of the hive. The queen will lay egg for drones and this will attract mites. As soon as the cells are sealed take out and destroy it with fire. Another frame is put in as replacement. Repeat this four (4) times to reduce infestation almost to zero. Another biological control
method is to uncap the drone’s cells and take out all the larvae. This is done far away from the apiary site.

**Chemical Control:**

Formic Acid is used to control varroa mite and has produced satisfactory results since it leaves no residual in wax or honey. Honey can still be sold as organic. Formic acid is prepared by using pieces of cotton in a plastic bag. Each bag contains 60% of formic acid soaked in a small ball of cotton and sealed correctly. The first dose is placed inside the hive for 10 days. It is removed and the hive is left to rest for 7 days before the second application. The second dose is left for 7 days. This will be sufficient to control the level of varroa.

The dose should be placed inside the hive from 5-7pm, wearing your bee suit and gloves. Before putting the formic acid you make a hole in the bag for the scent to emerge slowly. The bag is placed on the side of the hive or between the first and the second super. Hives that don’t have broods or honey should not be treated. Hives in this condition should be fed two weeks prior to treatment, because the stress caused by the acid can make them swarm.

Oxalic acid is also used in as a chemical control of the Varroa and is safe since it leaves no residue in wax or honey. Two pounds of sugar is dissolved in one liter of purified water and 100 grams of Oxalic Acid is added to the syrup. On each frame lightly spray 5 ml with a syringe. This is done smoothly in the frames with broods. It can be applied every four days for four occasions.

**American Foul Brood:**

This is a destructive disease caused by microscopic bacteria called *Bacillus larvae* that produces spores and lives in the hive, pollen and honey. It causes a reduction in the population of bees since it kills the larvae. It can be transmitted from an infected hive to a healthy one when the bees steal the pollen and honey. Without proper control a whole apiary can be destroyed.

**Symptoms:**

- Brown and sunken cells
- Smells like rotten fish
- Weak pattern with many empty cells
- The larvae are liquid and sticky
- The dead larvae can be found at the bottom of the cells with the tongue outside and stuck to the superior part of the cells
Treatment:

The only way to control this disease is to burn the hive. There are no medicines to cure this disease, so it is better to lose a hive than a complete apiary. To control the risk to this disease on healthy hives you should:

- Sterilize all equipment that comes in contact with the infected hive
- Sealed the infected hive to prevent it from being visited by other bees
- Burn all infected hive with brood and frames. Bury the remains and ensure everything is burned and buried

**HONEY QUALITY CONTROL**

Some points to be considered when producing honey. Cleanliness, maturity, Deterioration and Food Safety are very important characteristics to keep in mind during the production of honey.

What is Honey?

- The naturally sweet substance produced by the worker bees from different species, principally *Apis melifera*, for its own nutrition from the flowers nectar or from the secretions from other living plant parts or from excretions of sucking plant insects which remain deposited on the living parts of plants and which the bees collect, transform and combine with their own specific substances that are subsequently stored and left in the combs to mature and age.

Honey should not have:

- Additives
- Foreign organic or inorganic substance

Honey can be classified as:

- Comb Honey - this is the honey that is still on the comb or built honey cells
- Liquid honey - this is the honey that has been extracted from the honeycombs
- Crystallized honey - is the honey that is crystallized or hardened
Honey is comprised of:

- A supersaturated solution of simple sugars, principally of fructose and glucose and in lesser proportions other carbohydrates, enzymes, amino acids, organic acids, minerals, aromatic substances, pigment, wax and pollen.

Colour of Honey:

- White to amber to dark
- Gets dark with time and when exposed to high temperature
- It depends on the type of flowers that the bees use as food
- The age and high temperatures or heating can affect the scent and flavour

Consistency of honey: Liquid, solid or creamy

Crystallization: Normal with time and due to the glucose content but only happens after a year of storage or at refrigeration.

HONEY MATURITY:

- Reducing Sugars
  - Expressed in % (g/100g)
  - Minimum: 65% honey from flowers
  - Variation in maturity is due to the adulteration (conditioning of other substances to it), nutrition and premature harvest

- Humidity: %
  - Maximum: 19%
  - Variation due to premature harvest, in appropriate storage
  - Honey that has more than 19% moisture will grow fungi and easily ferment
HONEY – CLEANLINESS:

- Ash (minerals): %
  - Maximum: 0.6%
  - Related to dirt, sand, molasses (Adulteration)
  - Heavy metals: standards

- Solid insoluble: %
  - Maximum: 0.3%
  - Variation due to inadequate filtration or hygiene
  - This includes bees, pieces of earth, lumber, and other contaminants

HONEY – DETERIORATION

- Acidity, meq/kg
  - Maximum: 40meq/kg
  - Related to freshness, micro-organisms (fermentation), overheating, use of acid (such as in the treatment of Varroa mites, formic acid, oxalic and lactic acid)
    - Diastase index
    - Hydroxymethylfurural (HMF)
    - < 6 months: 40 mg/kg
    - > 6 months: 80 mg/kg
  - Related to freshness, hydroxymethylfurfural is affected by heat and long term storage. Increases with time and if the honey has high acidity or is handled improperly.

HONEY – FOOD SAFETY:

- Chemical: Honey should not have the following:
  - Antibiotics
  - Pesticides
  - Heavy metals

- Microbiology: The microbiology of honey should not be over:
  - Account of total bacterium (Mesophilic, Aerobic): 100CFU/g
  - Salmonella, Shigella: 0/25g
  - Total Coliforms: < 10 cfu/g
  - Yeasts and Moulds: < 100 cfu/g
REQUIREMENTS FOR THE EXPORTATION OF HONEY

1. Animal health service
   • Apiculture disease – report to OIE
   • Apiculture disease surveillance
   • Health Programs in the apiary
   • On Farm Food Safety Programs
   • No veterinary drug use

2. Food Safety Services:
   • Registration of Belize as a certified country to export honey to the European Union
   • Registry of honey processing establishments
   • Inspection Services – Processing facility
   • Certification
     • Sanitary Programs - HACCP
     • Confirmation of the Standards for organic honey
     • Freedom from veterinary drug residues
     • Health certification

3. Laboratory Services:
   • Sanitary testing (microbial of fungus)
   • Residual testing (veterinary drugs, pesticides)
   • Chemical analysis (heavy metals)
   • Quality parameters
   • Liaise with reference laboratories

4. Liaison:
   • Competent Foreign Authorities e.g. – FVO (EU): FDA (US): CFIA (Canada)
   • Reference Laboratories

5. Promotional:
   • Import regulation
   • Certification from BAHA/BOS
CONCLUSION

Years ago beekeeping in Belize was one of the main sources of income within the agriculture industry. With the arrival of the Africanized bees, this reduced seriously because beekeepers were little prepared for the change. With the passing of time, some people interested in beekeeping and the preservation of the forest and the environment saw the need to revive the industry. Throughout the years and with good financial investment, beekeeping is having a comeback.

Beekeeping in Belize has great potential. The main product until now is honey. In the future it is expected that pollen, propolis, royal jelly, the stings and the by-products from honey will be an economical viable product for Belize.

Beekeeping yields not only an agriculture product that has a good price per pound produced but also has a high ecological value since it promotes the preservation of the forest and responsible agriculture. These two objectives have attracted the interest of Friends for Conservation and Development as it seeks to develop innovative methods for the protection of the forests and protected areas such as the Vaca Forest Reserve.

It is expected that this manual, dedicated to all beekeepers in Belize helps in promoting interest and enthusiasm for the further development of this noble industry.
REFERENCES

Mr. Isidoro Sho, Beekeeping Extension Officer, Tumul K’in Center of Learning, Blue Creek Village, Toledo District.

Mr. Margarito Leiva, Beekeeping Officer, Ministry of Agriculture and Fisheries, Orange Walk Town, Orange Walk District

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