SURVEILLANCE OF HONEY BEE DISEASES

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icipe
1. Colony collapse disorder (CCD)
2. Honey bee disease agents
3. Disease transmission in honey bees
4. Field diagnosis of honey bee diseases
5. Sampling of bees and hive products
6. Laboratory diagnosis of honey bee diseases
7. Activities of the pathology unit of the African bee health reference lab
COLONY COLLAPSE DISORDER (CCD)
Colony Collapse Disorder (CCD)

• **History**
  - From 2006, beekeepers in the United States began reporting sharp declines in their honeybee colonies.

• **Scope and distribution**
  - North America
  - Europe

Data source: U.S. Department of Agriculture’s (USDA) National Agricultural Statistics Service (NASS) NB: Data collected for producers with 5 or more colonies. Honey producing colonies are the maximum number of colonies from which honey was taken during the year. It is possible to take honey from colonies which did not survive the entire year.
Signs and symptoms of CCD

- Worker bees from a beehive or colony abruptly disappear.
- Few or no dead bees found in the hive,
- Presence of immature bees (brood),
- Small cluster of bees with live queen present, and
- Pollen and honey stores in hive.
Possible Causes of CCD

Stress factors in honey bee populations

- Farmer practices
  - Monoculture
  - Field size
- Bee food supply
  - Less variety
  - Less quantity
- Climate & weather
  - Planting season
  - Spring timing
  - Winter severity

Honey bee health

- Pesticides
  - Application procedures
  - Translocation
  - Dust-off
- Pathogens
  - Viruses, bacteria, parasites, Other diseases
  - Varroa mite
  - Increased transmission of other diseases
  - Resistance development to treatments
- Beneficial microbes
  - Susceptible to disease control agents
  - Competition with pathogens
- Acaricides*
  & other disease control agents
- Bee keeper practices
  - Attitudes
  - Pollination services
  - General care
  - Disease management

Residues in bee products

  - Hive foundations
  - Pollen/ Wax

*Pesticides which kill mites

Source: OPERA Bee health in Europe, 2013
HONEY BEE DISEASE AGENTS
Viral agents

- There are currently ~ 25 viruses identified in honey bees
- 12 Picorna-like viruses [(+) ssRNA viruses; 30nm]
  - 6 Dicistroviridae
  - 6 Iflaviridae
- 1 satellite virus
- 1 Tymoviridae
- 1 Baculoviridae (DNA virus)
- 1 Iridoviridae (DNA virus)
- 1 Tobacco ringspot nepovirus
- 8 Unclassified RNA viruses
Bacterial Agents

- European foulbrood
- American foulbrood

*Melissococcus plutonius*

*Paenibacillus larvae*
Fungal agents

- **Chalkbrood**
  - *Ascosphaera apis*

- **Stonebrood**
  - *Aspergillus fumigatus*
  - *Aspergillus flavus*
  - *Aspergillus niger*

- **Microsporidia**
  - *Nosema apis*
  - *Nosema ceranae*
Amoeba Disease

• *Malpighamoeba mellificae*
DISEASE TRANSMISSION IN HONEY BEES
Agents of honeybee disease transmission

From bee-to-bee

Transmission by pests

Human activities
Different possible transmission routes for honey bee viruses

Adapted from de Miranda et al. (2011).
FIELD DIAGNOSIS OF HONEY BEE DISEASES
Questionnaires

- A random sample of beekeepers is selected
- A structured questionnaire used to establish levels of experience, training and methods of husbandry used
- Data analysis and interpretation
Apiary Inspection

• Health and condition of brood.

• Health and condition of adult bees.

• Climatic factors that predispose bees to pests and diseases.

• Identify appropriate samples for pest or disease identification.
Brood disease inspection

- Normal healthy brood
- American foulbrood

"spotty brood pattern"
Brood disease inspection

- European foulbrood
Brood disease inspection

- Healthy bee larvae

- Chalkbrood

- Sacbrood

- Stonebrood

- Black Queen Cell Virus
Adult bee disease inspection

- Excreta (dysentery) on hive components
- Bees with deformed wings
- Disfigured and/or stunted adult bees
- Bees showing signs of paralysis
- Dead bees
SAMPLING OF BEES AND HIVE PRODUCTS FOR DISEASE DIAGNOSIS
Sampling Plan in Study Countries
Honeybee Colonies in Africa
Sampling Plan

• Be clear on:
  – What is to be collected
  – When it is to be collected
  – Who collects it
  – How it is to be collected
  – How it is to be stored and preserved

• Key:
  – Dry runs and Check-lists
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Sample Collection Equipment
Asepsis in sample collection

• To avoid cross-contamination of samples or spread of infections:
  – Wear gloves at all times
  – Change gloves or disinfect gloves between hives
  – Change hive tools or disinfect hive tools before use in the next hive
  – Use clean and sterile tubes, forceps, etc (do not re-use unless sterilized first)
Sampling for disease incidence studies

- Sampling of adult honey bees and brood
  - General surveillance
  - Targeted Surveillance (Sampling symptomatic cases)
Sampling of adult bees

Forager bees from a blocked hive entrance

Nurse bees from the brood comb

Min No. = 20 bees per sample
Sampling of brood (workers/drones)

Sampling for disease transmission studies

- Sampling of bees (adults, brood and eggs)
- Sampling of pests
- Sampling of hive products
Sampling of pests

- As described in an earlier presentation (Ayuka)

Varroa

Small hive beetles

Wax moths
Sampling of hive products

Honey

Wax

Pollen/beebread

Propolis
LABORATORY DIAGNOSIS OF HONEY BEE DISEASES
Microscopy

Light microscopy
- Bacteria, fungi

Electron microscopy
- viruses
Culture and biochemical testing

**Solid media**
- Bacterial and fungal cultures
- Observation of culture characteristics

**Biochemical testing used to identify**
Gram Positive/Gram Negative Bacteria

**Liquid media**
- Viral cultures
- Cytopathic effects observation
Immunodiagnostic techniques

e.g. Enzyme-linked immunosorbent assay (ELISA)
Molecular Techniques

PCR

Nucleic acid sequencing
Histopathology

Uninfected

Infected

Sectioned Varroa mites showing localization of virus infection
ACTIVITIES OF THE PATHOLOGY UNIT OF THE AFRICAN BEE HEALTH REFERENCE LAB
• Develop a standardized surveillance network assessment tool (SNAT).

• Surveillance of colonies for major honeybee diseases.

• Estimation of honeybee disease prevalence, incidence and distribution.
Surveillance Frequency

Depending on weather patterns of a country
Routine Diagnostic Activities

- Standardization, harmonization and coordination of methods (Standards set by the World Organization for Animal Health (OIE))

- Supply standardized stock-cultures of major bee pathogens to the satellite laboratories.

- Conducting inter-laboratory testing

- Perform confirmatory diagnoses
1. Training of satellite laboratory staff on bee disease diagnosis.

2. Training of beekeepers on good beekeeping husbandry practices.

3. Training on sample collection and preservation.

4. Training of trainers
Role of Satellite Labs on Disease Surveillance
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