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Managing Pests and Diseases in Commercial Bumblebee Production



Peter Šima, Koppert SK

Karel Bolckmans, Koppert BV

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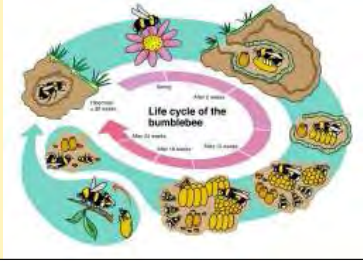
Bumblebees

- Bombus spp.
- Commercial bumblebee production: 1987
- Replaced manual pollination (vibration) and plant hormones in tomato production.
- Buzz pollinators
- Tomatoes, melons, berries, fruit trees, etc.
- Complementary or alternative to honeybees
- Different species :
  - *B. terrestris*
  - *B. canariensis*
  - *B. impatiens*
  - *B. ignitus*



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Bumblebee Mass Production

WHAT IS A BUMBLE BEE MASS PRODUCTION?

- Closed production
- "Industrial" production : > 500.000 colonies/year
- Different bumblebee species (specific requirements; hygiene)
- Controlled environment (RH, T, L:D regimes, hygiene)
- Controlled quality of inputs (queens, food, rearing material)
- Experienced team of employees
- High density of colonies/m^2
- Necessity for disease free breeding and rearing stock
- Intensive Quality Control and Quality Assurance

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Why managing pests and diseases ?

1. Prevent introduction and/or augmentation of pests and diseases in nature ("pathogen spill-over").

2. Regulatory requirements

3. Assure maximum :
   a) *cost-effectiveness* of production,
   b) *reliability* of production,
   c) *quality* of end-products.

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Quality Assurance & Quality Control

Risk Assessment of pests and diseases

- Which parasites/diseases are relevant to check ?
- Which parasites/diseases are not relevant but have to be checked (legislation) ?
- What is not relevant ?



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Quality Assurance & Quality Control

Preventive **measures**

- **Internal Quality control**
  (inputs, process, output, rearing material, monitoring of pests)

- **External Quality control**
  (process ISO 9001, health – State Veterinary and Food institute)

- **Permanent Veterinary Control**
  - ✓ Mandatory
  - ✓ Koppert Slovakia – registered establishment
  - ✓ Samples 12/year

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Quality Assurance & Quality Control

prevention is key !

The rearing process and its control points

1.Inputs – pollen, sugarwater, queens and males are checked for the presence of pests and diseases (checked by company lab, and by authorised independent lab)

2.Process – developing colonies are regularly checked for the presence of pests and diseases (by company lab)

3.Outputs – expedition size colonies are checked for the presence of pests and diseases (by company lab and official vet. lab)

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Rearing Process

- **Production of mated queens**
  - Selected colonies for queen and male production
  - Harvesting queens and males
  - Mating queens
  - Hibernation of mated queens
- **Production of colonies**
  - Colonies for queen and male production
  - Commercial colonies

⇒ Closed cycle: no input of wild queens and males
⇒ No usage of or contact with honeybees
⇒ Contained facilities : completely isolated from the outside world

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Main principle
stamping-out technique

- Stamping-out technique or "Pasteur technique"
- Originally developed by Louis Pasteur for silkworm production
- Principle: all material which goes back into the rearing system has to be completely free from diseases
- Bumblebee production:
  - Each and every colony which is used for queen and male production is thoroughly checked for the presence of pests and diseases. Zero-tolerance.
  - Contained facilities : no contact with outside world
  - Clean rearing conditions
  - Disinfection of tools (e.g. tweezers are disinfected with disinfectant, …) and mating cages
  - No commercial colonies can be brought back in the area of the production facility.

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Quality Assurance Procedures in Bumblebee Production

1. Quality Assurance Procedure in Queen Rearing
2. Quality Assurance Procedure before Hibernation (diapause)
3. Rearing Colonies for Expedition

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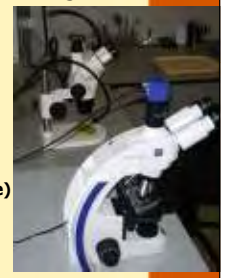
1. Quality Assurance Procedure in Queen Rearing

a) Colonies entering the reproduction phase are sampled and (lab) checked for the presence of pests and diseases prior to entering production of queens and males.

b) Only the colonies which are completely free from pests and diseases are selected (positive selection).



Sampling

- **Queen production - regular colonies (5 workers/hive)**
  - suspicious colonies (10 workers/hive)
- **Controlled mating - in the case of poor mating results**
- **Each sample must be correctly marked to insure traceability**
- **Samples are killed and stored in freezer (-18°C)**

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Examination method

Several methods are available for detection of diseases and parasites
We use microscopic techniques.

1.) Dissection of individuals

2.) Examination of air sacs for presence of tracheal mites (*Locustacarus buchneri)* under binocular microscope

3.) Examination of gut, ventriculus and Malpigian tubules for presence of *Nosema bombi*, *Crithidia bombi* and fat body for presence of *Apicystis bombi* under microscope

4.) Results are evaluated and written into the production QC records

Positive samples:

- **very rare**
- **stamping out method → infected colonies are destroyed**
- **secondary samples are taken of nearby colonies**

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STATISTICS:

- **Year 2006 - 3700 samples of 5 workers = 18500 workers**

Nosema bombi

2004 – 1 infected specimen
2005 – not detected any infected bumblebee
2006 – 1 infected specimen
2007 – Not detected
2008 – Not detected
2009 – Not detected (independen PCR confirmation)
2010 – Not detected till so far (independent PCR confirmation)

Locustacarus (Bombacarus) buchneri,
Apicystis bombi, Crithidia bombi

Not detected at all (since 2009 confirmed by PCR)

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2. Quality Assurance Procedure Hibernation

- Queens which are mated together ("mating series") stay together during hibernation period
- **Each** mating serie is sampled (10 QQ/batch)

Examination method

Microscopic technique (described previously)

Positive samples.
- **very rare**
- **Stamping out method → contaminated series are entirely destroyed**

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Standard hygiene precautions

- All tools (mainly forceps) and work surfaces are disinfected with desinfectant between working on different colonies.
- Escaped bumblebees are not introduced back into colonies but collected and destroyed.
- All breeding materials are cleaned and disinfected prior to reusing.

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STATISTICS:

- **Year 2006 - 1000 samples of Queens**

Nosema bombi

2004 – not detected
2005 – not detected
2006 – 1 infected specimen
2007 – Not detected
2008 – Not detected
2009 – Not detected (independent PCR confirmation)
2010 – Not detected till so far (independent PCR confirmation)

Locustacarus (Bombacarus) buchneri,
Apicystis bombi, Crithidia bombi

Not detected at all

Standard hygiene precautions

- All tools and work surfaces are disinfected with ethanol
- All breeding materials are cleaned and disinfected prior to reusing

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3. Rearing Colonies for Expedition

- Queens needed for production of colonies are:
  - coming from checked colonies
  - checked again prior to hibernation
- Suspicious colonies are immediately destroyed.
- The rearing process is under control of experienced employees (training !) and Standard Operating Procedures (SOP's).
- The entire production is under control of the State Veterinary Authority.

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- By performing methodological and systematic checks we are able to keep our bumblebee production under control
- Critera for stamping out bumblebee diseases and pests are very strict
- Without regular and systematic checks, bumblebee production is under constant risk
- Uncontrolled bumblebee production can be under threat of numerous parasites resulting in :
  1) Introduction and/or augmentation of bumblebee pests and diseases in nature,
  2) FATAL quick destruction of the rearing colony,
  3) Long-term decrease of production yields and of final product quality.

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Pest and Diseases Management

1.) List of known and potentional pests and diseases
2.) Detailed documentation of each pest and disease
3.) Evaluation of the risks of each pest and disease
4.) Detection methods
5.) Actions
   - Standard Operating Procedures
   - systematic checks
   - stamping out technique
6.) Checking the validity of decisions and change if needed
7.) Actualisation of documents

P&D Management document is a tool for insuring sustainable quality of a bumblebee rearing.

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Thank you for your attention!