Overview of bee diseases and available treatment options

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Medicines for bees - What can EMEA do to increase availability
London, 14 and 15 December 2009

Headlines

- introduction
- diseases of a honeybee colony
  - brood diseases: American and European foul brood, chalkbrood, stonebrood, sacbrood
  - adult bee diseases: nosemosis, viral diseases, varrosis, acarosis, tropilelosis
  - pest: small hive bettle (*Aethina tumida)*
  - Colony Collaps Disorder - CCD
- conclusions

Health of honeybee colony?

- one queen, couple of ten thousands of workers of different ages (drones and brood) are able to survive and perform their mission
- usually falls ill one group of the honeybee colony or one age group of workers
  - brood diseases
  - adult bee diseases

Defence mehanisms of individual bee

- anatomical and physiological barriers
  - cuticle and hair
  - tracheal system
  - peritrophic membrane of the midgut
- nonspecific immunity
  - haemocytes
  - production of interferon
- natural and acquired resistance to certain pathogens

Defence mechanisms of the bee colony

- hygienic behaviour
  - detection and removal of sick and dead brood
  - removal of debris and dead bees
- propolisation of foreign bodies
- antimicrobial activity of propolis, honey and pollen
- antimicrobial activity of royal gelly
- honeybees usually die out of the hive
- emergency swarming
- mechanisms of Indian bees towards varroa
- mechanisms of African bees towards small hive beetle

Insufficient defence mechanisms

- poor beekeeping technology, migratory beekeeping, insufficient foraging and malnutrition, pharmaceutical substances in the hive, unprofessional medical treatment
- urbanisation
- environmental pollution
- agricultural technology: using of pesticides, herbicides and acaricides, planting of monocultures, genetically modified plants?
- climate changing - global warming: unusual vegetation in the inappropriate time
- global trade

Diseases and pests of honeybees

- infectious diseases
  - viral diseases
  - bacterial diseases
  - fungal diseases
  - parasitical diseases
- pests
- non infectious diseases - colony disorders

Council Directive 92/65/EEC

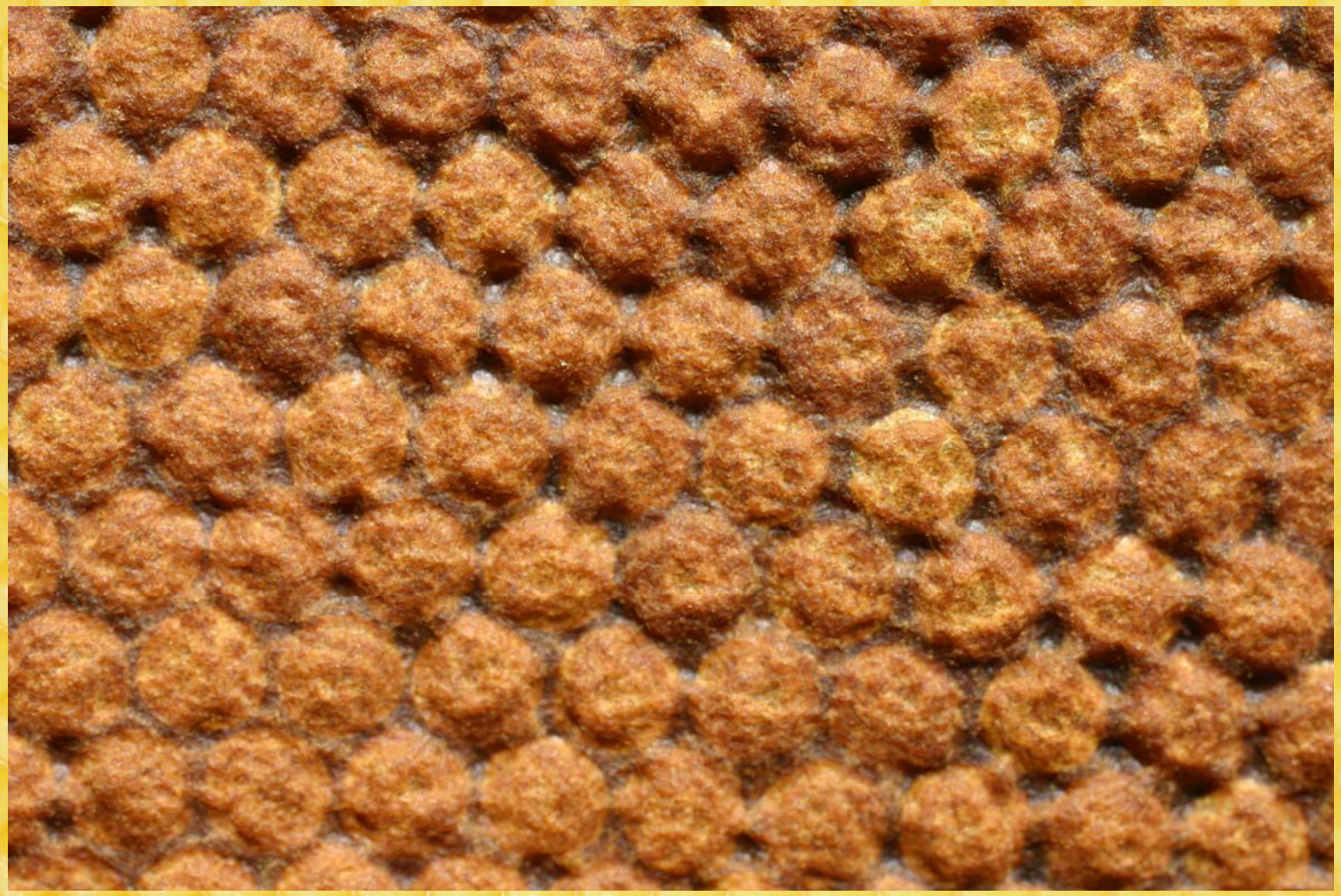
- lays down the provisions for intra - Community trade in bees
- sets out the health certification requirements for the import of bees from third countries
- notifiable diseases are:
  - American foul brood
  - *Aethina tumida* (the small hive beetle)
  - *Tropilaelaps* mite
  - Varroosis
  - Acarapisosis
  - European foul brood

Terrestrial Animal Health Code

Acarapisosis of honey bees
American foulbrood of honey bees
European foulbrood of honey bees
Small hive beetle infestation (*Aethina tumida*)
***Tropilaelaps* infestation of honey bees**
Varroosis of honey bees

American foul brood

- *Paenibacillus larvae subsp. larvae* a spore forming bacteria
- highly contagious
- occurs at any time when brood is present
- can kill a colony
- spreads to other colonies
- spores are able to survive for many years
- are very resistant to disinfectants



healthy capped brood pattern

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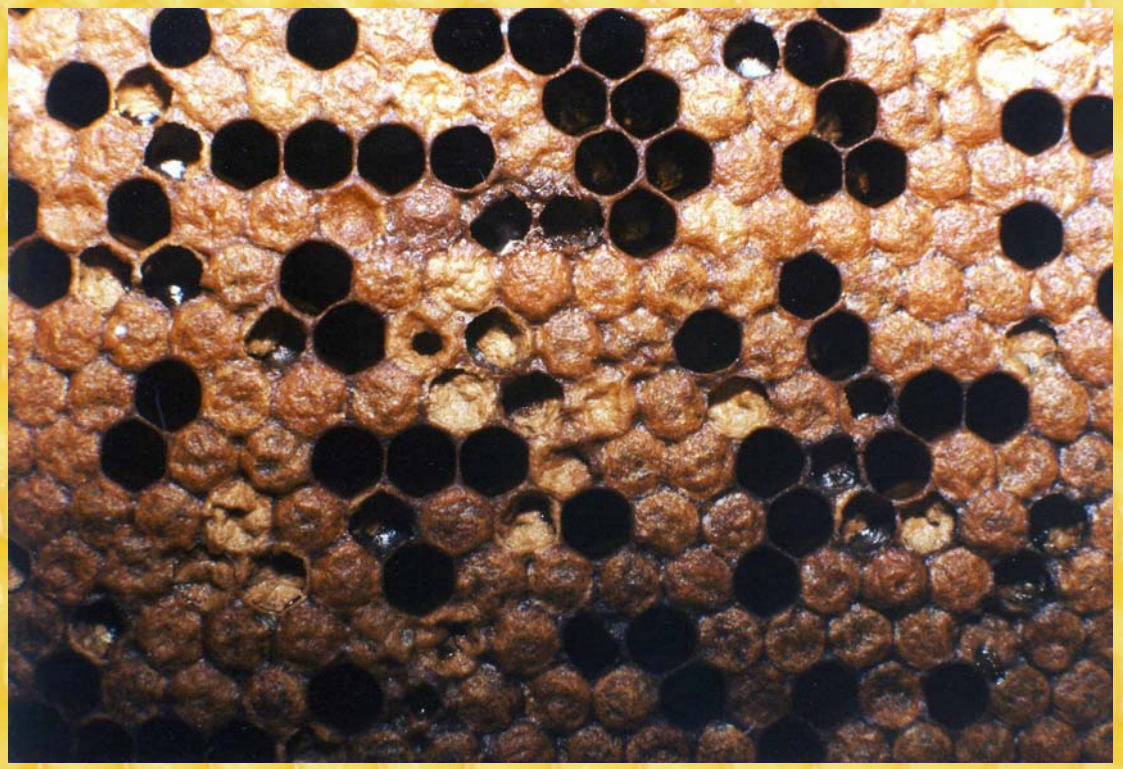
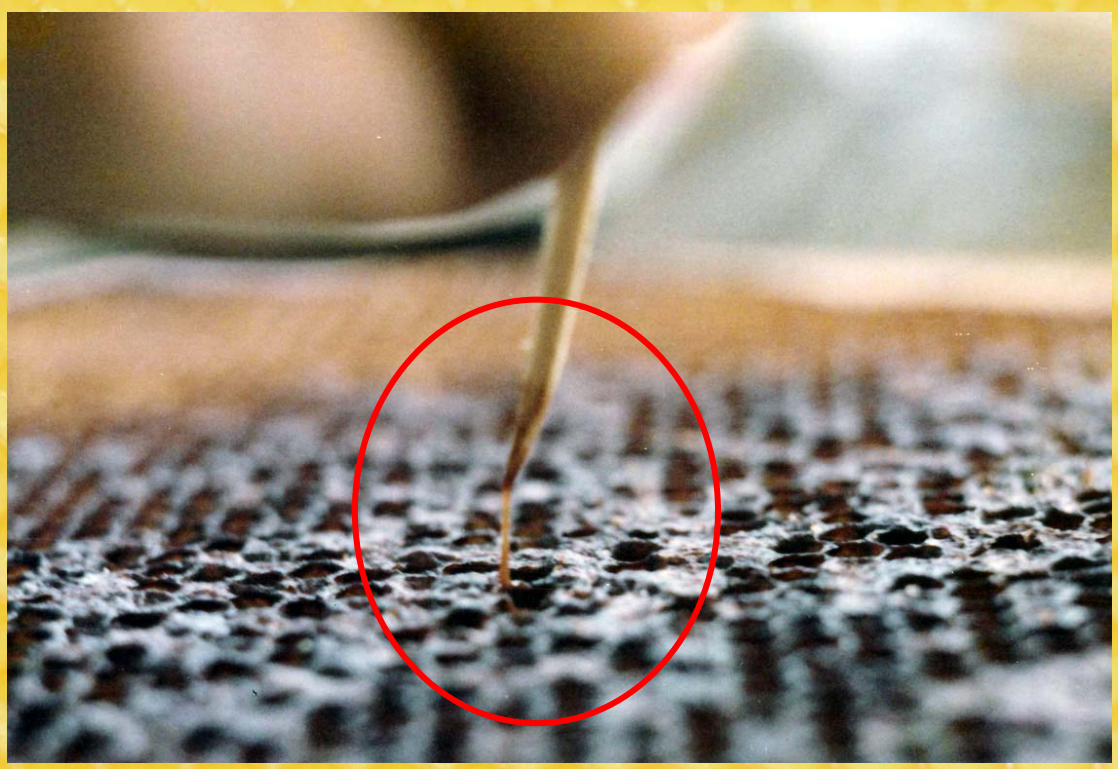
Signs of American foul brood

- capped brood is affected
- wax caps are sunken, perforated, moist and darker



Signs of American foul brood - cont.

- sick larvae are light to dark brown, amorphous and can stretch even up to 3 cm



Eradication - prevention

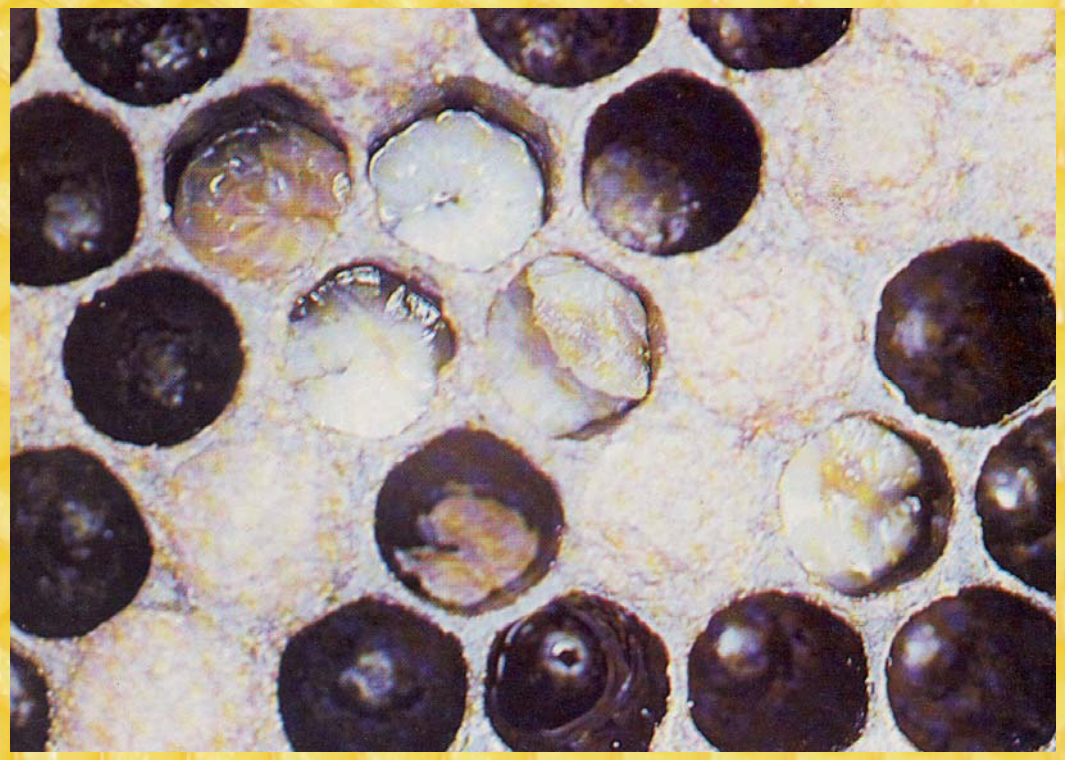
- American foul brood is a notifiable disease
- treatment is not possible; antibiotics do not kill very resistant spores
- antibiotics are not allowed
- destruction of infected colonies is compulsory
- proper preventing measures should be employed
  - maintenance of beekeeping hygiene
  - regular examination of colonies

European foul brood

- *Melissococcus pluton* and many secundary bacteria: *Paenibacillus alvei, Enterococcus faecalis, Brevibacillus laterosporus, Lactobacillus euridice*
- the disease could be serious or it disappears
- usually it is stress-related
- no treatment - eradication - the same as American foul brood
- in some countries antibiotic treatment is permitted under certain circumstances: supervision by veterinarians and taking into account long withdrawal period: up to six month

Signs of European foul brood

- uncapped brood is affected; larvae are twisted, yellow to brown and remain segmented



Chalkbrood

- is caused by the fungus *Ascosphaera apis*
- it invades larvae and kills them when they have been capped
- affected larvae release millions of spores
- they adhere to combs and to adult bees
- fungus can remain infectious for long time
- no medical treatment
- maintaining good beekeeping hygiene and strong colonies is the best way of the control

Signs of chalkbrood

- infected larvae are hard, chalky-white and mottled grey to black
- we can see dead larvae on the floor at the hive entrance

Stonebrood

- is caused by the fungus *Aspergillus flavus* and *A. fumigatus*
- pathogenic also to adult bees and other insects, birds and mammals
- affected brood is mummified
- mummies are hard and solid as a stone

- zoonosis - beekeepers should protect themselves
- urgent destruction of the affected colonies!

Sacbrood

- is disease caused by the virus *Morator aetatulae*
- infected larvae do not pupate and remain stretched with heads towards the top of their cells
- there is no specific treatment
- if much of the brood is affected the queen should be replaced from the uninfected colony

Signs of sacbrood

typical gondola
shape infected larva
which is
easily removed

Viral diseases

- Chronic Paralysis Virus
  - abnormal trembling motion of the wings
  - have reduced body hair, appear darker and shiny
- Acute Paralysis Virus
  - is more virulent
  - affected bees die quickly
- Israeli Acute Paralysis Virus (2004)
  - strongly related to Colony Collaps Disorder (CCD)

- many others viruses…
- no medical treatment

Nosemosis

- is a disease of the digestive tract caused by a spore forming protozoan *Nosema apis*
- chronic infection weakens the bees, shortens the productive life of the workers, and reduces their ability to produce brood food
- result is a decreased honey production
- queen and drone activities are reduced
- acute infection results in dysentery, defecating in the hive and increased winter losses

Nosemosis - cont

- *Nosema apis* is present in most apiaries; even if the infection is not obvious it causes significant damage in apiculture
- is highly contagious and it spreads in the bee colony, within the colonies and with migrating beekeeping to long distances
- improper beekeeping technology increases the risk of the disease and bee loses and decreasing of the production

Nosemosis - *Nosema cerana*

- primarly parasite of Asian bee *Apis cerana*
- 1994 on *Apis mellifera in Spain*
- 2006 in France, Germany, United States
- *N. cerana* and *N. apis* differ on spore morphology; they are recognised by genetic sequencing
- *N. cerana* is more virulent than *N. apis*
- it is linked (not yet proved) to the Colony Collapse Disorder

Treatment

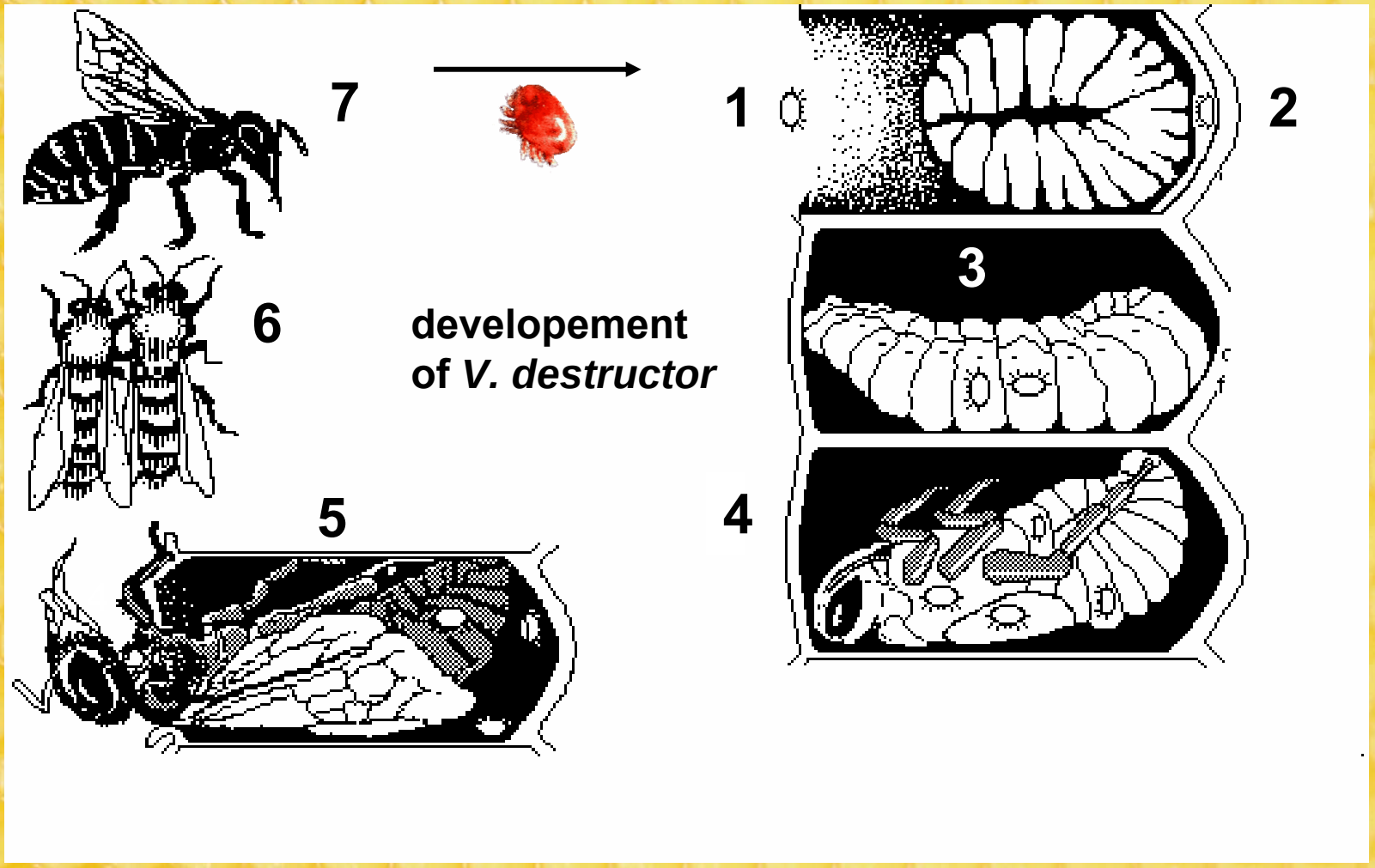
- Fumagillin produced by fermentation of *Aspergillus fumigatus* is highly effective to the vegetative stage *N. apis*
  - possible site effects on human health
  - no MRLs established
  - in the EU countries it is (was) not allowed
- research of the alternative methods of treatment
- transfering the infected colony to disenfected combs and hive is the best control measure

Prevention

- maintaining strong and vital bee colonies
- regular replacment of the old combs
- disinfection of combs and equipment
- arranging proper water supplies
- proper feeding and food supplies
- avoiding disturbing colonies during winter
- regular checking the infection and the disease
- many others….

Varrosis

- caused by the mite *Varroa destructor* - varroa
- originaly parasite of Asian honeybees *Apis cerana* which have developed natural resistance
- varroa feeds with hemolimfe of bees and larvae - prefers drone brood; larvae and bees are weakened and less immunocompetent
- varroa could be a vector of other bee pathogenes
- if we do not help, honeybee colony dies within 1 to 3 years



Source: http://maarec.psu.edu/pest&disease/pest13.gif

Signs of varrosis

- heavy infested pupas die and are removed
- if they survive, bees show different body deformations
- are smaller and less vital
- are less resistant to other diseases
- have shorter life

Signs of varrosis on bee colony

- reduced number of adult bees
- neglected and dead brood, abnormal brood pattern
- many varroa in the hive

Control strategy

- infected bee colonies cannot recover
- the mite population has to be kept within such a level that colony is not biologically and economically affected
- the biology of honeybee, varroa and their interactions has to be fully understood
- beekeeping management has to be understood
- the level of varroa infestation has to be monitored regularly

Control strategy - cont.

- control is demanding because the host and the parasite are similar in their biology
- varroa is in the cupped brood majority of the life
- more than the method, proper organisation of the control is important:
  - all beekeepers in the area should treat varroa at the same time with the same medicine
- it is necessary to mind the quality of honeybee products
- it is necessary to mind beekeeper safety - the protective clothes are obligatory

Control methods

- biotehnical methods
  - drone brood removal
  - comb traping
  - manny others
- use of chemicals
  - synthesised chemicals
  - natural substances
- combination of both - integrated varroa control
- problem - not authorised substances!

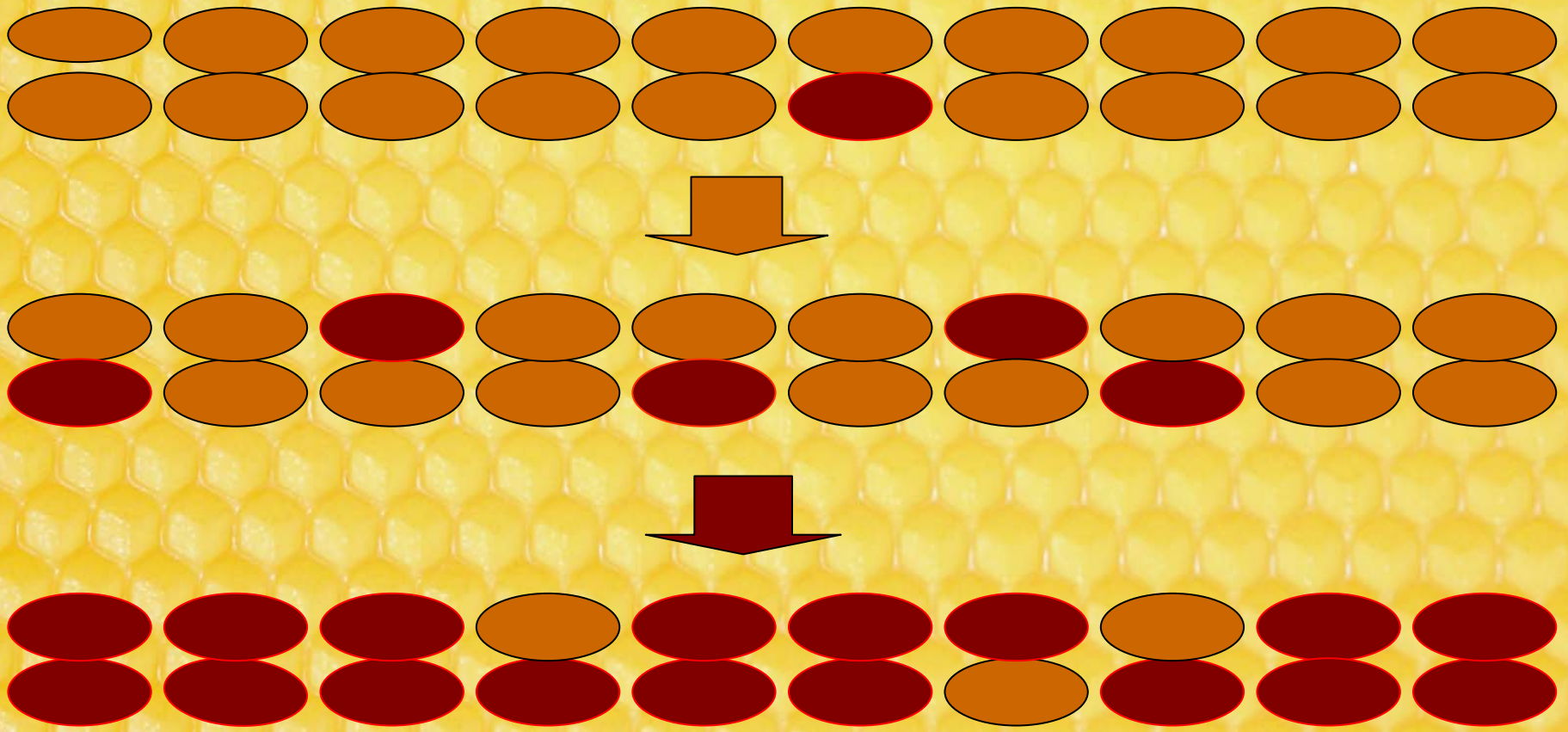
Medicines have to be authorised

- authorisation requires an exact scientific evaluation to prove that the medicine is not harmful to the:
  - consumers
  - beekeepers
  - honeybees
  - environment

Authorisation

- EMEA - European Agency for the Evaluation of Medical Products
- CVMP - Committee for Veterinary Medical Products
- MRLs for all the veterinary drugs should be established - some exceptions
- animals are divided into the major / minor use and the major / minor species - MUMS; also honeybees are included
- for the MUMS already obtained data could be evaluated or can be acquired from the academic or other institutes and estimated by the CVMP

Resistence



Source: http://beebase.csl.gov.uk/pdfs/managing_varroa.pdf

Some substances evaluated by EMEA

Veterinary drug	Annex	MRL (ppb)	Food
Amitraz (Apivar)	I	200	Honey
Coumaphos (Perizin)	I	100	Honey
Cymiazole (Apitol)	III	1000	Honey
Flumetrin (Bayvarol)	II		Honey
Formic acid	II		
Fumagillin	No recemendation		
Lactic acid	II		
Menthol	II		
Oxalic acid	II		
Thymol	II		

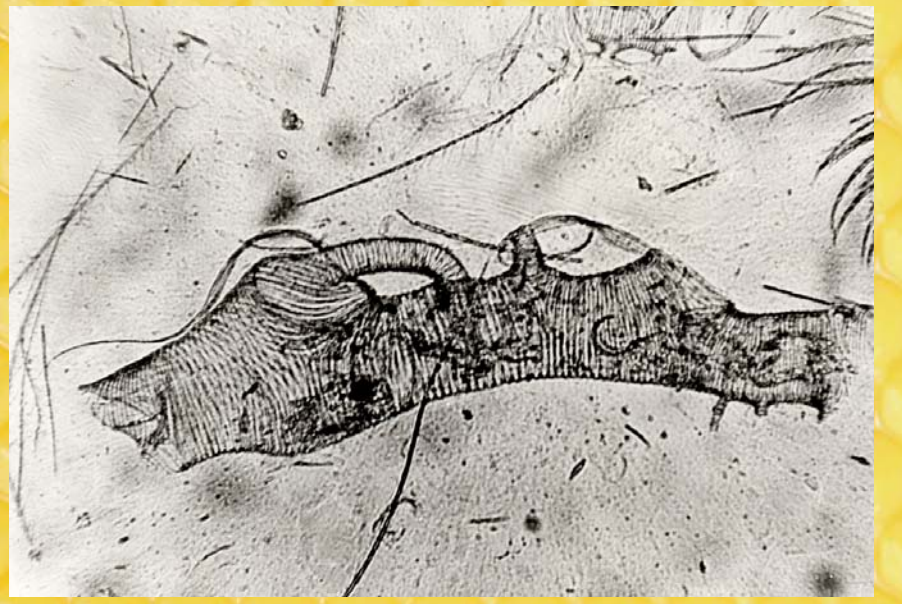
Acarine disease - *Acaraposis apium*

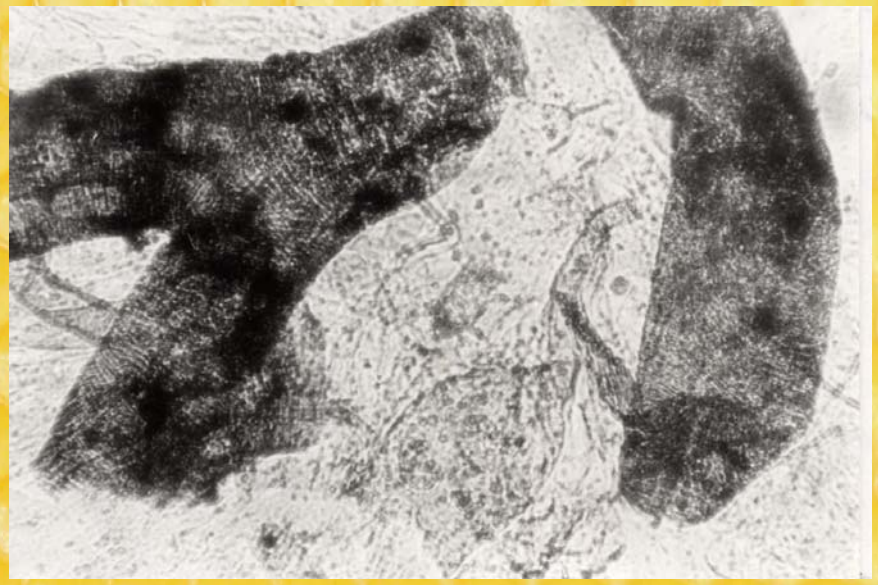
- mite *Acarapis woodi* (Rennie) completes its life cycle within the prothoracic tracheae of young bees and feeds with hemolimfe
- mites can be observed under microscope
- male: 11-12 days; female: 14-15 days
- infestation is not obvious during summer time, but it spreads among the bees in the colony; the infested bees have a shorter life span

Signs of acarine disease

- are obvious late in winter and early in spring when bees begin to fly out of the hive
- bees cannot fly, they crawl and die
- if the winter is long there are not enough bees to maintain the temperature in the winter cluster, and the entire colony dies
- treatment: today it would be possible to use the medicines for systemic varroa treatment

- in EU the disease does not pose a problem currently!





darkened infested tracheae obstructed by mites in various development stages

Tropilelaps infestation of honeybees

- mites from the genes *Tropilelaps* are parasites of honeybee brood primarily of *Apis dorsata*
- *Tropilelaps clarae* and *T. mercedesae* are damaging pests also to *Apis mellifera*
- an infestation can be easily recognised either visually on bees or by examining hive debris
- clinical signs of the disease are similar to varrosis
- treatment is similar to that of varroa

- it is an exotic diseases to EU; the contingency plan should be provided

Small hive beetle (*Aethina tumida*)

- an exotic pest to EU (probably Portugal, 2004); a serious threat to European apiculture
- it multiplies in the infested colony and destroys combs and colony
- its origin is in Africa where it does not cause much harm, however in America where it was introduced in 1998 has already destroyed thousands of colonies
- treatment is similar to that of varroa
- in EU the contingensy plan should be provided

Colony Collapse Disorder - CCD

- mysterious honeybee disease (syndrome) of the worldwide concern
- sudden disappearance of bees
- no dead bees inside or around the hive
- queen and brood are left
- pollen and honey are not robbed
- minimal evidence of wax moth

- probably combination of many factors
- all losses are not CCD

Conclusions

- we need different beekeeping strategy
  - different feeding program
  - more frequent comb changes
  - education of beekeepers
- more research on honeybee biology and physiology
  - maybe we are not always right
- research on honeybee medicines
  - alternative treatments
  - the methods should be in accordance of honeybee biology
  - more experiments
  - are honey bees really “MUMS”

Bees are a type of fly, hardworking, created by God to provide man with all needed honey and wax. Amongst all God's beings there are none so hard working and useful to man with so little attention needed for its keep as the bee.

Anton Janša (1734-1773)

Thank you for Your attention

Sources

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- http://en.wikipedia.org/wiki/Anton_Jan%C5%A1a
- others