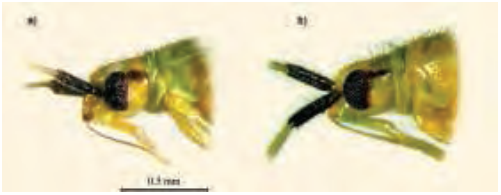
- *Macrolophus* spp. (Heteroptera : Miridae)
  - Small predatory bugs (+/- 3mm)
- Palearctic species
  - Widely used in European greenhouses
  - Biological control of aphids, whiteflies, thrips, spider mites on eggplants, tomatoes,…

- Facultative phytophagous predators
  - In times of prey scarcity: feeding on plants
- Piercing-sucking mouthparts

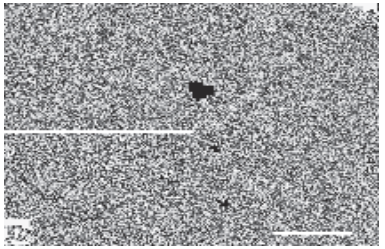
- Two commercially distributed species:
  - *M. pygmaeus* and *M. caliginosus*
- Morphologically very similar



Adapted from Martinez-Cascales *et al.*, 2006

M. pygmaeus often sold as "*M. caliginosus*" by biocontrol companies (Perdikis *et al.*, 2003, Martinez-Cascales *et al.*, 2006, Machtelinckx *et al.*, 2009)

- Our objective:
  - Endosymbiotic community in *M. caliginosus* and *M. pygmaeus*

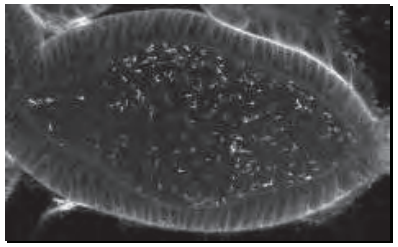


Adapted from Vandekerckhove et al., 1999

  - Symbiosis :'living together of two dissimilar organisms' (De Bary, 1879)
  - Most important and best known arthropod endosymbiont: *Wolbachia*

Wolbachia

- Obligate intracellular alpha-proteobacterium with an exceptionally wide host range within the arthropods
- Approximately 66% of all insects infected (Hilgenboecker et al., 2008)



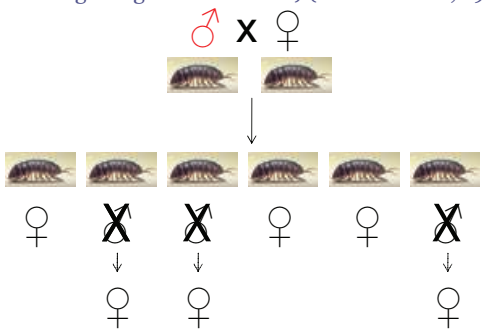
- Possible influence on the fecundity (Vavre *et al.*, 1999)
- In rare cases: obligate for its arthropod host (Dedeine *et al.*, 2001)

Wolbachia

Manipulates the reproduction of its arthropod host

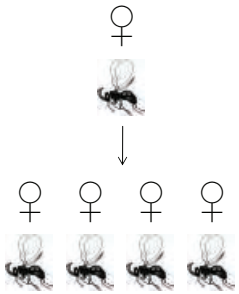
- Feminization

  Infected genetic males convert into females (prevention of the androgenic gland formation) (Rousset *et al.*, 1992)



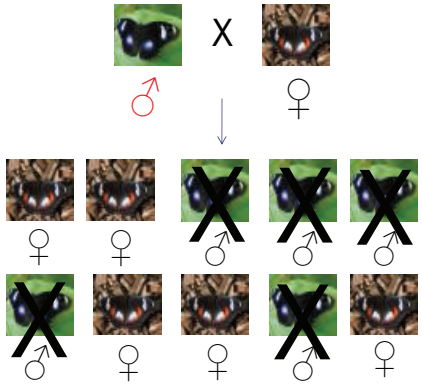
Parthenogenesis

Infected females produce female offspring of unfertilized eggs in haplo-diploids (thelytoky via gamete duplication) (Stouthamer *et al.*, 1990)



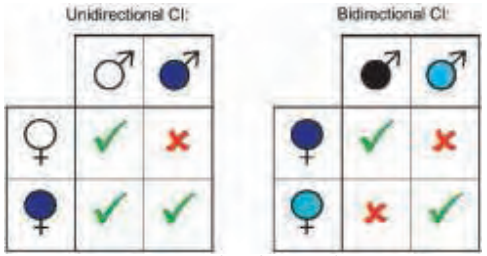
Male killing

- *Wolbachia* bacteria kill male progeny during embryogenesis while female progeny survives (Stevens *et al.*, 2002)



Cytoplasmic incompatibility

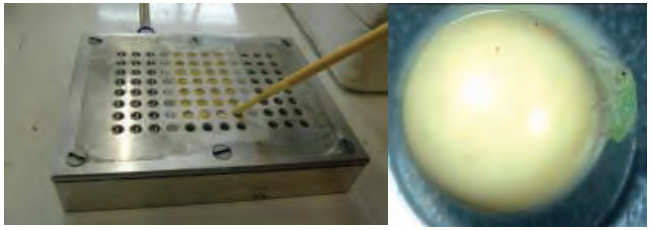
- Probably most common effect of *Wolbachia* (Stouthamer *et al.*, 1999)
- Cross between an infected male and an uninfected female or a female infected with another *Wolbachia*-strain results in embryonic mortality



Source: Engelstädter *et al.*, 2009

Effect of *Wolbachia* in *M. pygmaeus*?

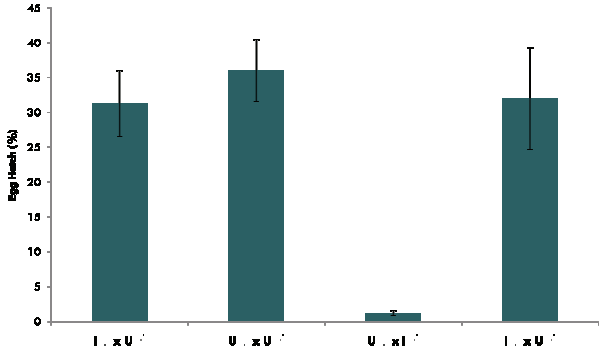
- *Macrolophus pygmaeus* is infected with *Wolbachia* (Machtelinckx et al., 2009)
- An infected strain was cured by adding tetracycline to an artificial diet based on egg yolk



Crossing experiments

- Infected males with infected females [I-♂ x I-♀]
- Uninfected males with uninfected females [U-♂ x U-♀]
- Infected males with uninfected females [I-♂ x U-♀]
- Uninfected males with infected females [U-♂ x I-♀]

Crossing experiments



Wolbachia causes cytoplasmic incompatibility in *M. pygmaeus* (only 8 out of 702 eggs hatched)

Other endosymbionts?

- Besides *Wolbachia*: increasing number of endosymbionts found in arthropods (Duron *et al.*, 2008)

Rickettsia (MK, P)  

 *Arsenophonus* ("Son-killer")

Cardinium (CI, P, F)   

 *Spiroplasma* (MK)

Future research

- Reproductive effect of endosymbionts in *M. caliginosus*
- Infection status of wild *Macrolophus* spp.
  - Same endosymbiotic community?
  - Bidirectional incompatibility?

Conclusion

- *Wolbachia* induces strong CI in *M. pygmaeus*
  - May have vital implications for the commercial production of *Macrolophus* sp. and their use in biological control
  - Suppression of the population growth by interaction of populations with a different infection status

Thank you

- PhD. grant to T. Machtelinckx from 'Institute for the Promotion of Innovation by Science and Technology in Flanders' (IWT)
- Organizers of the 12th Workshop of the IOBC AMRQC Working Group and this session 'The Role of Microbiota in Insect Mass Rearing and Quality Control'

- Thank you for your attention!

Faculty of Bioscience Engineering

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