Genetics and biology of the mango blossom gall midge, *Procontarinia mangiferae*, a pest with highly adaptable life strategies

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Photo: A. Franck - CIRAD
The mango blossom gall midge, *Procontarinia mangiferae*

The only *Procontarinia* species feeding on several mango organs

- Inflorescences
- Very young fruits
- Reproductive organs
- Young growth units
- Young leaves
- Vegetative organs
Biological cycle of *P. mangiferae*

- Larvae fall and bury themselves in the soil
- Larvae grow within mango organs
- Pupate
- Adults emerge from the soil
- Cycle ~3 weeks

End of the flowering season → 100% diapause (Prasad, 1971)
Objective: to improve our knowledge of the biology of *P. mangiferae* in order to develop IPM strategies

- by describing its **genetic diversity** and assessing the determinants of the genetic structure of its population

- by understanding **the diapause strategies** involved in maintaining populations from one flowering season to the other

- by modeling **the female dispersion** within and between orchards
Genetic diversity and structure of populations

• Objectives of this study
  – When is *P. mangiferae* present in Reunion island?
  – Are the populations genetically structured according to biotic and/or abiotic factors?

• Materials and Methods
  – Field surveys of larvae populations during 14 months in three orchards
  – Genetic studies were performed using:
    • 1 mitochondrial gene (COI – 370 bp)
    • 11 newly developed microsatellites
      (Amouroux et al., 2012, *Mol Ecol Ressources*)
When is *P. mangiferae* present in Reunion island?

- *P. mangiferae* is present all year round in mango orchards, feeding on young leaves or inflorescences.

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Genetic structure of the populations

- Two clusters in sympatry
- One cluster more frequent in the West coast
- West coast = the main mango production area
  - Agricultural practices
  - Density of resources

(Amouroux et al. 2013, *Biological Invasions*)
Diapause of *P. mangiferae*

**Objectives:**
- Is there variation in the rate of diapause induction during the year in natural conditions?
- Has temperature an effect on diapause duration in controlled conditions?

**Materials and Methods**
- Measure of the rate of diapause every month during one year
- Laboratory experiments at constant temperatures (26 C and 20 C) and with transfer from 26 C to 20 C
Rate of diapause induction during the year in natural conditions

- Maximum average rate of diapause: 30%
- The highest rates of diapause were observed on larvae collected in summer from mango leaves.
Effects of temperature on diapause duration in controlled conditions

- Diapause duration longer at 26 °C than at 20 °C
- A temperature decrease from 26 °C to 20 °C triggered off the emergence of adults
Dispersal abilities of *P. mangiferae*

• **Objective:**
  – to investigate the ability of *P. mangiferae* females to contaminate a new orchard from surrounding orchards

• **Materials and Methods**
  – measurement and modelling of the number of larvae produced by non-native females in an orchard without native *P. mangiferae*
Main results of the dispersal model

• On average, 4 000 females arrived each day in the orchard (0,5 ha)

• Females landing in the orchard is controlled by the resource density

• Resource attractivity varied according to the phenological stages

• Resources were attractive up to 8 m

• Damages were limited in the « covered » orchard
Conclusions

• One single species is present all year round, feeding on inflorescences and young leaves

• Diapause can occur each month, is maximal in summer but did not exceed 30%

• Emergence after diapause is synchronized by cool temperature

• Numerous non-native individuals can colonize an orchard

• Resources orientate the female flight and are attractive up to 8 m
Consequences for IPM

• Populations must be controlled at a large scale

• Development of strategies to break the cycle of *P. mangiferae* by intercepting larvae falling from mango trees

• Development of strategies against larvae in diapause in the soil and against permanent populations in summer

• Development of orchard management practices favoring the natural predators and parasitoids

• To favor the phenological synchrony in mango orchard
Thanks for your attention