Allan DEBELLE – 22.05.25

# *Drosophila suzukii*

# My career

- Insect reproductive biology
  - Biological control
  - Insect mass-rearing
  - Data science

→ **Consulting**
→ **Teaching**

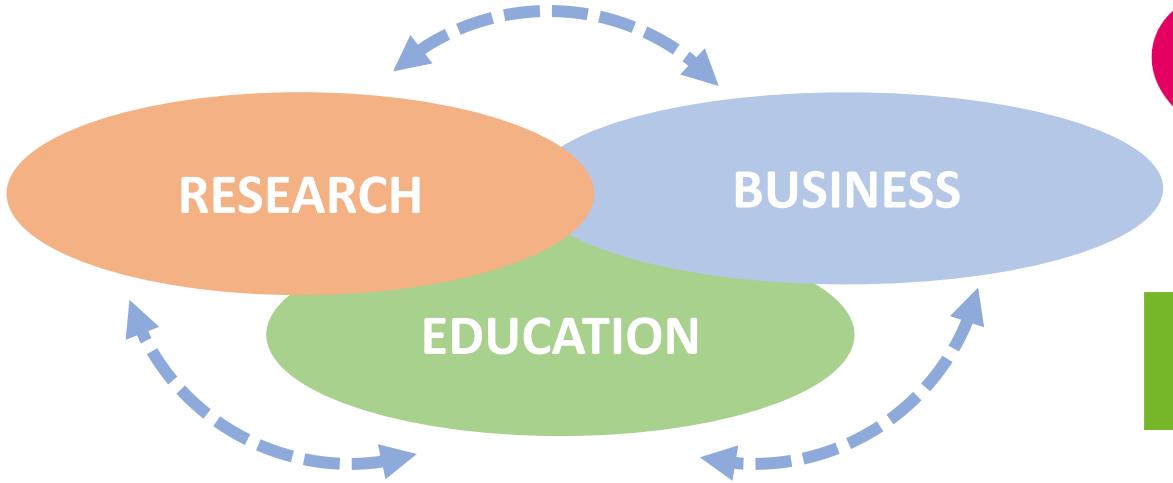


# La Chaire Innov'Arbo (2024-2028)

**GOAL**

Federate education, research and business

to innovate for fruit tree farming



# *D. suzukii* in France

- *Drosophila suzukii*
  - Arrived in Europe in 2008, in France in 2010
  - Soft fruits (cherries, strawberries, raspberries)
  - Up to 13 generations/year
  - Up to 80% of yield loss


**Cherry sector**

- 7 500 ha
- 2650 farms
- 33 000 T of fruits

# Current projects on *D. suzukii*

- Sterile insect technique: projects OPTIMISTII and CHERRY TIS
- Parasitic wasps : project SUZoCARPO
- Combination of techniques : project STRATOS

# *D. Suzukii pest management*

| Produit (substance active) | AMM | Nombre max d'applications | DAR | Spectre |
|---|---|---|---|---|
| ARGICAL PRO (kaolin) - **utilisable en AB** | AMM pérenne | 1 au début de la véraison | - | Adultes |
| KARATE ZEON (lambda cyhalothrine) | AMM pérenne | 2 | 7 jours | Adultes |
| DECIS PROTECH (deltaméthrine) | AMM pérenne | 3 | 7 jours | Adultes |
| NATURALIS (*Beauveria bassiana*) - **utilisable en AB** | AMM pérenne | 5 (Intervalle minimum de 5 jours) | 3 jours | Adultes |
| DELEGATE (spinetoram) | Retrait de l'usage le 30/06/2024 Date de fin d'utilisation : 31/12/2025 | 1 | 3 jours | Adultes |
| MOVENTO (spirotétramate) | Retrait de l'usage le 30/04/2024 Date de fin d'utilisation : 31/10/2025 | 2 (Intervalle minimum de 14 jours) | 21 jours | Adultes |

Le tableau suivant présente les produits pour lesquels une demande d'AMM 120 jours a été obtenue en 2025 :

| Produit (substance active) | AMM 120jours | Nombre max d'applications | DAR | Spectre |
|---|---|---|---|---|
| EXIREL (cyantraniliprole) | AMM 120 jours obtenue du 01/04/2025 au 30/07/2025 | 3 (Intervalle minimum de 10 jours) | 3 jours | Adultes |
| SUCCESS 4 (spinosad) - **utilisable en AB** | AMM 120 jours obtenue du 01/04/2025 au 30/07/2025 | 2 | 7 jours | Adultes |
| AFFIRM (emamectine) | AMM 120 jours obtenue du 01/04/2025 au 30/07/2025 | 3 (Intervalle minimum de 7 jours) | 7 jours | Adultes |
| SOKALCIARBO (kaolin) - **utilisable en AB** | AMM 120 jours obtenue du 01/04/2025 au 30/07/2025 | 5 (Intervalle minimum de 4 à 5 jours) | 3 jours | Adultes |

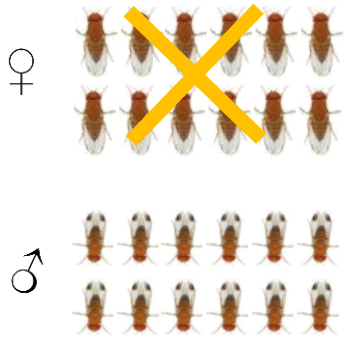
**Also:**

- Repellents
- Mass trapping
- Attract&Kill
- Parasitoids (*Ganapsis*)
- Nets

# Sterile Insect Technique (SIT)

**1. Mass-rearing in an insect farm**

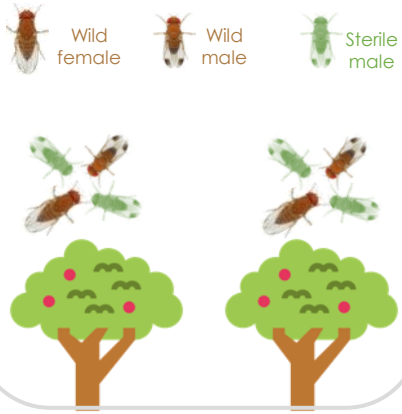
**2. Sexing**



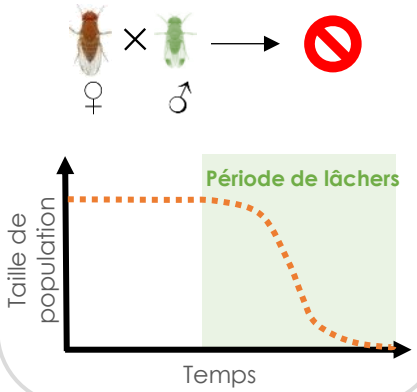

**3. Sterilisation via ionizing radiation**

**4. Weekly releases in crops**

**5. Sterile males compete with wild males**




**6. Sustainable management of *D. suzukii***




- Species-specific
- Lower use of pesticides
- Proven efficacy on many species

- Area-wide pest management method
- Not instantaneous
- Requires weekly production + releases

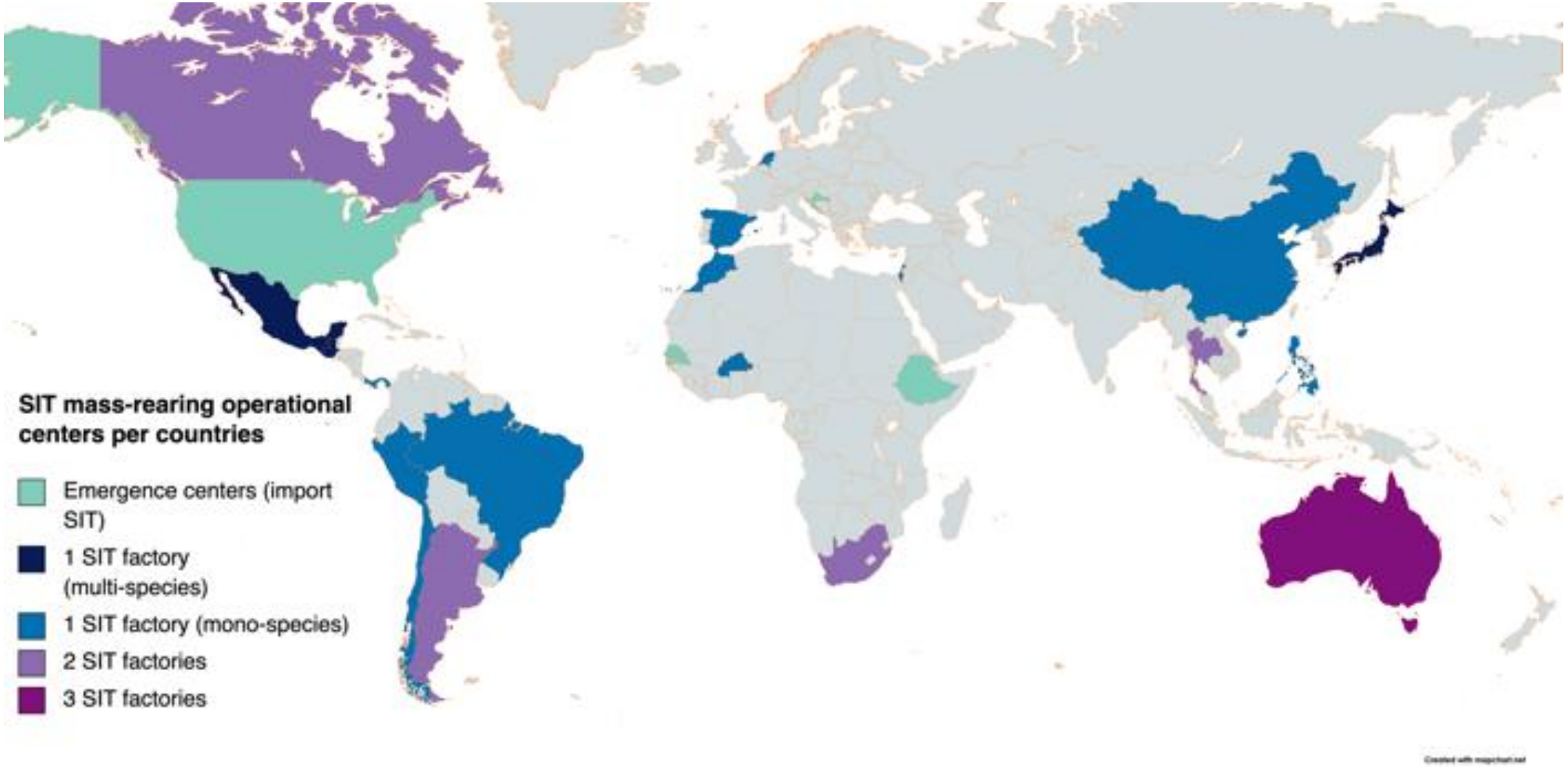
# SIT incompatibility

- The targeted pest species cannot have these characteristics:
  - Pathenogenesis
  - Sterile insects (adults) are creating damage

  +

  - Short and synchronous reproductive period
  - Reproductive sites hidden
  - Very low movements or high migration
  - Very long life cycle

# SIT exemples



# SIT exemples

**Some very large facilities and programs exporting sterile flies**

**El Pino, Guatemala**
Production capacity 2500M flies/week

**Mexico**
1000M/week

# SIT exemples

*Cydia pomonella*

**Canada (OKSIR)**

20 000ha

**Example : Suppression of codling moth in Canada**

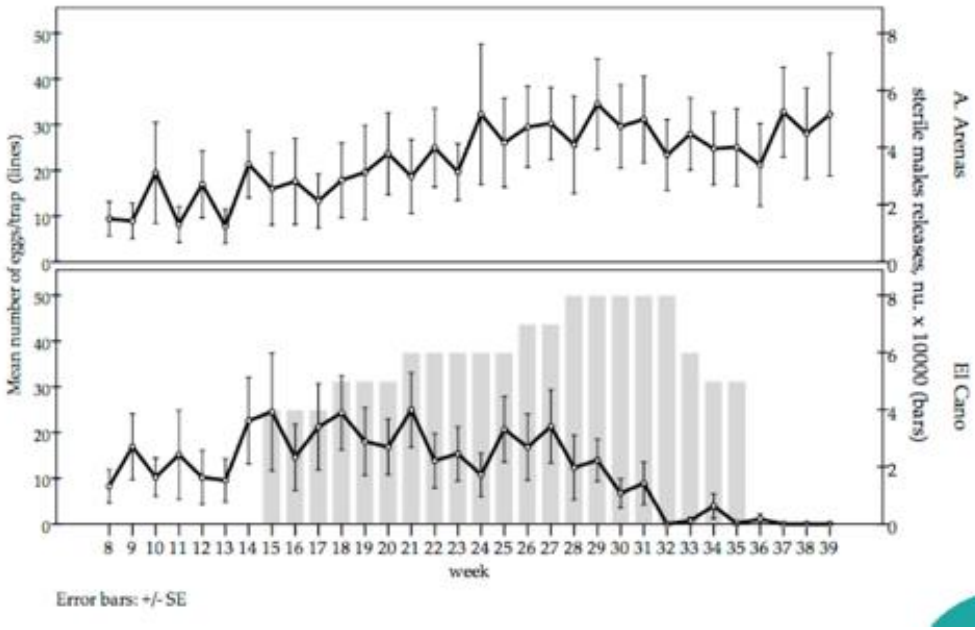
- 2900 ha
- <0.2% fruit damage
- 94% pest reduction
- 96% reduction of pesticides
- Improvement of rural-urban relationships
- Opening of new markets
- Cost/benefits: 1 / 2.50

https://www.oksir.org/

*Aedes aegypti*

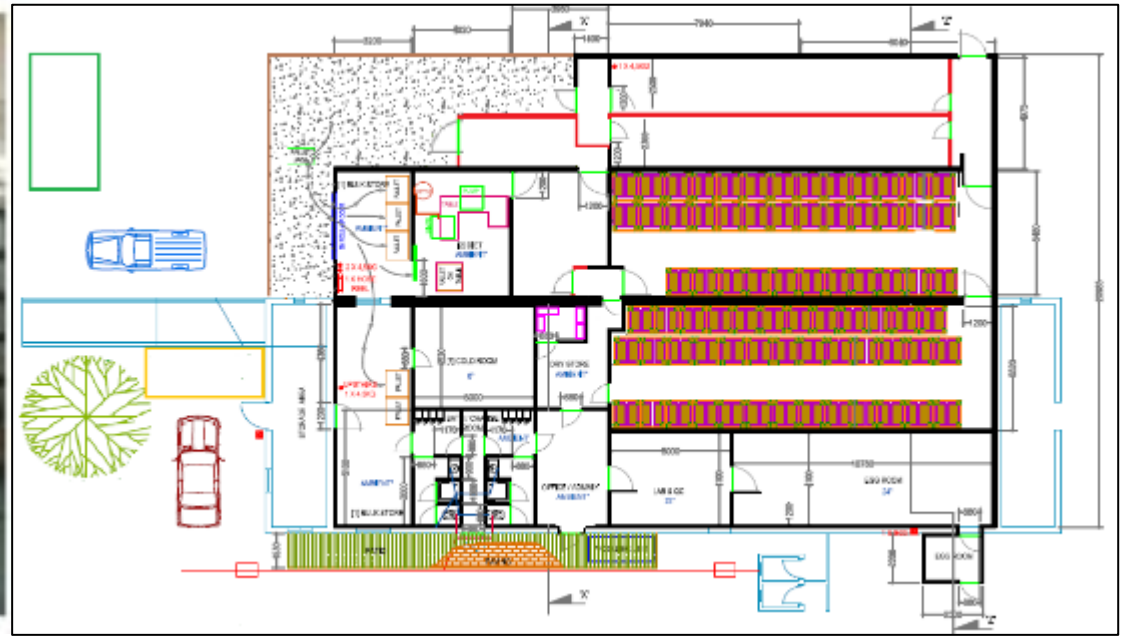
**Cuba**

50ha



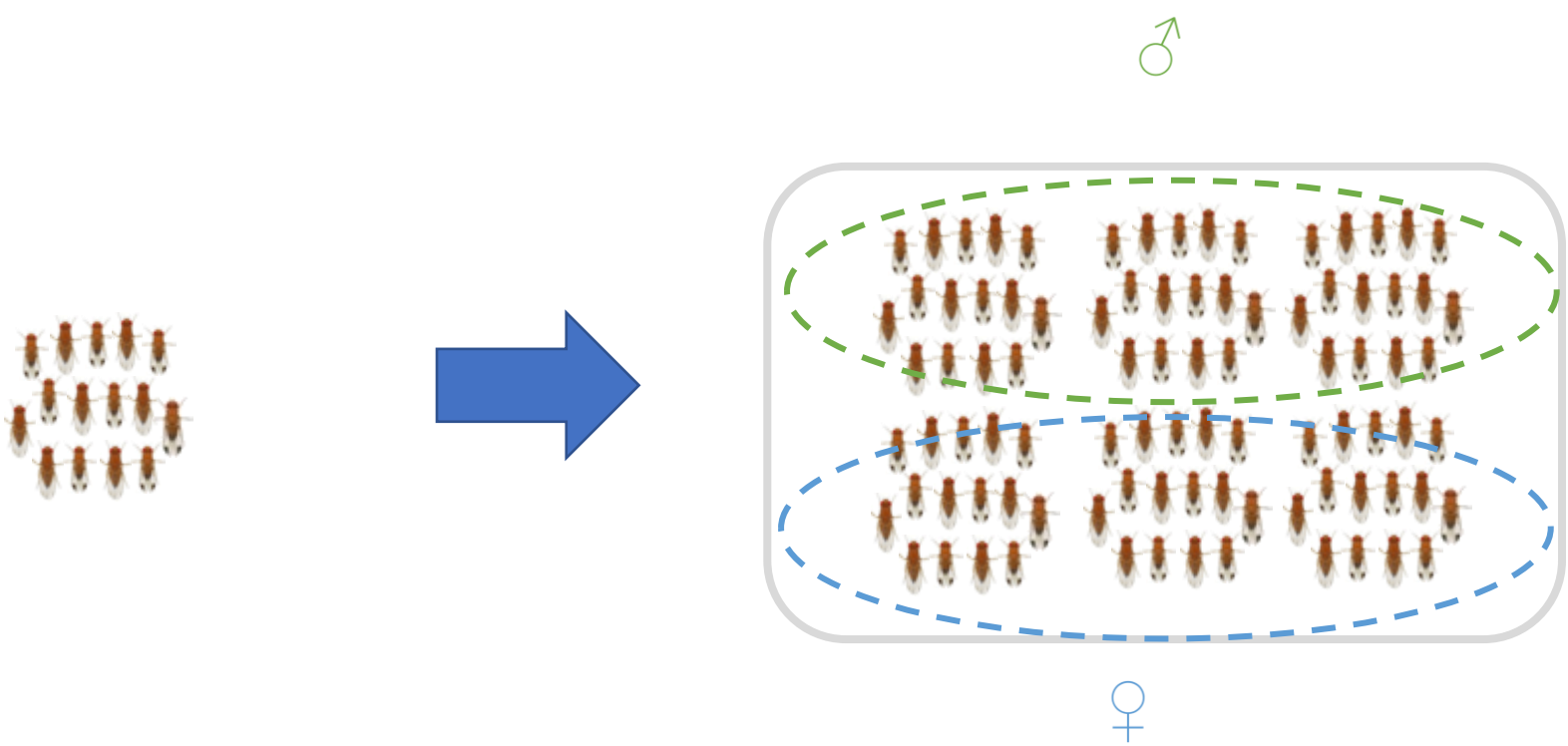
# Mass-rearing

- Insect mass-rearing
  - Building an insect farm
  - Designing industrial production equipment



# Sexing

- Why ?
  - Costs
    - Production
    - Releases
  - Risks
    - Efficacy
    - Damages



# Sterilisation

X or gamma rays

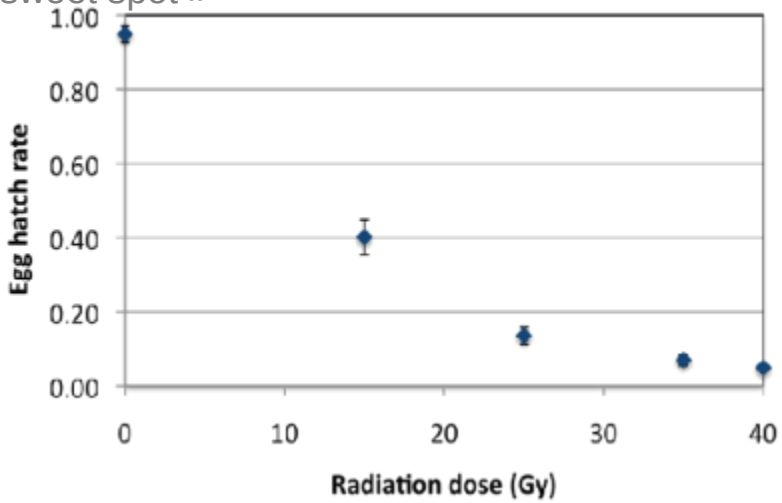
Spermatozoids are motile but sterile

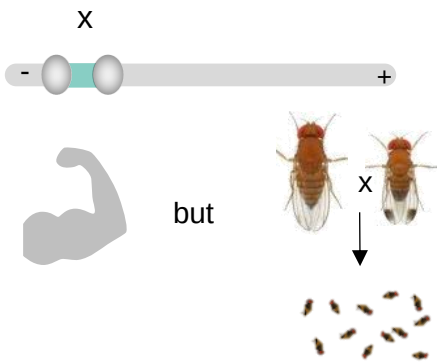
Ionizing rays damage DNA

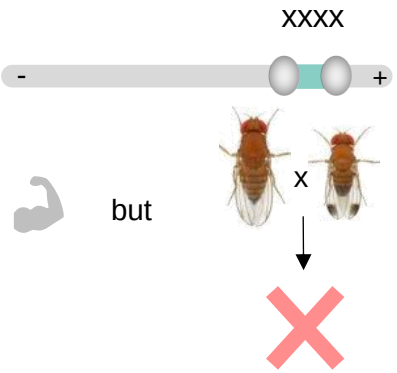
Egg development aborts

- How ?
  - Ionizing rays
    - Fragmentation of chromosomes in germ cells (lethal dominant mutations, translocations, etc)
- Optimal dose?
  - Why ?
    - Find the « sweet spot »

*Dose-sterility curve*



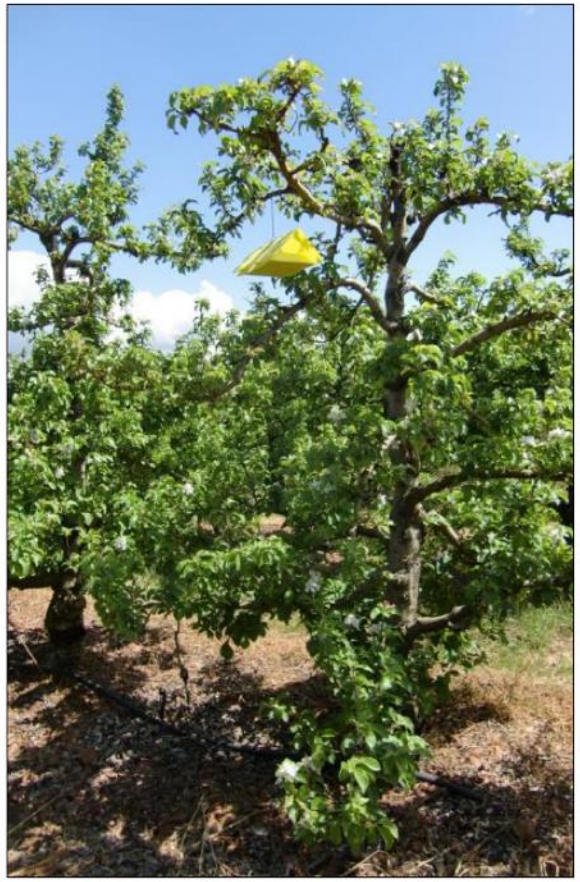



# Releases

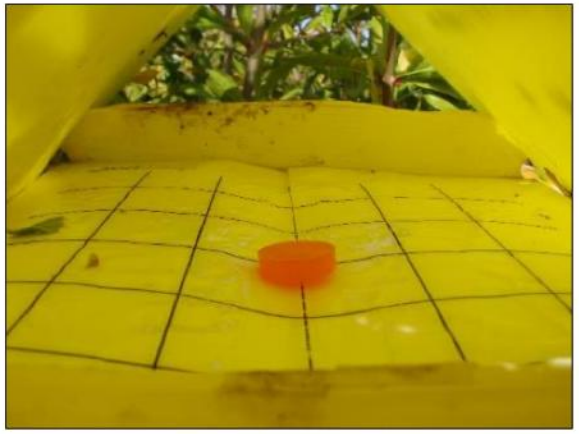
- How ?
  - Storage
  - Releases
- Variables to take into account
  - Release grid (space)
  - Number of males / ratio
  - Timing
    - Frequency
    - Season
    - Day


# Monitoring

- Why ?
- How ?
  - Trapping
    - Marking
    - Frequency
  - Crop damage/monitoring
- Feedback loop !
  - Modelisation!



**Connected traps**



# Goal: 10 million sterile males/week

**Cherry crops to protect**

- Annual production → 33 000T
- Cherry crops area → 7500ha
    - **Sub-area to protect → 2000ha**

**Production goals**

- 5000 sterile males/week/ha (0.5 male/m2)
- Weekly sterile male production?
    - **10 000 000 sterile males/week**

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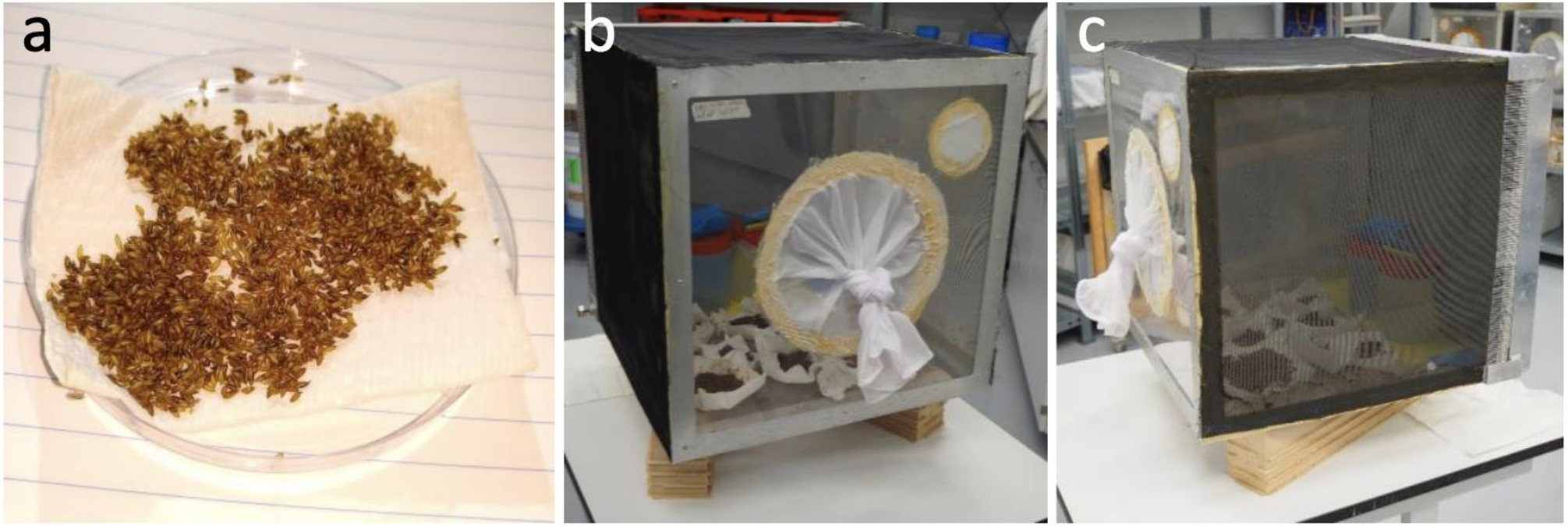


T = 23°C
RH = 65%
Photopériode = 14:10

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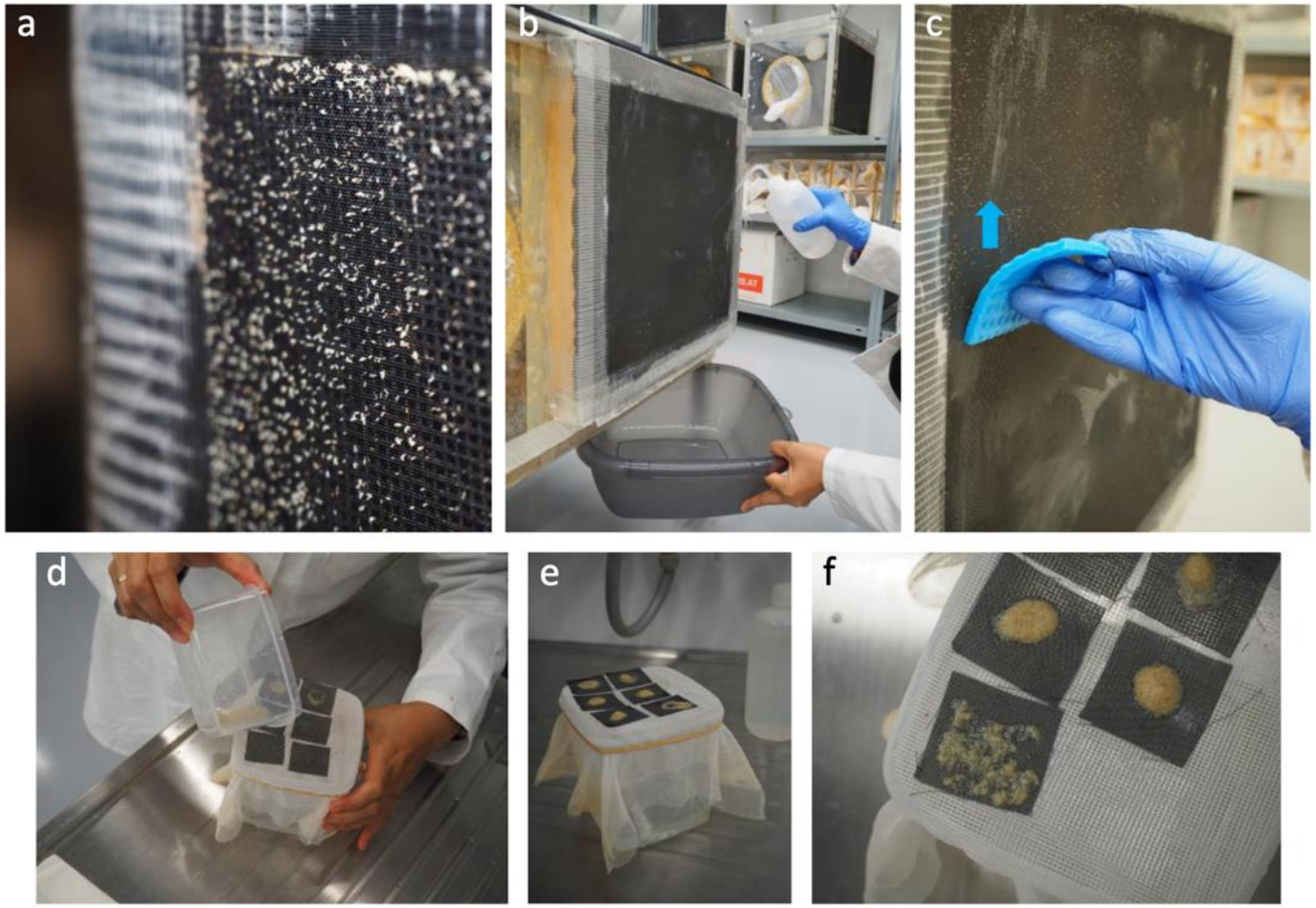

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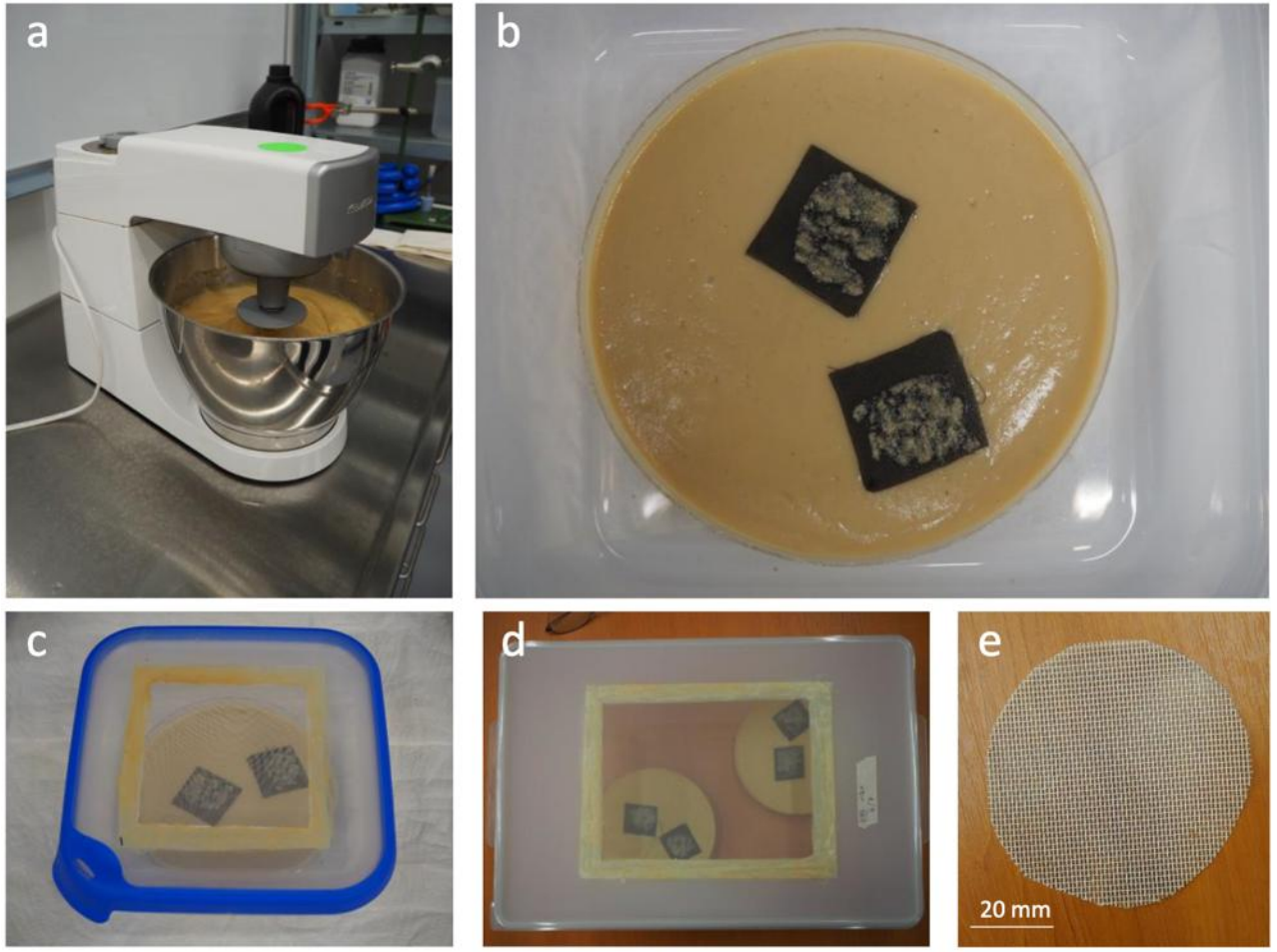

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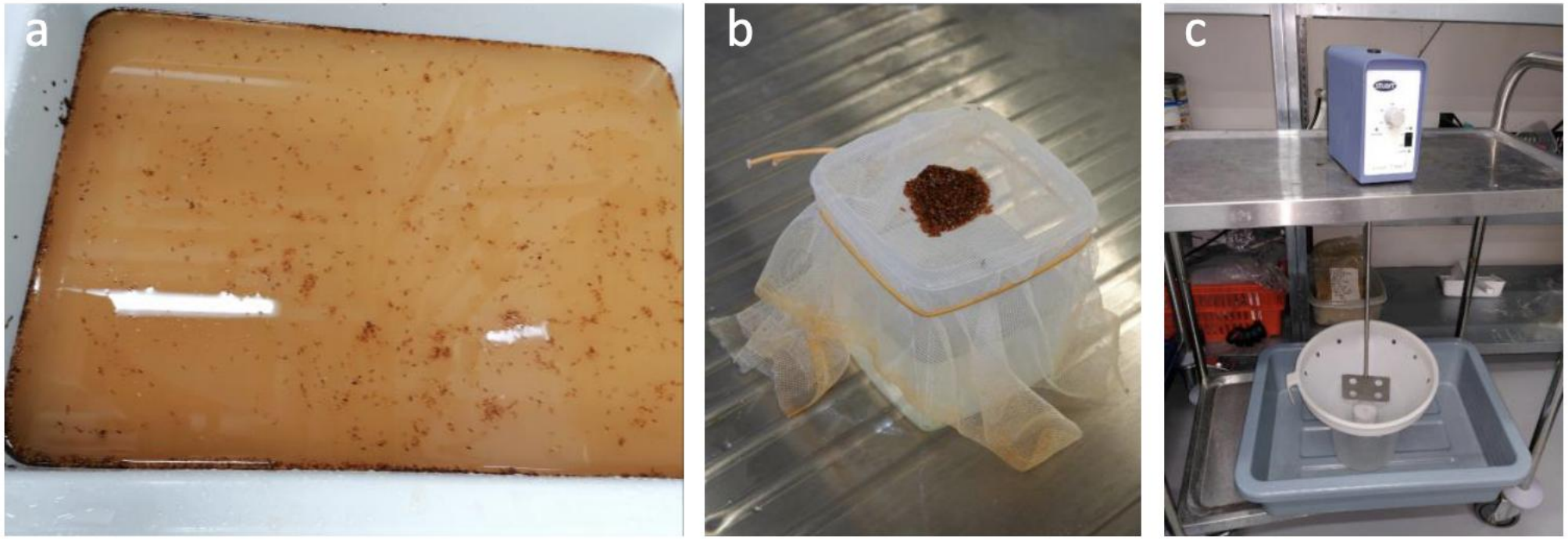
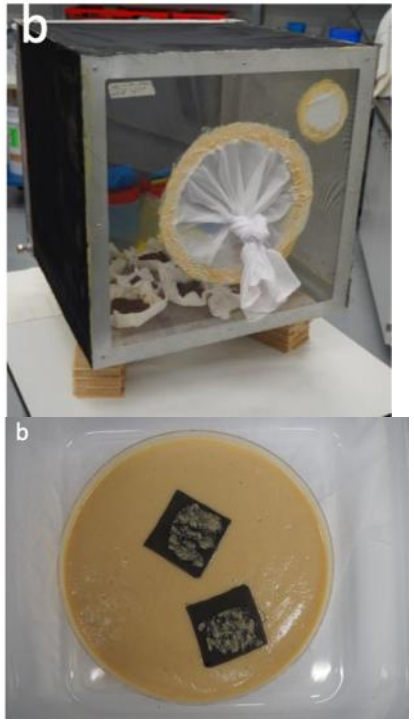


# Goal: 10 million sterile males/week

30 000
pupae




**115 000 sterile males**

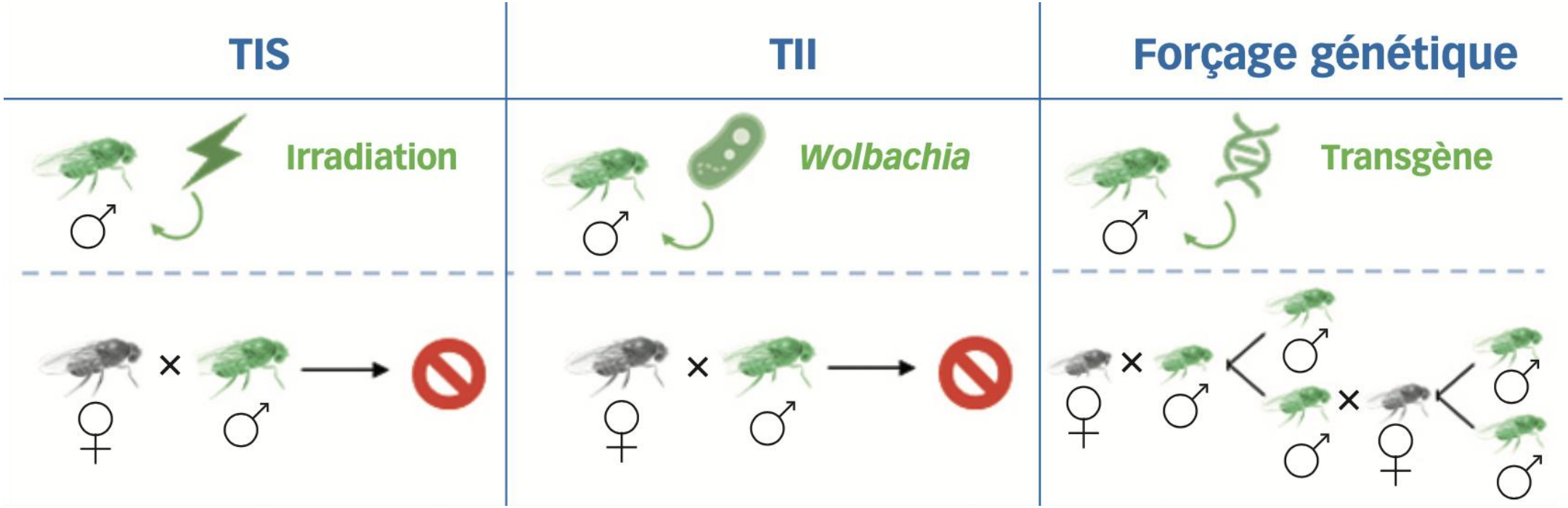
**10 000 000 sterile males/week**

~ 90 cages & 6000 plates

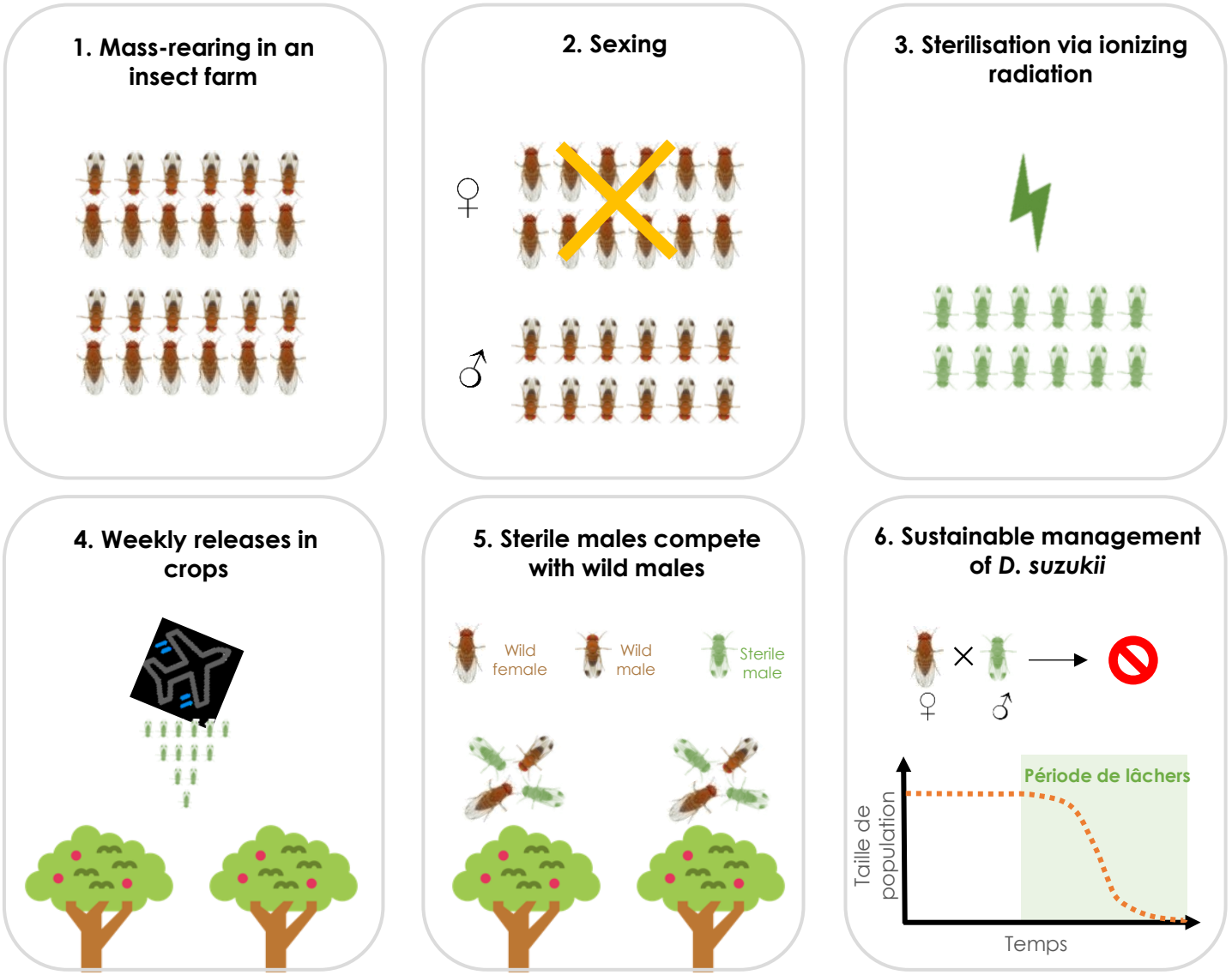
**54m2** **405m2**

# Verticality


# TIS variations



# Take-home message

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# Thanks !


- **R&D Engineer**
- **Innov'Arbo coordinator (2024-2028)**
- **Consulting**
- **Teaching**