# Nets and covers to protect cherry trees from rain and insects

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# Why secure production of cherry trees ?

- **Cherry production is uncertain**
  - It depends on weather conditions
    - Rainfall: cracking - up to 100%
      - Most of the time crop destruction and loss of quality
    - Wind: markings on fruit
      - Important for the tender varieties (which are susceptible)
        - Summit
        - Blush varieties
    - Cherry doubling:
      - First observed in France in 2004
      - Quite common for the last 5 years
        - Susceptibility depends on the variety
        - Non susceptible varieties: fruit doubling for the last 2 years in Nîmes
  - Pests
    - Cherry fly (*Rhagoletis cerasi*)
    - *Drosophila suzukii* in France since 2011
    - Goat moth
    - *Capnodis tenebrionis*: increasing in the South-East of France over the last 5 years
    - Wasps
      - Damage on late and very late varieties in Nîmes for the last 7 years

# New production systems to secure cherry production

* Row-by-row protection
* Orchard fully protected

# Protection from insects: choose the right nets

* Mesh size of nets
  * Trials in orchards: 2009/2013
  * Laboratory trials:  2012

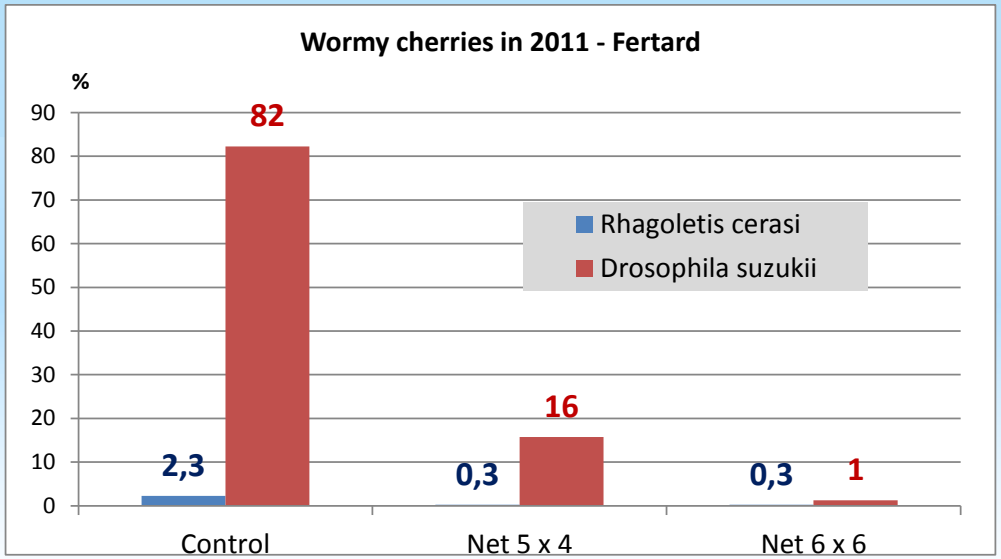
# Different types of nets tested*

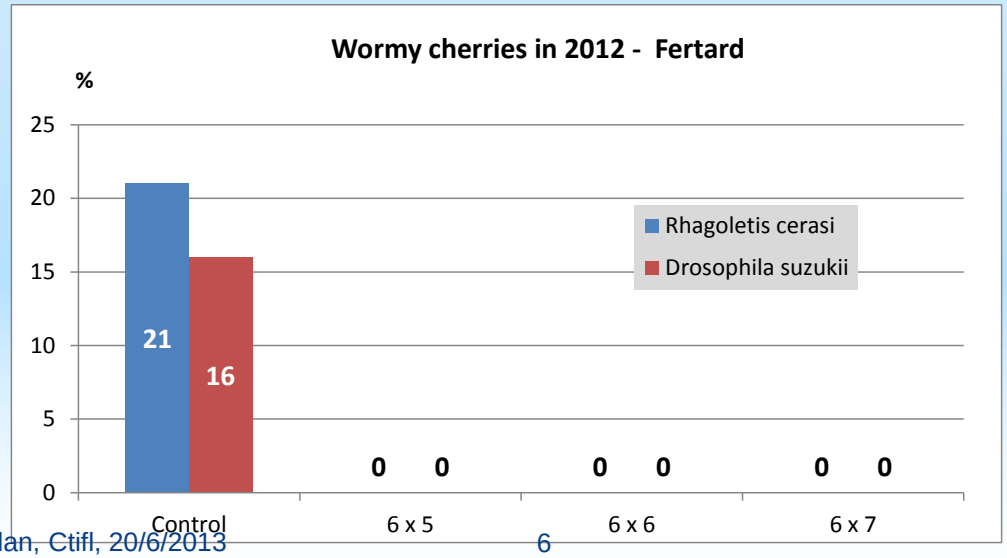
| Nets | Mesh size | | Weight | Shading |
|---|---|---|---|---|
| | mm | mm | g/cm² | % |
| **Woven net 5 x 4** | 2,21 | 3,42 | 72 | 10 |
| **Woven net 6 x 5** | 1,38 | 1,71 | 79 | 17 |
| **Woven net 6 x 6** | 1,38 | 1,38 | 85 | 18 |
| **Woven net 6 x 7** | 1,38 | 1,14 | 93 | 20 |

* Trials carried out wih the company Filpack

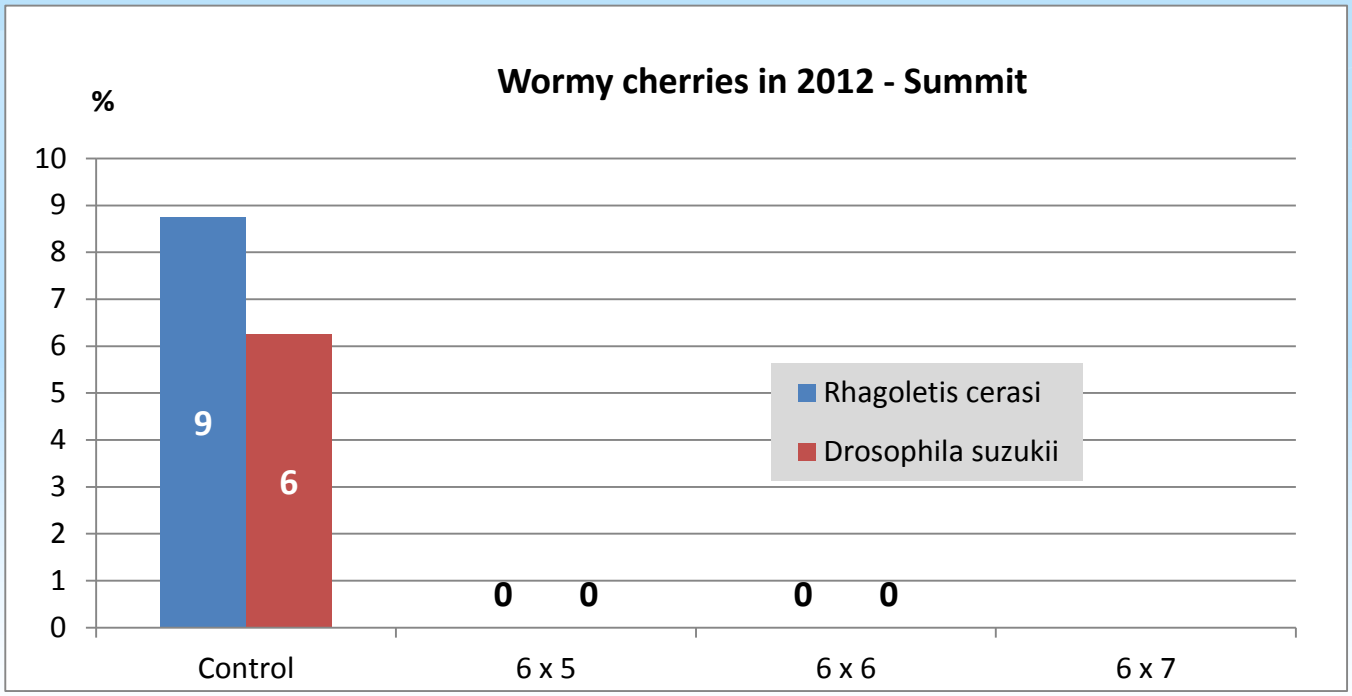
**Net 6 x 6 : 1.38 mm - 18% shading**

# Trial at Ctifl Balandran Centre: results 2011/2012



# Trial at Ctifl Balandran Centre: results 2012



# Different types of nets tested: trials in orchard

## Conclusion

- Nets 5 x 4 (mesh size 2.21 mm x 3.42 mm): not suitable for control of *Drosophila suzukii.*
- Nets 6 x 6 (mesh size 1.38 mm x 1.38 mm) and 6 x 7 (mesh size 1.38 mm x 1.14 mm): suitable in 2011 (2012: few *Drosophila suzukii*) for control of *Rhagoletis* and *Drosophila suzukii*.
- Results in 2013 will be interesting because of strong presence of *Drosophila suzukii* this year.

# Choice of mesh size: laboratory tests in 2012

***Drosophila suzukii* through the nets (8 trials and 8 *Drosophila* per trial)**

| Nets | Mesh size (mm) | Average (Number) | Average (%) | Standard deviation (Nb) | CV (%) |
|---|---|---|---|---|---|
| **6 x 5** | 1,38 x 1,71 | 4,0 | 71 | 1 | 21 |
| **6 x 6** | 1,38 x 1,38 | 4,3 | 67 | 2 | 46 |
| **6 x 7** | 1,38 x 1,14 | 2,4 | 40 | 1 | 59 |
| **6 x 8** | 1,40 x 0,95 | 0,3 | 6 | 1 | 173 |
| **6 x 9** | 1,37 x 0,81 | 0,0 | 0 | 0 | / |

# Choice of mesh size: laboratory tests in 2012

## Conclusion

* Under controlled conditions very favorable for *Drosophila suzukii* to slip through the nets:
* Net 6 x 9 (mesh size 1.37 mm x 0.81 mm ) is the only one that does not allow *Drosophila suzukii* to pass through
* Nets with a mesh size equal to or greater than 1.14 mm allow 40 to 70 % of *Drosophila suzukii* to pass through
* Net 6 x 8 (mesh size 1.40 mm x 0.95 mm) seems to be a good compromise between efficiency against *Drosophila suzukii* and temperatures in the fully protected orchard (double fruit)

# Row-by-row protection

- Training system: tree shapes
  - Hedgerow
    - Wall thickness not more than 2.00 m
    - Tree height not more than 2.70 m
  - Axis
  - Bi-axis, fan, UFO
  - Dwarfing rootstocks, semi-dwarfing
    - Axis, bi-axis
  - Semi-dwarfing to vigorous rootstocks
    - Fan
    - UFO

# Row-by-row protection

FAN

Fruiting wall

Axis

Bi-axis

# Row-by-row protection 2012/2013

Cover to ensure a perfect junction at the top

Cover to protect from rain

Net 6 x 8 to protect from insects

* Trials carried out with the company Filpack

# Row-by-row protection

## Equipment 2013

* 2 parts which are tied to the ridge cable
  * Cover width: 1.20 m
  * Net Filpack 6 x 8 (mesh size 1.40 mm x 0.95 mm)
  * A strip of very thick cover, 80 cm wide, is attached to the ridge cable to ensure complete sealing against rain and *Drosophila suzukii*.
  * Ridge cable: at 2.70 m
  * Nets unfurled after fruit setting
  * Nets are folded at the ridge cable
    * Just after harvest if there is no Goat moth, *Capnodis tenebrionis* or risk of double fruit
    * At the beginning of September if presence of Goat moth or *Capnodis tenebrionis*

# Row-by-row protection

## Results 2012

* Cracking: 3 % with protection, 28 % without protection
* Wormy cherries (cherry fly) on late variety: 0% on the protected trees and 18% on the control trees

## Results 2013

| Dates | Modality | Wormy cherries (%) | Cracking (%) |
|---|---|---|---|
| **06/06/2013** | Protected | 0 | 0 |
| | Control | 24 | 3 |
| **13/06/2013** | Protected | 0 | 0 |
| | Control | 9 | |
| **17/06/2013** | Protected | 0 | 0 |
| | Control | | |

# Fully protected orchard


Bi-axis shape and fruiting wall system

# Objectives

**Very intensive orchard and little pesticides**

- Rapid fruiting: 3rd-4th leaf
- Full production: 5th-6th leaf
- Pruning: quick and easy
  - Mechanical pruning before flowering
- Easy harvest
  - Easy access to the trees
    - Tree height: 2.70 m,
    - Tree thickness: 1 m
- Commercial production: 15 t/ha
- Fruit size: up to 26 mm
- Little pesticides

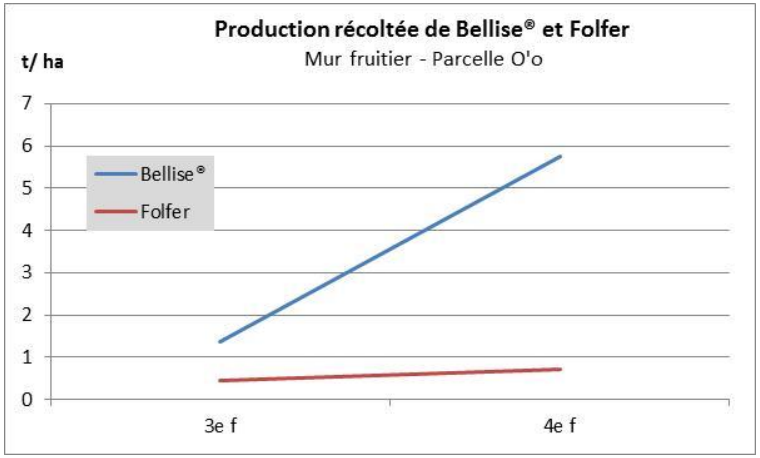
# Fully protected orchard

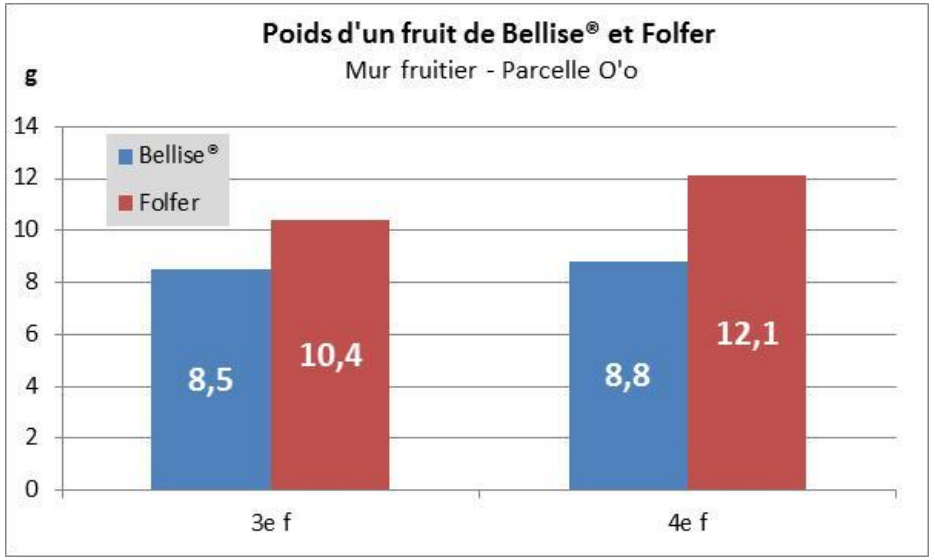
- **Planting in 2009**
  - Varieties : Bellise® and Folfer(cov)
  - Rootstock : Gisela 6
  - One row with 30 trees per variety
  - Tree shape: bi-axis
  - Training system: fruiting wall
- **Planting distance**
  - Between rows: 3.50 m
  - In-row: 2.50 m
  - Density: 1142 trees/ha
- **Nets**
  - Wall: net 6 x 5 (mesh size: 1.38 mm x 1.71 mm) (in 2009 we didn't know *Drosophila suzukii*)
  - Top: net 6 x 6 (mesh size: 1.38 mm x 1.38 mm)
- **Soil management**
  - Ramial chipped wood
- **Pollination**
  - Bumble bees

# Fully protected orchard

## Results (3rd-5th leaf)

- Production and size of fruit



# Fully protected orchard

## Plant protection 2012

- ***Monilia***
  - 0 treatment
  - 0 to 1% cherries with *Monilia*
- **Aphids**
  - 4 treatments (3 x kaolin in October 2011 and 1 x oil at end of winter)
  - Release of syrphids in May 2012
    - Release carried out too late (primary outbreaks)
    - Serious damage on Bellise®.
- ***Drosophila suzukii* and *Rhagoletis cerasi***
  - 0 treatment
  - 0% wormy cherries on Bellise® and Folfer

# Fully protected orchard

## Plant protection 2013

- Monilia
  - 1 treatment on young green fruit
  - <2 % of cherries with *Monilia*
  - Project 2013: covers unfurled before flowering
- Aphids
  - 0 treatment
  - Released of hover fly (trial with Koppert company) before first outbreaks (begenning of flowering) : very good aphid vontrol
  - Project 2013 : go on the hover fly released to precise the right amount
- Cherry fly and *Drosophila suzukii*
  - 0 treatment
  - 0% cherry fly
  - 10% *Drosophila suzukii*

# Fully protected orchard

**Factors controlled with the current equipment**

* Cracking
* *Monilia* (with covers unfurled before flowering)
* Aphids
* Goat moth
* *Capnodis tenebrionis*
* Wasps
* Cherry fly (*Rhagoletis cerasi*)

# Fully protected orchard

## Factors currently not under control

* *Drosophila suzukii*
  * Mesh size too large
  * Project 2014: replacement with 6 x 8 nets (mesh size: 1.4 mm x 0.95 mm)
* Cherry doubling
  * In 2012, during the hottest hours of the day : +1 to +1.5°C inside the protection compared to outside
  * Project 2014:
    * Top nets: gray instead of transparent to improve shading and lower temperature inside the protection
    * Overhead sprinkling during the hottest hours of the day
* Earwigs
  * Currently no viable solution (except chemicals)