## Growing High-Density, High-Value Apple Plantings under Row-by-Row Exclusion Nets: Effects on Pests and Fruit Quality


## Can nets be used as a broad-spectrum tool to replace pesticides?

- If key pests can be controlled
- If diseases do not flare up
- If climate extremes are not too challenging
- If pollination can be achieved

## France

- Pionneers of orchard IPM netting (Alt'Carpo : "codling moth arrest")
- Used in organic and IFP certified orchards (>2500 ha)
- <1% CM damage under high pressure + no insecticides


Row-by-row


Full block



## 7-yr study 2012-2018

- Assess the effectiveness of a *complete* exclusion system for the prevention of apple fruit damage
  - Without using any pesticide sprays
  - On a 'Honeycrisp' high-density planting
  - Exclusion nets in place from bud-break to harvest
- Improve our knowledge of :
  - Primary and secondary pests and diseases, non-parasitic disorders
  - Photosynthesis and fruit quality: color, size, firmness, sugars, storage, etc.
  - Pollination under / through / below nets
  - Nets and structure : strenght, durability, ease of opening
  - Nets + sprays compatibility
  - Net rainproofness
  - Economic analysis

## Setup (St-Bruno)

- Cv. Honeycrisp / B9 (planted 2006)
- Zero sprays (no pesticides, growth regulators, fertilizers)
- Each plot: 10 m (12 trees)
- Compared treatments (6X):
  1) nets*
  2) No nets

*ProtekNet 60 (0,95x1,9mm)

Aerial photo of some rows

## Collected data

**Under exclusion from bud break to harvest:**

- Fruit damage (insects, diseases and non-parasitic)
- Foliar pests populations
- Temperature and photosynthesis
- Fruit load and quality (color, firmness, maturity, sweetness, etc.)

## Installation - spring

## Complete exclusion

## Opening (for summer work)

## Opening (for pollination)


## Collected data

| | 2012 | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|
| **Installed** | 10 May | 22 April | 13 May | 4 May | 5 May |
| **Opened for pollination** | 14, 17, 18 , 19 May | 10, 14, 15, 16 May | 20, 21 May | 14, 17 May | 23, 24 May |
| **Fruit damage** | X | X | X | X | X |
| **Foliar pests** | X | X | | | X |
| **Fruit quality** | | X | X | X | X |
| **Temp./photosynthesis** | X | X | | X | X |
| **Fruit load / pollination** | | | X | X | X |
| **Climatic extremes** | Storm (April) Frost (May) | Storm (July) Frost (May) | -- | Hail (July) | -- |

## Leafhoppers


**% infested leaves**

| June | 2012 | 2013 | 2016 |
|---|---|---|---|
| No nets | 15,7 ± 1,3 * | 1,7 ± 0,7 * | 0 |
| Nets | 2,5 ± 0,7 | 0,1 ± 0,1 | 0 |

## Aphids

**Infestation index**

| August | 2012 | 2013 | 2016 |
|---|---|---|---|
| No nets | 3,2 ± 2,4 | 5,3 ± 2,0 * | 5,3 ± 2,0 |
| Nets | 5,5 ± 2,4 | 14,0 ± 3,8 | 5,3 ± 2,0 |

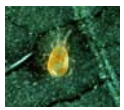
## Phytophagous mites

*Eggs + motile forms of Tetranychids*

**Total/leaf**

| August | 2012 | 2016 |
|---|---|---|
| No nets | 7,4 ± 1,9 | 1,2 ± 0,3 |
| Nets | 10,1 ± 2,7 | 1,2 ± 0,2 |

## Predatory mites



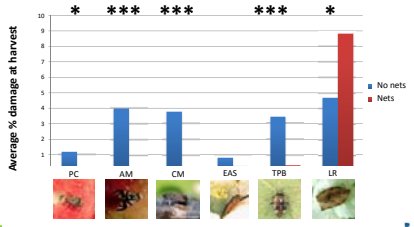
*Eggs + motile forms of Phytoseids and Stigmaeids*

**Total/leaf**

| August | 2012 | 2016 |
|---|---|---|
| No nets | 5,0 ± 1,3 | 2,8 ± 0,6 |
| Nets | 7,5 ± 1,5 | 4,1 ± 0,8 |

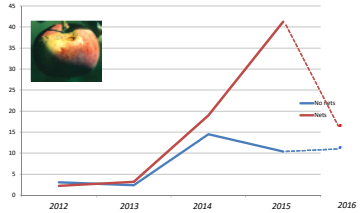
## Fruit pests (2012-2015)

(120 apples/unit: 29-08-12, 04-09-13, 27-08-14, 01-09-15)



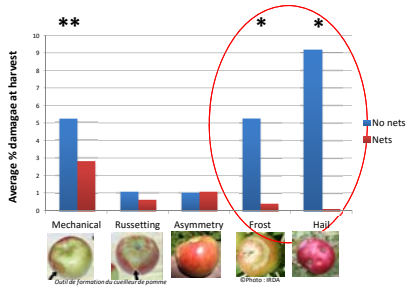

## Leafroller damage – 2012-2015

(*Choristoneura rocaeana*, Obliquebanded leafroller)



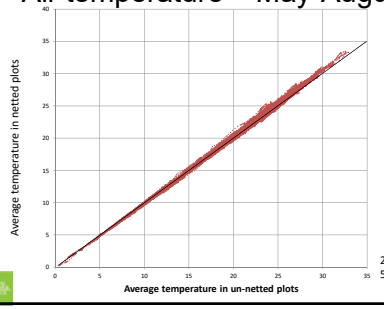
## Non-parasitic damage (2012-2015)

(120 apples/unit: 29-08-12, 04-09-13, 27-08-14; 01-09-15)




## Climatic effects of nets (2012, 2013, 2015)

## Air temperature – May-August




2015, 1 dot= 5-min average

## Protection from BMSB in Quebec


## Tree productivity (2012)

| | Photosynthetic activity | | Fruits /cluster | Fruit size (mm) |
|---|---|---|---|---|
| | Fv/Fm | Chlorophyl (mg/m²) | | |
| **No nets** | 3,8 ± 0,3 | 2,3 ± 0,1 | 1,1 ± 0,1 | 73 ± 0,9 |
| **Nets** | 3,5 ± 0,1 | 2,1 ± 0,1 | 1,0 ± 0,1 | 74 ± 1,5 |

120 fruit clusters / treatement
3 july 2012, 12 july 2013,
120 fruits / treatement
28 august 2012, 4 sept 2013

## Fruit quality (2013-2014)

| | No seeds | Color index | Brix (%) | Maturity | Firmness (lbs) |
|---|---|---|---|---|---|
| **No nets** | 5,3 ± 0,2 | 1,9 ± 0,1 | 12,2 ± 0,2 | 5,6 ± 0,1 | 16,0 ± 0,3 |
| **Nets** | 4,3 ± 0,7 | 1,8 ± 0,2 | 12,0 ± 0,2 | 4,5 ± 0,4 | 16,1 ± 0,4 |

ca 120 fruits / treatment
4 sept 2013, 4 sept 2014

## Five years of pesticide-free Honeycrisp :

- Requires investment (11$/m/10yr)
- Requires additional labour for pollination (0,60$/m/open day)
- Complicates thinning / other sprays
- Protects fruit from insects - except for OBLR?
- Protects from birds / mammals
- Protects from mechnical injuries (hail, etc.)
- Does not result in scab epidemic
- Does not significantly affect tree physiology
- Produces high-quality fruit
- Reduces temperature extremes / risks (frost, sunburn)
- Slows down fruit maturity by ca. 1 wk

## Acknowledgments


- **Organisationnal support:**
  - IRDA - Réseau-pommier
    Valentin, Franz, Jonathan, Audrey, Marie-Alice, Mélanie, Alessandro, Cindy, Benoit, Jocelyn, Mikael, Frédérique..
  - CETAB +, Univ. Laval, PolyMTL
- **Financial support 2012-2018 :**
  - PCAA (Programme canadien d'adaptation agricole)
  - Organic science cluster II (AAAC)
  - Innov'action (MAPAQ)
  - Les Producteurs de Pommes du Québec
  - Dubois Agrinovation (nets)


## Partners 2012-2018

Teams:
- V. Philion, F. Pelletier, J. Veilleux, D Cormier (IRDA) ;
- J Tavares (Poly Mtl)