

# Les fongicides et la tavelure : un couple irrésistible!

Vincent Philion & Valentin Joubert



# Au programme:

- Retour sur les produits à risque
- Suivi canadien (2011 & 2012)
- Projet volet 11.1 (2013 & 2014)

***Fongicides non sujets à la résistance:***

**Minéraux et dérivés**

Cuivre

***Cuivre fixe copper spray***

***Copper 53W***

***Bouillie bordelaise***

***copper sulphate***

***Microfin***

Soufre et dérivés

***Kumulus, Microthiol***

***Chaux soufrée***

Carbonates

***B2K Bicarbonate de potassium***

***Ferbam***

***Ziram***

Dithiocarbamates

***Dithane, Manzate, Penncozeb***

***Polyram***

***Maestro, Supra Captan 80WDG***

Phthalimides

***Folpan 50WP***

Pyridinamine

***Allegro***

**Contacts multisites**

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Pyridinamine

***Allegro***

## **Fongicides sujets à la résistance:**

**Unisites et à  
risque de  
résistance**

**Guanidine (U12)**

**Equal, Syllit (Cyprex)**

**Benzimidazoles (1)**

**Senator (Benlate)**

**Nova, (Nustar)**

**IBS (3)**

**Inspire Super (mélange avec AP)**

**AP (9)**

**Vanguard**

**Scala**

**Sovran**

**Qol (11)**

**Flint**

**SDHI (7)**

**Luna Tranquility (mélange avec AP)**

**Fontelis**



# Apple Scab Resistance Survey

Kathryn Carter, Margaret Appleby, Kristy Grigg-McGuffin, Leslie Huffman  
Ontario Ministry of Agriculture, Food & Rural Affairs

# Sondage canadien

## Apple scab: a growing concern

Apple scab is a serious disease caused by the fungus, *Venturia inaequalis*. The fungus attacks foliage and fruit, often making it unmarketable. It is characterized by brown to olive-coloured spots on leaves (Fig. 1) and fruit (Fig. 2 & 3). Apple scab activity occurs from the emergence of green tip until leaf drop in the fall.

This major disease in apple orchards is managed with fungicide treatments combined with proper sanitation. Resistance to sterol inhibitor (SI) (Group 3) and strobilurin (Group 11) fungicides may contribute to recent apple scab control failures in Ontario orchards.

## Apple scab resistance survey

As part of a national resistance survey, Ontario sites were randomly selected by the Ontario Apple Growers from the five growing districts (Fig. 4).

Cooperating growers left 6-8 trees unsprayed per site. Leaves with fresh primary scab lesions were collected.

The University of Guelph Pest Diagnostic Laboratory isolated conidial spores from the scab lesions.

### Modified SMOR method

Isolates were plated on fungicide media (Fig. 5) treated with either a SI (Nova or Inspire) or a strobilurin (Flint).

Relative growth of each isolate was determined by comparing the growth of the isolate treated with a fungicide to an untreated control (Fig. 6 & 7).

### DNA Screening

Additional testing for resistance to strobilurins (Flint, Sovran, Pristine) was done using PCR to detect the presence of the G143A mutation.

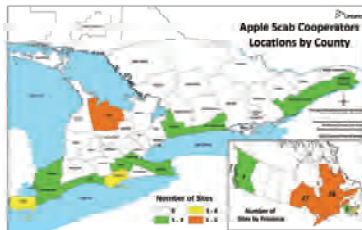


Figure 4. Ontario apple scab co-operator locations by county. Sites were selected as part of the national resistance survey, including British Columbia, Ontario, Quebec, New Brunswick and Nova Scotia. Numbers represent the total apple scab collection sites in each province (inset).



Figure 6. Incubating plates with scab isolates.

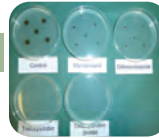


Figure 8. Scab isolates sensitive to fungicide.

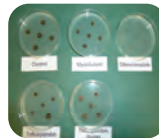


Figure 7. Scab isolates resistant to fungicide.

## Apple scab resistance results: Ontario

Resistance is dependent on how the fungicide was used. Though some orchards in your area may show resistance to a product, don't assume it's in yours! Each orchard needs to be individually tested for resistance and each product needs to be evaluated.

**Sanitation works!**  
Apply urea and shred leaves in late fall or early spring to reduce over-wintering apple scab pores.

Although an orchard may be resistant in laboratory tests, it does not mean control failure is occurring in the field. It will eventually fail, however, if use of the product is continued.

Testing for apple scab fungicide resistance can be challenging, expensive and, at times, inconclusive. However, it can be used as a very useful tool to make appropriate apple scab control strategy decisions.

This work was supported by the Pest Management Centre of Agriculture and Agri-Food Canada, Pesticide Risk Reduction Program ([www.agr.gc.ca/gmmp](http://www.agr.gc.ca/gmmp)), in partnership with Ontario Apple Growers, Apple Growers of New Brunswick, Nova Scotia Fruit Growers' Association, Federation des producteurs de pommes du Québec, British Columbia Fruit Growers' Association and the Apple Working Group of the Canadian Horticulture Council. We gratefully acknowledge: Melody Metzger, Shannon Kuechman Shinn, Gabe Ho and Todd Marrow at the Pest Diagnostic Laboratory. Funding was provided by Bayer CropScience Inc., BASF Canada Inc., E.I. DuPont Canada, Dow Agro-Sciences Canada and Brixigen Crop Protection. Technical assistance by Ken Wilson, Lindsay Poir, Brian Sutton, Frankie Cooper, Michelle Livingston, Rebecca Vandertoren and Andrea Ricci.

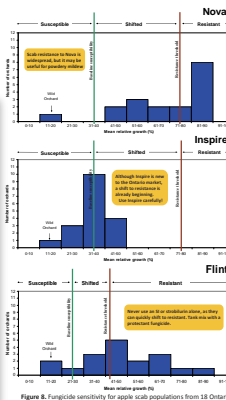


Figure 6. Fungicide sensitivity for apple scab populations from 18 Ontario orchards surveyed in 2012.

Table 1. Presence of the G143A mutation associated with strobilurin (Flint, Sovran, Pristine) resistance from Ontario orchards surveyed in 2009 and 2011.

County	Orchard	# Isolates tested	Resistant isolates	G143A mutation	
2011	Essex	11-Wildcat	10	10%	
		11-1	10	0%	
	Kent	11-3	10	20%	
		11-4	10	0%	
	North York	11-5	10	0%	
		11-6	10	0%	
	Simcoe	11-7	10	70%	
		11-8	10	10%	
	Niagara	11-9	10	0%	
		11-10	10	0%	
	Grey	11-11	10	0%	
		11-12	10	0%	
11-13		10	0%		
Durham	11-14	10	0%		
	11-15	10	0%		
Northumberland	11-16	10	0%		
	11-17	10	0%		
Lambton Kent & Chatham	11-18	10	40%		
	11-19	10	0%		
2009 (Ontario orchards, George Swindle, MSU)	Lambton	00-1	15	6%	
	Essex	00-2	24	100%	
	North York	00-3	10	100%	
	Hamilton	00-4	10	60%	
	Grey	00-5	9	89%	
	00-6	11	100%		
Durham	00-7	24	100%		
	00-8	24	4%		
	00-9	14	0%		

### Next Steps

Continuation of this national apple scab survey in 2012 will test 40 additional orchards.

National powdery mildew resistance survey will begin in 2012.

### Take Home Message

- Use caution when using Nova, (Nustar) Inspire and Flint (Sovran, Pristine); results indicate scab populations may be shifting or resistant in some orchards.
- Presence of the G143A mutation indicates a high level of resistance to strobilurins; however, there may be other genes associated with resistance that we did not test.

**SI and strobilurin fungicides should:**

- only be used as preventative treatments.
- always be tank mixed with a protectant fungicide.

Prudence avec:

Nova, Inspire Super  
Sovran, Flint

La résistance au Sovran et Flint peut  
arriver brusquement

Utiliser en protection seulement ??!?!?  
Utiliser en mélange seulement ??!??



## ***Fongicides sujets à la résistance:***

**Unisites et à  
risque de  
résistance**

***Guanidine***

***Equal, Syllit***

***Benzimidazoles***

***Senator***

***IBS***

***Nova***

***AP***

***Vangard***

***Scala***

***QoI***

***Sovran***

***Flint***

***SDHI***

***Fontelis***

**Mélanges  
d'unisites**

***SDHI + AP***

***Luna Tranquility***

***SDHI + QoI***

***Pristine: Non recommandé***

***IBS + AP***

***Inspire Super***

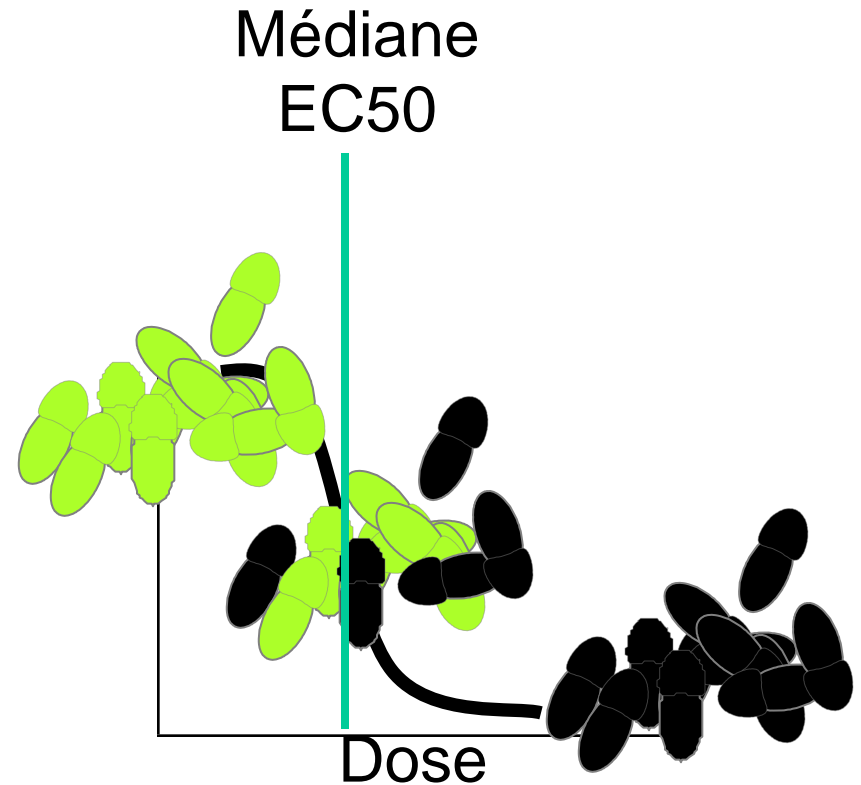
# Projet volet 11.1 (2013 & 2014)

- AP = Vangard & Scala ?
- SDHI = Fontelis & Luna ?
- Dodine?
- Autres fongicides
- 32,000\$

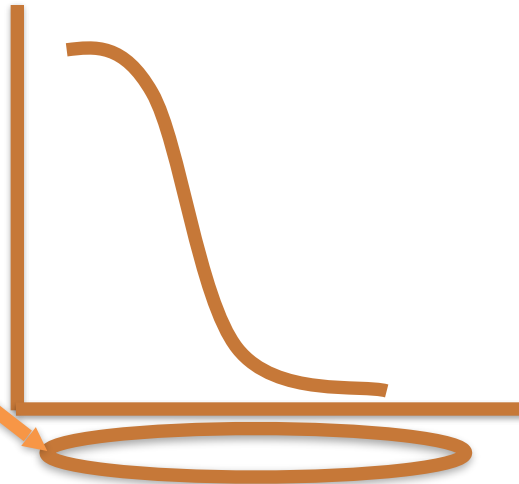
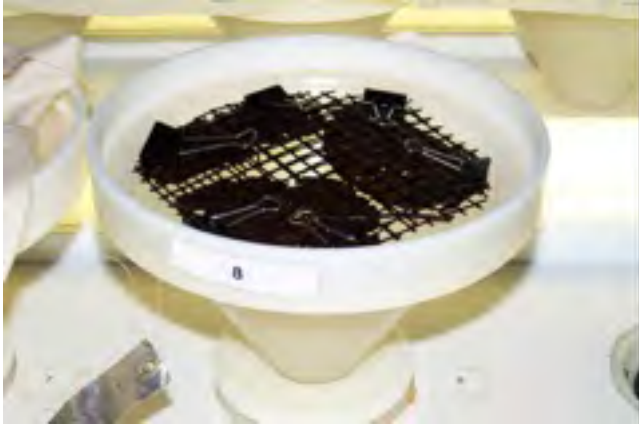


# EC50 population...

- Test courant: entomologie, poissons, mammifères, etc.
- Échantillon représentatif



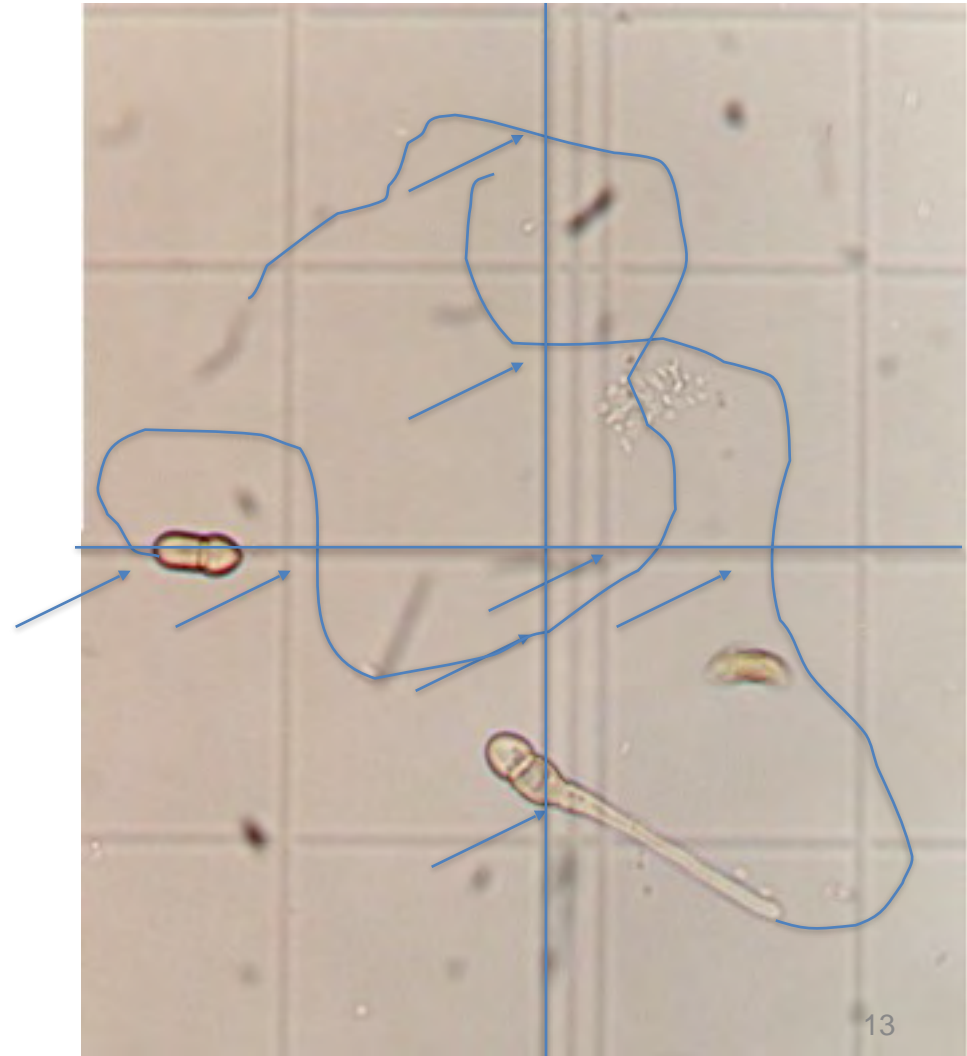
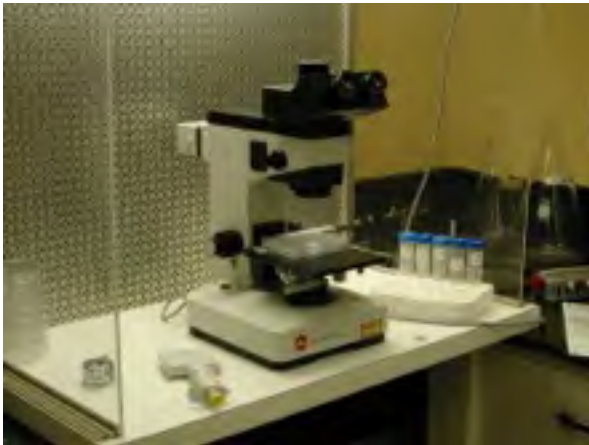
# Méthodologie



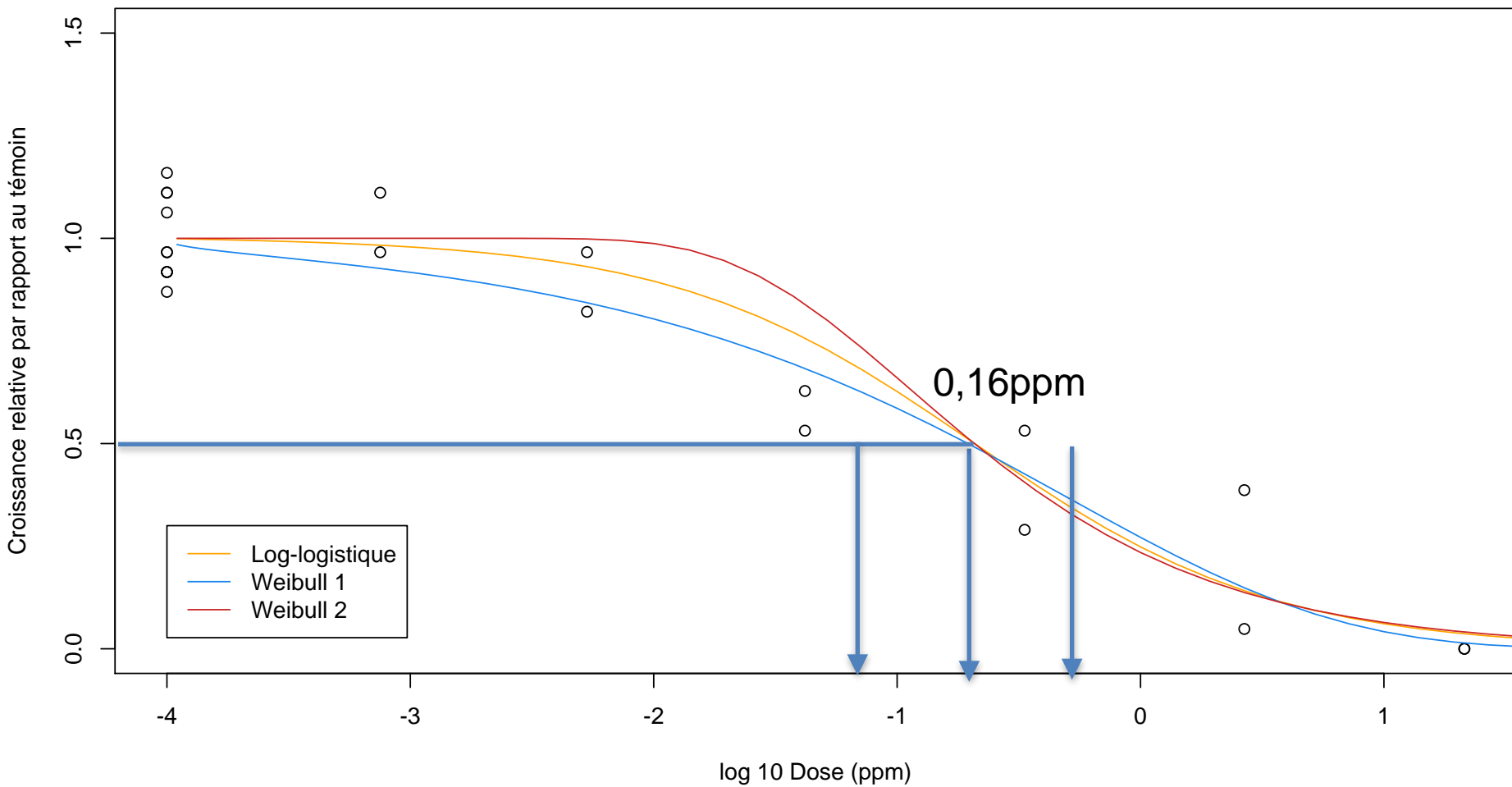
Dose

# Croissance mycéliale

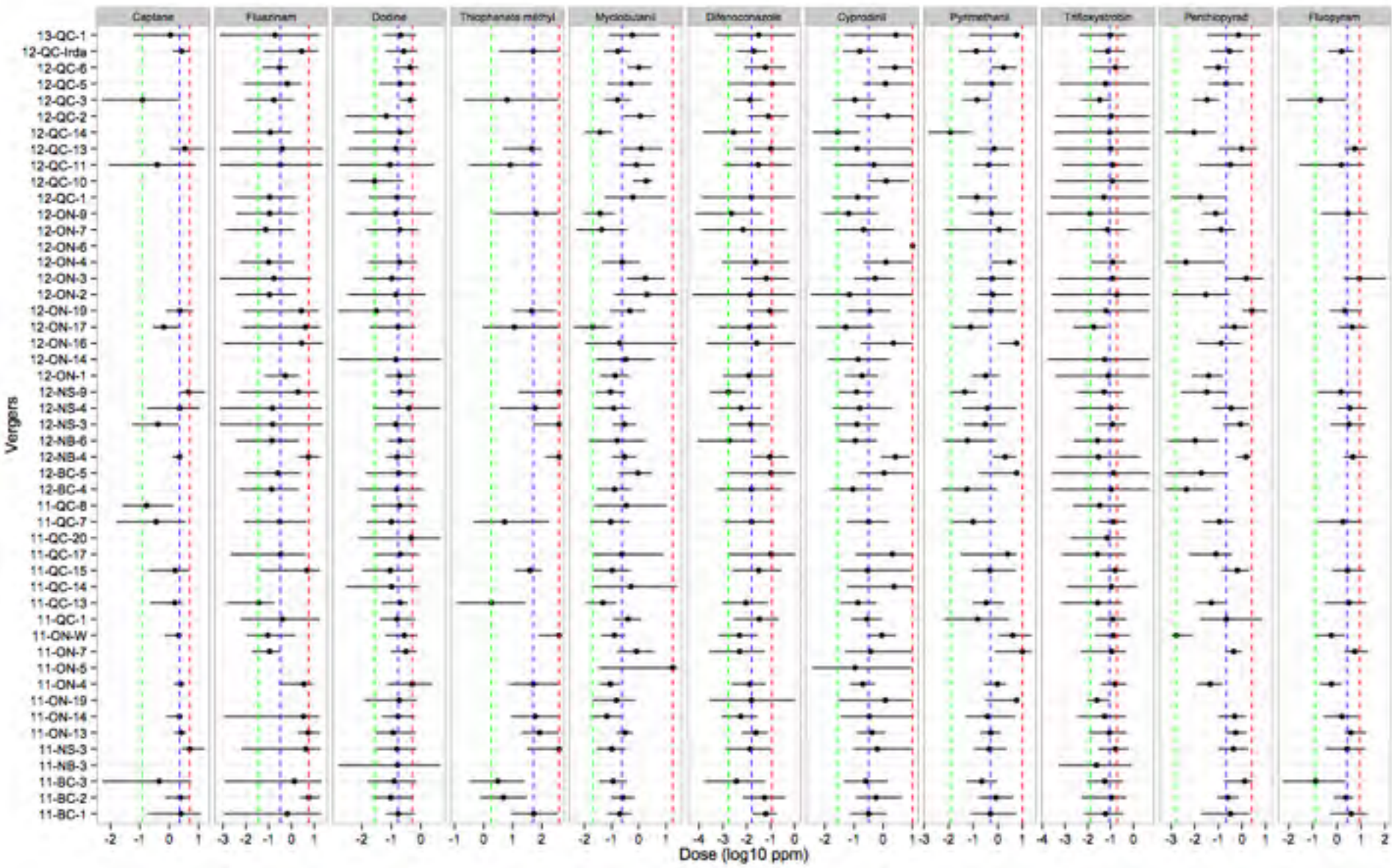
- 48 heures incubation
- “Méthode du recouvrement linéaire”
- Line-intercept assessment method



## Développement mycélien en présence de Captane pour le verger 11-QC-8



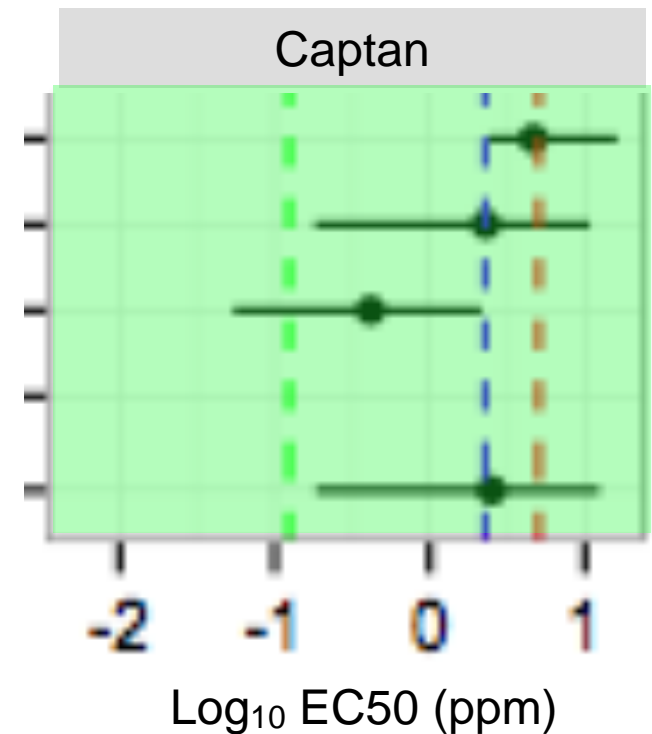




**49 vergers, 11 fongicides testés**  
**412 relations doses-réponses**

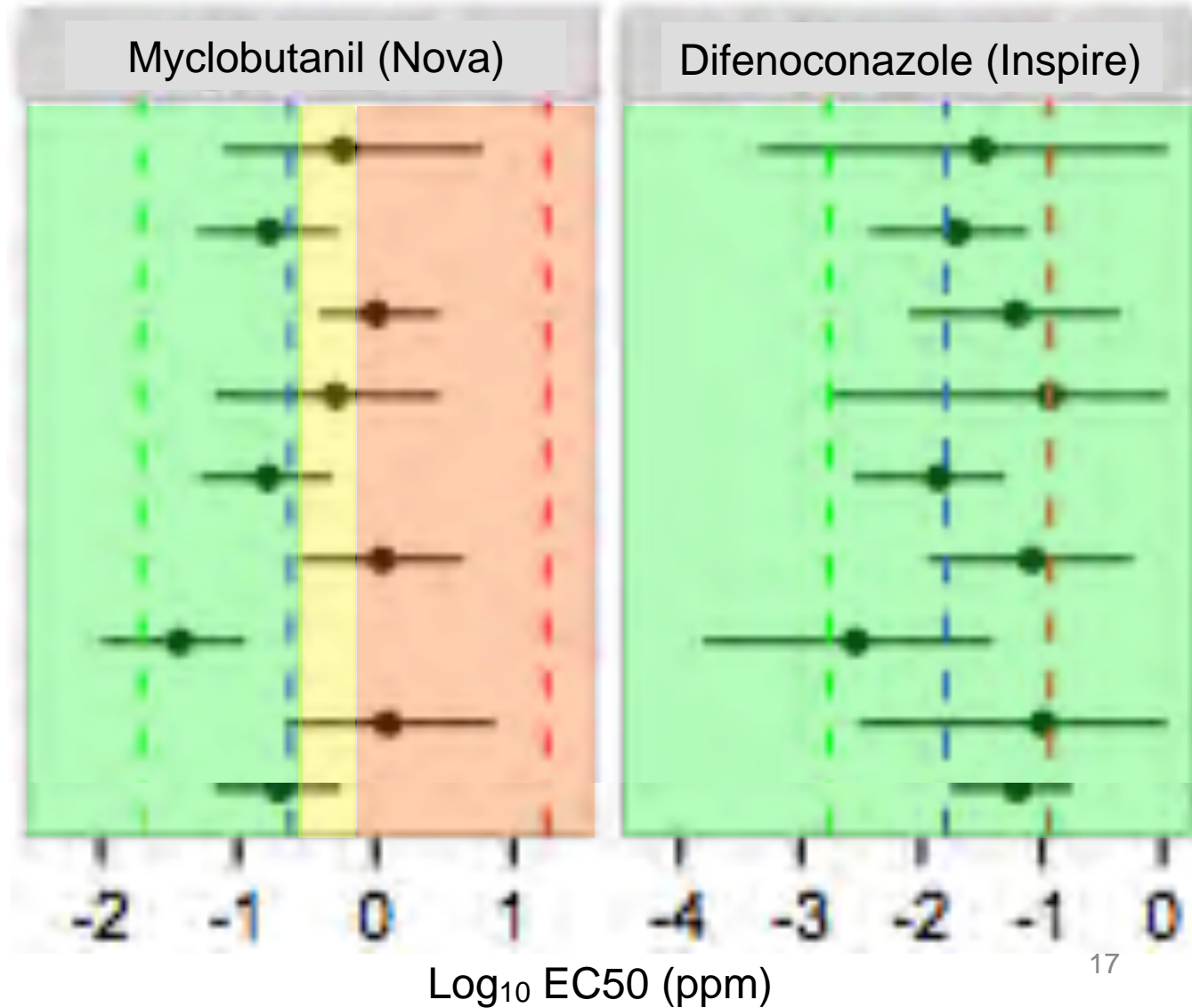
# EC50 pour le Captan

- Variations significatives entre vergers
- Dose terrain suffisante

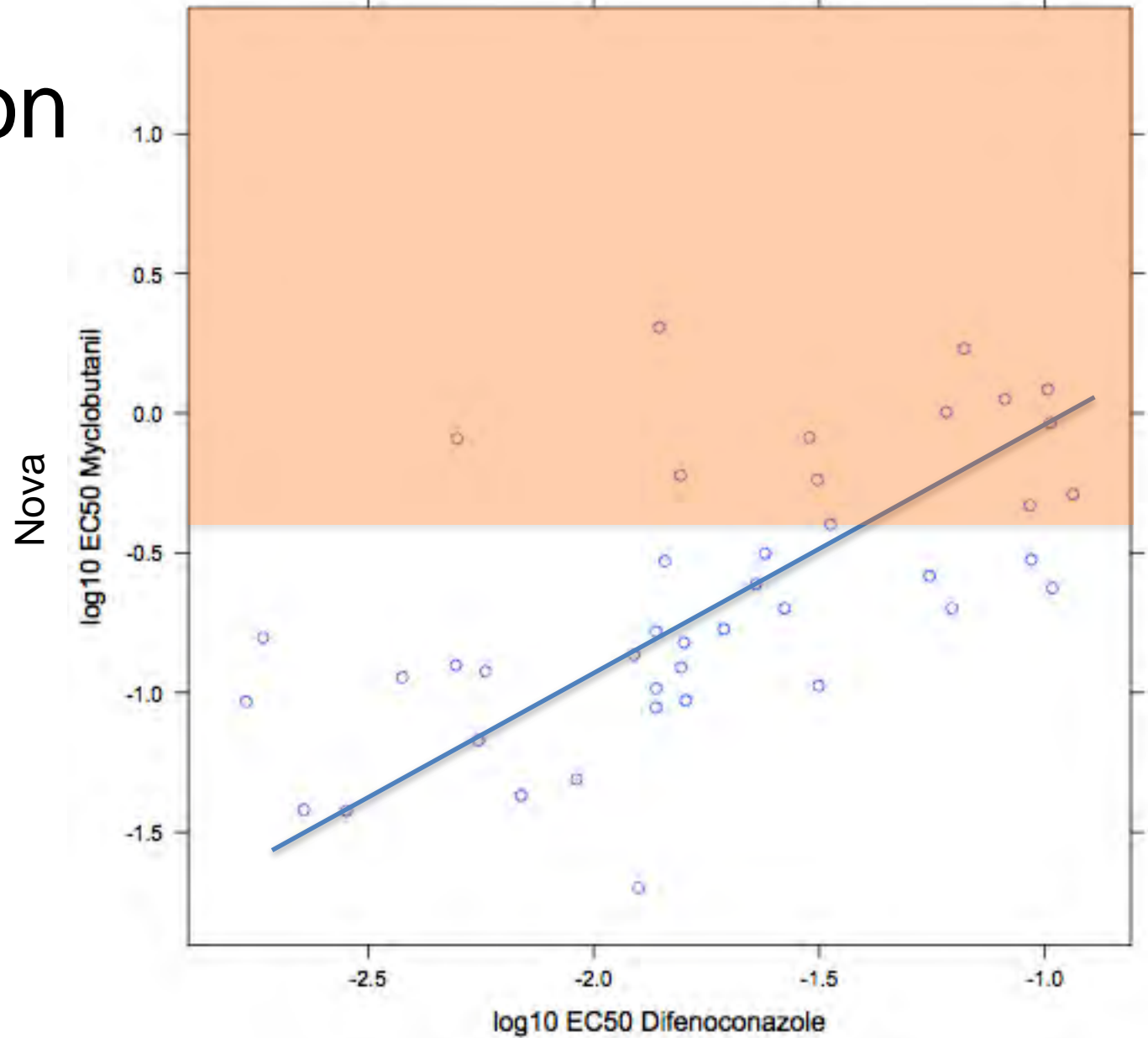




# EC50 pour les IBS



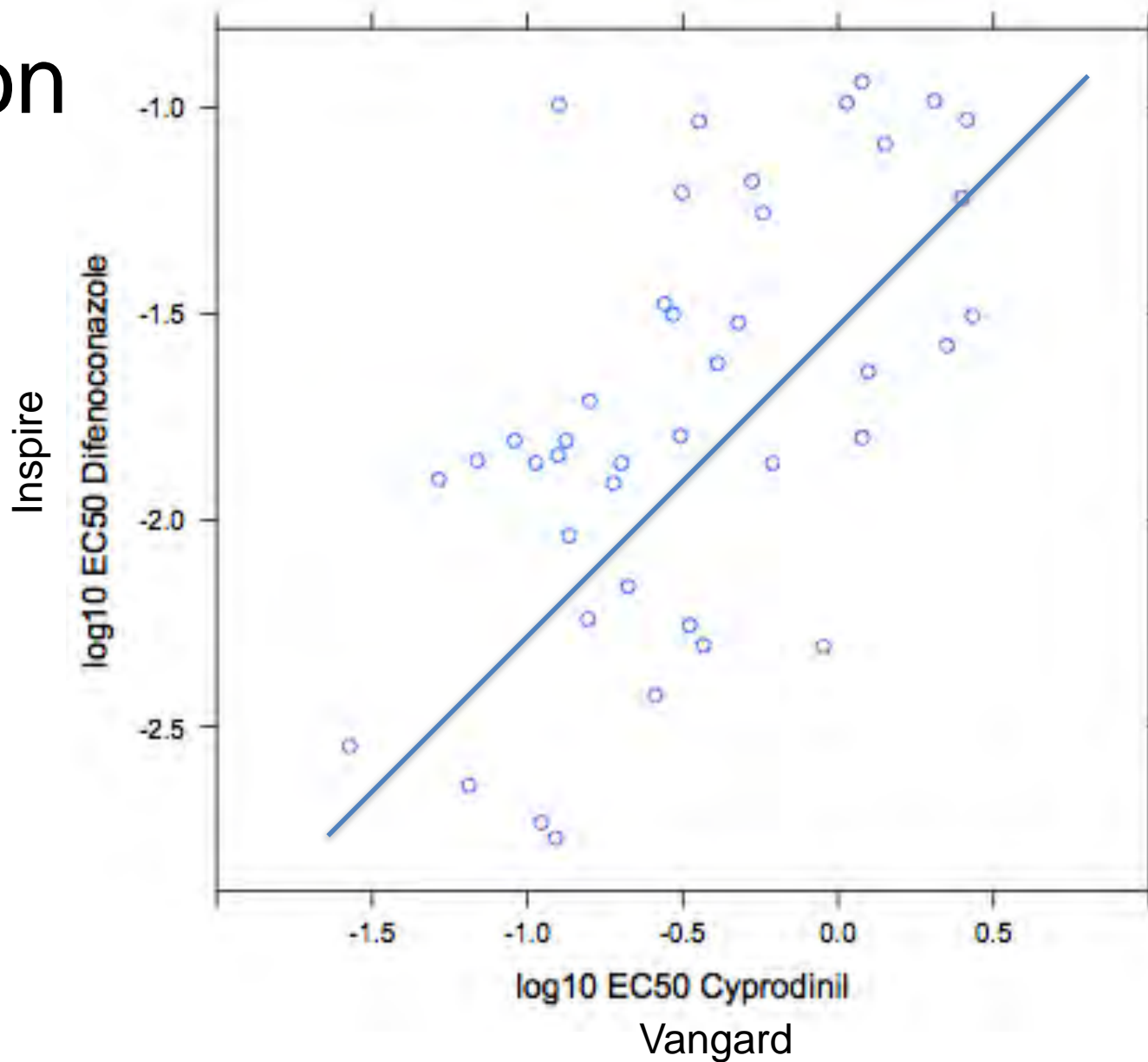
# Corrélation IBS



(R = 0,61, t=4.8, df=39, p<0.001)

Inspire

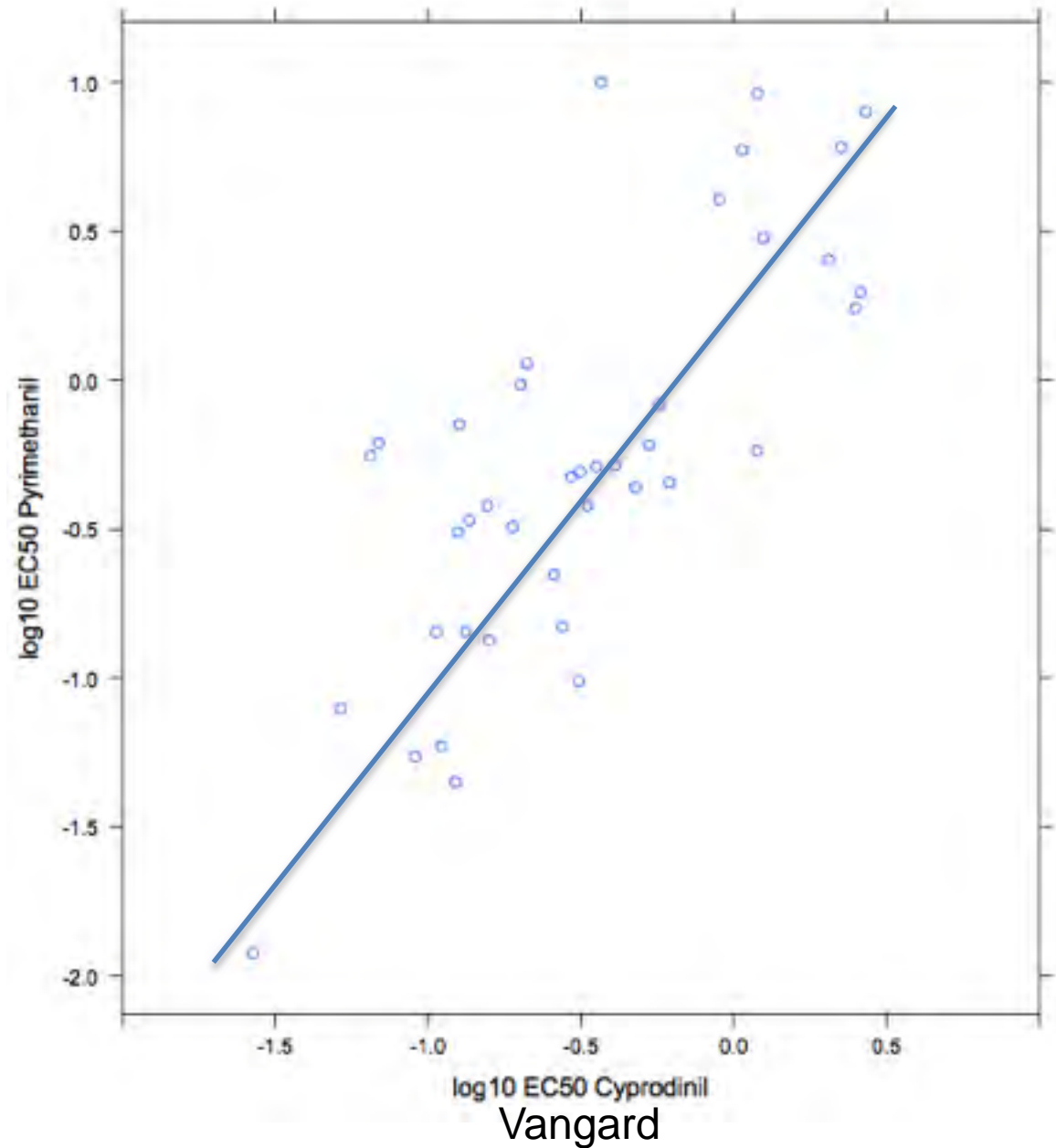
# Corrélation IBS vs AP



$R = 0,59$  ( $t = 4.5$ ,  $df = 39$ ,  $p < 0,001$ )

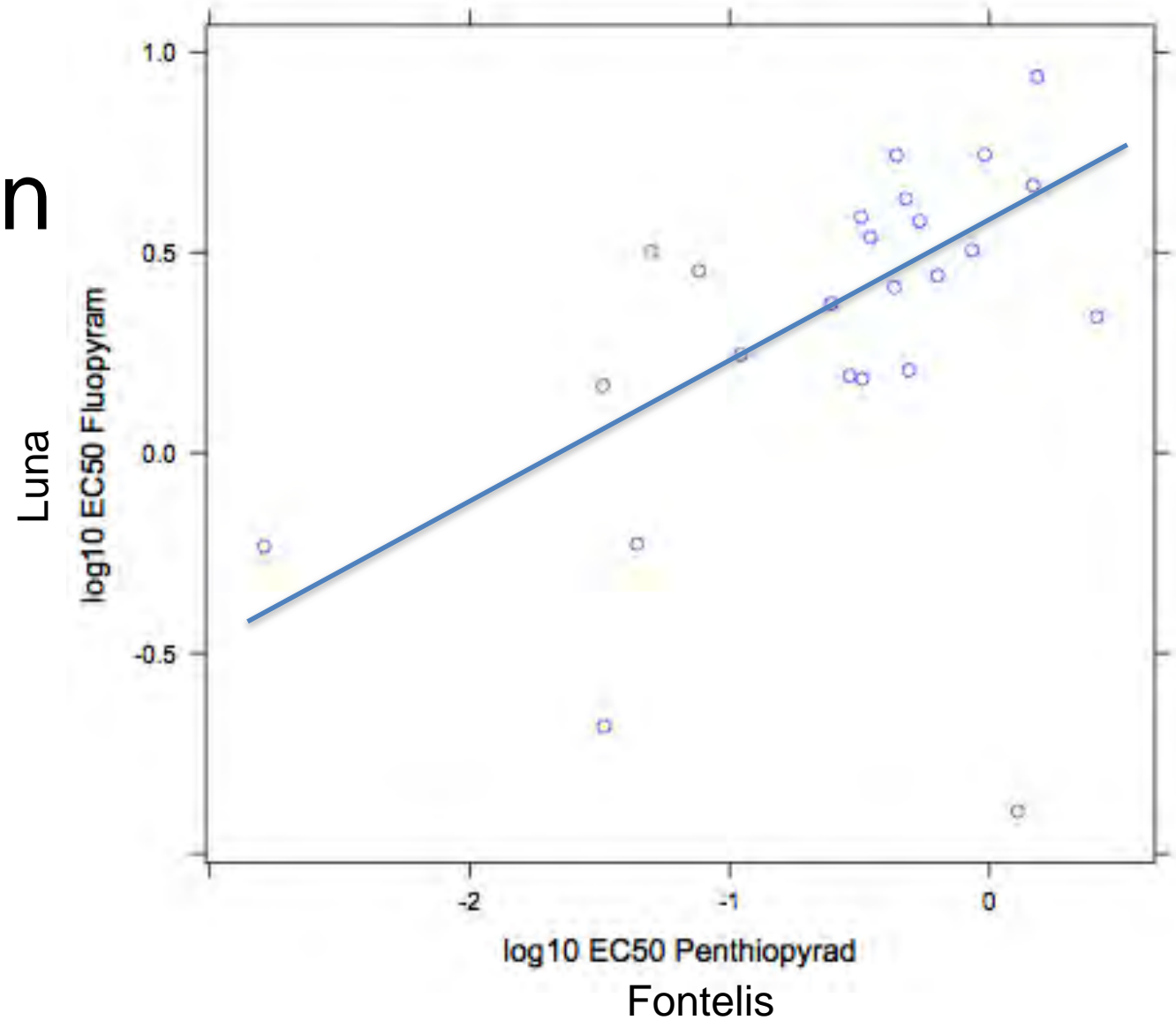
# Corrélation AP

Scala



$R = 0,77$  ( $t = 7.4$ ,  $df = 38$ ,  $p < 0.001$ )

# Corrélation SDHI



R= 0,42, t = 2.2, df = 22, p = 0.04).

## Fongicides sujets à la résistance: Situation 2012

<b>Unisites et à risque de résistance</b>	<b>Guanidine</b>	<b>Equal, Syllit</b>
	<b>Benzimidazoles</b>	<b>Senator</b>
	<b>IBS</b>	<b>Nova (&gt;40% des vergers)</b>
	<b>AP</b>	<b>Scala (Qc)</b> <b>Vangard (Qc)</b>
	<b>Qol</b>	<b>Sovran</b> <b>Flint</b>
	<b>SDHI</b>	<b>Fontelis</b>
<b>Mélanges d'unisites</b>	<b>SDHI + AP</b>	<b>Luna Tranquility</b>
	<b>SDHI + Qol</b>	<b>Pristine: Non recommandé</b>
	<b>IBS + AP</b>	<b>Inspire Super</b>

# Résultats antérieurs

- 18 vergers testés en 2003 & 2004
- Sites avec résistances multiples
- Benzimidazoles (Senator) =
  - Quasi totalité résistance « pratique »
- IBS (NOVA) =
  - 33% sites avec résistance « pratique »
- AP et QoI OK

# Conclusions

- La résistance progresse
- La fin de l'utilité des AP approche
- Le difénoconazole encore OK.
- QoI = Pas facile, mais indice de fin.
- SDHI = Vie courte ?
- Captan = tolérance observée, mais OK.
- Méthode plus flexible et moins couteuse

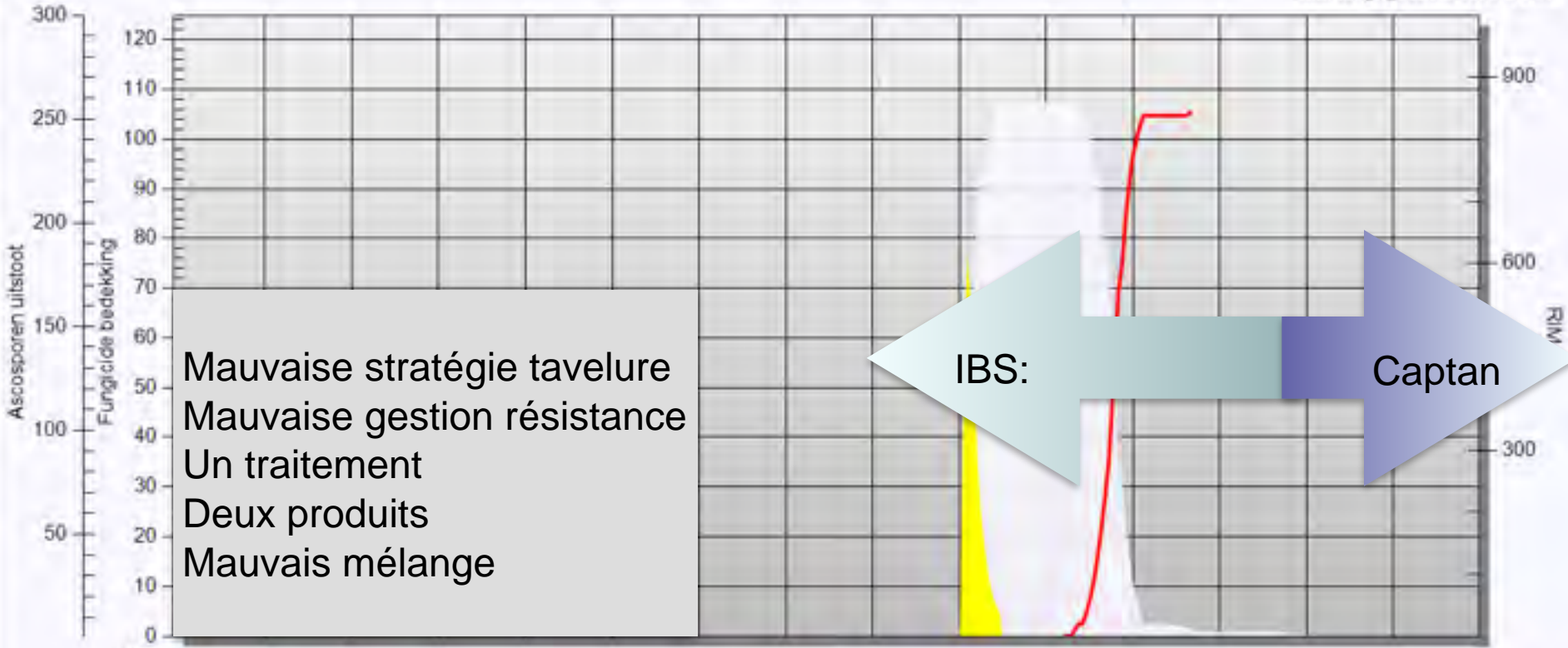


# Comment préserver les unisites?

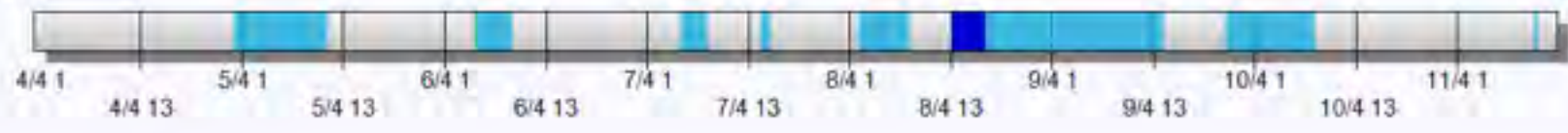
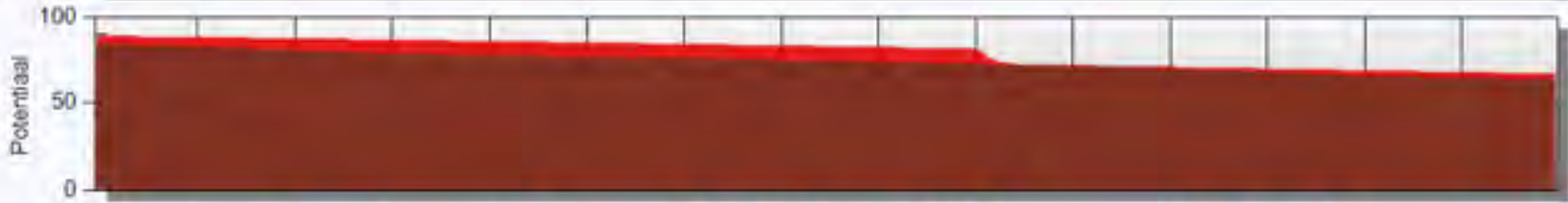
- MAINTENIR LA TAVELURE FAIBLE
- Réduire leur utilisation (Cibler l'usage)
- Ne pas couper les doses
  - Moins efficace
  - Accélère la sélection de la résistance
- Mélange ou Rotation?

# RIMpro Dronen

Laatste gegevens: 28-7 10:30



Mauvaise stratégie tavelure  
Mauvaise gestion résistance  
Un traitement  
Deux produits  
Mauvais mélange



# Partenaires du projet



**Agriculture, Pêcheries  
et Alimentation**

**Québec** 

**irda**

Institut de recherche  
et de développement  
en agroenvironnement