COMITE NORD BRETAGNE - PLANTS

Analysis of potato volunteer density under the influence of cropping practices : a contribution to the modelling of *Phytophthora infestans* primary inoculum production

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13th EuroBlight Workshop - St Petersburg, Russia, 9-12 Oct. 2011

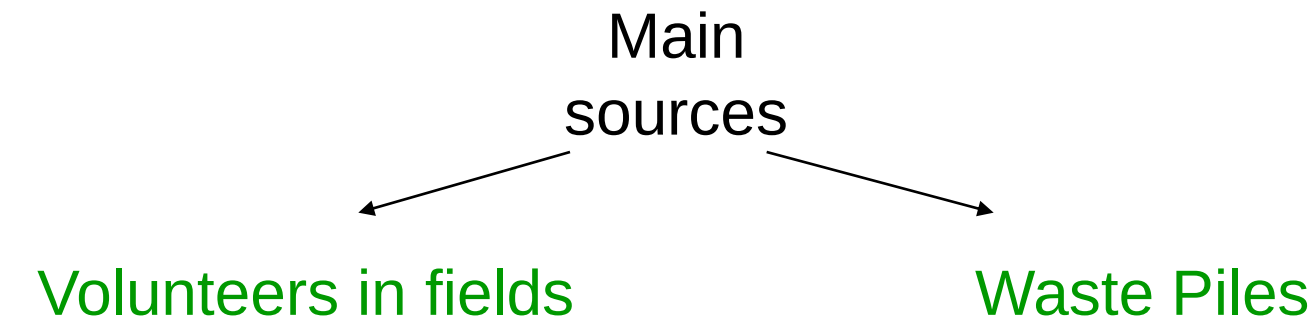
Integrated management of late blight

- Need for a description of primary inoculum sources
- Major sources
  - Infected seeds: difficult to quantify
  - Soil/Oospores: no evidence in France
  - Volunteer potatoes
    - In commercial fields: from tubers left in soil after potato harvest and growing as weeds in succeedding crops
    - In waste piles: from tubers in outgrade piles and discard heaps

Volunteers in fields and piles

- Volunteer potatoes in commercial fields:
  - Growing concern
  - Found in production situations with mild winters
  - May emerge throughout the entire year, especially in cool and coastal locations
  - Difficult to control with herbicides
- Waste piles not always well controlled

Aim: quantify the potential sources of primary inoculum



- Agronomic objective: quantification of the density of volunteer potatoes in a wide range of production situations to take into account the effects of climate, cultivar and other cultural practices:
  - In commercial fields
  - In waste piles
- Methodological objective: design of a sampling strategy

Method: quantification of potato volunteer density

- Sampled units
  - Commercial fields with potato crop the previous year, in Brittany
  - Waste piles, in North-Pas de Calais & Picardie
- Methods
  - Quadrat counts (1 m²) randomly distributed in fields or piles
  - Field and pile size measurements
  - Survey of farmers
- Variables
  - Density: number of potato stems per surface unit (m^{-2})
  - Field and pile areas (m²)
  - Cropping practices (data not shown)

Method: quantification of volunteer density in two different production areas

In Brittany,

on May 2010 and May 2011

Mild winters, oceanic climate

in cereals and grass **fields**

near Brest 1 and Landivisiau 2

wheat (18), barley (5), maize (7) and ray-grass (3)

in 13 **fields,** uncultivated field, at the time of sampling

St Pol de Léon 3

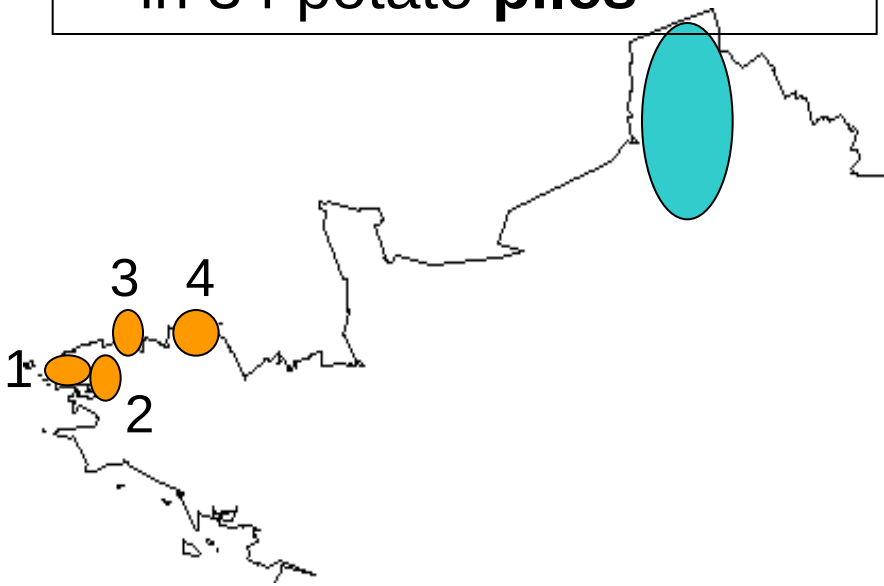
in 18 artichoke **fields**

near Paimpol 4

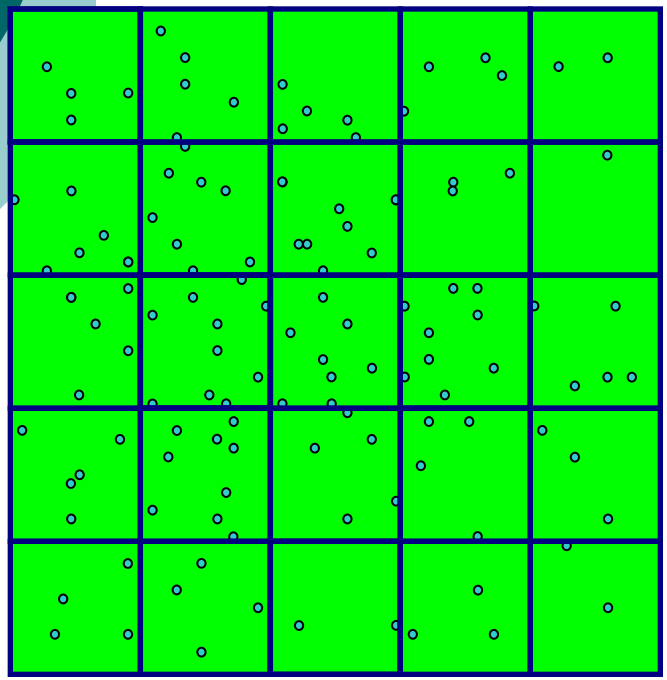
In North-Pas de Calais & Picardie, on May 2011

« Cold » winters

in 34 potato **piles**



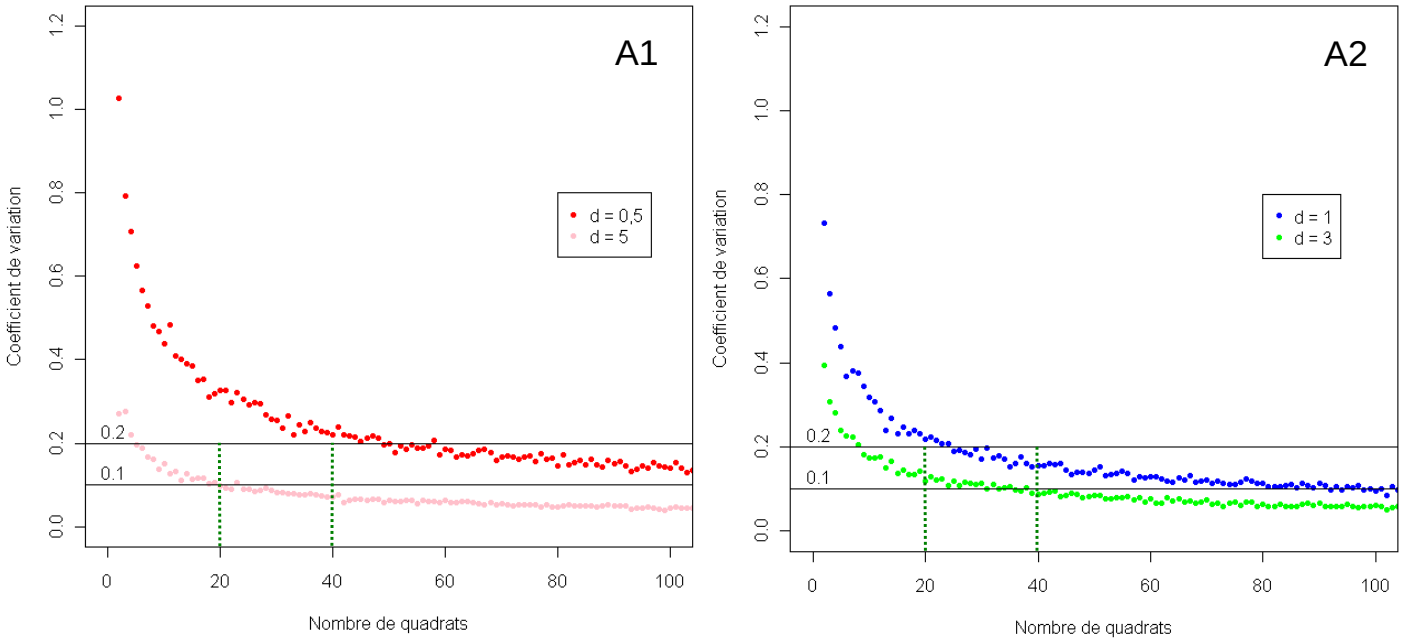
Method: determination of the number of quadrats to observe as a function of potato volunteer density to achieve a given precision



- Number of quadrats to observe : determined by the simulation
- Fields with a given volunteer density were simulated, assuming that potato stems were spatially randomly distributed.
- These fields were sampled several times using *n* quadrats. This was repeated for various densities.
- This permitted to assess the relationship between the precision on quadrat counts and volunteer density, for various sampling sizes.

Results : Number of quadrats to observe

determined by simulation



if 0,1 ≤ d < 0,5 then nb = 40 (cv ≈ 40 %)

if 0,5 ≤ d < 1,0 then nb = 40 (cv ≈ 20 %)

if 1,0 ≤ d < 3,0 then nb = 30 (cv ≈ 15 %)

if d ≥ 3, then nb = 20 (cv ≈ 10 %)

d : volunteer density (m^{-2})

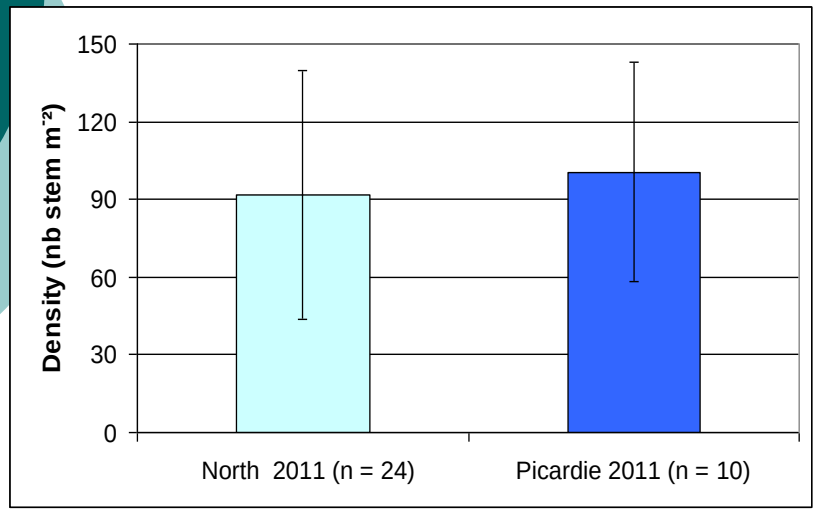
nb : number of quadrats used for sampling

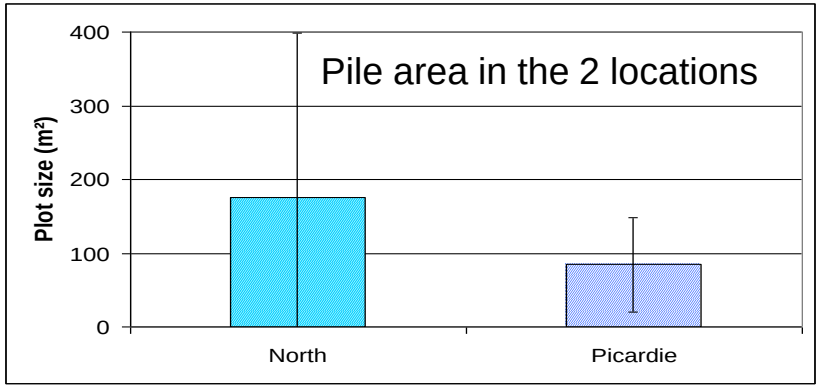
cv : coefficient of variation on the density

(Mean and standard deviation of 300 experiment replicates)

North-Pas de Calais waste piles (4 May 2011)

Density of volunteers in piles in North-Pas de Calais and Picardie - 2-5 May 2011





- High density of volunteers before the emergence of adjacent potato fields
- No difference between the 2 locations
- Late blight inoculum observed on 1 pile in North-Pas de Calais
- Bigger piles in North-Pas de Calais than in Picardie

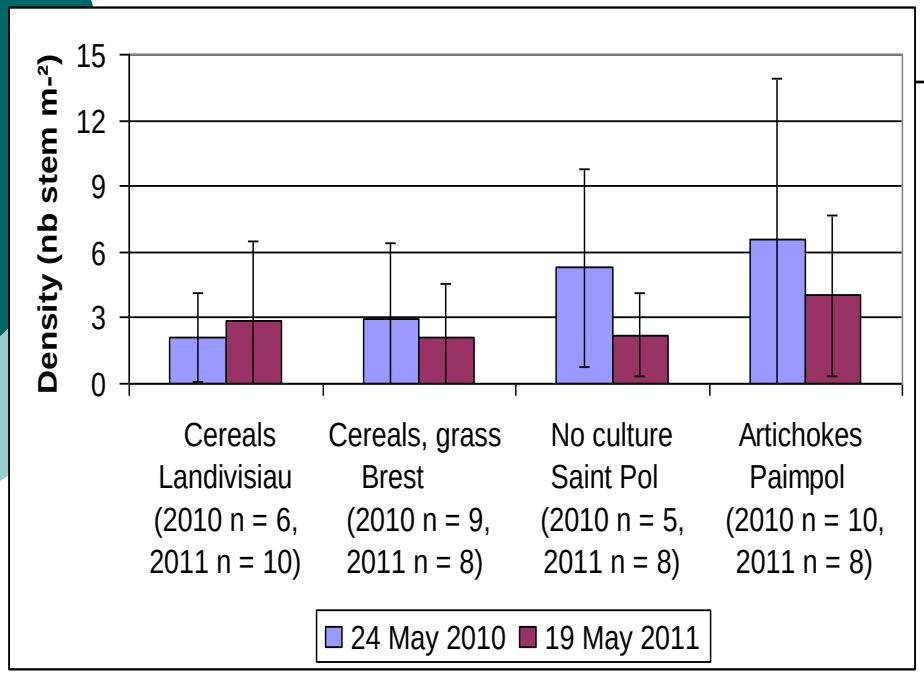
Volunteers in Brittany fields

In **artichoke** field

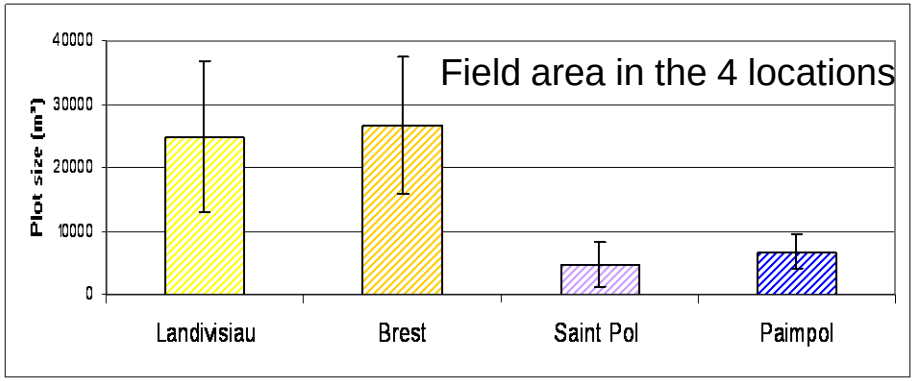
In **barley** field

In **maize** field

Volunteer density in Brittany fields as a function of years and locations

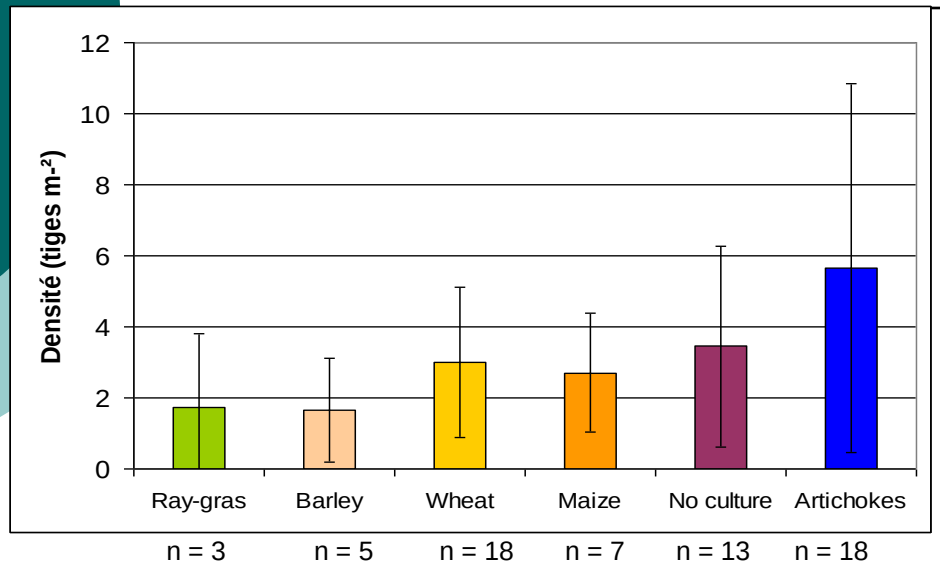


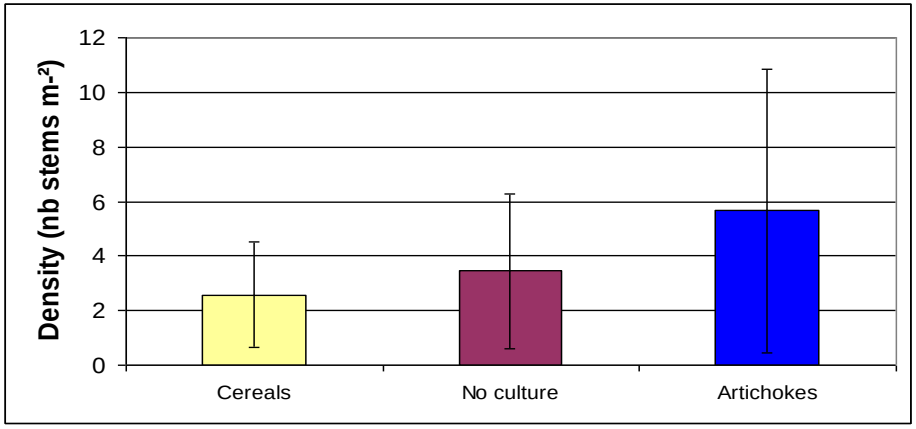
- Volunteer density depends on
  - year
  - location
  - fields in each location
- 1 blighted plant observed in a wheat field, in Landivisiau, 2011



- Fields near Brest / Landivisiau compared to St Pol / Paimpol:
  - smaller density of volunteers
  - greater areas

Volunteer density in Brittany fields as a function of the crop following the potato





- Volunteers in all crops
- Volunteer density depends on the crop
  - Highest in artichokes: no chemical treatment, but mechanical weed removal
  - Lowest in ray-grass and barley: efficient competitive crops
  - Intermediate
    - Wheat: less competitive than barley
    - Maize: herbicides
    - Bare soil
- Less volunteers in cereal crops than in other crops

Conclusion and perspectives (1)

- A mathematical tool was proposed to help decide the sampling size as a function of potato volunteer density
  - Usefull tool for optimal spatial sampling
  - Realistic, due to time constraint for collecting data.
- Original data : Volunteer density was quantified for a wide range of production situations.
  - Found in all crops
  - Density is variable according year, crop and fields for the same crop
- Limit: volunteers were observed only once

Conclusion and perspectives (2)

- Need for a model that simulates volunteer dynamics as a function of cropping practices and climate.
- Coupled with an epidemiological model, this model will help design integrated management strategies of potato late blight (SIPPOM model – Simulator for Integrated Pathogen Population Management - Lô-Pelzer et al., 2008).
- It will also allow to improve the French DSS as it will make possible to better quantify primary inoculum.
- This volunteer density simulator could help design control strategies for other potato pests than *P. infestans.*

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Thanks to

Didier Andrivon	*INRA , UMR BiO3P, Le Rheu*
Bertrand Edern	*INRA, UMR APBV, Ploudaniel*
Denis Gaucher	*Arvalis – Institut du Végétal*
Pauline Lasue	*Fredon de Picardie*
Mathilde Bodiou	*Chambre d'agriculture des Côtes d'Armor*
Nicolas Mezencev	*Chambre d'agriculture du Finistère*
Yvon Pouliquen	*Bretagne Plants*
Jo Petton	*Bretagne Plants*

Thank you for your attention !

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