# The A2 invasion in France:
population structures of *Phytophthora infestans* during the first few years

*12 Euroblight Workshop, Arras, 3-6 May 2010*

# French populations of *P. infestans* : a short history

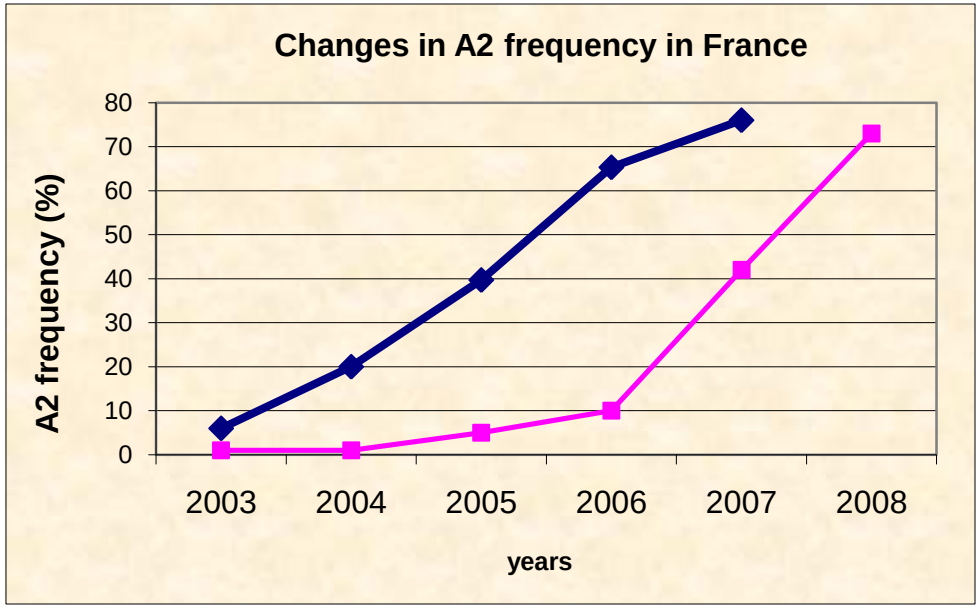
- **1980s – 1990s: the second migration**

  - Populations almost monomorphic for MT
    - A1 only in field crops
    - Rare A2s in gardens and on tomatoes
  - Limited polymorphism for phenylamide resistance
  - Pathogenicity :
    - Virulence: variations on a main theme ( 1.3.4.7.10.11)
    - Consistent adaptation to the dominant cultivar Bintje
  - Molecular markers consistent with 'new' population *sensu* Spielman *et al.* (1990)

  > **Clonal population introduced in the 1970s, and evolving under selection and genetic drift**

# French populations of *P. infestans* : facing a third invasion?

- A major change in MT frequencies since 2003
- Simultaneous with similar changes in NW Europe



# French populations of *P. infestans* : new questions

- **Where do these new isolates come from?**
- **Why do they invade current populations?**
- **Will the invasion change the reproductive status of *P. infestans* in France** ( oospores) ?
- **Will it change their adaptive traits:**
  - Virulence?
  - Adaptation to prevalent cultivars?
  - Fungicides?

# Investigation strategy

- **Get back to samples collected in 2004 and 2005 in both regions**
    - Northern France: start of the invasion
    - Brittany : *a priori* not concerned yet

- **Type them with polymorphic SSR markers**

- **Analyse population structures with no *a priori***
    - Assignation methods (PCA, Bayesian methods…)
    - Population genetics tools to look for signs of recombination

# Sampling and typing

- **Sampling**

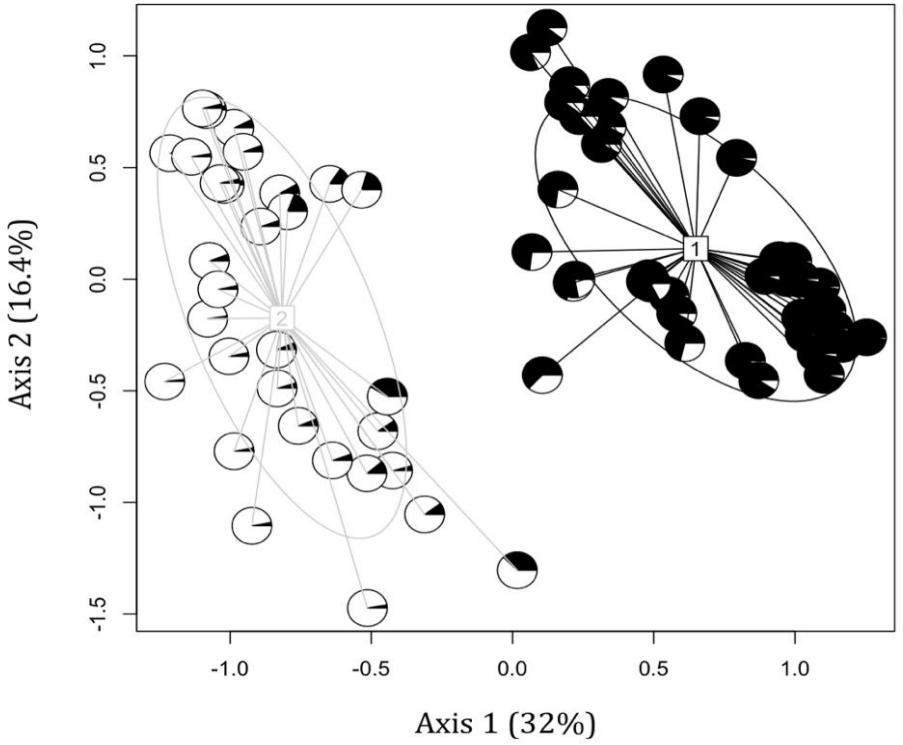
  All isolates from Bintje,

  to avoid discrepancies due to cvs

| | GPS position Lat | Long | 2004 | 2005 | Total |
|---|---|---|---|---|---|
| **North** | | | | | |
| P01 | N50 10 04.4 | E2 36 46.2 | 10 | . | 10 |
| P02 | N50 30 47.9 | E2 46 14.0 | 10 | . | 10 |
| P03 | N50 30 27.8 | E2 46 13.4 | 1 | . | 1 |
| P04 | N50 29 47.7 | E2 46 54.2 | 2 | . | 2 |
| P05 | N50 15 13.8 | E2 16 29.2 | 3 | . | 3 |
| P06 | N50 16 04.9 | E2 15 08.4 | 8 | . | 8 |
| P07 | N50 35 07.1 | E2 57 18.9 | 7 | 10 | 17 |
| P08 | N49 49 33.6 | E2 23 04.1 | 10 | 1 | 11 |
| P12 | N50 15 22.2 | E3 21 10.1 | . | 16 | 16 |
| P13 | N50 15 09.6 | E3 23 30.3 | . | 16 | 16 |
| P14 | N50 33 38.5 | E2 55 46.8 | . | 7 | 7 |
| P15 | N50 40 11.4 | E2 35 59.4 | . | 9 | 9 |
| P16 | N50 39 53.5 | E2 36 16.8 | . | 4 | 4 |
| P17 | N50 20 20.3 | E2 52 40.8 | . | 11 | 11 |
| P18 | N50 18 53.7 | E2 52 30.3 | . | 4 | 4 |
| P19 | N50 18 57.2 | E2 53 20.8 | . | 5 | 5 |
| **Total North** | | | **51** | **83** | **134** |
| **Brittany** | | | | | |
| P09 | N48 22 27.7 | W4 44 48.7 | 11 | 9 | 20 |
| P10 | N48 30 00.6 | W4 19 14.7 | 14 | 17 | 31 |
| P11 | N48 29 59.9 | W4 19 19.1 | 11 | 8 | 19 |
| P20 | N48 06 29.1 | W1 47 35.3 | . | 16 | 16 |
| **Total Brittany** | | | **36** | **50** | **86** |
| **Total** | | | **87** | **133** | **220** |

# French populations of *P. infestans* : a two sided coin

- **Two clusters**
  - * genetically diverse
  - * but distinct

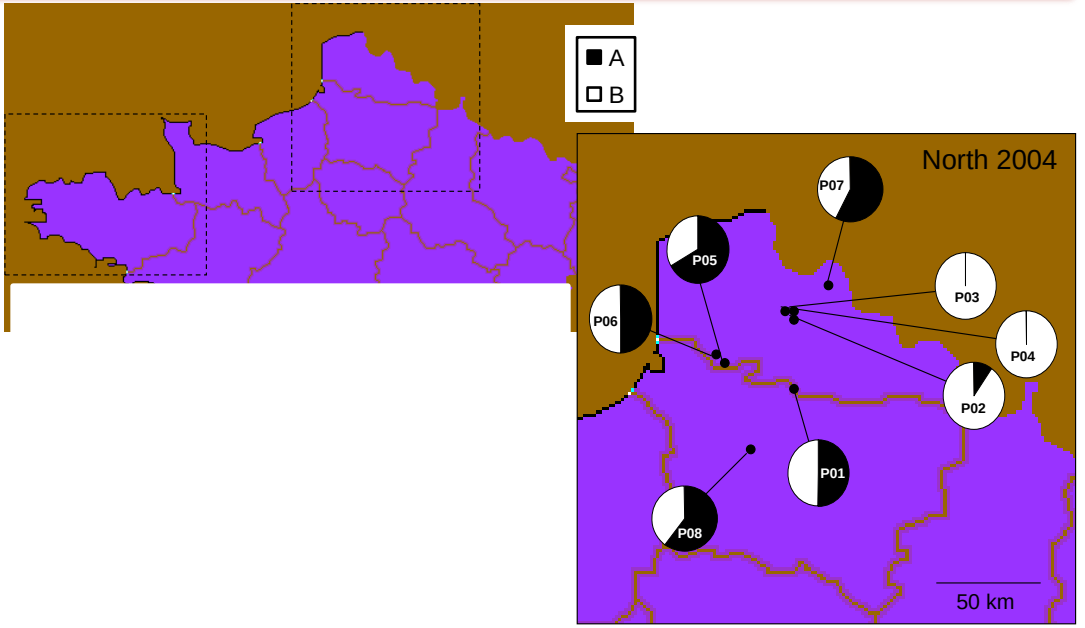



PCA on the 70 multilocus SSR haplotypes of *P. infestans* + non-hierarchical classification (Ward's method).

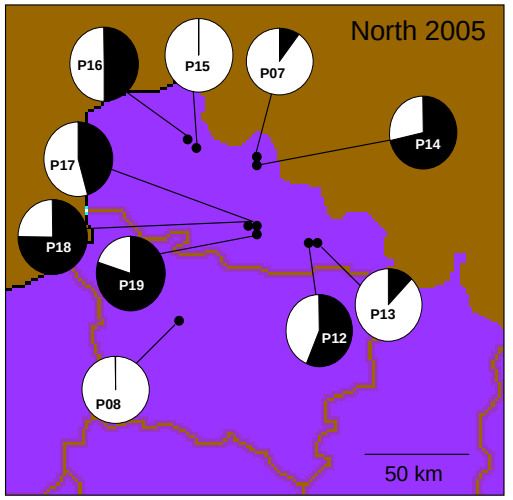
Pie-charts: probability of assignment (STRUCTURE) to Cluster A (black) and cluster B i(white).

# Spatio-temporal changes, 2004-2005

- **Northern France**
  - Many fields with both clusters present
  - No clear change in cluster frequencies between years




- **Brittany**
  - Cluster B appears– but only the A1s in it!



# So what…

- **regarding invasion**
  - Complicated pattern
    - The easy part : two clusters
    - The tricky part: both mating types within each cluster

# In for more questions…

- **Populations structures**
  - Why didn't A2s emerge before, if present in same clusters as A1s?
  - Why does cluster B invade now?
  - Is cluster B related to Blue 13?
- **Mating systems**
  - Why didn't A1 + A2 from cluster A mate (at least more often)?
  - Will clusters A & B mate?
- **Adaptation**
  - Cluster B more virulent – is it useful/relevant?
  - Cluster B resistant to phenylamides – is this related to fitness?

# What's next?

- Populations from 2006 – 2008 typed now
  - **Analyses underway**
    - Suggest that A1 / A2 get even more separated now
      - » More discriminating power with additional loci
      - » Loss of genotypes due to drift over time?
  - **Phenotypic features** > see poster by Roselyne
  - **Adaptation**
    - Status of virulence/ phenylamide resistance re. fitness still unclear
    - No obvious differences between A1/A2 re. aggressiveness

# With a little help from my friends…

| Who | did what? |
| --- | --- |
| • **Josselin Montarry** | about everything… |
| • **Roselyne Corbière**<br>• **Isabelle Glais**<br>• **Gladys Mialdea** | sampling, typing etc… |
| • **François Delmotte** *( INRA Bordeaux)*<br>• **Hélène Magalon** | population genetic analyses |