INRAE

Five years of *Phytophthora infestans* populations changes in France: patterns and hypotheses

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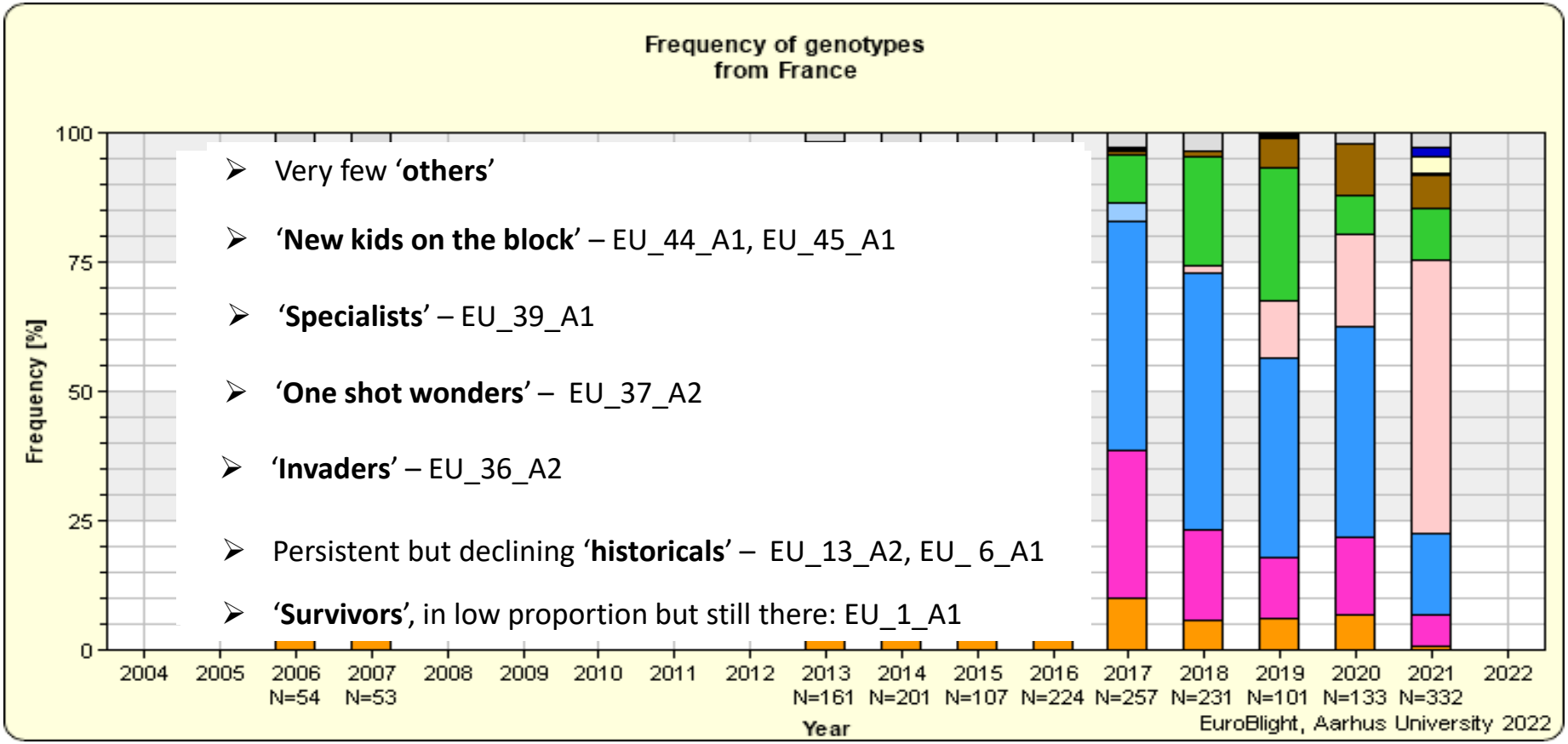
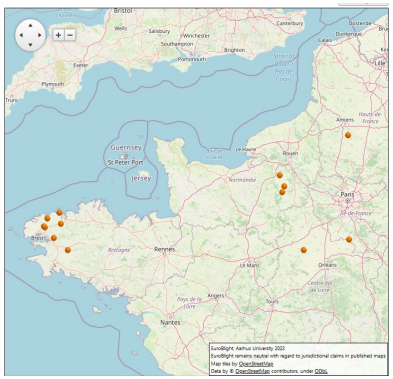
Phytophthora infestans population structures in France: clones and changes

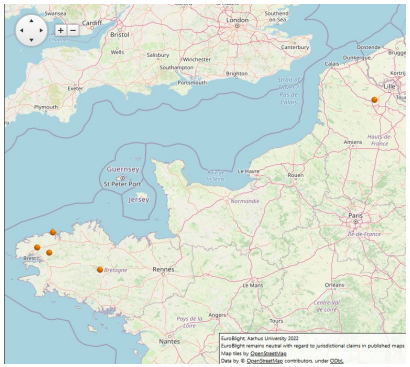
- **Clonal structures, and fast frequency shifts**
- **Seven main patterns**

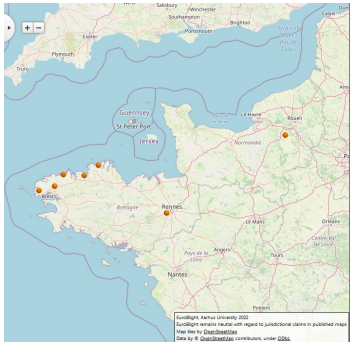


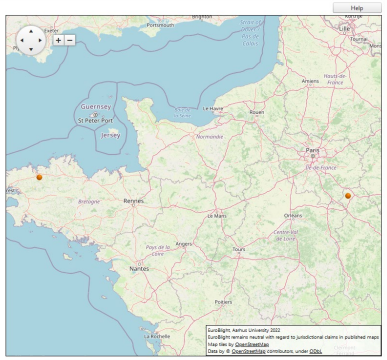
- Very few '**others**'
- '**New kids on the block**' – EU_44_A1, EU_45_A1
- '**Specialists**' – EU_39_A1
- '**One shot wonders**' – EU_37_A2
- '**Invaders**' – EU_36_A2
- Persistent but declining '**historicals**' – EU_13_A2, EU_ 6_A1
- '**Survivors**', in low proportion but still there: EU_1_A1

‘Survivors’ – EU_1_A1: why there, and why still there?



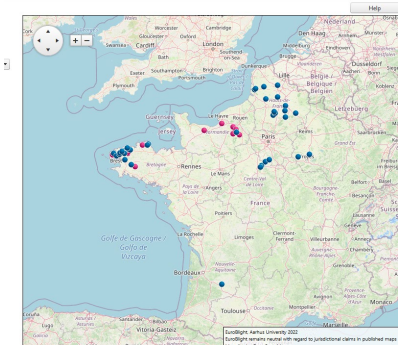
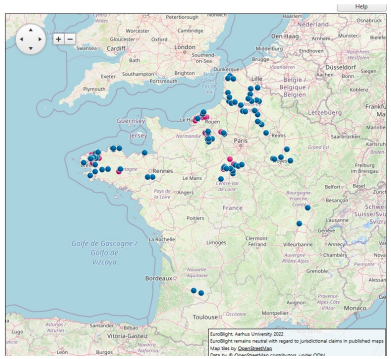
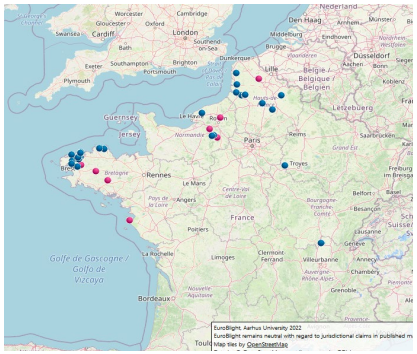
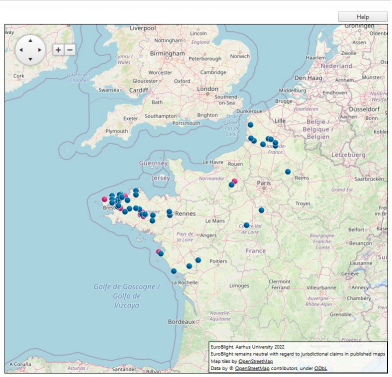
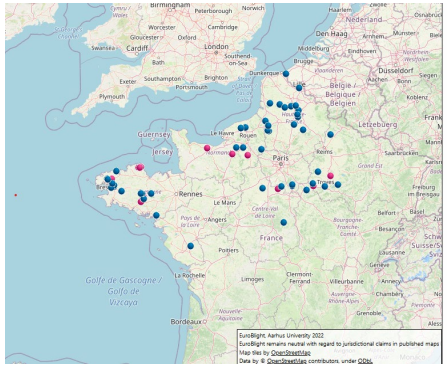






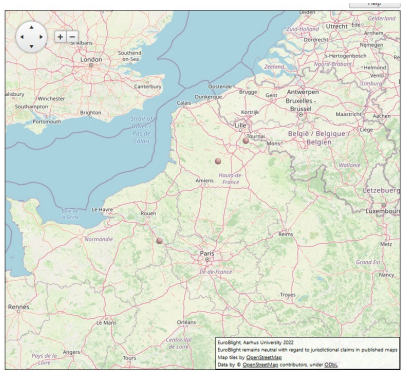
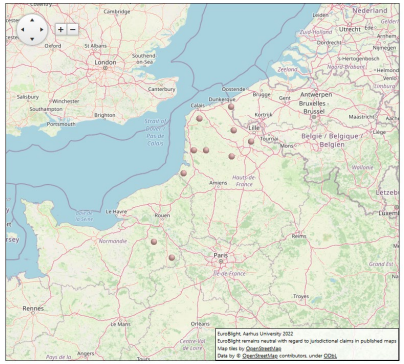
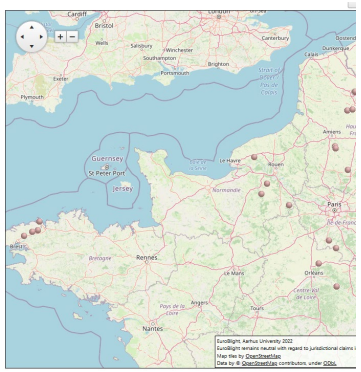
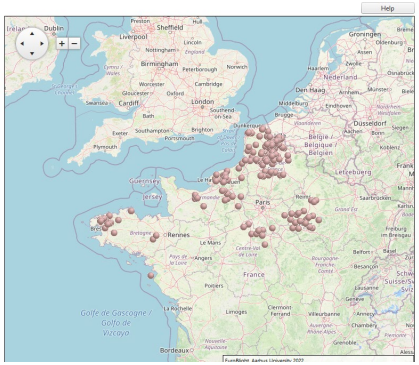
- ***Features***
  - ✓ Mainly in the west (scattered occurrences elsewhere)
    > earlier crops? /climate dependence?
  - ➢ Shrinking distribution > detected (almost) only in France since 2018
    > restricted to local refuges ?
    > on the verge of extinction?
  - ✓ Also present on tomato > host preference?

‘Historicals’ – EU_6_A1 & EU_13_A2: still widespread, but declining

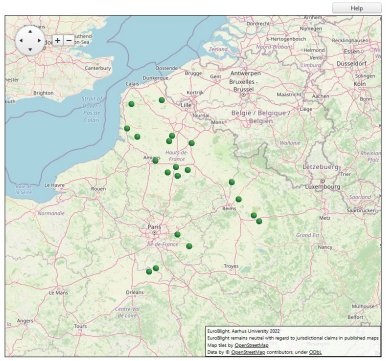
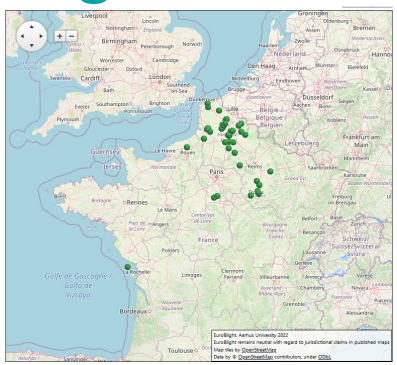
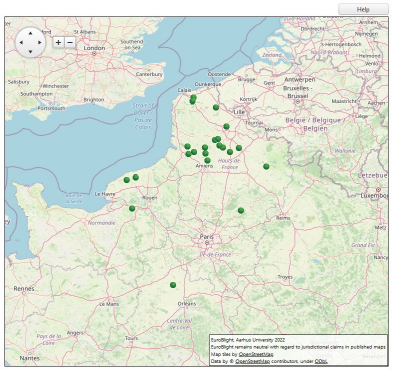
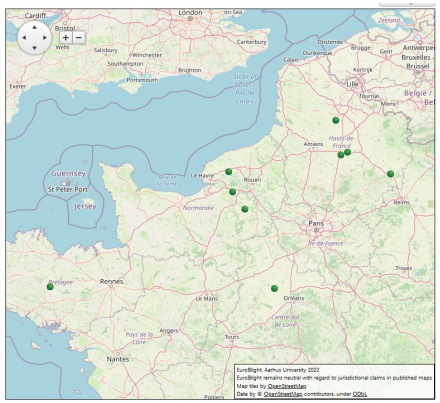
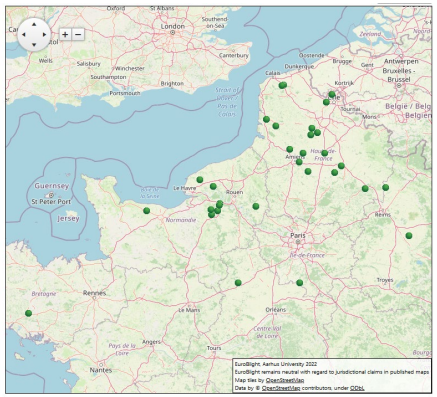
- ***Features***
  - ✓ Contrasting distributions: EU_6_A1 mainly NW, EU_13_A2 everywhere
    - > climate dependency for survival?
    - > oceanic regions serving as refuges? (see also EU_1_A1)
  - ✓ Declining frequency > lower fitness despite maintained pathogenicity
    - > accumulation of deleterious mutations over time (Muller’s ratchet)?
    - > pathogenicity not sufficient to explain fitness > other traits involved

‘Invaders’ – EU_36_A2: chance and fitness

- ***Features***
  - ✓ EU_36_A2: recent (first seen in 2018 in F), but expanding fast
    - > first detections separated from one another > likely multiple introductions
    - > big geographic gaps between initial locations > human introductions rather than natural spread?
  - ✓ Not the most pathogenic, but quite fit genotype
    - > present on potato and tomato > a versatile genotype
    - > reported ability to infect tubers > improved asexual survival?

‘One shot wonders’ – EU_37_A2: too dependent on a single trait?

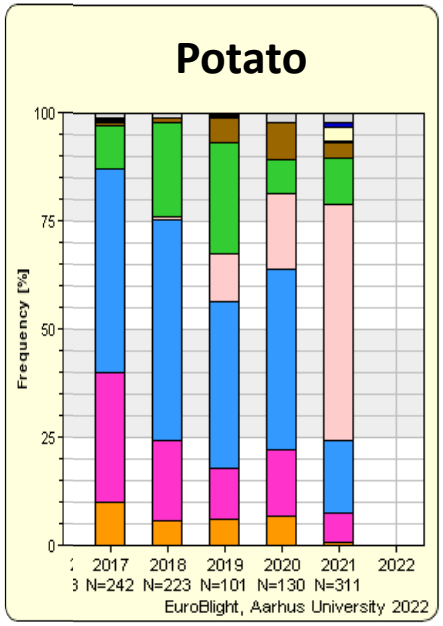






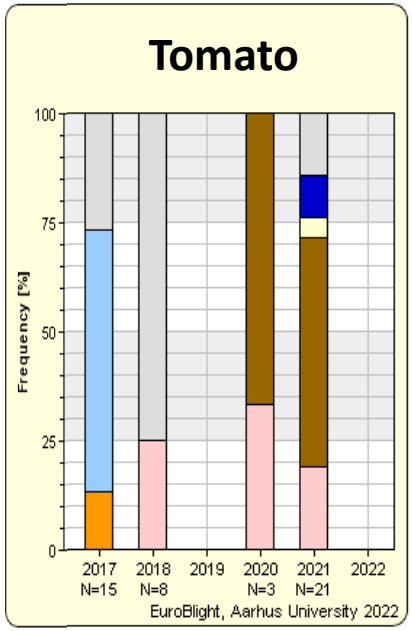
- ***Features***
  - ✓ ‘Boom and bust’ dynamics > correlative of fluazinam use?

    > seemed somewhat more abundant in 2021 than in 2020
    > more fluazinam used in severe epidemic?
    > sampling bias ?
    > primarily localised in Northern and central France, not in the west > later crops more intensely sprayed?

  - ✓ Displaced by EU_36_A2 > factors for differential fitness between both clones still unclear

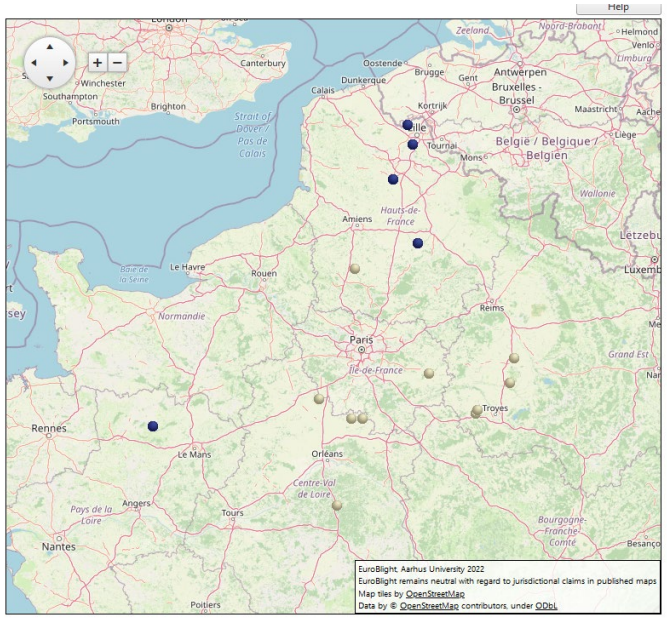
‘Specialists’: how competitive are they?





- ***Features***
  - ✓ EU_39_A1 and EU_44_A1 mainly on tomato
    - > clear host preference in these genotypes
    - > genetic similarity between the two clones
  - ✓ Tomato population still poorly known
    - > specialists, but also ‘others’ mainly from tomato
      - > strong sampling bias

‘New kids on the block’ – EU_44_A1, EU_45_A1: future invaders… or shooting stars?



- ***Features***
  - ✓ First and multiple detection in 2021
    - > same type of scattered distribution as for the first cases of EU_36_A2
      - > likely multiple independent introductions
      - > human actions rather than wind blown inoculum?
  - ✓ No information sor far on phenotypes
    - > tests underway
    - > unpredictable fate in coming years – see you in 2023 and 2024!

Take -home messages - and working hypotheses

- **'Others': still a mystery**
  - No clear evidence for sexual reproduction
  - Sampling biases and insufficient coverage of tomato populations

- **Range of different dynamics > probably different mechanisms behind**
  - Selection (EU 37-A2)
  - Host preference (EU-39_A1)
  - *Climate and survival?*

- **Oceanic refuges ?**
  - EU_1_A1, EU_6_A1
  - *Sampling strategies to be adapted when hunting for the rare?*

- **Fast changes > prediction power limited?**
  - 'One shot wonders' vs 'future invaders':
    - make your bets on EU_44_A1 and EU_45_A1
    - See you at the next workshop to know if they were right
  - Should be improved if driving mechanisms better identified

- **Fitness clearly not equivalent to pathogenicity**
  - Dependency to population size /strength of epidemic
  - *Local adaptation : climate? hosts? Prophylactic management practices?*
  - *Muller's ratchet: effective or not?*
  - *Founder effects : chance and the success of invasions? (EU_36_A2)*

Thanks…

- **To all sample collectors over the years which make this survey possible**
- **To David, Jens and the EuroBlight network for sharing info, providing mapping tools and naming of new genotypes**
- **To all of you for listening to this presentation**