


Rating potato varieties: 30 years of experiments reanalyzed to explicit resistance and explain its variability.

19th EuroBlight Workshop 13-16 May, 2024

Delphine Chauvin, phD student with Arvalis and INRAE

Context

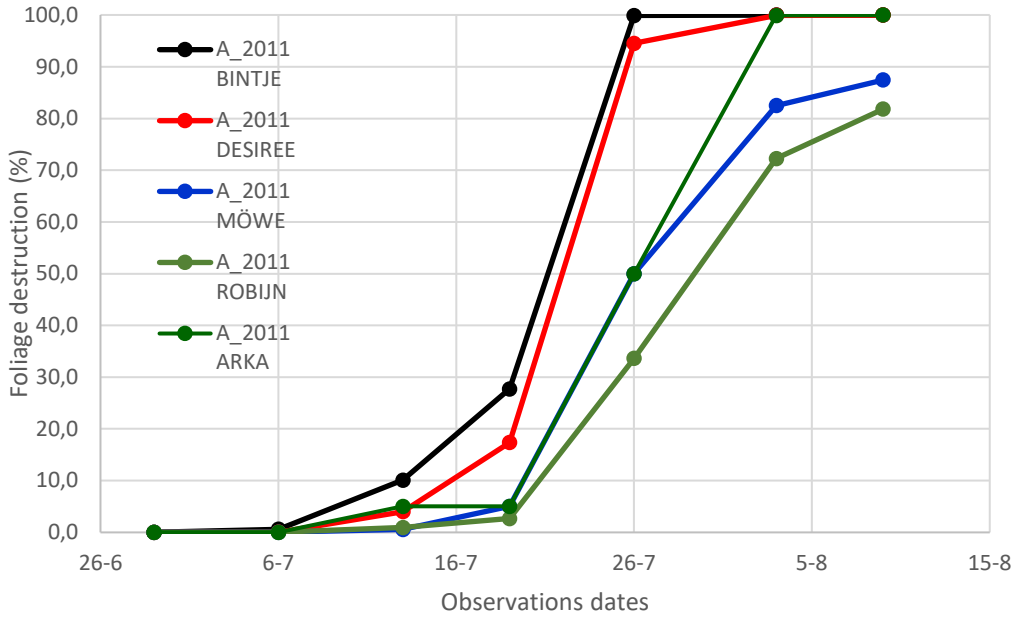
- Varietal resistance : reduce disease and needs for treatments
- Variability : difficulty for prediction

- Goal :
  - explore epidemics diversity
  - create types
  - evaluate predictability

- In this presentation :
  - Epidemic diversity and discrimination types created
  - Comparison with official ratings
  - Variables importance to predict epidemic type

Datasets

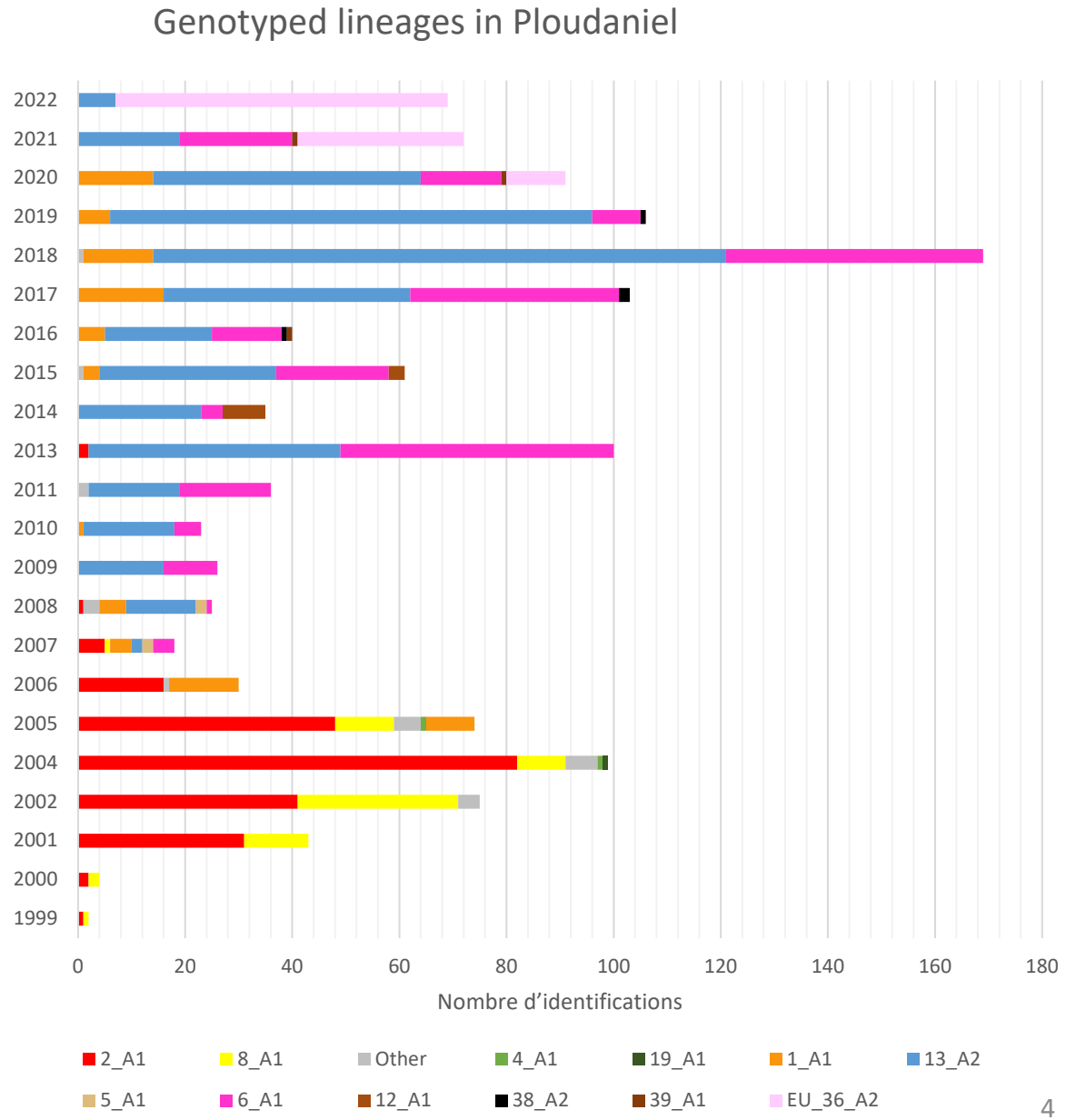
- Epidemic dataset :
  - 2526 sets of foliage destruction observations
  - 1 site : Ploudaniel, France, oceanic climate
  - 29 years, from 1994 to 2022
  - 201 potato genotypes
    - 43 varieties (1427 curves)
    - 23 differential hosts (759 curves)
    - 3+120 breeding lines (340 curves)



Datasets

- Climate dataset :
  - Weather station in Ploudaniel : daily temperature, humidity and wind
  - Variables : means between planting and harvest

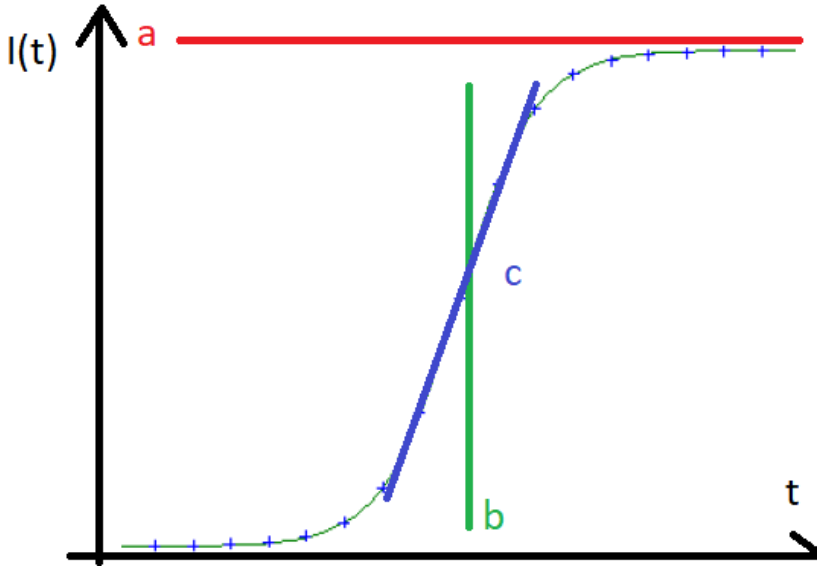
- *Phytophthora infestans* dataset :
  - From 1999 to 2022 : genotyped lineages from the fields
  - Variables : 1st and 2nd most frequent lineages, lineages diversity, % 1st most frequent lineage



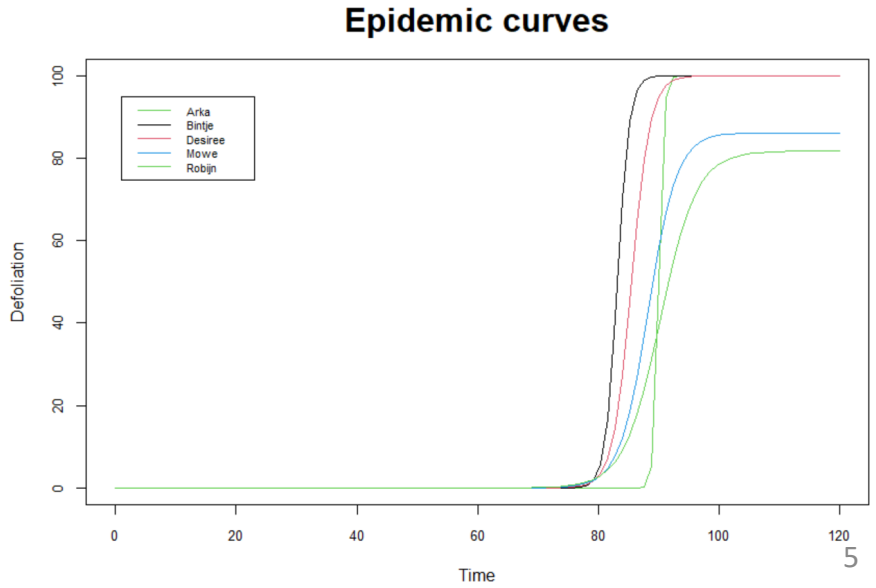
Classification method

- Logistic regression :
  - a: asymptote, final severity
  - b: time 50% final severity (inflection point)
  - c: inverse of slope at inflection point

- PCA on a,b,c
- Hierarchical clustering on PCA results



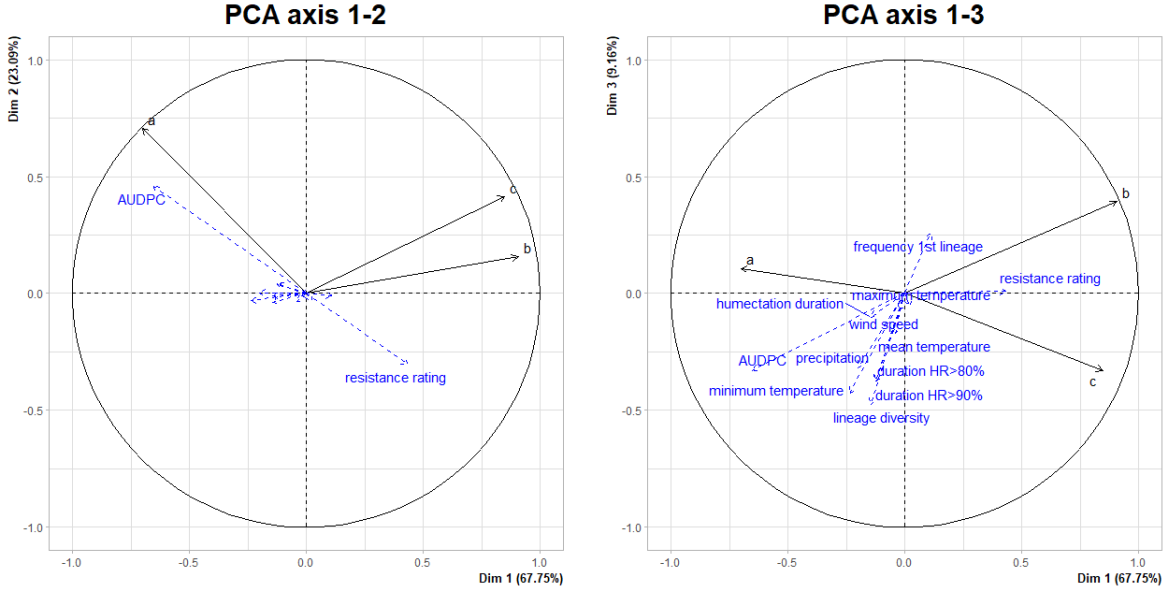
$$I(t,a,b,c) = \frac{a}{1+\exp(\frac{b-t}{c})}$$

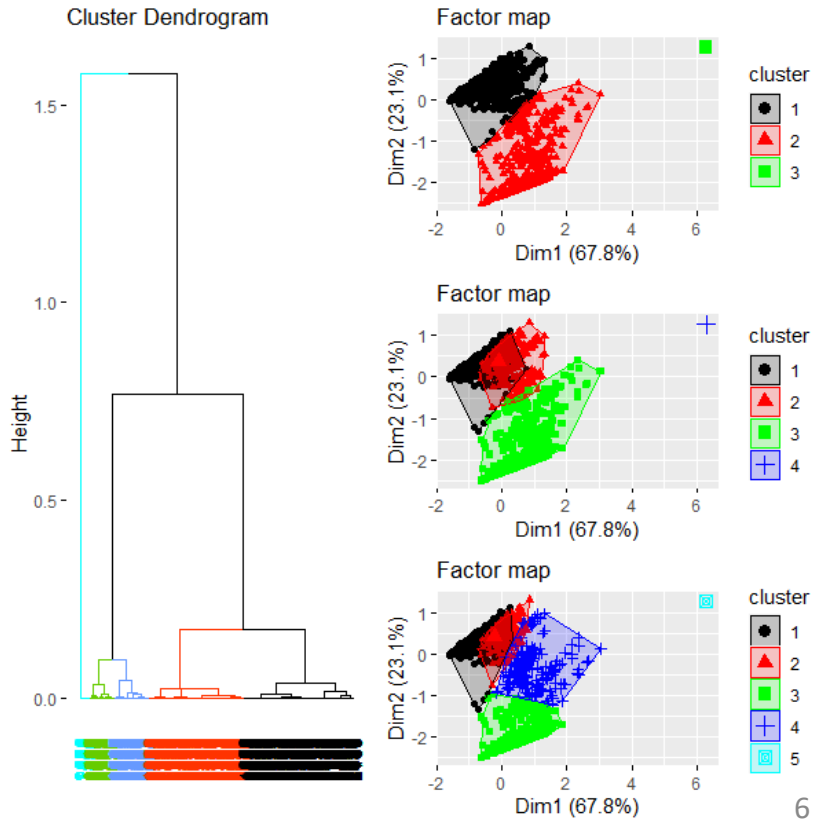


Classification method

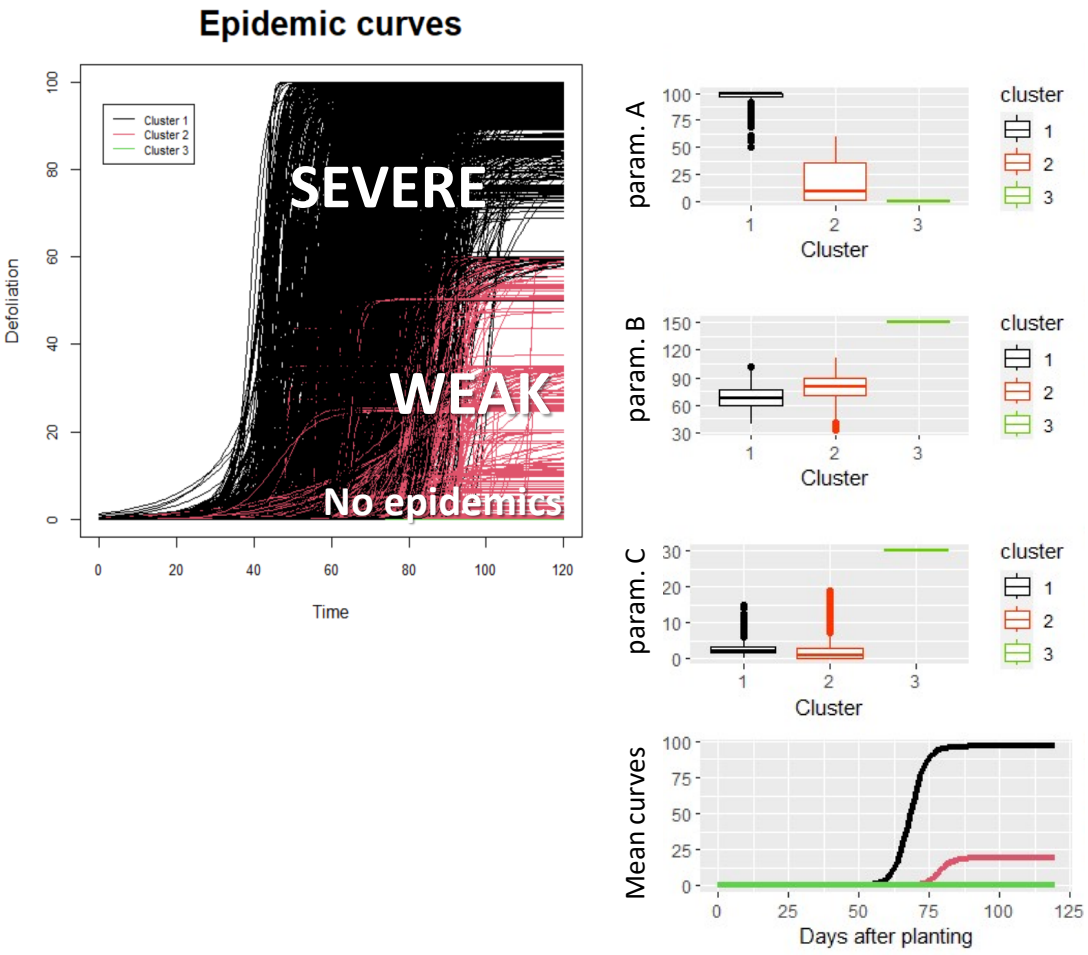
- Logistic regression :
  - a: asymptote, final severity
  - b: time 50% final severity (inflection point)
  - c: inverse of slope at inflection point

- PCA on a,b,c
- Hierarchical clustering on PCA results

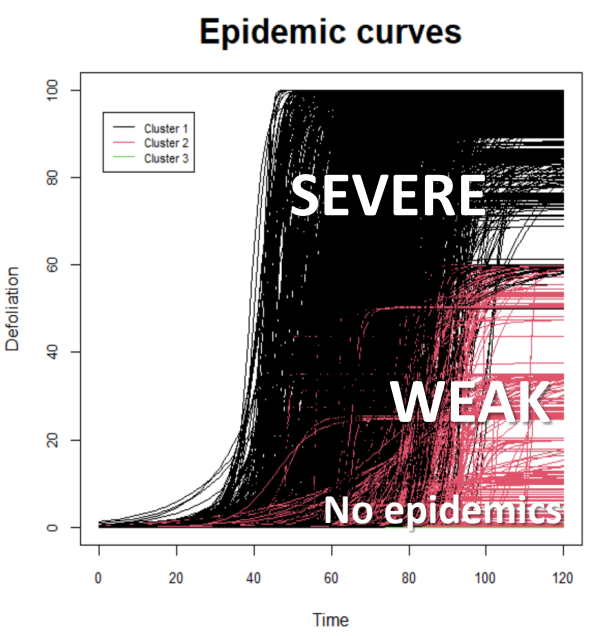


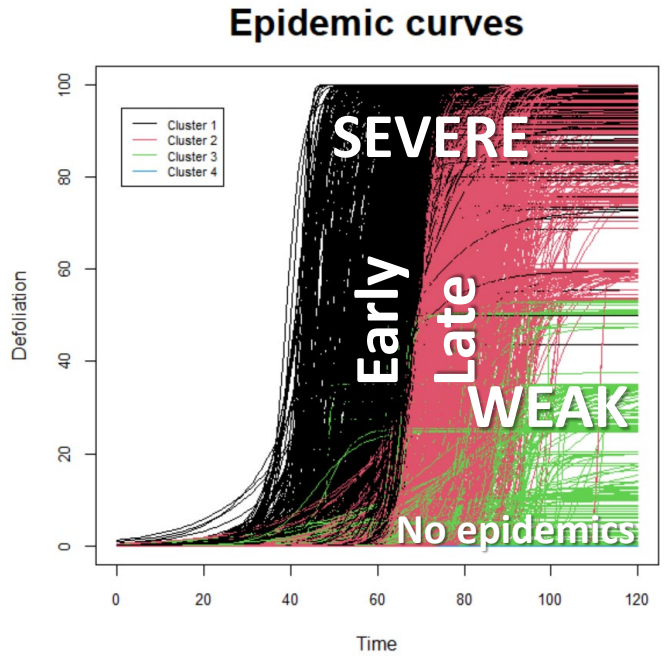


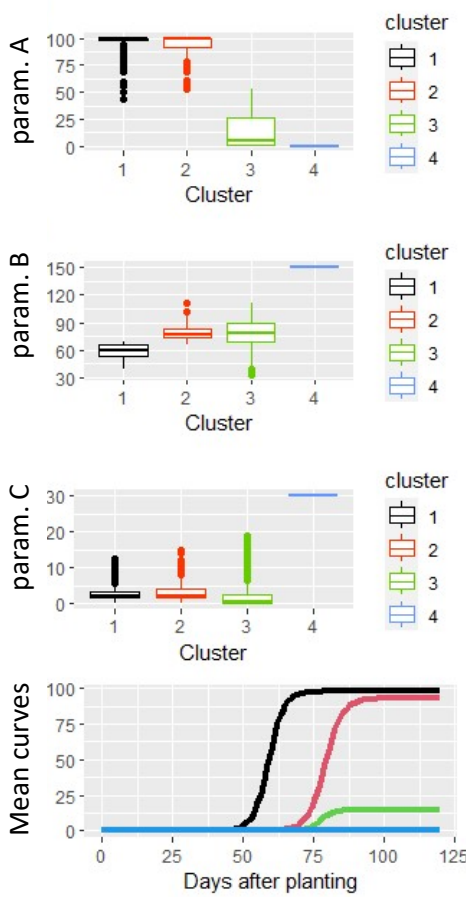
Classification results



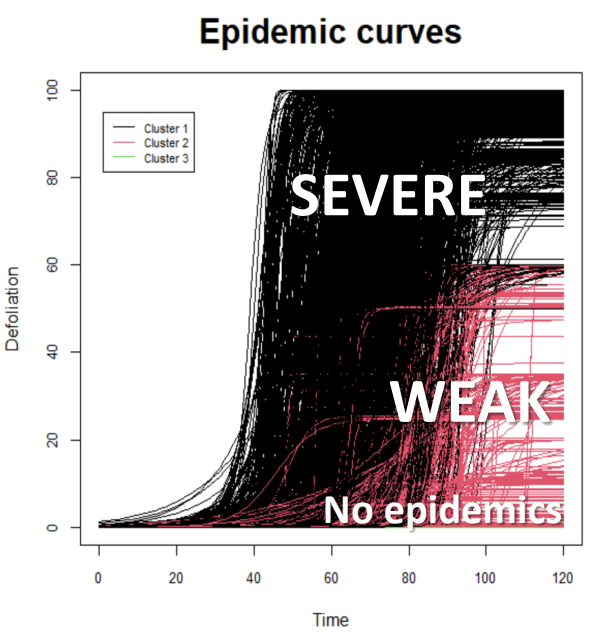
Classification results

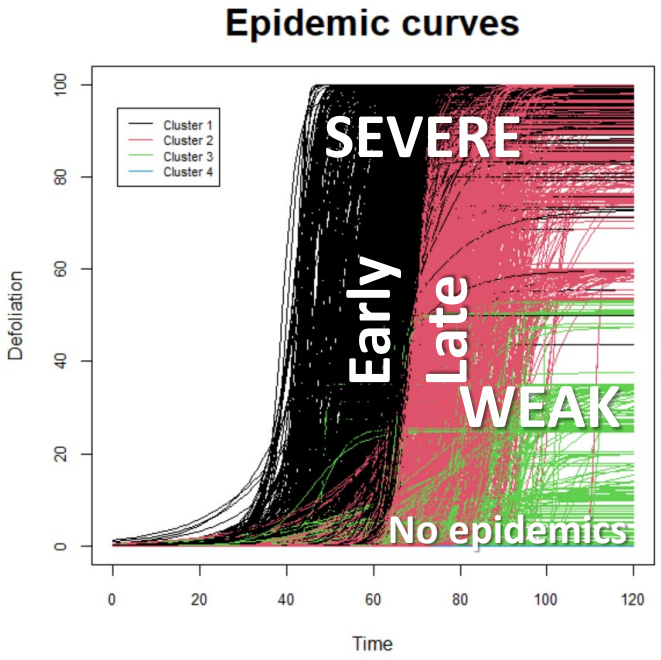


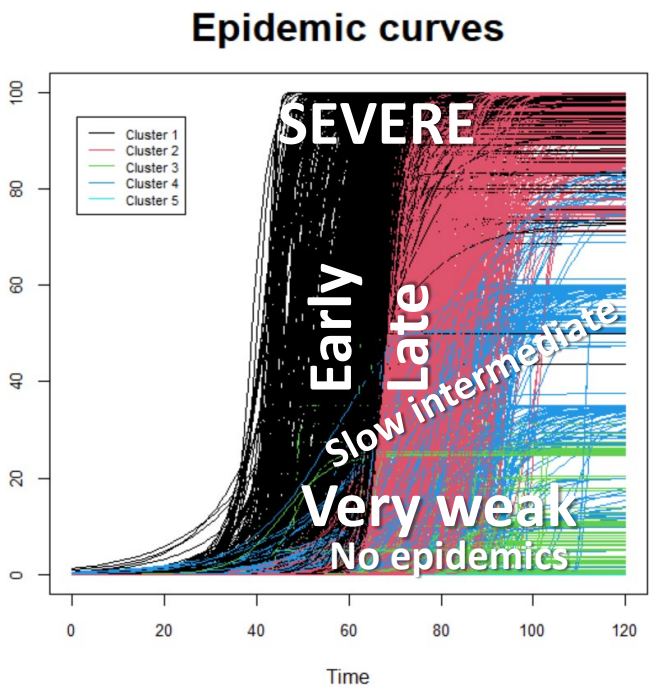


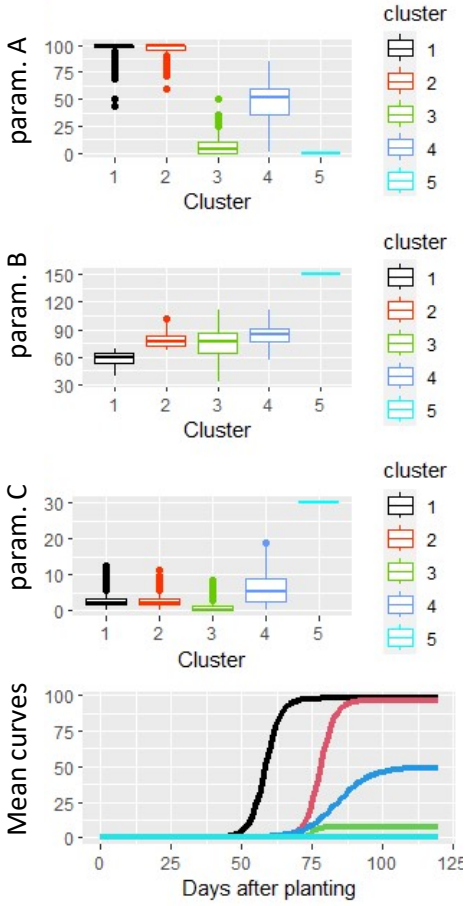


Classification results



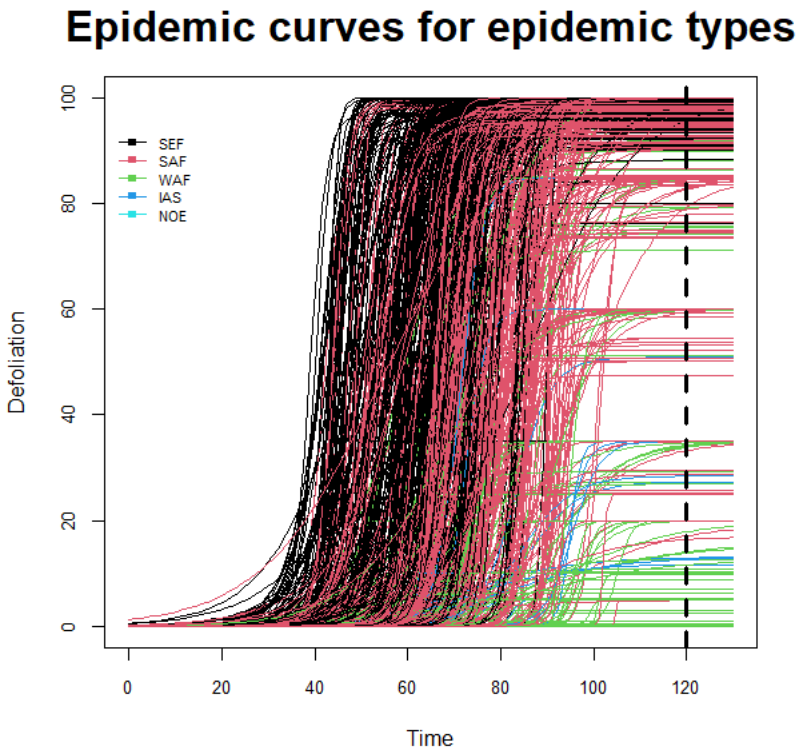


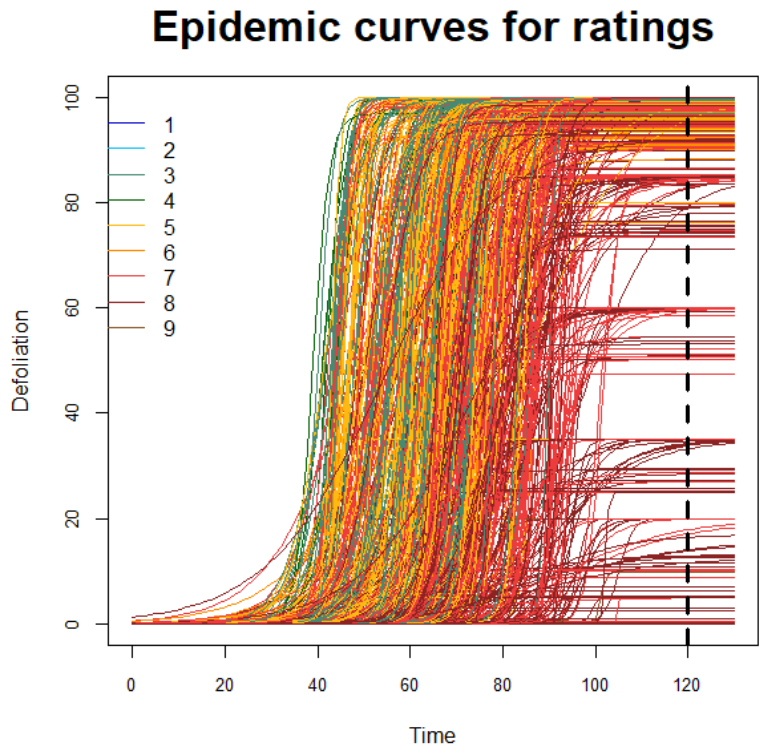




Classification compared to official ratings

For 34 varieties with official resistance ratings
1 color = 1 variety : most frequent epidemic type or official rating



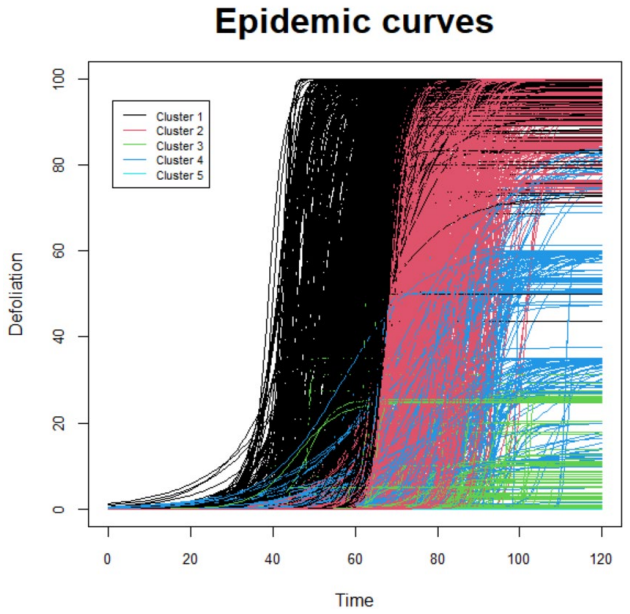


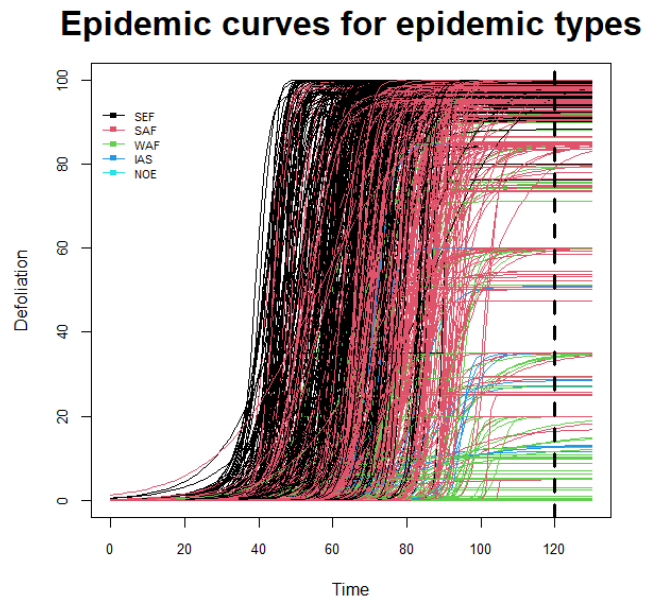
Discrimination between types clearer :

- Less groups
- Type assignment co-occurs observations and larger time period VS evaluations different ages and over 2 years

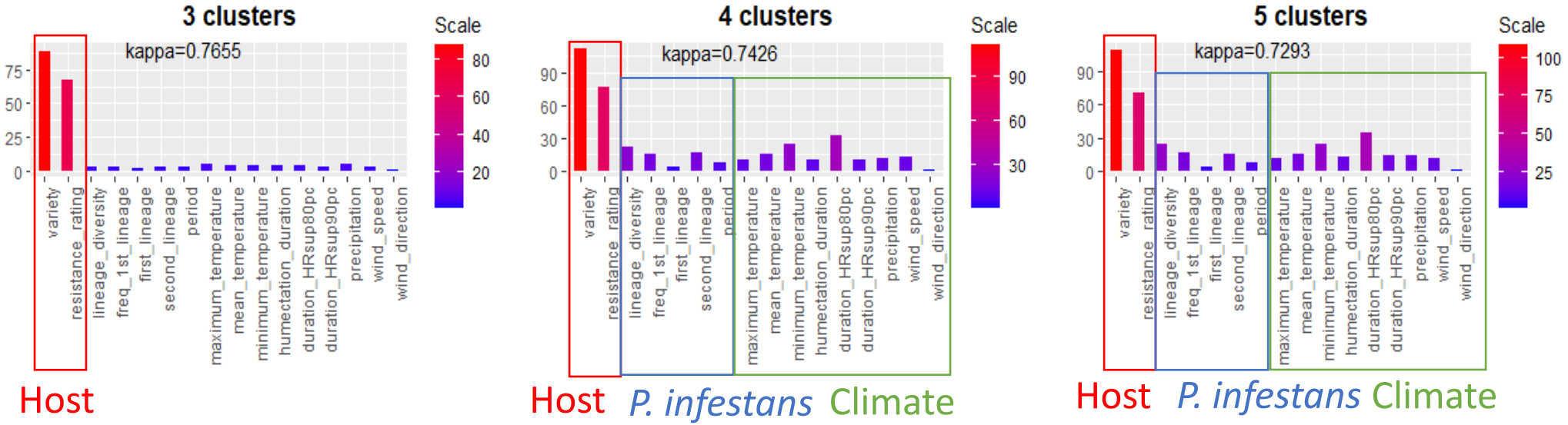
Predicting epidemic types

- 5 epidemic types :
  - Linked to epidemic parameters
  - Apparently discriminative enough
  - Variability of varieties
- Predictability of types ?
- Method : random forest (machine learning) and importance of variables



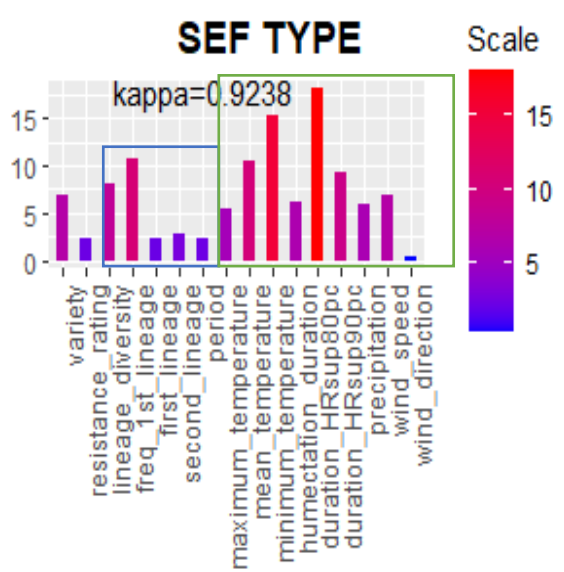


Predicting epidemic types

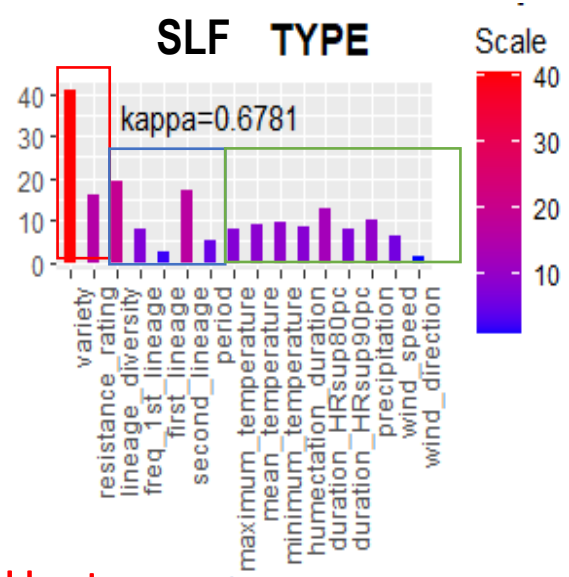


- 3 cluster : host sufficient to predict
- 4 cluster and more : importance of pathogen and climate

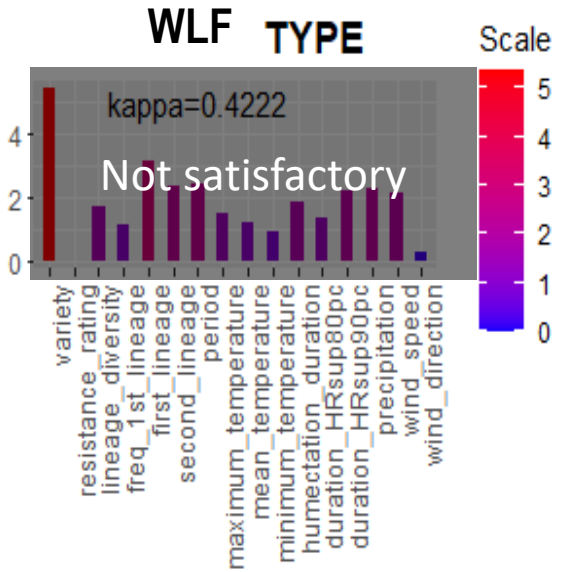
Predicting epidemic types

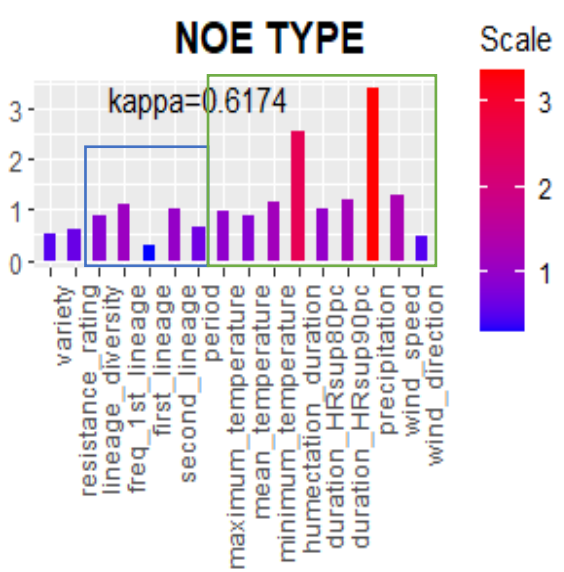


P. infestans Climate



Host *P. infestans* Climate





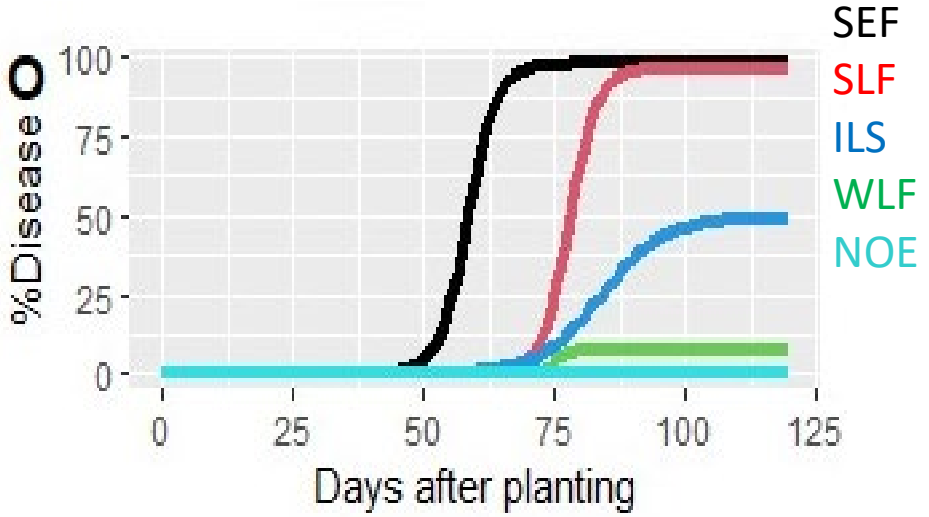
P. infestans Climate

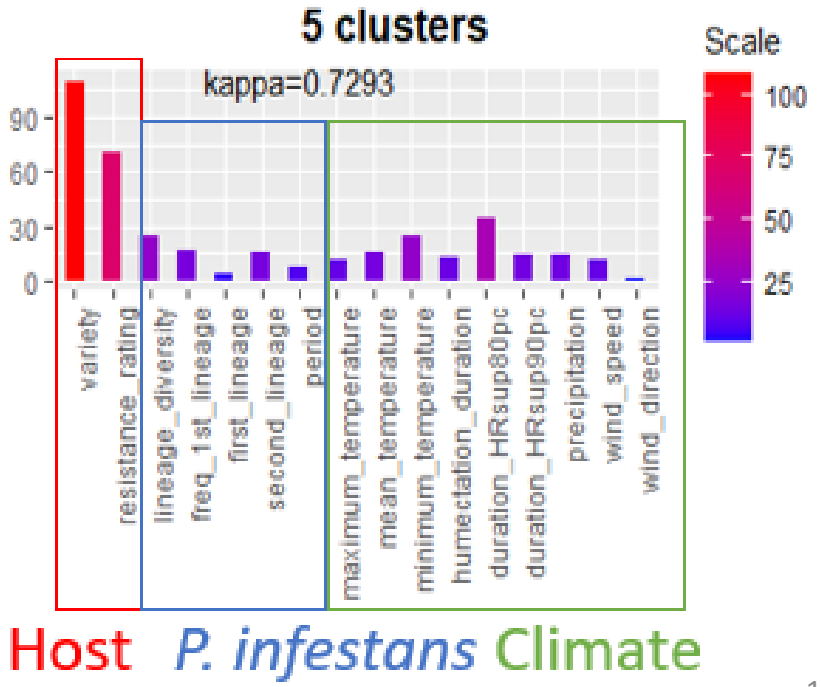
- Severe early type : climate > *P. infestans* > host
- Severe late type : host > *P. infestans* > climate
- No epidemic type : climate > *P. infestans* > host

Conclusion

- Typology based on severity, timing and slope of epidemics

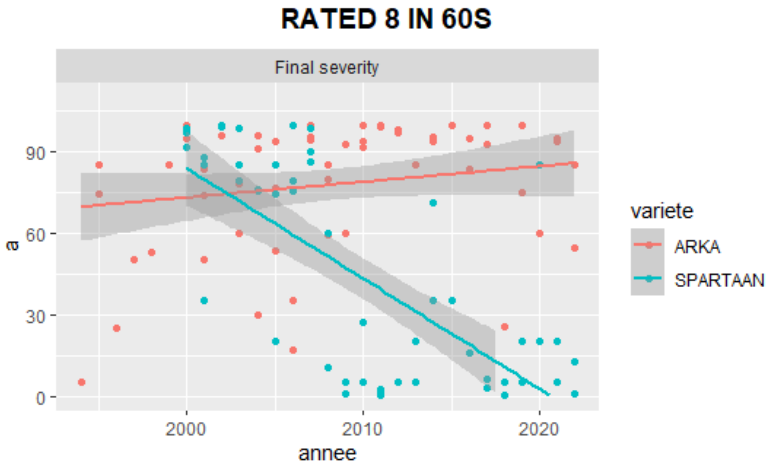
- Combining varietal resistance with predictive tools faces :
  - Creating discriminative and predictable types
  - Knowing varietal specific features
  - Taking into account pathogen population

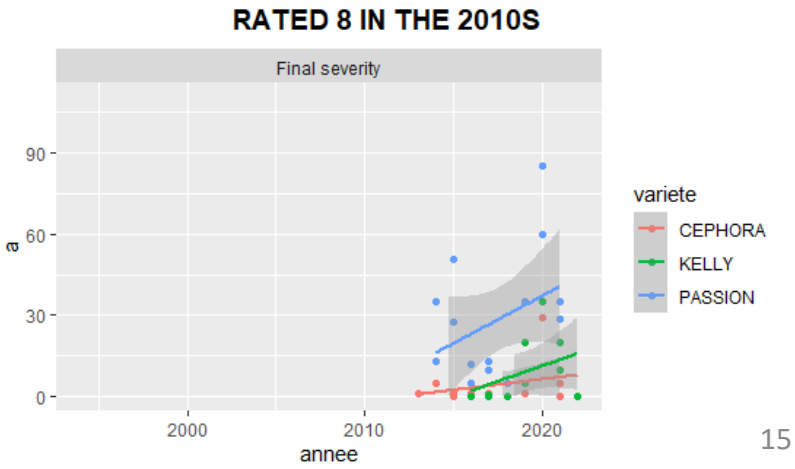




What's next ?

- For individual registered varieties :
  - Changes of epidemic parameters over time
  - Steps or gradual loss of resistance ?
  - A common rule ?

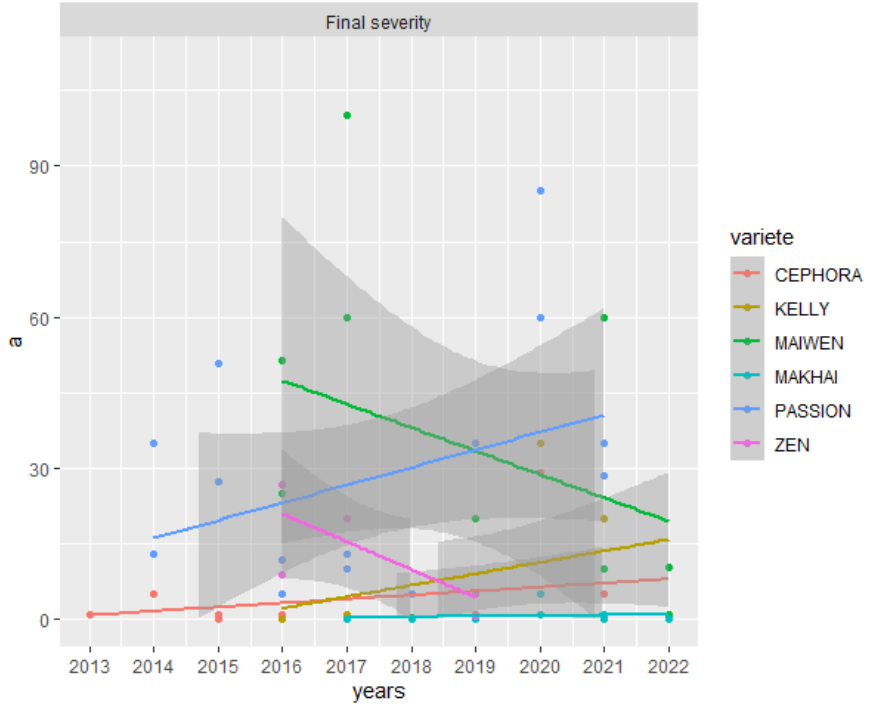


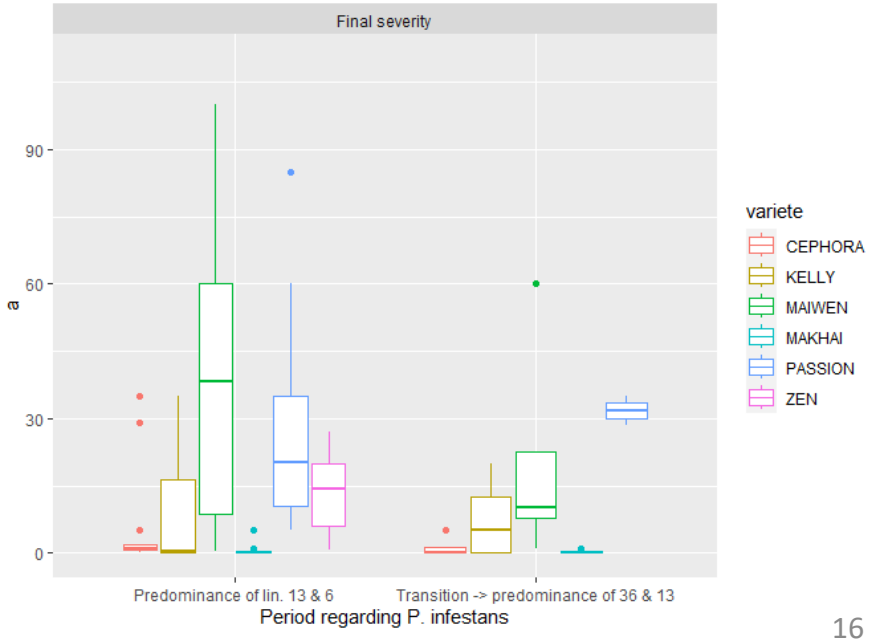


What’s next ?

- For individual registered varieties :
  - Changes of epidemic parameters over time
  - Steps or gradual loss of resistance ?
  - A common rule ?

- Challenge to untangle resistance erosion, specific year effects, lineages effects etc…





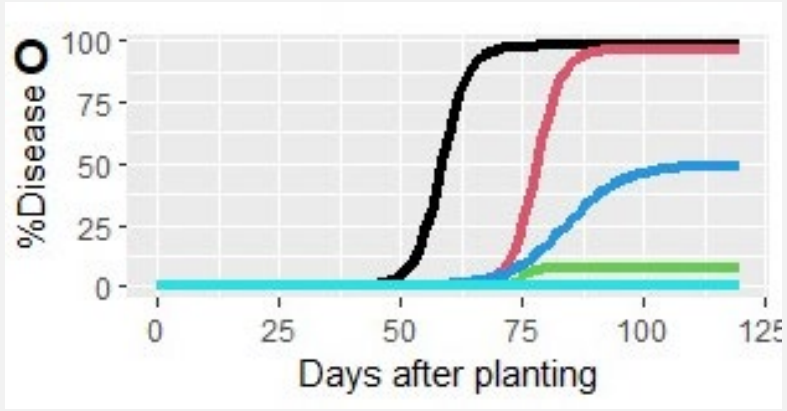
Thanks you for listening and thanks to every person that made this work possible :

- Thanks to GEVES and Roland Pellé for providing the main dataset and to RGCO for the agronomical managment of the experiments

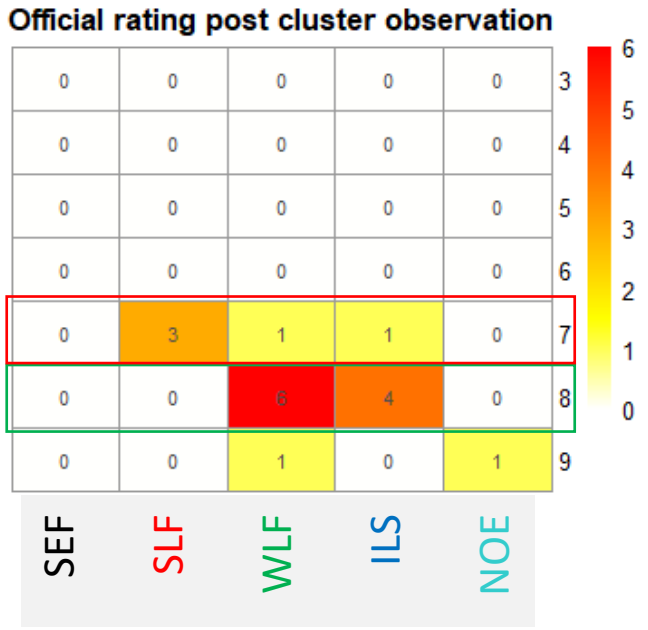
- Thanks to Roselyne Corbière and Romain Mabon for providing the *Phytophthora infestans* dataset

- Thanks to Melen Leclerc, Didier Andrivon and Denis Gaucher for their supervision on this work

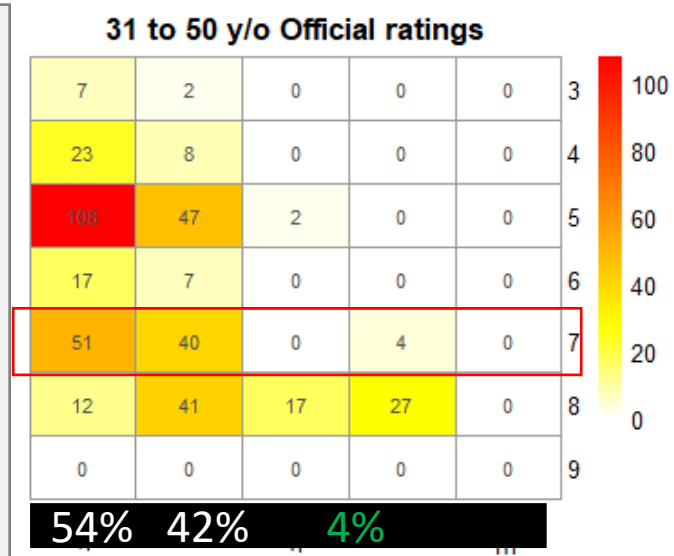
Classification compared to official ratings

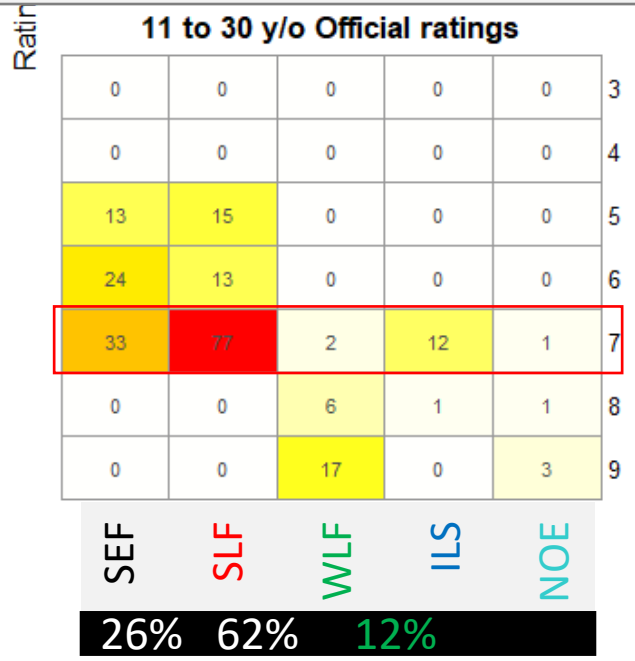


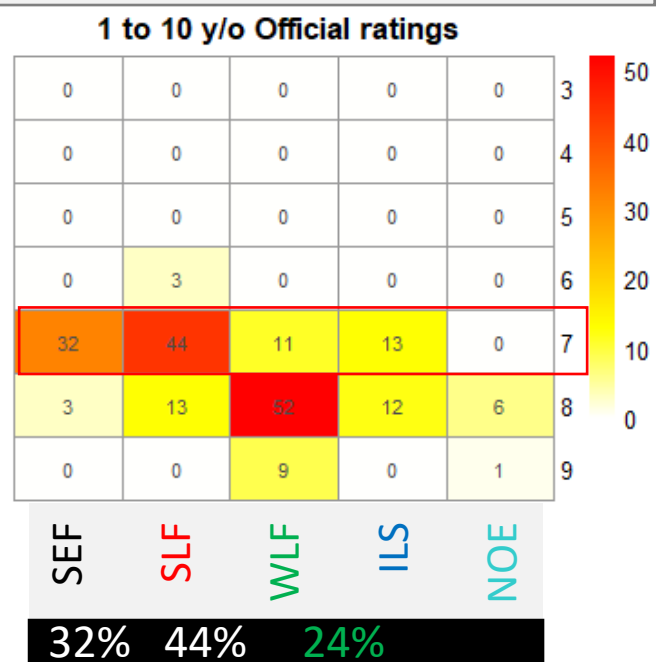
SEF
SLF
ILS
WLF
NOE

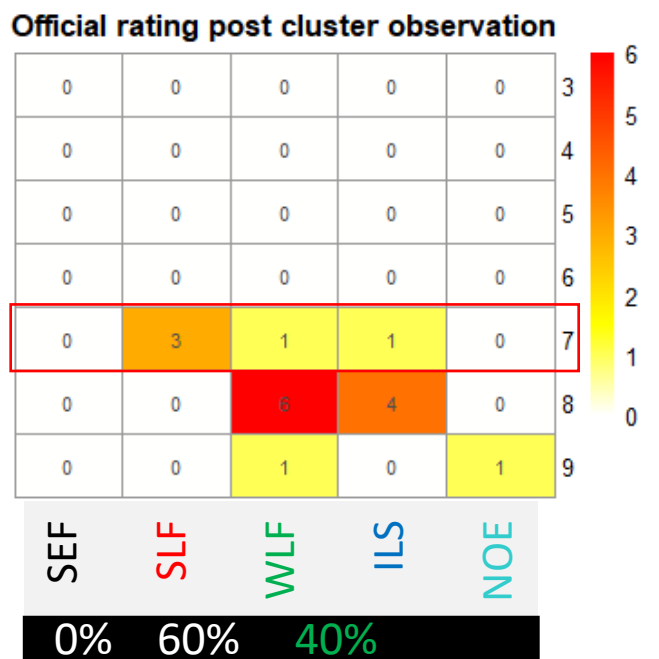


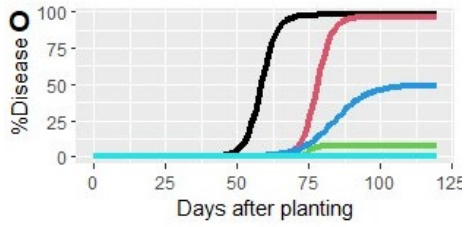
Classification compared to official ratings











Classification compared to official ratings