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Spatiotemporal evolution of pathogen stresses in bread wheat in France: study of rusts and septoria coexistence

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Background

Long-term changes of pathogen stresses of coexisting pathogens have been understudied so far, partly due to the lack of available data. In France, every year for decades, biotic stresses observed during crop cycle were synthesized within the regional grey literature, the 'Avertissements Agricoles' published by regional plant protection services (SRPV) of the French Ministry of agriculture. The PESTOBSERVER platform was launched to provide free access to these data.

Aim: We investigate patterns of coexistence among three major pathogens from 1996 to 2006 in France at a regional level, i.e. among yellow rust *Puccinia striiformis* f.sp. *tritici*, brown rust *Puccinia recondita* f. sp. *tritici* and septoria *Mycosphaerella graminicola*

Dataset

PESTOBSERVER platform: <http://pestobserver.eu>

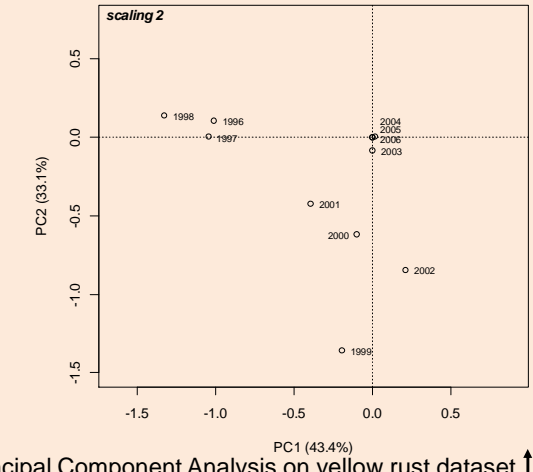
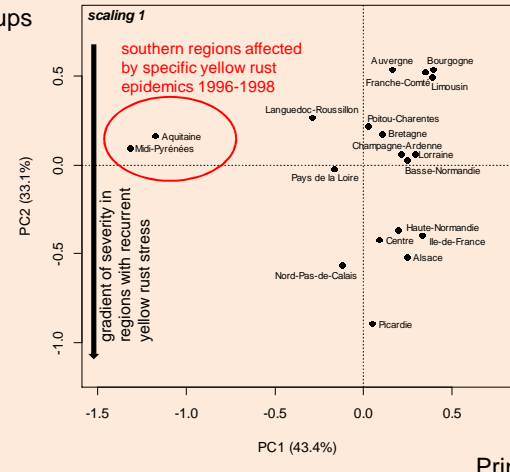
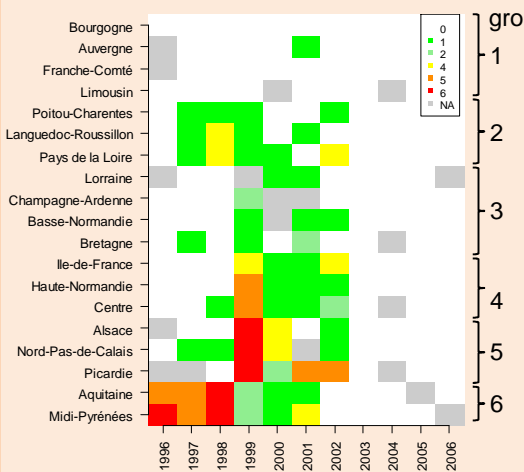
Data analysis:

- ✓ interpretation of documents based on double reading (identification of key information, circa 150 pages)
- ✓ classification of pathogenic stress using a 0-6 scale: 0 (no disease) to 6 (highest stress)

Statistical analyses:

- ✓ multivariate analysis: Principal Component Analysis (PCA)
- ✓ clustering: K-means algorithm
- ✓ comparison of stresses: Cochran-Mantel-Haenzel test

Main results and interpretations

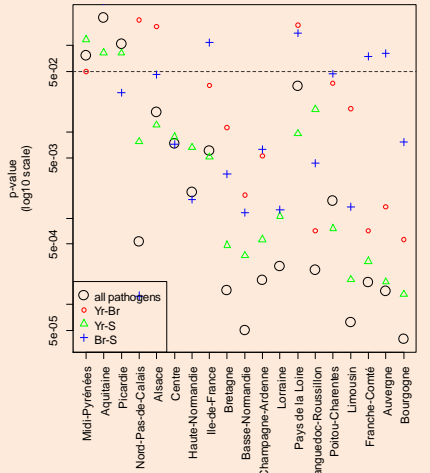


levels of yellow rust stresses (groups based on clustering) (split per year and French region) ↑

Principal Component Analysis on yellow rust dataset ↑

- Distinct patterns of yellow rust stresses in France between 1996 and 2006, in accordance with literature [1]:
- ✓ low or no stress (groups 1, 2, 3)
 - ✓ medium stress in 1999 (group 4)
 - ✓ high stress in 1999-2000 (group 5, axis 2) in northwestern regions known to be characterized by recurrent epidemics interspersed with epidemic-free years [1]
 - ✓ high stress in 1996-1998 in the southern regions (group 6, axis 1), associated with an epidemic related to the dominance of the Mediterranean pathotype of yellow rust (6E16) and large areas sown with a susceptible cultivar (Victo) [1]

↓ results of Cochran-Mantel-Haenzel test (split per year and French region, p-value < 0.05 corresponds to an absence of correlation between pathogen stresses)



To summarize, the analysis identify key trends of pathogen stresses during the period studied, highlighting the relevance of the information available

Absence of correlation among pathogen diseases:

- ✓ except for the 'Midi-Pyrénées' and 'Aquitaine' regions, where all pathogens tend to have a medium to high disease level at least during part of the period studied (1996-2001), although this pattern is dependent on the unexpected y. rust epidemics of 1996-1998.

Perspectives

The interpretation of 'Avertissements Agricoles' is a valuable source of information which may contribute to understand coexistence profiles among crop pathogens over several decades. In perspective, PESTOBSERVER platform will be used to complete the spatiotemporal wheat disease database for additional major pathogens, and these disease will be then analysed, with specific focus on the effect of climatic conditions and resistance genes at a regional scale.

Literature reference: [1] de Vallavielle-Pope, C., Ali, S., Leconte, M., Enjalbert, J., Delos, M. & Rouzet, J. (2012). Virulence dynamics and regional structuring of *Puccinia striiformis* f. sp. *tritici* in France between 1984 and 2009. Plant Disease, 96:131-140.