Relative influence of agricultural systems, pathogen pressures and soci-economic drivers on spatio-temporal changes of cultivated bread wheat varietal and genetic diversity over recent decades in France

To cite this version:
Rémi Perronne, David Makowski, Céline Schott, Mourad Hannachi, Robin Goffaux, et al.. Relative influence of agricultural systems, pathogen pressures and soci-economic drivers on spatio-temporal changes of cultivated bread wheat varietal and genetic diversity over recent decades in France. EU-CARPIA Genetic Resources 2017 - Crop diversification in a changing world: Mobilizing the green gold of plant genetic resources, 2017, Montpellier, France. , 1 p., 2017. hal-02790829

HAL Id: hal-02790829
https://hal.inrae.fr/hal-02790829
Submitted on 5 Jun 2020

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Introduction

To deal with climate instability and recurrence of new pest pressures, enhancing within-crop cultivated diversity has been regarded as a relevant way to ensure yield inter-annual stability while reducing the usage of synthetic inputs. However, a detailed knowledge of the main drivers of within-crop cultivated diversity and their relative influences is still lacking. In this study, we focused on bread wheat varietal and genetic diversity in France, an important production area known to be characterized by temporal changes in diversity between contrasted agricultural production regions. We defined an extensive list of potential drivers that could be grouped into three main categories: agricultural systems, pathogen pressures and socio-economic drivers.

We addressed two questions:
1. Does the combination of drivers identified presented a higher explanatory power for varietal rather than genetic diversity?
2. Does the drivers associated with agricultural systems were more explanatory of the level of varietal rather than genetic diversity?

Main results and interpretation

Schematic representation of the influence of different potential explanatory drivers of the spatio-temporal structure of the spatial varietal diversity $N_2$ (left) and the spatial genetic diversity $H_1^*$ (right). Two best models were chosen based on AICc: (1) the best model integrating only the four drivers related to the agricultural system (in red, 25 years × 53 districts considered) and the best model accounting for the ten drivers (in blue, 9 years × 48 districts). Only significant effects were shown *$P < 0.05$; **$P < 0.01$; ***$P < 0.001$. The sign of the relationship was also indicated.

- The main explanatory drivers explained the spatio-temporal structure of the spatial varietal diversity more than the genetic one (only potential drivers related to the agricultural systems $R^2_{adj} = 21.0\%$ vs $3.5\%$, all potential drivers $R^2_{adj} = 48.8\%$ vs $18.5\%$).
- The drivers associated with agricultural systems explained more the spatial varietal diversity than the genetic diversity, in contrast with the effects highlighted for the level of risk of some pathogens.
- The total production area of bread wheat and the diversity of preceding crops both positively influence the varietal and genetic diversity.

Conclusion

The spatio-temporal structure of bread wheat diversity differed between varietal and genetic diversity over the period 1981-2006 in France. These contrasted patterns could be due to different drivers affecting these varietal and genetic diversity. As an example, the varietal diversity was mainly positively affected by the total production area of bread wheat and by the diversity of preceding crops that could be associated with different sowing dates, while negatively associated with pressures of some pathogens, sometimes due the nature of the preceding crop increasing the severity of diseases. In contrast, the genetic diversity appeared to be as much affected by the drivers of the agricultural system as the level of risk of pathogens.

Acknowledgements: This work was supported by a grant overseen by the French National Research Agency (ANR) as part of the “Investissements d’Avenir” program (LabEx BASC; ANR-11-LABX-0034). It has benefited from a previous project funded by the FRB that allowed in particular to collect and complete previous historical and genetic data and communicate about the new indicator $H_1^*$ to French stakeholders. We thank COOP de France – Métiers du Grain for the availability of data on mergers between agricultural cooperatives.