

Global comparison of agronomic and environmental performances of grain legumes to grow in Europe

Charles Cernay^{*1}, Elise Pelzer¹, Jean-Marc Meynard^{3,4}, Tamara Ben-Ari¹ & David Makowski^{1,2}

¹INRA, UMR 211 Agronomie, F-78850, Thiverval-Grignon, France

²AgroParisTech, UMR 211 Agronomie, F-78850, Thiverval-Grignon, France

³INRA, UMR 1018 Sciences pour l'Action et le Développement: Activités, Produits, Territoires, F-78850, Thiverval-Grignon, France

⁴AgroParisTech, UMR 1018 Sciences pour l'Action et le Développement: Activités, Produits, Territoires, F-78850, Thiverval-Grignon, France

*Correspondence: charles.cernay@grignon.inra.fr

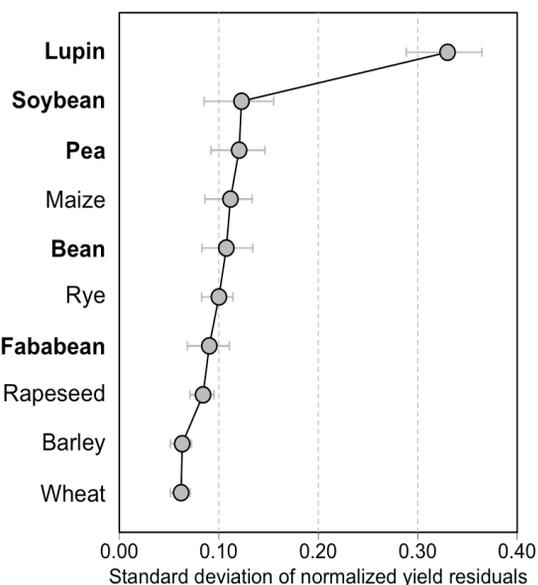
Comparing the agronomic and environmental impacts of grain legumes in Europe using 2 methods

- Importance of increasing grain legume production in Europe
- Numerous local experiments of grain legume performances
- No global quantitative synthesis

1. Ranking grain legumes along a risk gradient

- Crop yield variability and risk of yield loss over 1961-2013
- Major legumes and non-legumes across Europe and the Americas
- Yield time series from the Food and Agriculture Organization (FAO)

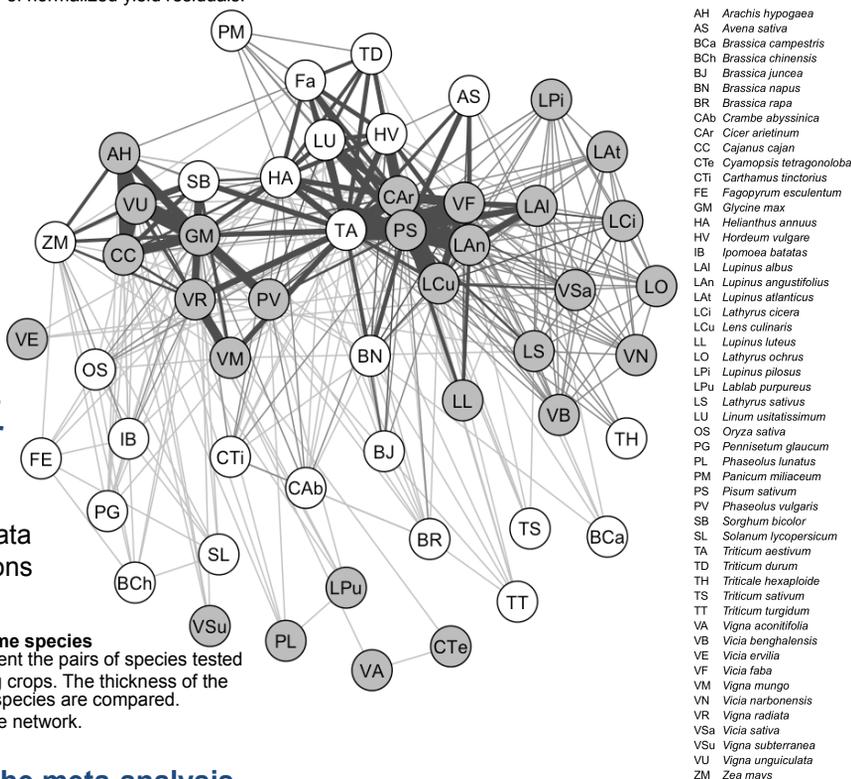
Standard deviation of normalized yield residuals for 10 crops in Western Europe over 1961-2013. Polynomial regression models are used to calculate normalized yield residuals. Horizontal lines correspond to 95% confidence intervals. Among the 10 crops, 5 are grain legume crops (bold names) and 5 are non-legume crops (non-bold). All crops are ranked according to standard deviation of normalized yield residuals.



2. Ranking grain legume performances for various criteria and explaining their variability in function of agroclimatic and technical factors

- Meta-analysis of published experimental data
- Broad spectrum of climate and soil conditions
- Contrasted crop management techniques

Network of grain legume species (grey points) and non-legume species (empty points) reported in the meta-analysis. The links represent the pairs of species tested at the same experiment site(s), either as preceding or succeeding crops. The thickness of the links increases with the number of experiment sites at which the species are compared. The Latin Names of plant species are mentioned at the right of the network.



Comparing the rankings produced by the meta-analysis with the rankings derived from the measures of variability and risk in grain legume yields

- An overall assessment for a large range of grain legume performances
- A solid basis for evaluating their values into European food systems
- A contribution for building future scenarios of grain legume expansion in Europe