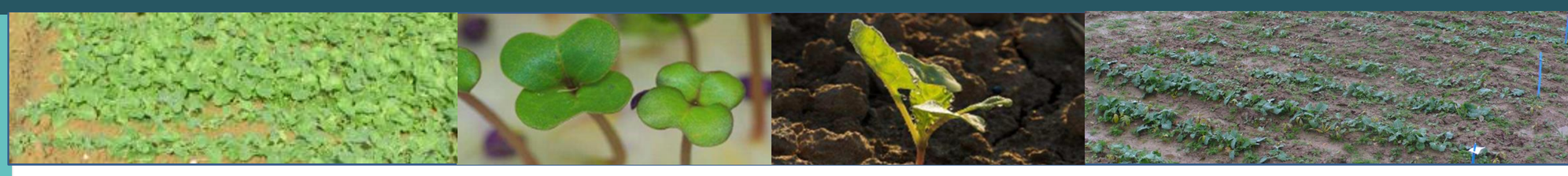
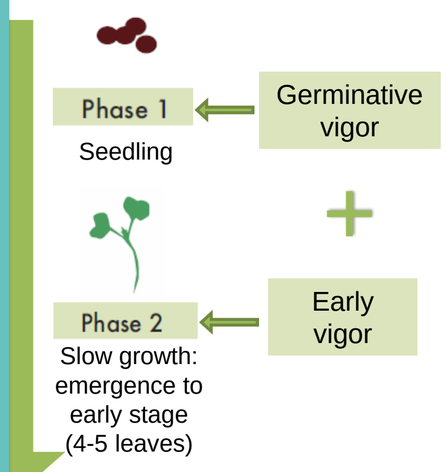
Genetic determinants of germinative and early vigor in oilseed rape

Marianne Laurençon



Social-economic context



Oilseed rape (OSR) is the third oilseed crop in the world, the first in Europe and France. The crop commonly fails to establish efficiently, which limits yield potential, increases costs to control weeds, diseases, pests and can lead to a crop failure. Poor establishment is partly explained by low germinative or early vigor of the genotypes and is exacerbated under limiting conditions (drought, seeding conditions). Effective canola establishment is expected to became more challenging with climatic fluctuations and restriction in the use of crop protection products in agroecology. Therefore, oilseed rape vigor is one lever to bypass abiotic and biotic stresses during fall and ensure the well-establishment of the crop before winter. This research will focus on deciphering the genetic determinants of germinative vigor and early vigor in order to detect associated loci and optimize tools for breeding of high vigorous OSR plants.

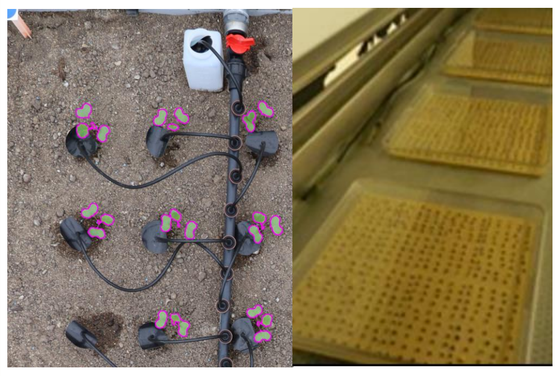
Scientific context

- The genetic determinism of vigor is polygenic and subject to genotype x environment x management interactions.
- Germinative vigor could be explained by a set of already identified functional traits but its genetic architecture remains to be deciphered. Moreover, early vigor is still not characterized by precise traits nor genetically.
- Therefore, quantitative genetic approaches will be implemented, the resolution of which depends on a small linkage disequilibrium decay and on the maximization of the genetic diversity explored.
- Our first hypothesis is that there is an interesting and valuable genetic diversity in more distant germplasm for germinative and/or early vigor but also from progenitor species.
- Our second hypothesis is that decision support tools in breeding such as genomic selection (GS) and phenomic selection (PS) are suitable for vigor prediction. In particular, NIR spectra could be used as a proxy for endophenotype and therefore use phenomic selection as a new breeding tool could be a affordable method to select for vigor.

Objectives and strategy

- What are the genetic determinants involved in early vigor in OSR ?
- What is the added value of using interspecific diversity to enlarge our knowledge of genetic determinism of a complex trait such as vigor?
- Can we use phenomic selection (PS) to predict vigor and what is its added value compared to genomic section (GS)?

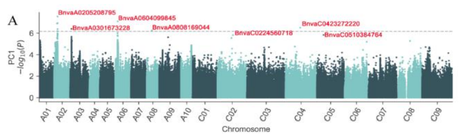
1. PHENOTYPING
Identification of traits for germinative and early vigor



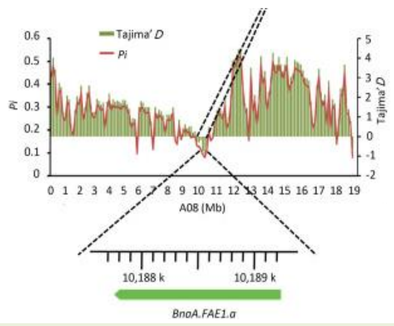
Genetic diversity tested:
138 winter OSR
91 spring OSR
13 winter fodder
2 rutabaga
22 elite hybrids F1
44 parental lines

Traits:
Germination time and rate
Imbibition speed
Elongation speed
Leaf cover kinetic
Aerial biomass
Root biomass
…

2. GENETIC ANALYSES
2.1. QTL detection by GWAS

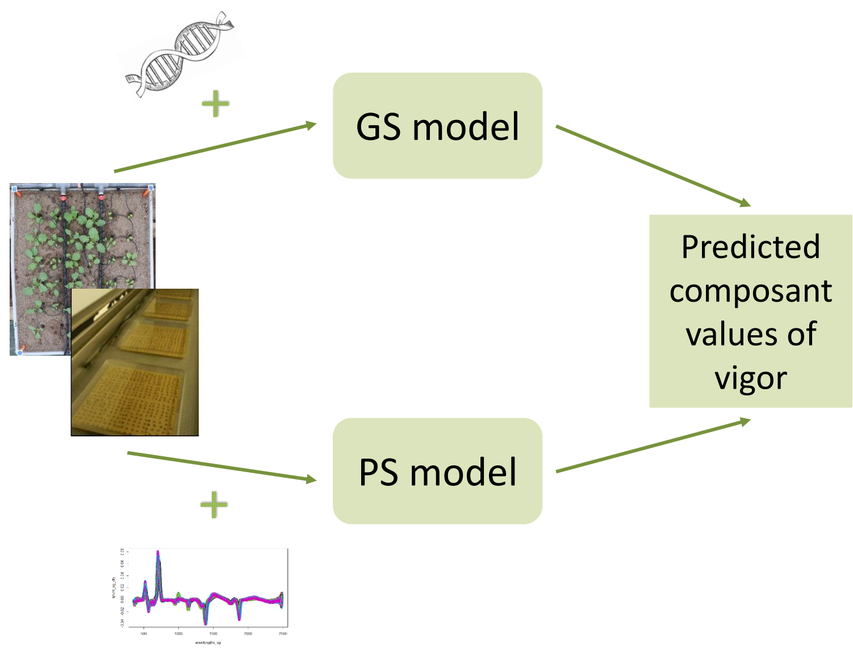


2.2. Characterization of interspecific genetic diversity



Panel + 100 resynthesized lines

3. **PREDICTIONS**
Comparison between genomic selection (GS) and phenomic selection (PS) to predict vigor



Perspectives

The main outcomes of the thesis will be:

- Characterization of genetic resources for traits identified as priorities for the crop
- Identification of genetic determinants of germinative and early vigor to select for vigor
- Provision of tools for breeding
- Knowledge to support the transition to agroecological practices

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