Alfalfa to get back into planetary boundaries

2025 world alfalfa congress
FRANCE REIMS-CHÂLONS

Sequence 2: Physiology and Genetics

Dejan Sokolović

Young professionals session

FROM 03 › TO 06 nov. 2025

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Phenotypic traits shaping the genetic structure of alfalfa

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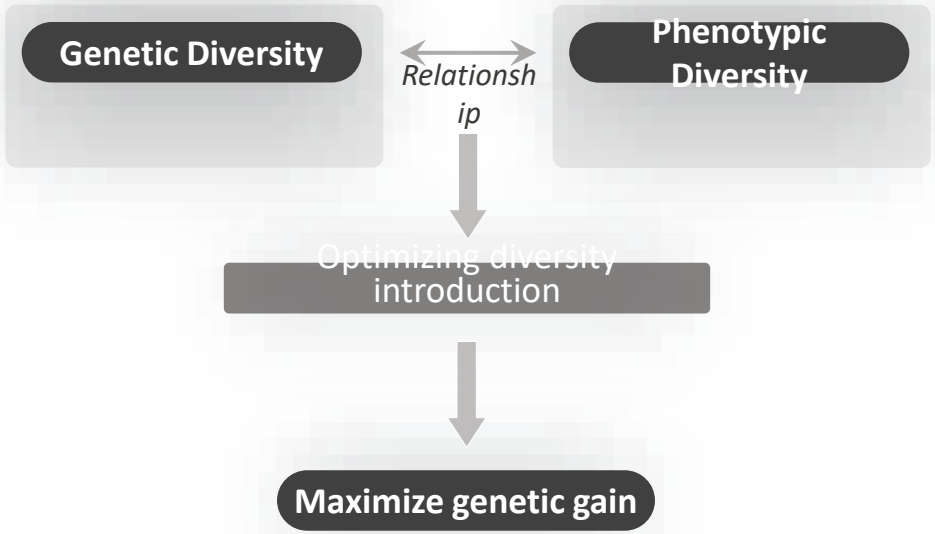
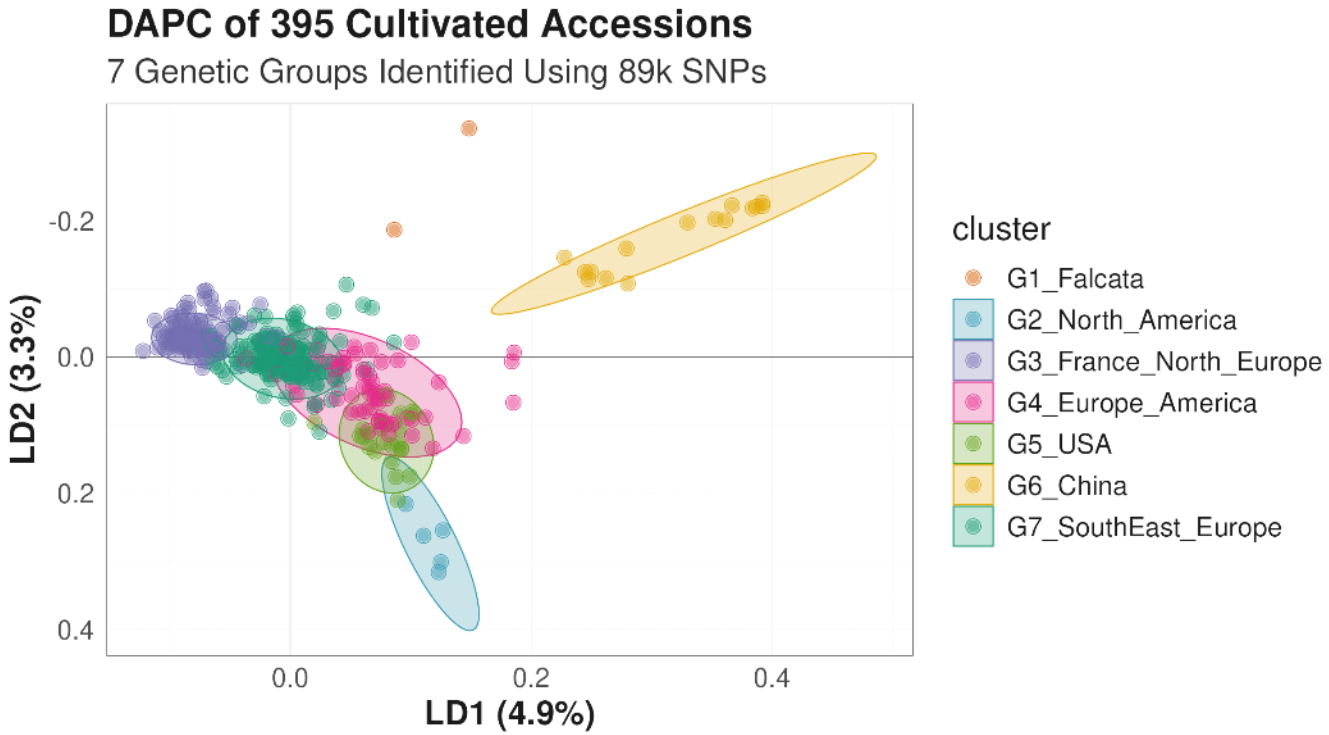
The genetic structure of cultivated alfalfa

Despite progress, breeding remains limited by our poor understanding of phenotype–genotype relationships.

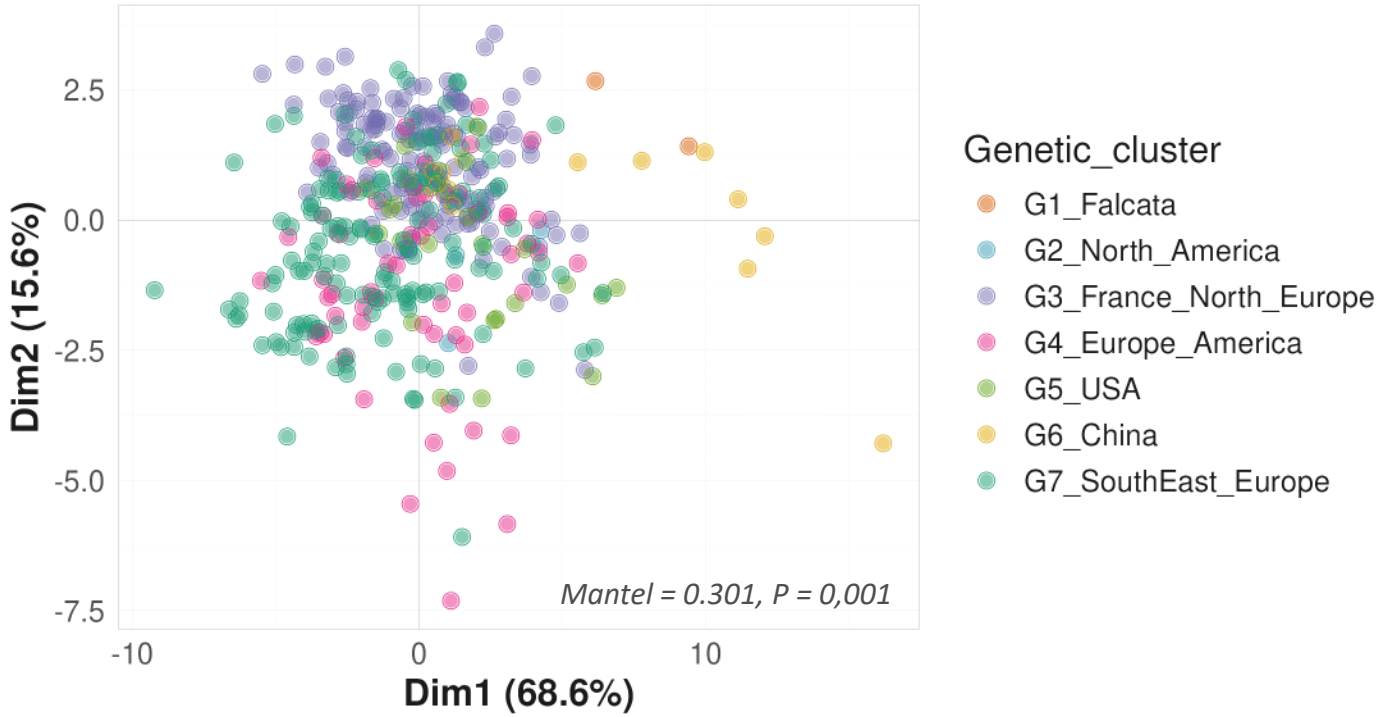




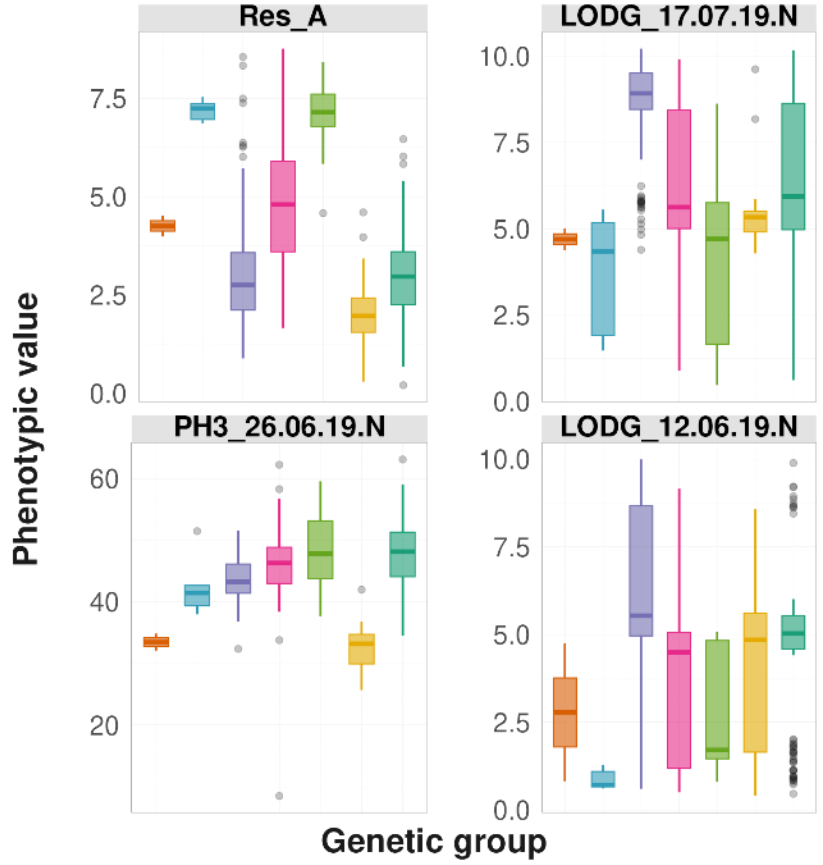
→ The genetic groups mirror the geographic origins of the accessions.

Hypotheses: *Certain phenotypic traits should have a determining influence on the genetic structure of alfalfa, due to the evolution of human selection practices and the adaptation of the species to various environmental and agricultural conditions*

RESULTS | Weak genotype - phenotype alignment, but key traits drive divergence



Phenotypic structure (217 traits). *Accessions colored by genetic group (molecular markers)*



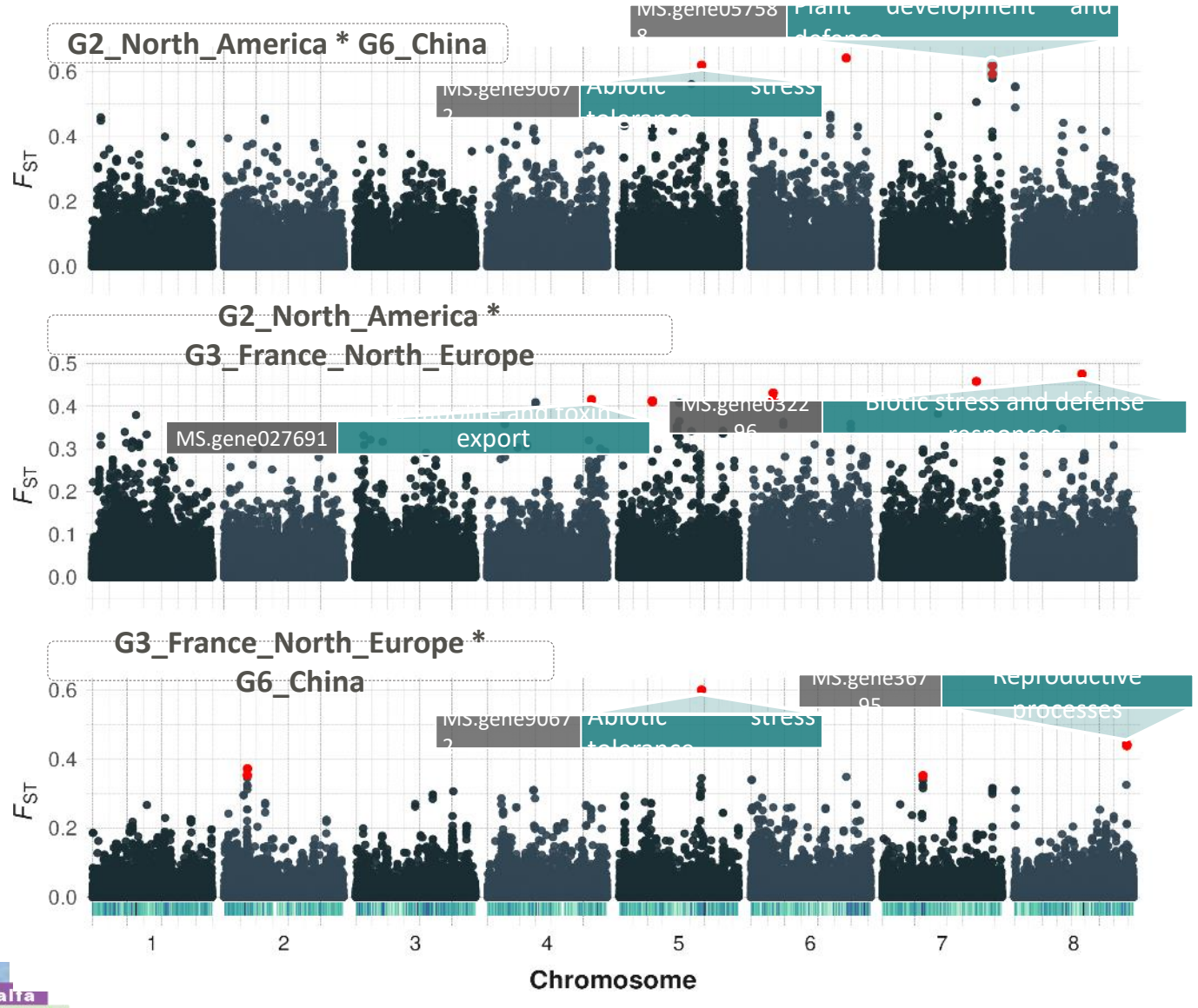
Most discriminating phenotypic traits *for distinguishing genetic groups. Data are grouped and color-coded by genetic group*

Res_A *(anthracnose resistance),* ***LODG*** *(Lodging susceptibility),* ***PH****(Plant height)*

→ Genetic diversity and phenotypic structure show only weak correspondence.

→ The most discriminant traits partly reflect the region-specific selection goals.

RESULTS | Key genomic regions linked to agronomic traits drive genetic differentiation



1. **Implications for alfalfa breeding:**
   - Integrating phenotypic and genomic data reveals the complexity of alfalfa improvement.
   - Specific traits are targets for adaptation to climatic and agronomic challenges.
   - Genomic regions identified for marker-assisted selection.

2. **Perspectives**
   - Functional validation of candidate loci (expression analyses, crosses).
   - Broader phenotyping under contrasting environments.
   - Extend to additional biotic and abiotic traits (disease, drought, salinity).

Arcia-Ruiz I. et al. (2025). Phenotypic and Genomic Insights into Alfalfa Diversity: Identifying Critical Loci for Enhanced Resilience. *The Plant Genome*, in press.

Poster GE03 (WAC 2025)