

Selection and multi-environment yield stability analysis in a switchgrass (*Panicum virgatum* L.) half-sib panel

Background/Objective

Switchgrass is a key perennial bioenergy crop, but breeding for stable, high biomass yield is hindered by strong genotype $\times$ environment interactions and complex population structure. Here, we developed models to identify stable, high-yielding half-sib families across multiple environments to support efficient selection for broad and region-specific adaptation.

Approach

- 200 switchgrass half-sib families were evaluated across 8 location $\times$ year environments.
- Biomass yield was analyzed using mixed models to estimate Best Linear Unbiased Predictions (BLUPs).
- Genotype $\times$ environment interactions and yield stability were assessed via Additive Main effects and Multiplicative Interaction (AMMI) and Genotype plus Genotype by Environment (GGE) biplot analysis.
- High-yielding and stable families were identified using integrated yield–stability indices.

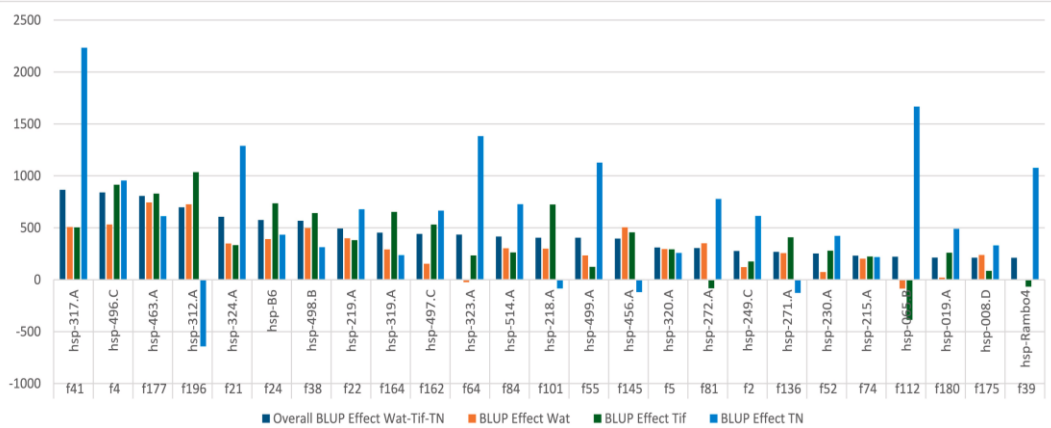
Results

- BLUP analysis revealed moderate to high heritability for biomass yield at the family level and strong repeatability at the individual plant level.
- AMMI and GGE analyses explained most of the genotype $\times$ environment interaction and identified distinct mega-environments in GA and TN.
- Several half-sib families exhibited either broad adaptation with stable yields or high, region-specific performance, enabling clear prioritization of candidates for advancement.

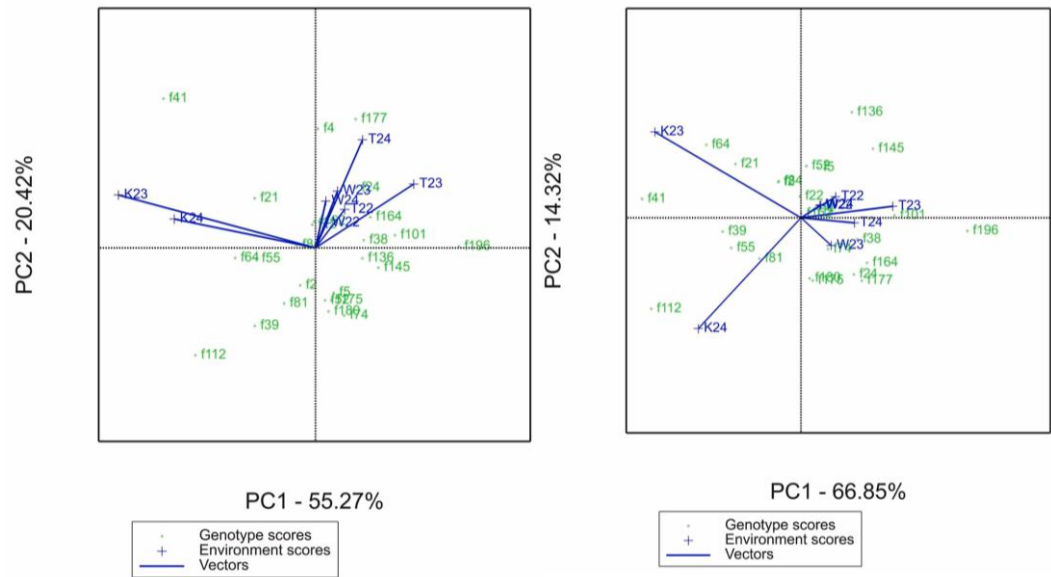
Significance/Impacts

We show that integrating BLUP-based prediction with multi-environment stability analysis improves selection accuracy for biomass yield in switchgrass, enabling identification of both broadly adapted and region-specific high-yielding families, reducing the risk of environment-driven selection errors in support of the development of resilient, high-biomass cultivars.

Irfan, J.A.et al.. Biomass and Bioenergy (2026) 209, doi.org/10.1016/j.biombioe.2025.108885.



BLUP deviations across all environments combined



GGE biplot based on environment-specific BLUPs, showing environments as blue vectors.

AMMI biplot for biomass yield showing environments as blue vectors.