



Transfer learning: a powerful tool to improve genomic prediction accuracy

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Typically, plant breeders need to grow thousands of plants in different environments to select ones with the best performance. That takes time and money. Genomic selection is a technique that helps optimize breeding by using a plant's DNA to predict how well the plant will perform—before it's grown—which reduces the time and resources needed to develop new lines. But genomic selection doesn't always work perfectly, especially when information like environmental data (e.g., temperature and moisture) is limited.

Researchers tested a new strategy within genomic selection called transfer learning, a machine-learning technique. Transfer learning uses patterns from one dataset and applies that information to make predictions on a slightly different, but related,

dataset. Crop breeders can thus borrow information about plant performance in one environment (like a well-irrigated field) and adapt that knowledge to improve predictions in another environment (drought conditions). The researchers investigated the potential of transfer learning when applied with Ridge regression, a statistical method that prevents “overfitting” and enables models to make predictions across a variety of different datasets. Prediction was done using 11 real-world datasets, including wheat and rice trials.

The results were very interesting: Transfer learning demonstrated the potential to significantly enhance genomic prediction accuracy with improvements of up to 23% in certain scenarios. This indicates that crop breeders can achieve more precise predictions even when working with limited data. Overall, this approach can save time, reduce costs, and accelerate the development of improved crop varieties—an important contribution to food security in the face of a changing climate.

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Montesinos-López, O. A., Barajas-Ramirez, E. A., Salinas-Ruiz, J., Montesinos-López, A., Gerard, G., Vitale, P., Dreisigacker, S., Saint Pierre, C., & Crossa, J. (2025). Optimizing genomic prediction with transfer learning under a ridge regression framework. *The Plant Genome*, 18, e70049.

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