Science Societies

Randomization across breeding cohorts reduces confounding environmental effects, improving selection accuracy

May 14, 2026

Researchers assessed the degree to which randomization across breeding cohorts could improve selection accuracy using simulations based on real genotypic data from University of Illinois wheat breeding lines. Photo by Ann Marshall, USDA-ARS.

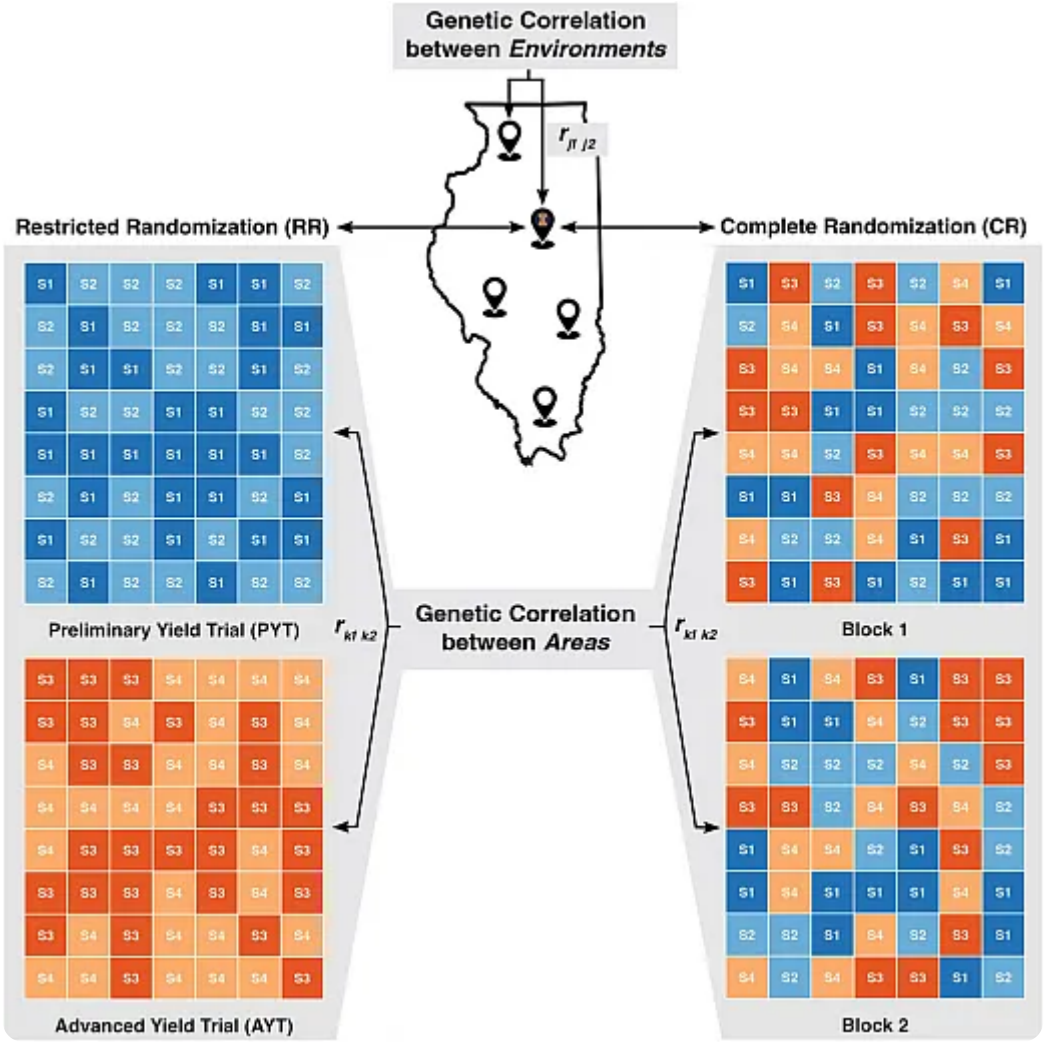
A variety's observed performance depends on both genetics and environment; thus, randomized field trial designs are crucial to ensure breeders can select the best genetics. Breeders select individuals for crossing (to make new genetic combinations) and for advancement to another stage of testing (where they can evaluate individuals for traits of interest before variety release).

The field trials that breeders typically use are designed to maximize the accuracy of selection for advancement. Groups of related breeding materials within a specific selection stage (cohorts) are generally assigned to different trials, and randomization is done within a trial. Soil characteristics, management, and microclimates tend to be similar within a trial area but can differ across trial areas. When selection is done within selection stage, this is not a problem. However, plant breeders also may combine all their trial data together for analysis to make parent selection decisions—genomic selection is one example where this is done. In these cases, the genetic and environmental impacts on performance are partially intertwined, potentially impacting selection accuracy.

Research published in *The Plant Genome* used simulations based on real genotypic data from University of Illinois wheat breeding lines to investigate the extent to which selection accuracy can be improved by randomizing individuals from different testing stages together. Results confirmed that when individuals in different stages of testing

are analyzed together for selection, randomization of all individuals together without regard to their testing stage is ideal for maximizing selection accuracy. However, when genomic relationship information is included in analyses, the benefit from randomization becomes smaller.

This study points out that testing individuals in different cohorts separately partially confounds genotype and environment effects. While genomic relationship information can help mitigate this confounding, greater randomization should be considered.



Testing designs done by the researchers. Under Restricted Randomization (RR), cohorts were separated by their area within an environment. These cohorts were treated as individual trials, and individuals were only randomized within their trial. Under Complete Randomization (CR), areas were treated as blocks of a single trial, and all individuals were

randomized together without regard to their testing stage. Image courtesy of Jessica Rutkoski, University of Illinois.

Dig deeper

Ackerman, A., & Rutkoski, J. (2026). Randomization across breeding cohorts improves the accuracy of conventional and genomic selection. *The Plant Genome*, *19*, e70218. https://doi.org/10.1002/tpg2.70218

More science

Back to issue

Back to home

Rate this article