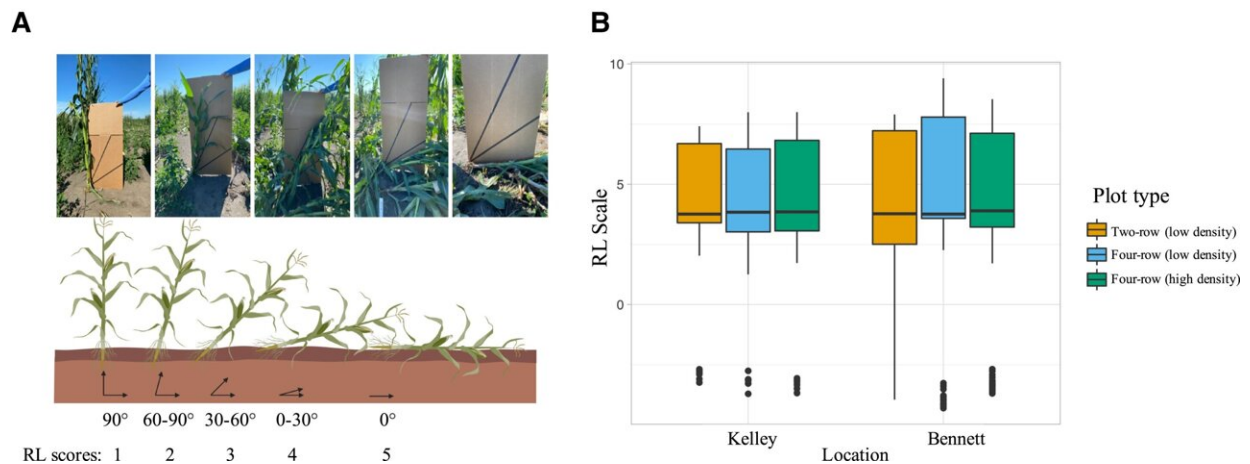


# Researchers hunt for hard-to-spot genetic links to improve crop and livestock breeding

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Field evaluation of root lodging after the 2020 derecho. A) Quantification of root lodging with a protractor. The root-lodging (RL) scores ranges from 1 to 5, and the angle of deflection from vertical was converted to a 1-to-5 score, with 1 being unaffected and 5 being completely root lodged. B) Distribution of root-lodging scales (RL scale) across 6 environments after spatial correction. This correction results in some plots having RL scale values >5. See Materials and methods for details about the conversion from RL scores to RL scales. Center line, median; box limits, upper and lower quartiles; whiskers, 1.5× interquartile range; points, outliers. Credit: *Plant Physiology* (2023). DOI: 10.1093/plphys/kiad194

When a hurricane-like derecho knocked down corn plants across Iowa in August 2020, it was devastating for farmers. But it also presented a

natural experiment for an Iowa State University research team, which fanned out across flattened fields in the days after the storm to record how crops held up.

High winds caused widespread lodging, which happens when a corn plant's stalk breaks or its roots fail to keep it upright. The genetic makeup of corn stalk strength is well-studied, but little research has looked at what makes roots more resistant to lodging. By analyzing post-derecho observations of their genotyped test plots, searching for hereditary causes of root lodging, Iowa State researchers identified 118 genes that may affect corn root stability.

"That storm was such a disaster, so it was exciting to be able to make some lemonade out of lemons," said Patrick Schnable, Baker Professor in Agronomy and Iowa Corn Promotion Board Endowed Chair in Genetics.

The root lodging study, [published](#) in the journal *Plant Physiology*, is an example of how advanced statistical analysis can help mine the expanding volumes of data collected by crop and livestock breeders, hunting for hard-to-spot relationships between the [genetic code](#) and complex traits that matter.

Genetics is the cornerstone of breeding, but genomes-to-phenomes research powered by innovative statistical analysis and modeling can provide deeper insight that will be essential to meeting future agricultural production needs, said Schnable.

"There are enormous challenges facing the world in terms of food supply. Agriculture was invented in a world different than the one we'll be facing in the coming decades," he said.

Developing crops and livestock that are more resilient to diseases and

changing [weather conditions](#) is complex and urgent, said distinguished professor of animal science Jack Dekkers. Deeper data analysis can speed up adaptation efforts.

"Breeding progress comes faster when you have a better understanding of the genetic basis of the traits you're trying to improve," Dekkers said.

## Statistical detective work

The statistical detective work of searching for associations between genomic and phenomic data sets often tangles with environmental variation and other confounding factors. In the study of the derecho-damaged corn, researchers initially weren't able to detect the genetic causes of [root](#) lodging. Statisticians only found the genes of interest after including in their models the condition of neighboring plants, which impacted the effects of the extreme winds, Schnable said.

Associate professors of statistics Vivekananda Roy and Somak Dutta analyzed the post-derecho [corn](#) data. Their models integrate multiple methods of scanning [large data sets](#), account for numerous sources of variation and employ strategies for more efficient processing. Their approach is like knowing the Dewey Decimal System when you're looking for a library book instead of searching shelf-by-shelf, Roy said.

"If you know how the books are arranged, that's a lot better," he said.

**More information:** Zihao Zheng et al, The 2020 derecho revealed limited overlap between maize genes associated with root lodging and root system architecture, *Plant Physiology* (2023). [DOI: 10.1093/plphys/kiad194](#)

Provided by Iowa State University

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