Science Societies

Growing more bountiful wheat, year after year

Study finds consistent genetic gains over six decades

By Shea Topel

March 25, 2026

USDA photo by Scott Bauer.

A new long-term study reveals that decades of wheat breeding have steadily increased yields in hard red spring wheat, demonstrating the real impact of sustained public investment and innovation. But with global demand rising, researchers warn that even faster genetic gains will be needed to ensure future food security.

This article is part of our Down to Earth series, which breaks down and explains food, farming, and environmental sciences for readers of all backgrounds, including those without formal scientific training.

Plant breeders across the Northern Plains continuously develop new varieties of hard red spring wheat to ensure the most productive harvests possible. But how much progress have those efforts really delivered? A study published in the journal *Crop Science* fills that gap and provides a comprehensive look at long-term improvements in this important class of wheat.

The study analyzed more than 60 years of data from a USDA-ARS coordinated wheat nursery and found that each new generation of varieties has steadily improved how much grain can be harvested from the same fields. On average, yields rose by about 0.61% per year and even up to 1% per year for individual public breeding programs when developing varieties for their local environments. It shows the importance of

long-term breeding efforts, public breeding programs across the country, and the value of sustained investment in crop improvement.

A century of wheat improvement—and rising demand

Wheat, one of the most important crops in human history, has long been selectively bred for grain yield, pest and environmental resistance, and quality. In the past century, we've seen massive increases in wheat production thanks to advanced farming techniques and new varieties of wheat that grow better than ever before.

Meanwhile, the global food demand is expected to rise sharply, and estimates show that wheat production must increase by roughly 50% by 2050 to meet demand. To do this, breeders must continue to develop new varieties with improved yields while preserving the grain quality, disease resistance, and resilience that farmers rely on today.

To meet global food demand, breeders must continue to develop new varieties with improved yields while preserving the grain quality, disease resistance, and resilience. USDA photo by Jack Dykinga.

In every breeding cycle, wheat breeders select the plants that perform best, like those that produce higher yields and superior quality, mature at the right time, and resist diseases or lodging. Over time, the gradual improvement in these traits is referred to as genetic gain. By tracking genetic gains, breeders can determine how effective they have been at improving wheat and identify where new strategies might be needed to accelerate progress.

Hard red spring wheat accounts for about a quarter of the annual wheat production in the United States. Breeding efforts for hard red spring wheat started in the 19th and early 20th centuries. Many public breeding programs and private seed companies have long worked to develop varieties suited to the region's short growing season, disease pressures, and harsh climate. Until now, however, there has been no comprehensive long-term analysis of the genetic improvement in this class of wheat. This study fills that gap, showing steady yield gains over six decades while maintaining high grain-protein levels.

Tracking genetic gains over time

To track long-term progress, scientists analyzed data from the Hard Red Spring Wheat Uniform Regional Nursery, a century-old USDA-ARS coordinated network of field trials to test new wheat varieties across the Northern Great Plains. Using this remarkable historical data, the team measured the improvement achieved through breeding since the 1960s. Across the region, yields showed steady gains over time, although the rate of increase has slowed in recent decades. The annual yield gain in the Northern Plains matches progress seen in other major wheat regions around the world, confirming that breeding efforts continue to deliver real results. Most importantly, these increased yields have not come at the expense of grain protein, which has remained stable despite its negative correlation with yield.

Tracking how much improvement has already been achieved helps breeders understand what's working and where innovation is needed. USDA photo by Jack Dykinga.

Wheat breeders worldwide face the ongoing challenge of producing more grain to meet rising global demand for food and livestock feed. To reach those goals, breeding programs are going to need much higher rates of genetic progress. Tracking how much improvement has already been achieved helps breeders understand what's working and where innovation is needed. By analyzing long-term data, studies like this one provide a valuable benchmark to drive future wheat improvement

Despite challenges such as disease outbreaks and changing environments, hard red spring wheat breeding in the Northern Plains has continued to deliver steady improvements. The study's findings highlight how public breeding programs play a vital role in sustaining regional food production and adapting crops to local conditions. Although the pace of yield gains has slowed in recent decades and remains below the levels needed to meet future demand, new breeding innovations offer opportunities to accelerate this progress. By investing in modern breeding approaches, we can help ensure that farmers, communities, and consumers continue to benefit from healthy, resilient wheat for generations to come.

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Gill, H. S., Blecha, S., Brault, C., Glover, K., Green, A., Cook, J., Lorenz, A., Read, A., & Anderson, J. A. (2025). Genetic gains from 60 years of spring wheat breeding in the Northern Plains of the United States. *Crop Science*, *65*, e70106. https://doi.org/10.1002/csc2.70106

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