Science Societies

What is the future for ancient grains?

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The term ancient grains typically refers to cereal and pseudocereal species that have remained largely unchanged by modern breeding practices, such as einkorn (Triticum monococcum L.) shown here. Photo courtesy of Alamy/WILDLIFE GmbH.

Ancient grains—such as einkorn, emmer, spelt, quinoa, and amaranth—are enjoying renewed interest for their rich history, nutritional benefits, and potential role in sustainable farming. Once staples of early agriculture, these grains offer diverse flavors, higher nutrient density, and genetic traits that could strengthen modern wheat and farming systems. With ongoing research, breeding innovations, and growing consumer awareness, ancient grains may soon shift from niche specialty crops to mainstream staples that support both health and climate-resilient agriculture.

As global consumers grow increasingly conscious of health, sustainability, and food diversity, interest in ancient grains has risen sharply. These grains, once staples in early agriculture, are experiencing a renaissance among health-conscious eaters, artisanal bakers, and sustainable agriculture advocates. While often grouped together in the marketplace under the umbrella of “ancient grains,” these crops include a diverse set of species with distinct botanical, agronomic, and nutritional characteristics. Understanding their origins, potential uses, and future prospects is crucial as researchers and farmers work to integrate them into modern agricultural systems.

What are ancient grains?

The term *ancient grains* typically refers to cereal and pseudocereal species that have remained largely unchanged by modern breeding practices. Traditionally, this includes wheat relatives such as spelt (*Triticum spelta* L.), emmer (*Triticum turgidum* subsp. *dicoccon*), and einkorn (*Triticum monococcum* L.). These grains are classified as "covered" wheats because their hulls remain tightly attached to the kernel after harvest, requiring mechanical or manual processing before consumption, unlike modern wheat, which is "free-threshing."

A comparison of the grain heads of modern wheat and three ancient wheats. Photo courtesy of Caitlin Youngquist and originally published here.

In addition to these true wheats, the term has been broadened by marketers to encompass several pseudocereals and lesser-known grains including quinoa (*Chenopodium quinoa* Willd.), buckwheat (*Fagopyrum esculentum* Moench), amaranth (*Amaranthus* spp. L.), teff (*Eragrostis tef* [Zucc.] trotter), millet (various genera such as *Panicum*, *Setaria*, *Digitaria*, and *Echinochloa*), and sorghum (*Sorghum bicolor* L.). While these species are not botanically related to wheat, they are included because of their ancient use in human diets, nutritional richness, and traditional cultivation systems.

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Historical context and domestication

The story of ancient grains begins thousands of years ago when early agricultural societies began domesticating wild grasses. Evidence suggests that hunter-gatherers first harvested wild relatives of these grains before selecting for traits like non-shattering heads (where seeds remain attached to the plant) and ease of threshing. Over time, such traits became genetically fixed in cultivated varieties.

Einkorn, one of the earliest domesticated wheat species, was grown in the Fertile Crescent over 10,000 years ago and likely represents one of the first steps in the agricultural revolution. Emmer followed closely and became a staple in ancient Egypt and Mesopotamia. Spelt, a more recent hybridization between emmer and goatgrass, became widespread in Europe during the Bronze Age and was a common grain until it was gradually displaced by modern bread wheat.

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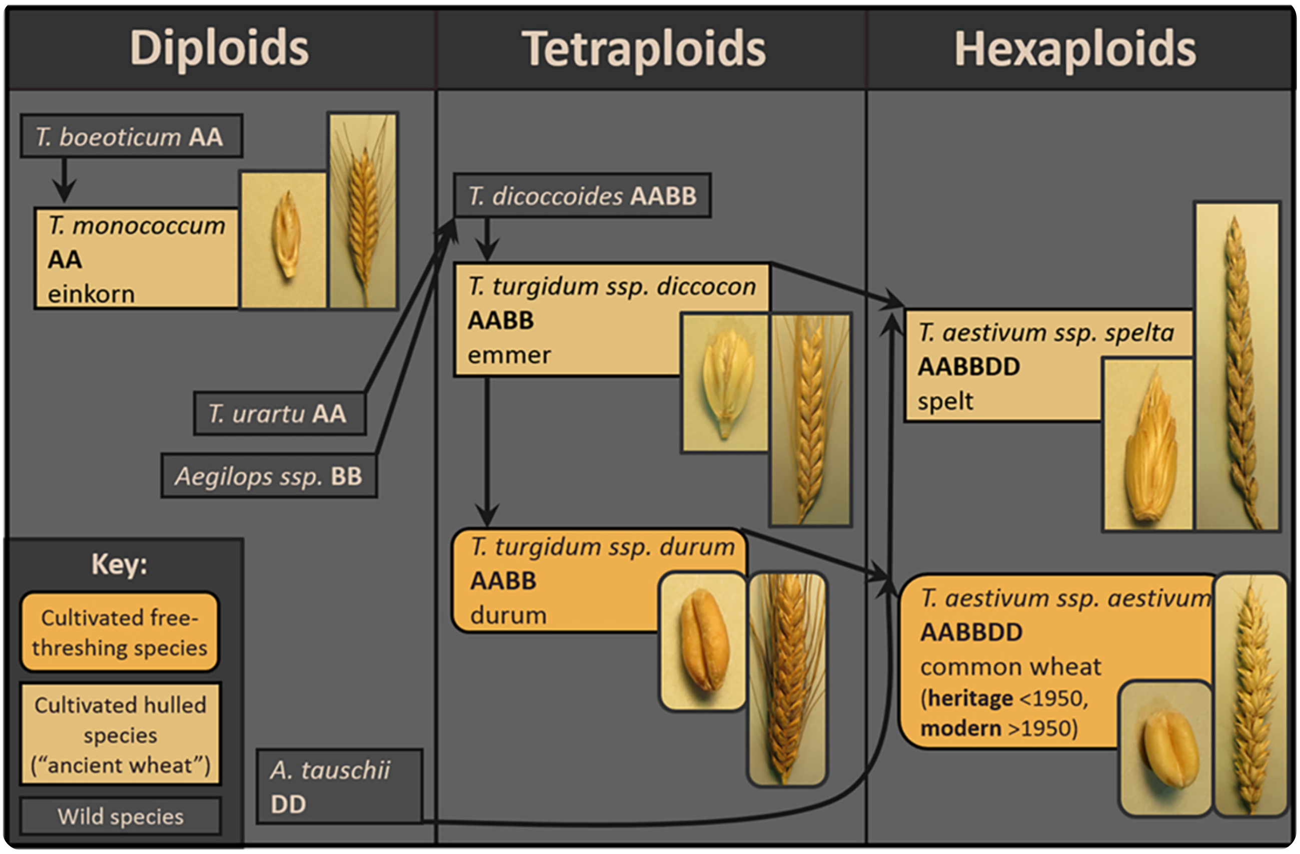
Ancient wheat species differ in their ploidy and genome composition:

- Einkorn is *diploid* (2n = 14), containing the A genome.
- Emmer is *tetraploid* (2n = 28), with the A and B genomes, like modern durum wheat.
- Spelt is *hexaploid* (2n = 42), carrying the A, B, and D genomes, the same as common bread wheat (*Triticum aestivum* L.).

All three are self-pollinating species and require dehulling before consumption. Their genetic similarities to modern wheat also present opportunities for breeding and genetic improvement.



The genealogy of cultivated members of the Triticum family, including various cultivated ancient wheat species, durum wheat, and common wheat (figure from Kissing-Kucek et al., 2015).

Nutritional value and health implications

Ancient grains are often praised for their nutritional density. While not gluten-free, both emmer and einkorn can have lower celiac reactivity, lower alpha-gliadin epitopes, and lower alpha-amylase/tripsin inhibitor (ATI) content than modern wheat (see Figure 3 in Kissing-Kucek et al., 2015). This lower celiac reactivity and lower ATI content has led some individuals with non-celiac gluten sensitivity to report better tolerance of ancient wheat products. However, individuals with celiac disease must still avoid these grains entirely, and it is always recommended that dietary changes be made under medical supervision (Brouns et al., 2022).

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Beyond gluten content, ancient grains are rich in dietary fiber, protein, and essential micronutrients. They have been reported to contain elevated levels of phosphorus, potassium, pyridoxine (vitamin B6), beta-carotene, and unsaturated fats, all contributing to their superior nutritional profile (Stallknecht et al., 1996). Notably, emmer wheat has shown promising antihyperglycemic and antioxidant properties, making it a potential functional food for managing type 2 diabetes (Christopher et al., 2018).

Amaranth seeds (left), flour (right), and cookies (bottom). Photo by

Diejun Chen, USDA-ARS.

The flavor of ancient grains is often described as richer and more complex than that of modern wheat with nutty or earthy undertones. This makes them highly attractive for artisan baking, whole grain dishes, and specialty food products.

Breeding and agronomic development

Despite their appeal, ancient grains face significant agronomic challenges that limit their scalability. Most varieties are spring types, meaning they are planted in spring and harvested in late summer. For regions with cold winters, converting these to winter-hardy types would greatly expand their geographic range and improve yields. Another major breeding goal is to develop free-threshing forms of these grains to reduce processing costs, labor, and loss of grain quality caused by dehulling.

In our Cornell Small Grains research program, we are working on converting ancient wheats into winter-hardy, free-threshing lines suitable for organic and low-input farming systems. This includes introgression of desirable traits from sources of winter hardiness and free-threshing germplasm while maintaining the nutritional integrity of the ancient genomes.

Harvesting einkorn in Wyoming. Photo courtesy of Caitlin Youngquist and originally published here.

Dr. Friedrich Longin at the University of Hohenheim has led significant efforts in reintroducing ancient grains into modern agriculture. His breeding work focuses on adapting ancient varieties to contemporary cultivation needs while preserving their unique qualities (University of Hohenheim, 2022).

Moreover, spelt has shown potential in wheat improvement programs, particularly for enhancing yield-related traits and stress tolerance in bread wheat (Xie et al., 2015). Such cross-utilization could also offer avenues for increasing the genetic diversity of modern wheat, which has narrowed significantly over decades of breeding for uniformity and yield. A free-threshing spelt variety, Elwha River, was developed by Dr. Kevin Murphy at Washington State University by backcrossing the free-threshing trait from wheat into spelt.

Prospects for increased production

While interest in ancient grains is growing, scaling up their production poses several logistical and market challenges. As with many specialty crops, the development of a stable supply chain is a significant barrier. From seed availability to post-harvest processing, each step requires infrastructure and knowledge that is not yet widespread. Recently, the introduction of small stone ground mills (e.g., https://www.newamericanstonemills.com) has reduced one of the bottlenecks in the supply chain for flour. These affordable mills facilitate their installation in artisan bakeries and small farms. Small local mills facilitate the preservation of the identity of small batches of flour, mediate flour quality and safety, and keep the processing and value within rural communities (Econopouly & Jones, 2020).

Moreover, consumer education is vital. Many consumers are unfamiliar with how to cook or bake with ancient grains and may not fully understand their health benefits. Increased marketing efforts, recipe development, and inclusion in institutional food programs could drive adoption.

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Additionally, ancient grains may align well with sustainable agriculture. Their adaptability to marginal lands, lower fertilizer requirements, and potential for organic farming make them attractive in the context of climate-resilient agriculture.

Conclusion

The future for ancient grains is promising but will depend on a combination of breeding innovation, agronomic research, supply chain development, and consumer awareness. These grains offer a compelling blend of history, nutrition, and agricultural diversity, and their reintroduction into modern food systems could support healthier diets and more resilient farming systems.

As breeding programs continue to improve traits like winter hardiness, free-threshing ability, and yield, and as consumer demand grows, ancient grains may transition from niche specialty crops to mainstream alternatives that enhance biodiversity, cultural heritage, and global food security.

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