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NYBG Scientist and Colleagues Make the Case That the Ancient Practice of Planting a Mixture of Cereal Grains Could Be a Promising Strategy for Agriculture to Adapt to Harsh Growing Conditions Caused by Climate Change

In a Cross-Disciplinary Research Paper, They Present Evidence That These Once-Common Mixtures Can Provide Reliable Yields Despite Drought and Other Climate Change Threats

A mixture of cereal grains grown by a farmer in Kutaber, Ethiopia, consists of two bread wheat (*Triticum aestivum*) and two barley (*Hordeum vulgare*) varieties. (Photos by Alex C. McAlvay, Ph.D.)

Bronx, NY—Planting a mixture of cereal grains such as wheat, barley, and oats together in the same field could be a promising strategy for farmers to cope with the substantial yield losses and other challenges that are anticipated to occur as a result of climate change, according to a newly published paper by a New York Botanical Garden (NYBG) scientist and six colleagues. In a comprehensive, cross-disciplinary review of existing research, lead author Alex C. McAlvay, Ph.D., Kate E. Tode Assistant Curator at NYBG's Institute of Economic Botany, and his co-authors found that a mixture of cereal species would likely be more resilient than single-species crops and able to provide reliable grain yields when faced with drought, extreme precipitation, infertile soils, and pests, among other climate change-related threats to agriculture.

"For millennia, farmers have used combinations of multiple crop species and varieties to manage risk and mitigate losses due to uncertain environmental conditions, approaches that may prove useful in confronting rapid climate change," the scientists write in "Cereal species mixtures: an ancient practice with potential for climate resilience. A review," which has been published online by the journal *Agronomy for Sustainable Development.*

Climate researchers predict that wheat, barley, and other small grains are likely to experience severe yield losses under even conservative climate change scenarios because of the impact of extended droughts, increased extreme weather events, and other consequences of climate change unless farmers adapt their growing practices. One of the reported advantages of sowing a mixture of grain species is that it ensures a yield under a range of environmental conditions.

Dr. McAlvay and his colleagues reviewed ethnohistorical, agronomic, and ecological research on the use of mixed grain species in agriculture with a focus on climate change adaptation, including two case studies of Ethiopian smallholder farmers. Archaeological, historical, and ethnographic evidence suggests that mixtures of grain species, known as maslins, have been planted for more than 3,000 years in at least 27 countries spanning Eurasia, Northern Africa, and, later, North America. Maslins have included varying combinations of a wide variety of species such as rye, barley, rice, various millets, and oats, and multiple species of wheat. The planting of maslins has declined over the past several hundred years and been replaced in many regions with monoculture crops of single species, a trend driven by changing consumer preferences and the increased use of irrigation and chemical fertilizers.

Maslin agriculture persists, mainly on smaller farms, in several regions, including the Caucasus, the Greek Islands, and Ethiopia and Eritrea in the Horn of Africa, where maslins can contain more than three wheat and four barley varieties. In most regions where maslins are used, farmers have told researchers that they sow, harvest, process, and consume the components of the mixture together. The proportions of components vary widely not only across countries but also from farmer to farmer and year to year.

In field trials, experimental cereal mixtures have had higher yields compared to single-species crops. For example, Dr. McAlvay and his co-authors cite a paper from the year 2000 about a field trial of an Eritrean maslin of wheat and barley in which the maslin crop outperformed the sole-cropped wheat and barley by 20 and 11 percent, respectively. Although the greater yield of maslins in general is likely driven by many factors, the authors note that barley is more resistant to drought, while wheat yields more in wet years—suggesting that such a mixture would be well-suited to both greater droughts and more extreme weather, two of the predicted consequences of climate change.

Although maslins are currently used on small, family-run farms, Dr. McAlvay and his colleagues write that mixed crops “may also present an opportunity for larger-scale and industrial farming systems to reduce inputs [such as fertilizer and water] or increase yield stability in the face of climate change.” Addressing long-standing consumer preferences for single-grain breads or other foods made with cereal grains, they note that technology to separate grains on an industrial scale has existed for many decades and that barley or oats are often added to enhance the volume and nutrition of mass-produced wheat bread.

From the available literature on farmer experiences and agronomic field trials, Dr. McAlvay and his co-authors conclude that maslins "appear to possess the potential for a variety of desirable characteristics, which may be advantageous in adapting cropping systems to climate change—including heightened yield advantage, yield stability, pest and pathogen resistance, weed suppression, and drought tolerance."

"Cereal species mixtures: an ancient practice with potential for climate resilience. A review" is available at the following link: https://doi.org/10.1007/s13593-022-00832-1

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