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Pliable Plants

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We need crops that can adapt to a less predictable environment.

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Producing higher-yielding crops has been a goal for farmers ever since there have been farms. Plant breeders since Gregor Mendel have recognized the heritability of crop traits and how they relate to yield. Heritability is crucial, but it's only one factor—there's also the question of how stable an inherited trait will be under different environmental stresses.

We now have tools at our disposal that Mendel could never have dreamed of. The addition of genes for C4 photosynthesis into non-C4 plants, for example, gives us crops that are much more efficient at using water and nitrogen (see "Supercharged Photosynthesis").

But such advances are only worthwhile if they lead us to crops that yield well in the variable and unpredictable environments that we now face. In the northern Great Plains, as an example, farmers have seen temperatures increase and precipitation patterns change during critical pollination times. We need to develop plant varieties that can withstand these changes.

According to the U.S. Department of Agriculture, 73 million acres of farmland in the United States were taken out of production between 1990 and 2012. Similar trends can be seen worldwide. The reasons are many, but three broad categories are desertification, rising oceans, and urbanization.

This loss of land means that we need to use what we have left more efficiently. Take the average U.S. corn acre, which produced 171 bushels of corn in 2014, according to USDA estimates. A bushel of corn weighs about 56 pounds. If, say, 80 acres are urbanized, other areas need to increase production by 760,000 pounds to replace the lost food.

There are a variety of agronomic ways to do that, one being genetically modified crops. Many people object to such plants, but they've resulted in considerable improvements to human and environmental health. One major benefit is the increase in "no-tillage acres," which greatly reduces soil erosion. This in turn prevents silt from entering streams and reservoirs, prevents the runoff of agrochemicals, and increases the water-holding capacity of the land.

Consider what happened in South Dakota during droughts in 1972 and in 2012. In 2012 the corn yields were about 70 bushels per acre greater than they'd been in 1972, thanks in part to improved crop genetics and the soil's increased water capacity.

Agronomists continue to prepare for an uncertain future. Food insecurity is a real and tangible threat. Through genetic engineering, conventional breeding, and research into improved management practices, agronomists are developing crops with smaller carbon footprints while also increasing yield and nutritional values, and they're doing all this on a shrinking number of arable acres. No small feat.

Sharon Clay is a professor of plant science at South Dakota State University and a past president of the American Society of Agronomy.