Plant breeders have been enhancing desirable traits in crops like flavor, yield, and pest resistance since the birth of agriculture. Some of these transformations have dramatically changed the appearance of crops. One example is maize. Breeding practices have taken maize from a grass with little seed production to the top grain crop produced worldwide. Even with the high-yielding maize varieties available, there is great demand for maize to be used in food products, animal feed, and biofuel.

Increasing yield potential is a combination of genetics and management practices. Planting timing and spacing, the application of fertilizer, irrigation, and weather conditions throughout a season interact with genotypes. For maize, there are two main traits that breeders can focus on to increase maize production without increasing the number of acres planted. The first is increasing the number of kernels or kernel size of plants so that individual plants produce more grain. The second is to increase the density tolerance of plants, enabling farmers to decrease the spacing between plants and rows, such that more maize can be planted on existing cropland.

In recent history, density tolerance appears to have been the focus of breeding efforts. In the 1950s, planting densities of 30,000 plants/ha were the maximum, whereas currently, farmers plant up to 80,000 plants/ha. Maize breeder and geneticist Elizabeth Lee, from the University of Guelph, points out that while density tolerance may have received most attention, other traits were also improved upon. One example is the stay-green trait, where plants have an extended growth period even in dry conditions.

“Stay green is basically a balancing of source and sink,” Lee explains. “The amount of carbon fixed during the grain period has been improved, which results in better stay green.”

However, at the same time, kernel size and number have shown limited change and have not contributed to increased maize yields.

Lee and co-authors recently published an article in Crop Science (http://bit.ly/2Et6Nvh) to investigate if there is potential for breeders to increase both kernel size and number (referred to in the article as yield potential) as well as the density tolerance in future hybrids.

In this article, the researchers present the results of a series of experi-
• Since the 1950s, maize breeders have focused on increasing density tolerance of hybrids to increase yields.
• Density tolerance genes are independent of genes controlling kernel size and number.
• This research demonstrates that breeders can focus on increasing kernel size or number without altering density tolerance.

Hybrids can produce a greater yield per plant stand,” Lee says. These flex-ear hybrids that could take advantage of flexi-situations where there was a reduced density were hybrids known as flex-ear varieties with fewer plants, so the research team had a hunch that the genes for kernel size and number were present and flexible in the commercial germplasm available.

“Genotypes possessing both attributes were easily identified in a segregating population, which is also evidence that genetic variation is still present for yield potential in the commercial germplasm pool,” the authors state in the article. Lee says that these results are “applicable to environments where drought and high temperatures are not the main limitations of yield, which are Canada and the traditional U.S. Corn Belt in most growing seasons.”

The U.S. and Canada are major producers of maize, and while it has not been confirmed that maize has reached a yield plateau in North America, yield increases may be slowing. Research suggests that solar brightening is responsible for 27% of maize yield gains from 1984 to 2013. Additionally, the yield gap has narrowed to less than 25% between observed and potential maize yields. If maize is nearing a plateau, this research will be important information for maize breeders as it demonstrates that breeders can focus on increasing kernel size or number without altering density tolerance to provide a way to continue to increase maize yields to meet future demands.

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Dig Deeper

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all, as indicated by the dietary diversity survey, it is especially popular among women and children. “Due to its relatively short season, mung bean can also shorten the lean, hunger season, which is key to fighting chronic malnutrition,” Abaye says. Also, when families diversify their farm, they may have an opportunity to generate additional income.

Getting to Know the Community

Before encouraging women in Senegal to grow this new crop, Abaye and her colleagues had to take time to get to know the communities they were working with. Through meetings with community leaders and members, they were able to identify the unique needs and production gaps of each village. In interviews with women in Senegal, they spoke of mung bean giving them energy, increasing their milk production, and improving the health of their children. “In societies where women eat last and least, it is of interest to focus on a particular crop women prefer to consume and feed their children,” Abaye says.

The original USAID-ERA project, started in February 2011, will end this year. Abaye hopes to find new partners and continue the work. Currently, she and her colleagues are developing mung bean varieties for Senegal. “The selection of the mung bean lines we are currently screening are based on specific criteria that women requested,” she says, “such as multi-purpose varieties that can be used as vegetables... or as livestock feed and cover crops.”

Reflecting on being a representative to receive this award, Abaye says, “It was a tremendous honor, for sure. I have been empowered and honored by the women I have been working with for the last seven plus years in Senegal. I have received by far more than I ever contributed to the community.”