Improving the Nutritional Quality of Sweet Corn

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The Need

Many American diets don't provide enough critical micronutrients like carotenoids (provitamin A, lutein and zeaxanthin), tocochromanols (vitamin E and antioxidants), iron and zinc. The non-provitamin A compounds lutein and zeaxanthin are particularly important in delaying onset of age-related macular degeneration – a leading cause of irreversible blindness in elderly populations of Western societies. Improving the nutritional quality of crops through plant breeding – called biofortification – is a cost-effective and sustainable way to help address nutritional deficiencies.

The Approach

Sweet corn is one of the most consumed vegetables in the United States and a natural target for micronutrient biofortification. Despite its importance to plant function and human health, the genetics underpinning nutrient levels in fresh sweet corn kernels were largely unknown. This project involved mapping the genome of sweet corn to identify genes responsible for variations in micronutrients of fresh kernels, including provitamin A, vitamin E, iron and zinc levels. The findings of this genetic mapping study were used to develop and test crop-breeding prediction models, with the goal of aiding rapid and cost-effective development of biofortified sweet corn, appropriate for growing in New York and the Northeast. In initial breeding trials, as sweet corn kernels become higher in carotenoids, they become more orange; this could serve a promotional benefit, as consumers already identify orange vegetables (carrots, sweet potatoes) with eye health, and because consumers are increasingly seeking new colors, shapes and varieties in their produce.

The Impacts

The researchers successfully identified key gene associations – some unidentified before this work – responsible for concentrations of micronutrients in fresh sweet corn kernels, including vitamin E, provitamin A, iron, zinc, lutein and zeaxanthin. Initial modeling suggested that selecting for more zinc might also increase cadmium to dangerously high levels, but the researchers were able to learn how to select against cadmium while still increasing zinc. Collectively, these results will help enhance breeding efforts centered on improving the nutrition of fresh sweet corn kernels, with benefits to seed companies, growers, processors, consumers and rural communities in New York state and beyond.