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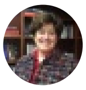
Tweaking Photosynthesis to Help Feed the World



By Ruth Kava — November 24, 2016

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At this time of year, we look forward to feasting to celebrate the holidays. But, as Earth's population grows, feasts may become more scarce.Currently there are more than 7 billion people on the planet; according to some authorities [2], the increase in population between 1900 and 2000 was greater than that in all of human history. Although these same folks note that the rate of population growth has been slowing, we can still expect that by the year 2100, there will be over 11 billion people hanging around this planet. So, how are we going to feed them all? No, organic agriculture isn't going to do it. Genetic engineering will be needed to help increase food production. And scientists are working constantly to find new and more efficient ways to alter food crops and increase production.

One such method, as my colleague Dr. LeMieux explained here, [3]is to alter the "expression" of some of a plant's genes — that is having the plant make more than usual of its complement of proteins. This method of manipulation has just been described [4] in the journal *Science.* It involves altering the way green plants respond to changing light in their environment.

When exposed to excess sunlight, green leaves have the ability to shed excess light energy as heat (a process known as nonphotochemical quenching of chlorophyll fluorescence or NPQ) . During this time, photosynthesis slows down, as does the plant's utilization of carbon dioxide to make sugars and starches. When the plant is then shaded, it takes a while for it to regain its usual rate of photosynthesis, making the overall process less efficient. Dr. Johannes Kromdijk from the University of Illinois and colleagues postulated that if they could somehow make plants respond more quickly to shading, they could increase the overall rate of photosynthesis and make the plants more productive.

Using the tobacco plant as a model system, these investigators set out to speed up the recovery rate from NPQ. To do this, they inserted genes to increase the production of several proteins that control the recovery from NPQ. When plants with such genes were grown in the field, they produced anywhere from 14 to 20 percent increases in plant material — stems, leaves, and roots — as well as increased plant height. Clearly, the purpose was not to grow bigger tobacco plants, but to used these plants as an model of what could happen should similar alterations be made in the genomes of food crop plants. In other words, this study was a "proof of concept".

The authors point out that "Efficiency of photosynthesis in the shade declines even further with rapid light transitions caused by clouds and wind-driven movement of overshadowing leaves." But, they concluded, "Increases in crop productivity of 15%, as obtained here, demonstrate a potential means to achieve the increases in crop yield that are forecast to be necessary by 2050."

Much work remains in order to meet such goals — independent replication is necessary, as well as demonstrating that these results can indeed be obtained in food crops. Should this be accomplished, it's just one more way in which genetic engineering can help provide the increased food production that will be needed to feed an ever-expanding human population.

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