More carbon dioxide in the air could threaten rice crops

June 7 2012, By Joel N. Shurkin

Worker in Rice field in Canggu, Bali. Credit: Annie Mole

The increase in carbon dioxide in the Earth's atmosphere--linked to human-caused global warming--may have another effect scientists hadn't foreseen. Researchers at the U.S. Department of Agriculture in Beltsville, MD may have found a consequence that could produce a crisis in the world's food supply.

Genes from wild, weedy rice, the rice that existed before farmers started to breed rice to emphasize certain traits, could be cross-pollinating with cultivated rice to produce a grain that has many characteristics farmers earlier eliminated.

The hybrid rice doesn't look the same as cultivated rice, doesn't taste the

same, and has lost many attributes that make today's rice a reliable, nutritious food staple. Essentially, 10,000 years of cross-breeding to make rice the staple of billions of people could be undone, turning the crop into weeds.

The Earth's human population now numbers 7 billion, and currently the world can feed itself. But, if a major grain crop such as rice fails--and as the population continues to soar--the result could be disastrous, said Lew Ziska, a plant physiologist at the USDA, lead scientist in the study.

The study was published in PLoS One. The study did not prove this was happening in nature as as greenhouse gases increase, only that it is possible.

The research involves two different populations of rice plants, a wild rice sometimes called "red rice," and Clearfield, a cultivated rice that is resistant to herbicides. Wild rice in this context is not the food dish often called "wild rice," which is a different plant, but a naturally grown, genetically unaltered rice.

The weedy rice is the biotype, the form of rice that existed before the genetics were altered by selection.

Using growth chambers, the USDA scientists set the concentration of carbon dioxide in the air to three settings: 300 parts per million (what it was at the end of the 19th century), 400 ppm (what it is now), and 600 ppm (what it is projected to be by the end of this century). They placed the same ratio of cultivated rice to feral rice as is usually found on American farms in the South in the chambers.

The rice in the chambers exchanged genes.

"They did it the old-fashioned way," Ziska said. "They shed pollen."

"Most of the time rice is self-pollinating: a small portion of it does outcross," said Ziska. "Some of that pollen does go into other plants. And when you have weedy rice and cultivated rice, essentially being the same species, you get some crossover."

The results showed for the first time that carbon dioxide concentration can affect the gene flow between plants and that the flow is not necessarily balanced. Carbon dioxide is the main greenhouse gas believed to be bringing up temperatures in the world.

The higher the concentration, the greater the gene flow, the USDA scientists found. Moreover, the hybrid contained more wild rice genes than those of the domesticated variety, and that was not good news because, among other things, the weedy rice was susceptible to herbicides and most domesticated rice has been bred to be resistant.

The number of flowers produced by the wild rice at the highest carbon dioxide concentrations was double compared to the production at 300 ppm, a far greater increase than in the domestic rice. The wild rice also produced flowers eight days earlier, which apparently increased the cross-pollination.

The plant produced was less nutritious, didn't look as good and the seeds were more fragile.

Many other staples, including sunflower, oats, and sorghum could have the same problem, Ziska said: as concentrations rise, gene flow increases and the wild or weedy versions of the species could dominate.

Steve Linscombe, senior rice breeder and director of the Rice Research Station at Louisiana State University, cautioned that the results of the USDA experiment were limited. Carbon dioxide in the air could be important, he said, because "anything that increases gene flow is

important. But, it is just another variable among many."

The USDA scientists only tested one variety of wild rice and one variety of domestic rice under restricted conditions. It was not possible to tell from the study what is happening in nature or what would happen with different species of rice or different temperatures.

"Basing the world on one genotype, one species, that to me is always a problem," Linscombe said.

"There is a huge baseline of weedy rice in nature." He said that, historically, wild rice has continually crossed with domestic rice with no proven threat to the domesticated rice.

Source: Inside Science News Service