

Safe seed: Researchers yielding good results on food cotton in field

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Dr. Keerti Rathore and lab assistant LeeAnn Campbell harvest cotton from the first field trial of a variety that has gossypol levels low enough for human consumption. Low-gossypol cotton could ultimately make available 44 million metric tons of the high-protein seed every year to help feed malnourished people worldwide. Credit: (Texas AgriLife Research photo by Kathleen Phillips)

Field trials of a new cotton are verifying previous lab and greenhouse studies indicating the crop could become a source of protein for millions of malnourished people in the world.

The cotton was engineered so that the toxic gossypol is reduced to tolerable levels in the high-protein seed but remain at higher levels in the rest of the plant to ward off pests and disease.

"The results look very promising." said Dr. Keerti Rathore, the Texas

AgriLife Research plant biotechnologist in whose lab the cotton was developed.

Gossypol has long been a block for cotton farmers trying to make cotton seed available for human or animal consumption. Cotton fibers have been spun into fabric for more than 7,000 years, but generally only cattle have been able to eat the fuzzy seeds that are separated from the fiber. Cattle can tolerate the gossypol because it is gradually digested through their unique four-part stomach.



First yields from a field study of cotton with ultra-low levels of gossypol indicated that researchers are well on the way to developing a new protein source for human consumption. The test plot near College Station, Texas is being analyzed by developer Dr. Keerti Rathore, Texas AgriLife Research plant biotechnologist. Credit: (Texas AgriLife Research photo by Kathleen Phillips)

But less than three years ago, Rathore's paper in the [Proceedings of the National Academy of Sciences](#) announced that cotton plants had been successfully altered in the lab to "silence" gossypol in the seed.

Five generations of cotton plants produced in greenhouses and the small test plot in the field this year are showing similar findings, Rathore said, though the results have not yet been published in scholarly journals.

"We have analyzed the plant leaves, flower organs and seeds," Rathore said of the first plant grown under normal farm conditions. "The levels of gossypol and related defense chemicals are similar to that of regular cotton plants in the buds, leaves and flowers. But the seed is still showing the ultra-low levels of gossypol."

Rathore and his team used a scientific method called RNAi, a process also being used to explore cancer and HIV cures. This technology, discovered by Nobel laureates Andrew Z. Fire and Craig C. Mello, can silence specific genes. That enabled the team to target the gossypol gene in the cottonseed but let the gene express itself in the rest of the plant.

The "beauty of this project," Rathore said, is that the high-protein seed could be a new food source - especially in developing countries.

As reported in his original paper, the cottonseed from these plants meet World Health Organization and U.S. Food and Drug Administration standards for food consumption, potentially making a new, high-protein food available to 500 million people a year.

Rathore noted that for every pound of cotton fiber, the plant produces about 1.6 pounds of seed. The annual world cottonseed production equals about 44 million metric tons, and studies have shown the seed to be about 22 percent protein.



A boll of cotton with the ultra-low gossypol levels is maturing in the first field trial. The low-gossypol cotton was developed by Dr. Keerti Rathore as a new protein source for human consumption. Credit: (Texas AgriLife Research photo by Kathleen Phillips)

He said kernels from the safe seed could be ground into a flour-like powder and used as a protein additive in food preparations or perhaps roasted and seasoned as a nutritious snack.

Cotton Inc., which helps fund the research, is enthusiastic about the results.

"The entire cotton industry has a vested interest in expanding the uses of the cotton plant," said J. Berrye Worsham, Cotton Inc. president and CEO. "The success Dr. Rathore and his team have had with the field trial gets us one step closer to cotton being viewed as a fiber and a food source for future generations."

Previous attempts to breed cotton varieties without gossypol were not commercially successful because the toxin was removed from the seed as well as the rest of the plant. That left the plants vulnerable to insects and disease - a risk and a cost that farmers weren't willing to accept.

A way to extract gossypol out of the oil was developed years ago, Rathore noted, but at a cost. Plus, the meal left after the oil was extracted still contained the toxin so could not be consumed by humans, or as feed for pigs, chickens or turkeys.

Rathore plans to continue field trial studies to assure the stability of the gossypol-free cotton variety, and he has additional lines that he expects

have even lower levels of the substance. But, he adds, the greatest obstacle for seeing the variety grown in fields and ultimately feeding the world's hungry may be legalities.

Because the variety is "genetically modified," the scientist and AgriLife Research will have to negotiate with others who hold patent rights to some of the basic technologies used to develop this "ultra-low seed-gossypol" cotton. He will also have to seek approval through the U.S. Department of Agriculture, U.S. Food and Drug Administration and perhaps other agencies to make it commercially available as seed to farmers. That process could take years, he said.

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