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Unintended Effects of Genetic Manipulation
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New GMO Rice Lines in India Are High in Vitamin A Precursor, But Unfit for Cultivation Due to Low Yield and Lack of Plant Vigor

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By crossing a popular rice variety in India with GMO rice that the company Syngenta had engineered to express provitamin A, researchers have succeeded in developing new lines of the Indian rice with high levels of provitamin A. But unintended effects of the genetic manipulations — a much lower yield of grain, and plants that grew much less robustly — caused the new lines to be unfit for commercial cultivation, a recent study concludes.

The research — published in the online, peer-reviewed journal *PLOS ONE* in January, 2017 — is part of GMO "Golden Rice" efforts, extending over many years, to engineer rice varieties that are rich in provitamin A. (Provitamins are substances that can be converted to vitamins by the body). Proponents have argued that such engineered rice could help prevent severe Vitamin A deficiency in countries where rice is a main source of the calories in many families' diet. Others have questioned the wisdom of the effort, on a number of different counts. In this particular study, however, researchers concluded that a rice gene that is important for healthy plant development had been disrupted when the transgenic material that had been inserted into Syngenta's GMO rice for the provitamin A trait was bred into the Indian variety.

Plants from the interbred lines of rice that included Syngenta's transgene were dwarf-sized and had pale green leaves and "drastically reduced panicle size, grain number, and yield," compared to the parent rice variety, named Swarna, according to the authors.

To try to understand why, they carried out extensive molecular, biochemical, and morphological studies of the new lines, compared to the parent plants. Their study concludes that the transgene for pro-vitamin A had disrupted a gene called *OsAux1*, which "disturbed the fine balance of plant growth regulators . . . leading to the abnormalities in the growth and development" of the new lines. The transgene also seemed to be expressing in the vegetative tissues of the plants, including the leaves, when it was intended to be expressed only inside the grain.

The team of researchers also suggested that their results demonstrate how important it is to carry out the kind of careful analysis done here to understand the effects of genetic manipulations on GMO varieties before selecting ones to try to breed with local varieties. The study was conducted by researchers from the Indian Council of Agricultural Research and the University of Delhi. It was funded by the Government of India's Department of Biotechnology.

Sources

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