Some people are anti-GMO because they don’t like the idea of their food being genetically manipulated. But, what about food that is altered using the gene editing technology known as CRISPR-Cas9? And, what if the genetic change is one that would help the livelihood of farmers in developing countries? Lastly, what if the food that we’re talking about is chocolate...?

CRISPR-Cas9 chocolate may very well be coming down the pike. The cacao tree (*Theobroma cacao*) is a tropical tree that produces the cocoa beans that serve as the raw material of chocolate. The tree lies at the center of the multi-billion dollar chocolate industry and is therefore incredibly important for the economy of many developing countries.

The cacao tree has many pathogens. When the tree becomes infected, the result is reduced income for millions of farmers in developing countries. Each year, several plant diseases severely limit global production, with 20-30 percent of cocoa pods destroyed preharvest. Therefore, working to develop a disease-resistant cacao variety is an important advancement in the world of chocolate production. And, a team at Penn State has taken that goal one step closer to reality.

**What were the genetic edits made in the cocoa?**

The researchers used CRISPR-Cas9 to make cacao trees resistant to infection by their pathogens. In order to achieve this, they targeted a gene known as the cacao Non-expressor of Pathogenesis-Related 1 (*TcNPR1*) gene, which regulates many genes involved in the plant’s immune system.

When this gene is overexpressed in the plant, there is less infection of the cacao leaf tissue,
specifically by the pathogen Phytophthora. A gene similar to NPR1, called NPR3, regulates NPR1 in a negative way meaning that it decreases its expression. The researchers guessed that less NPR3 means more NPR1, which would result in less infection of cacao. In turn, they used the CRISPR-Cas9 gene editing system to take out the NPR3 gene, which resulted in a more protected plant.

This is the first example of using CRISPR-Cas9 technology to improve Theobroma cacao. Although there may be many, many more genes that could result in more protection from pathogens, this pioneering work is the first step in the right direction. This gene edited food goes way beyond the personal choices of people who can afford chocolate at any price, whether it's gene edited, GMO, organic, etc. This work will ensure the reliable productivity from cacao plants, which affects the livelihoods of millions of smallholder cacao farmers.