How safe is genetically modified cowpea?

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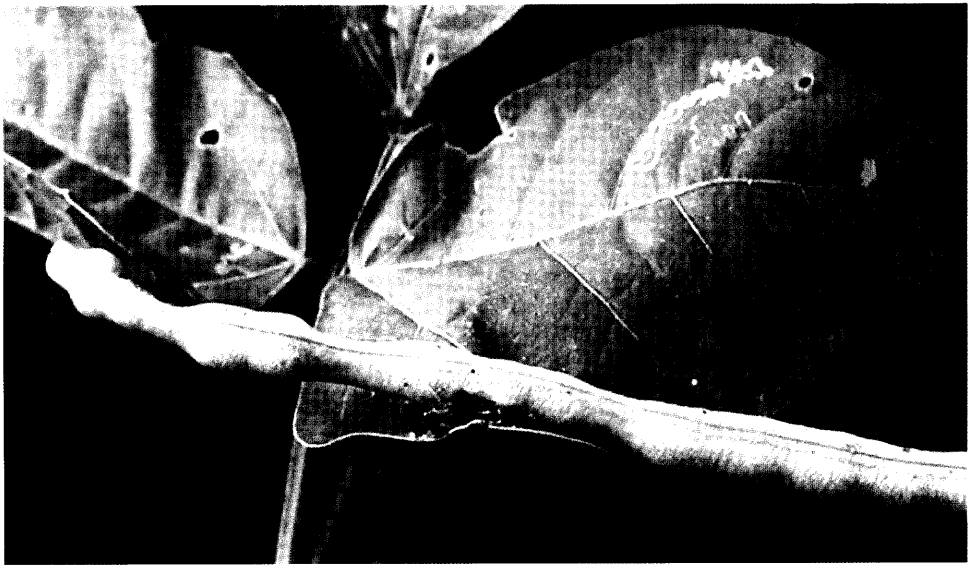
Genetically modified cowpea resistant to the cowpea pod borer (*Maruca vitrata*) will soon become a reality. But before that happens, IITA is making sure that it addresses some of the potential risks associated with using such genetically modified organisms (GMO). This transgenic cowpea contains the gene from the soil microbe *Bacillus thuringiensis* (*Bt*) that is toxic to the pest.

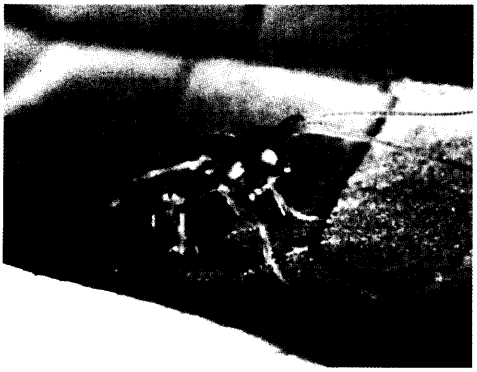
IITA started preliminary studies to assess concerns, including the development of resistance by the target insect pest to the insecticidal protein expressed in the plant, negative effects of the insecticidal protein on nontarget organisms present in the same agroecosystem, such as natural enemies or pollinators, the accidental introduction of the gene expressing the toxic protein into wild relatives of cowpea (referred to as "gene flow"), and negative effects on human and animal health.

In the meantime, a team of scientists headed by Dr T.J. Higgins of the Commonwealth Scientific and Industrial Research Organisation (CSIRO), Australia, successfully transformed cowpea with the *Bt* toxin-expressing gene. The transgenic plant has been tested in Puerto Rico but is not yet available for testing in Africa.

IITA started evaluating some of the unintended effects of the purified *Bt*-toxin on nontarget organisms, focusing on natural enemies of the target insect pest, the caterpillar of the pod borer (*M. vitrata*).



Typical damage by pod borer caterpillar boring into a cowpea pod. Photo by M. Tamò, IITA



Parasitic wasp Phanerotoma leucobasis laying its egg into egg of pod borer.
Photo by M. Tamò, IITA

In our first case study, we used a locally available natural enemy, a small parasitic wasp called *Phanerotoma leucobasis*, which develops by destroying caterpillars of the cowpea pod borer. This wasp has a curious biology because it can insert its small egg into the bigger egg of the pod borer, but its immature stages develop inside the caterpillar only when it starts feeding on the cowpea plant. It destroys the pod borer's internal organs from the inside, ultimately killing it.

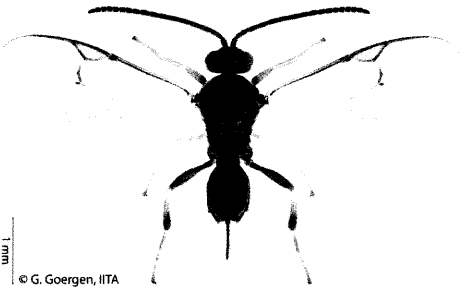
Following standard protocols in collaboration with Purdue University, USA, we first determined the lethal dosage of the *Bt*-toxin that could kill 50% and 95% of the young caterpillars. Subsequently, we let the wasp parasitize the eggs of the pod borer, and transferred the hatching caterpillars onto an artificial rearing diet contaminated with different doses of the toxin to let them feed on it.

The level of wasp mortality recorded in this experiment favorably compares with results obtained in other studies, and is primarily due to the death of the host caterpillar while feeding on the contaminated diet. Similar experiments are ongoing, using another natural enemy of the pod borer, the exotic parasitic wasp *Apanteles taragamae* introduced into our laboratories from the World Vegetable Center (Asian Vegetable Research and Development Center) in Taiwan.

What would then be the likely impact of *Bt* cowpea on these natural enemies in the field? This question will be definitely answered when real *Bt* cowpea plants will be available for testing in confined field experiments.

For now, we know from previous studies (Romeis et al. 2006) that the negative, unintended effects of *Bt*-transformed crops, such as corn and cotton on natural enemies and biodiversity at large are far less than those caused by repeated applications of synthetic pesticides to control the same pests under conventional crop protection schemes.

For the cowpea pod borer, several alternative host plants exist in the wild where the pest is exposed to the attacks of natural enemies throughout the year, hence providing natural refugia and thus avoiding being negatively impacted by the *Bt*-toxin present in the transformed cowpea.



Exotic parasitic wasp Apanteles taragamae.
Photo by G. Georgen, IITA

Reference

Romeis, J., M. Meissle, and F. Bigler. 2006. Transgenic crops expressing *Bacillus thuringiensis* toxins and biological control. Nature Biotechnology. 24:1. p 63-71. January. www.nature.com/naturebiotechnology