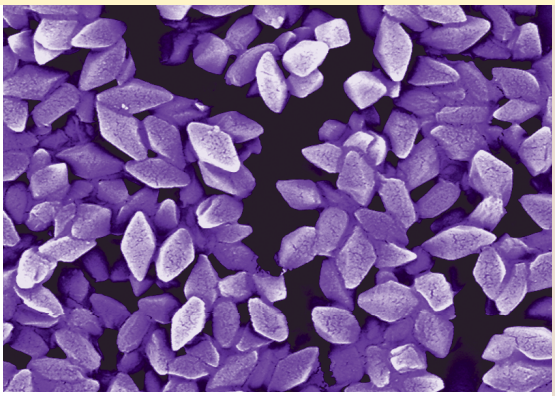
Safety of weevil resistant sweetpotato varieties

SASHA
Sweetpotato Action for Security and Health in Africa

JUNE 2011

Genetically modified (GM) crops contain traits that have been introduced by the tools of modern biotechnology. Their novelty has prompted comprehensive assessment of their human and environmental safety. With conventional breeding, thousands of genes are shuffled and recombined to obtain a desired trait. In comparison, modern biotechnology adds as little as one single gene to provide the desired trait to an existing well-performing variety. As a result, the level of genetic modification is only a tiny fraction of that produced through conventional breeding. However, a widespread lack of familiarity with biotechnology has led to consumer demands for sophisticated safety risk assessments.

CENTRO INTERNACIONAL DE LA PAPA
CIP



Crystal proteins active against insect pests (credit J. Ferre)

Safety issues

Prior to commercialization, the developers of GM crops or their derived foods must test them for safety. The tests follow protocols and standards established by international organizations such as the Organization for Economic Cooperation and Development (OECD), World Health Organization (WHO), and the UN Food and Agriculture Organization (FAO). Developers then submit a dossier for deregulation of the GM crop or food product to the appropriate national regulatory authorities for review. The decision by those authorities to approve, postpone, or reject the deregulation is based on scientific criteria.
After 15 years of commercialization, no damages to human health and or the environment have been associated with any approved GM technologies. Following the official protocols, all of the relevant, competent organizations have repeatedly found each GM crop and derived food to be as safe as its conventional counterpart.

Food safety (allergenicity and toxicity)

Toxicity and allergenicity are always the focus of safety assessments of new food products. The weevil resistant sweetpotato contains Cry proteins that are novel in this crop.

The Cry proteins after ingestion by the insect are typically recognizing and binding to specific receptors of cells the midgut intestine provoking their lyses which cause rapid paralysis of the digestive process leading to insect death. These receptors are unique and restricted to certain insect species and are absent in other organisms including human.

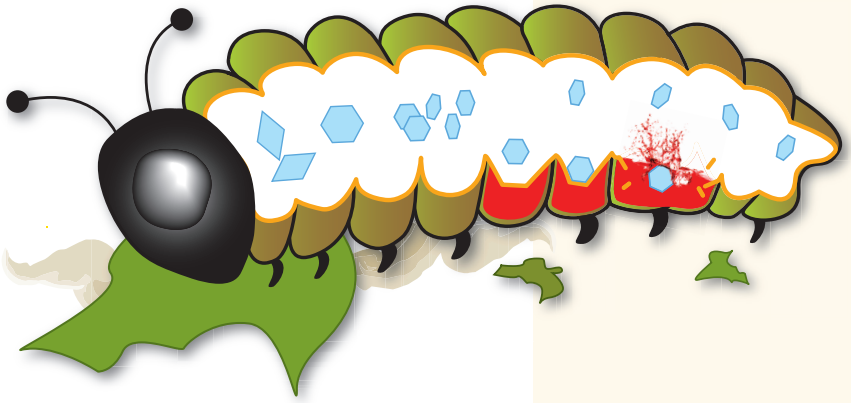
The amino-acid sequences of these proteins do not have meaningful similarity to any known protein toxicant/allergen. Considering that more than 10 genes producing Cry proteins have been tested and commercialized for up to 15 years, those used in sweetpotato are expected to be equally safe. Future testing will include a digestibility assay and feeding tests on small animals.

Nutritional composition:
In order to avoid nutritional changes that might result from natural variation during the in vitro regeneration process, GM crops are analyzed for substantial equivalence with their conventional counterparts. The nutritional and compositional parameters for conventionally-bred sweetpotato are known, and analyses of those in any GM variety will have to stay within the limits of their conventional counterpart.

Unintended effects on non-target organisms:
The introduction of new traits, resistance against pests or diseases in particular, always has at least some potential to affect other organisms that are ecologically relevant. Thus, it is important to assess the impact of new traits of the GM crops on non-target organisms in the context of existing crop management practices. Literature on the impact of Cry proteins on natural enemies of pests, pollinators, and herbivores is abundant, and risk assessment methodologies are well established. Considering the coleopteran specificity of the Cry proteins introduced in sweetpotato, few relevant species were identified in Ugandan fields that need to be tested.

Conservation of biodiversity:
Gene flow is the natural movement of genes among organisms of the same species; for example, between and among crop varieties or landraces. It generates new cultivars useful to farmers while maintaining biodiversity. Conservation of biodiversity is of primary importance. It is the reservoir of genes and alleles that farmers and scientists continuously use to face new challenges

GM sweetpotato in Biosafety greenhouse in Uganda (credit M. Ghislain)



Mode of action of Cry proteins against insects

posed by an ever-evolving environment, confronting factors such as climate change or the emergence of new pests and diseases.

Gene flow from GM crops is often perceived as potentially damaging to biodiversity. However, there is no evidence supporting this perceived risk in the case of sweetpotato. No wild species sexually compatible with the sweetpotato have been identified on mainland Africa. Crossing between cultivars resulting in a new cultivar is extremely rare due to multiple compatibility barriers, the fact that sweetpotato seeds are one or two per flower and germinate poorly, the fact that clonal propagation occurs through the planting of sweetpotato vine, and that farmers adopt improved varieties because of their superior qualities and market value. Hence, there is no a priori indication that weevil resistant sweetpotato varieties would impact on the conservation of biodiversity.

Resistance management
A concern in any resistance strategy is that the development of crops with resistance to pests or diseases will favor the emergence of resistant strains, due to selection or adaptation by the target organism. This is true for both conventional and GM crops, including those using biological control agents. To minimize the possibility that pests or pathogens will develop their own resistance to the resistant varieties, two resistance genes with different modes of action that independently confer full protection against weevils will be inserted into sweetpotato. Because simultaneous resistance of a pest to two Bt genes has never been documented and is assumed to be extremely rare, this strategy is expected to ensure effective and durable resistance.

CONTACT
Marc Ghislain
International Potato Center (CIP)
m.ghislain@cgiar.org