ICRISAT
Science with a human face

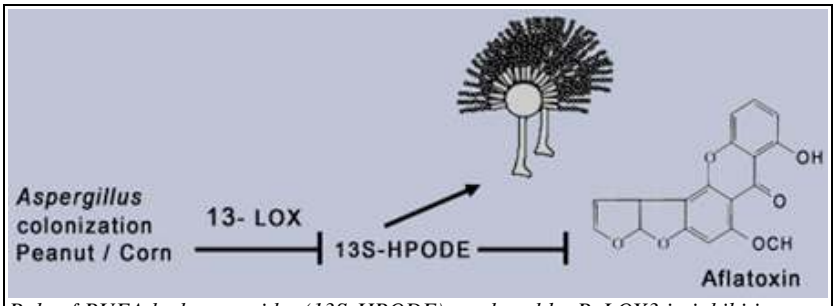
SATrends
ICRISAT's monthly e-newsletter

SATrends Issue 93 **August 2008**

1. Tackling toxins

Aflatoxins are toxic and carcinogenic substances produced by fungi such as *Aspergillus flavus* and *A. parasiticus* on a variety of food products. Contamination of groundnut (peanut) with mycotoxins such as aflatoxin has assumed significance in semi-arid regions of the world where over 4.5 billion people are exposed to uncontrolled amounts of these toxins. Although aflatoxin contamination does not affect crop productivity, it makes the produce unfit for consumption. Aflatoxin B1, the most toxic, is a potent carcinogen associated with liver cancer.

Aflatoxin contamination can be minimized by adopting certain handling and storage practices. Since conventional breeding methods for controlling aflatoxin are only partially effective, novel biotechnological methods are needed to develop pre-harvest host-plant resistance to the fungal pathogens.



Role of PUFA hydroperoxides (13S-HPODE) produced by PnLOX3 in inhibiting mycotoxin production in Aspergillus species. (Courtesy: Tsitsigiannis et al.,2005).

Manipulations by incorporating/ overexpressing specific antifungal genes that naturally inhibit the aflatoxin biosynthetic pathway can play a significant role towards this effort. Potential approaches include introducing hydrolytic enzymes (chitinases and glucanases) to provide transgenic protection against infection. Evidence suggests that lipid-derived secondary metabolites (oxylipins) produced by plants mediate plant host-pathogen interactions. Studies have indicated that *Aspergillus* sp. activate seed lipid pools that directly impact spores and mycotoxin development. The seed lipid lipoxygenases (LOXs) that catalyze the incorporation of molecular oxygen into free fatty acids either at position 9 or 13 of their carbon chains, (9-LOXs or 13-LOXs), may play an important role in the *Aspergillus*/seed interaction.

At ICRISAT, we have developed transgenic groundnut events carrying the rice chitinase (RChi) gene showing promising signs of post-harvest seed resistance. Further, the LOX-gene approach is being used to develop marker free groundnuts with durable resistance to A. flavus using a 13-LOX (PnLox 3) gene from peanut. This gene, in response to a fungal attack, sparks a series of reactions to finally form oxylipin, a potent inhibitor of aflatoxin biosynthesis. Our collaborator Prof Nancy Keller, University of Wisconsin, demonstrated this through in vitro studies.

By over expressing Pnlox3 we hope to achieve the down-regulation of AflR gene, which is the transcriptional regulatory gene in the aflatoxin biosynthetic pathway. The putative transgenic plants thus obtained are characterized at the molecular level for the presence and expression of the transgene, before being subjected to fungal bioassays. Protocols for screening of these transgenic events for resistance to A. flavus colonization and aflatoxin levels are being optimized in a lysimetric system that mimics conditions that the plants might face under field conditions.

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2. What's All the Heat With Climate Change?

Projections of the Intergovernmental Panel for Climate Change (IPCC) for southern Africa suggest an average annual temperature increase of 3.1°C and changes in annual rainfall of between -12 and +6%. Atmospheric carbon-dioxide levels for this scenario are expected to increase to around 700 ppm from the current 370 ppm.