Press Release:
Are GMO Pesticides Supertoxins? A New Analysis Raises Questions of Food and Environmental Safety

Oct 4, 2017, The Bioscience Resource Project, Ithaca, New York, USA

Summary: The chief benefit claimed for GMO pesticidal Bt crops is that, unlike conventional pesticides, their toxicity is limited to a few insect species. Our new peer-reviewed analysis systematically compares GMO and ancestral Bt proteins and shows that many of the elements contributing to this narrow toxicity have been removed by GMO developers in the process of inserting Bt toxins into crops. Thus, developers have made GMO pesticides that, in the words of one Monsanto patent, are "super toxins". We additionally conclude that references to any GMO Bt toxins being "natural" are incorrect and scientifically unsupportable.

New Publication Title: *The Distinct Properties of Natural and GM Cry Insecticidal Proteins*
Authors: **Jonathan R. Latham, Madeleine Love & Angelika Hilbeck** (2017), in *Biotechnology and Genetic Engineering Reviews*, 33:1, 62-96,
DOI: 10.1080/02648725.2017.1357295.

Background:
Bt toxins are a diverse family of protein toxins produced in nature by the bacterium *Bacillus thuringiensis*, which is a gut pathogen of many species. Naturally-occurring toxins (also known as Cry toxins) of *B. thuringiensis* are believed to all have very limited toxicity ranges. These toxins exist in nature as crystals packaged around DNA. Through a complex sequence of unpacking and protein processing steps these molecules are converted to active toxins and kill their targets by creating holes in the membranes of the gut lining of their victims.

Commercially, GMO pesticidal corn, cotton, and soybeans are widely grown around the world. GMO Bt crop varieties constitutively synthesize these Bt toxins and can contain numerous different Bt transgenes (1), each with somewhat different pest control properties. For this publication, we reviewed biosafety application documents for 23 globally traded Bt pesticidal GM crop events as well as peer-reviewed research and patents. We sought to compare GM proteins with natural ones. Our analysis is the first to explore the chemical and functional differences between GMO Bt toxins and natural ones.

The findings:
Our review describes numerous differences between naturally occurring and GM Bt proteins. Some are intentionally introduced but others are inadvertent in origin. First, all GMO Bt toxins are soluble proteins rather than crystalline structures; many GMO Bt toxins are truncated proteins; parts of natural Bt toxins are often combined to make hybrid GMO molecules that don't exist in nature; GMO Bt toxins often have added to them synthetic or unrelated protein molecules; GMO Bt toxins may be mutated to replace specific amino acids. Sixth and not least, all GMO Bt proteins are further altered inside plant cells. GMO crop plants themselves thus cause changes to the nature of Bt toxins.

Implications:
Surprising as it may seem, these changes are poorly taken into account in GMO risk assessment. For example, GMO regulators frequently refer to the "history of safe use" of specific natural Bt toxins. Regulators also controversially allow most tests of safety to be on surrogate toxins, rather than GMO crops themselves (2). Our next question was therefore to determine whether these physical changes enhanced Bt protein toxicity, which would imply real world food and biosafety implications.

In the publication, we identify clear theoretical reasons, and sometimes direct evidence, to

suppose that each of the six types of changes noted above enhances Bt toxin activity. For example, Ciba-Geigy measured their Bt-176 toxins to be 5-10 times more toxicologically active when inserted into plants. Monsanto patented a series of novel Bt toxins with up to 7.9-fold enhanced activity and called it these "super toxins" having "the combined advantages of increased insecticidal activity and concomitant broad spectrum activity." The most powerful of these is now found in commercial MON863 corn. Additionally, there are theoretical reasons to expect all GMO Bt toxins to have broader spectrums of activity. Natural Bt toxins are large, insoluble, and non-toxic precursors requiring unusual chemical conditions to become active toxins, but thanks to the processing undergone by all GMO Bt proteins these are far closer to the toxicologically active form having bypassed key specificity requirements.

Conclusion:
Apparently ignored by GMO biosafety regulators, Bt developers have been commercialising pesticide-containing GM crops with increased and broadened toxicity, undermining the chief safety advantage of Bt toxins over conventional pesticides.

Quotes:
"We are raising important questions here. This publication reveals compelling scientific reasons to be concerned about the toxicological consequences of GM Bt toxins in food and in the environment. But it also reveals the complex interplay between corporations which carefully select the data they share with regulators and, on the part of regulators, a willingness to ignore the science if it threatens to derail a GMO approval." says Jonathan Latham, Executive Director of The Bioscience Resource Project.

"Naturalness is a key claim about pesticidal GM crops. But it is constructed to justify the omission of actual testing of the GMO. "O" stands for organism, after all, but what we observe in the use of surrogate proteins for risk assessment is the reduction of biology to chemistry."--Angelika Hilbeck of the Swiss Federal Institute of Technology.

The publication is available open access from:
http://www.tandfonline.com/doi/full/10.1080/02648725.2017.1357295

Citation: Jonathan R. Latham, Madeleine Love & Angelika Hilbeck (2017) The distinct properties of natural and GM cry insecticidal proteins, *Biotechnology and Genetic Engineering Reviews*, 33:1, 62-96, DOI: 10.1080/02648725.2017.1357295.

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(2) Dolezel, M., et al. (2011). Scrutinizing the current practice of the environmental risk assessment of GM maize applications for cultivation in the EU. Environmental Sciences Europe, 23, 33. doi:10.1186/2190-4715-23-33
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