A simple question in a complex environment:

How much Bt toxin do genetically engineered MON810 maize plants actually produce?

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Bt maize MON810

- GM maize producing Bt toxin Cry1Ab against European stemborer (*Ostrinia nubilalis*)
- EU cultivation approval in 1998
- MON810 varieties on German seed lists since December 2005
- Cultivation in Germany less than 2000 ha in 2007

Research on Bt content in MON810 by Monsanto

Monsanto, 2002, Bt content in MON810: Data compiled from fields in Europe and US from 1994-1996.

- In leaves a total range (for all data) is given from 5.21-15.06 µg/g (fresh weight)
- Means of the data on leaves from the different trials are given as 8.60-12.15 µg/g (fresh weight).

Independent research on Bt content in MON810

- Little commercial or scientific information about how much Bt toxin is actually produced by Bt plants and whether the content is influenced by external factors.

- Quoted by authorities are only Monsanto's own figures

- Greenpeace studied Bt concentrations from 9 fields in Germany and 4 fields in Spain in 2006 to get more concrete data
  (Lorch&Then, 2007)

Results

- Bt production is extremely variable: from zero up to 15 µg/g (fresh weight, top leaf)

- Mean Bt concentration of MON810 plants in the field in 2006 was very much lower than expected: 0,5-1,3 µg/g (fresh weight, top leaf)

Results

Nguyen & Jehle (2007) confirm

- high variability and show
- even statistically significant differences between two fields in Germany,
- contents are about 30-40% lower then Monsanto's data, but in general higher then Greenpeace's: 2.4-6.4 µg/g (fresh weight, top leaf)

Why is there variability?

- Natural variability of plant metabolism
- Genetic or epigenetic effects in the plants
- Environmental and climatic effects on Bt plants (EU authorisation for 27 countries with different conditions, three climate zone and different bioregions and agricultural systems).
- No fully (ring tested) standardised testing methods

What is known about impact factors or correlations?

Abel et al: (2004):

- Bt content and photosynthesis are correlated

Bruns et al (2006):

- Bt content and nitrogen fertiliser are correlated

Griffiths et al (2006):

- soil quality can increase or decrease Bt content
- pesticide use can increase Bt content in leaves and roots
- Bt content increases towards flowering

What is known about impact factors or correlations?

Nguyen&Jehle (2007):

- significant difference between climate zone/ regional factors
- increasing Bt content in leaf through growing season
- epigenetic effects ?
- genetic background of different varieties ?
- genetic instability ?

Some conclusions

- No exact data about Bt content in MON810 after more than 10 years of commercial cultivation.
- There is no (ring tested) standardized procedure to determine Bt concentrations.
- No systematic research on climate, environment or other impact factors
- Many risk assessment studies might become unreliable

…and new questions

New study showed that the reaction mechanism of Bt toxins is very different then expected (Broderick et. al 2006):

- Effect of Bt toxin depends on gut bacteria

➢ No direct toxin-effect relation.

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Thank you very much for your attention

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