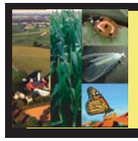
EPA Science Forum 2003
Partnering to Protect Human Health and the Environment



Assessing possible ecological risks of genetically modified crops: Genetic-monitoring of non-target organisms exposed to Bt corn

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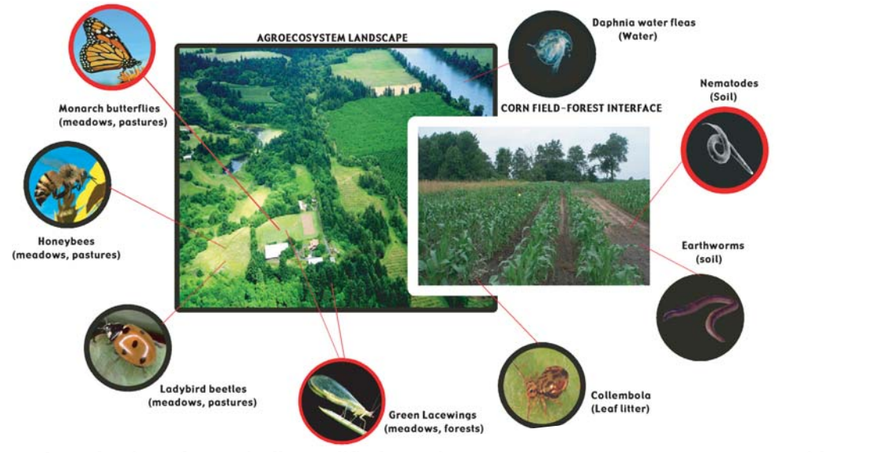
Emerging Technologies

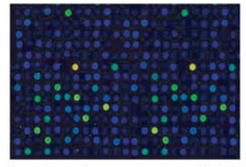
Genetically modified (GM) crops have great potential to reduce our dependence on chemical pesticides. One class of GM crops has been engineered with a gene from the bacterium *Bacillus thuringiensis* (*Bt*) to produce toxins that defend against a number of insect pests, including European corn borer, tobacco budworm, and western corn rootworm. While the EPA has taken great care to ensure that the *Bt* toxin does not detrimentally affect the environment, the long-term risks of incidental exposure to populations of untargeted insects and other animals must continue to be monitored.

Genetic monitoring **is a potentially powerful approach for assessing whether populations of beneficial organisms, such as butterflies and honeybees, are affected by long-term exposure to genetically modified crops. For example, analysis of gene expression levels using microarray technology may provide more sensitive assays of sub-lethal exposure to the *Bt* toxin than current methods. Analysis of variation in DNA sequences or molecular markers such as microsatellite DNA may demonstrate whether genetic diversity and population genetic structure are affected. Genetic monitoring of gene expression and molecular genetic diversity over time will help to establish population trends that reflect ecosystem-level changes.**



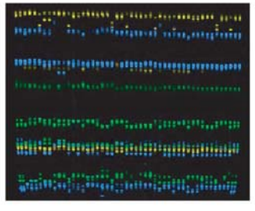
Introduction of genetically modified corn into an agroecosystem may expose a wide range of organisms to *Bt* toxins. The depicted groups of non-target organisms have been examined in previous studies of *Bt* toxin effects. Some groups (circled in red) have been shown to respond to *Bt* toxin exposure.

Assaying exposure and response of individuals to *Bt* toxins: Differential gene expression

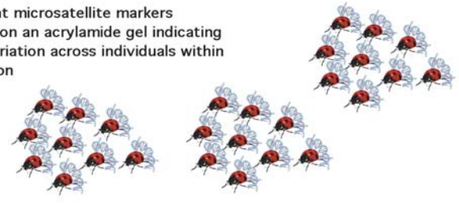


Display of a microarray gene chip indicating variable expression of different genes in a single individual

Assaying exposure and response of populations to *Bt* toxins: Genetic diversity (DNA sequence variability and variation at microsatellite DNA markers) within and among populations



Fluorescent microsatellite markers visualized on an acrylamide gel indicating genetic variation across individuals within a population



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