

**Transgenic poplar and the poplar leaf beetle:
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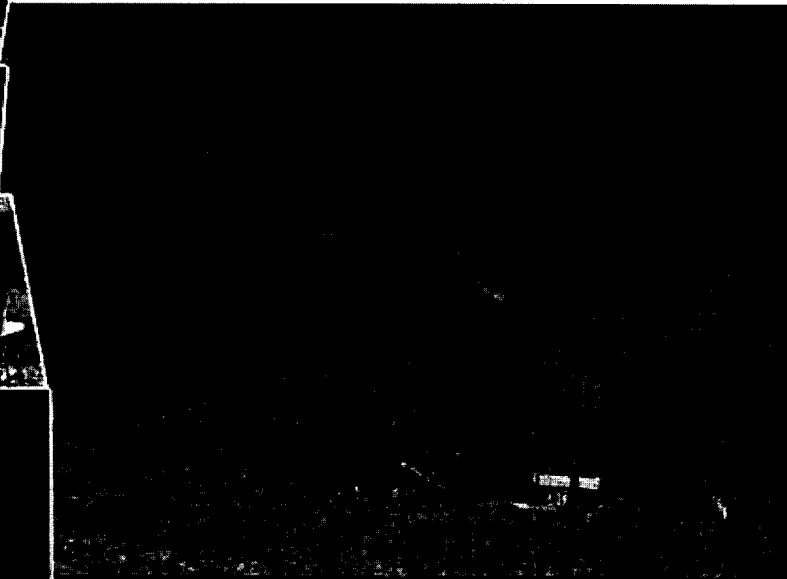
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TRANSGENIC POPLAR AND THE POPLAR LEAF BEETLE: STATE-OF-THE-ART ON THE RISK OF EVOLUTION OF INSECT RESISTANCE

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Nowadays, genetically-modified crops containing *Bacillus thuringiensis* (*Bt*) genes are spread worldwide. These *Bt* plants can provide a safe and effective method for controlling some key pests. However, laboratory-selected and field-evolved resistance to sprays of *Bt* toxins led to the expectation that pests would rapidly evolve resistance under prolonged exposure to *Bt* toxin from widespread transgenic plants. The speed at which the evolution of resistance to transgenic plants is likely to occur depends on key factors supported by the high dose refuge management strategy. To delay resistance, the initial frequency of alleles conferring resistance in insect field populations must be rare, the resistance to *Bt* plants must be recessive so that only resistant homozygotes can complete their life cycle on *Bt*, and a cost should be associated with resistance so that the fitness of resistant individuals will be reduced on non-*Bt* plants compared to susceptible individuals.

Poplars were the first genetically-modified trees with *Bt* genes. Transgenic poplars producing high levels of the toxin cry3Aa have been engineered and showed high toxicity to the phytophagous poplar leaf beetle *Chrysomela tremulae*. Study was focused on the key factor that could be involved in the postponement of *C. tremulae* resistance to *Bt* poplars.

In field populations of *C. tremulae*, it was detected that individuals were able to develop on *Bt* poplar and we estimated an initial frequency close to the highest value expected prior to the introduction of the pesticide in the field. This high level of resistance could lead to the rapid evolution of resistant populations in the absence of refuges for susceptible individuals. In the strain derived from one isofemale line able to develop on *Bt* poplar leaves, a high level of resistance (the resistance ratio was > 6,400) was found. The resistance on *Bt* poplar was found to be completely recessive. It was not surprising since it was determined that the concentration produced in the *Bt* poplar is much higher than the LC₉₉ of the F1 hybrids. This finding and additional data on the cost associated with resistance are consistent with the assumptions underlying the high-dose refuge strategy.

Key Words: GMO, transgenic poplar, *Bacillus thuringiensis*, *Chrysomela tremulae*, refuge, *Bt* resistance, resistance-allele frequency, fitness cost.

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