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Genetic and Ecological Risks from Biotechnologically-Derived Herbicide-Resistant Crops: Decision Trees for Risk Assessment

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I. INTRODUCTION

Many "alien" (introduced) plant species have been a source of "biological pollution" both to natural and agricultural ecosystems, occasionally displacing or driving to near extinction indigenous plant species or reducing crop yields. An alien species is typically introduced without its natural enemies, thus enhancing its ability to compete. Most of the weeds in ecosystems and many of the crops that can become volunteer weeds are those that have been introduced. Each alien species is comprised of a whole unique genome—thousands of genes. Genetic engineering introduces one or a few alien genes. Is this equally as risky as introducing a whole genome or is it only proportionately as risky (i.e. thousandths as risky) as introducing a whole genome? Even though the real answer is that "it depends on the properties of the gene vs. the genome," one sees pronouncements of the two extremes. A gene conferring resistance to pathogens and insects might change a scrawny, moldy wild species into a competitor, whereas resistance to a herbicide will lend little competitive advantage.

Introducing a gene by classical genetic crossing of a crop with an introduced, distantly-related wild species introduces the rest of the genome. Despite generations of backcrosses, deleterious traits may remain, especially those closely linked on the same chromosome. Thus, the genetic engineering approach of introducing single genes is more surgically clean, leaving an analysis of hazard of one gene instead of needing to worry about the risks from pieces of genome. Interestingly, no one has demanded risk analysis of such wild to domestic crosses; but just consider all the alkaloid-coding genes that are introduced to tomato by classical crossing with wild relatives when one wants but a single gene from the wild. These poisons are hazardous to people and other organisms, possibly conferring ecological advantages.

Often it has been stated that genetic engineering is just an extension of classical breeding and should not be considered differently. This is not completely the case. With genetic engineering, (1) the pool of genes is much larger, thus the risk that one gene could be harmful is increased;