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Ti and Ri Plasmids and Plant Transformation: State of the Art and Potential Applications

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Abstract

Plant genetic engineering started with the discovery of the Ti plasmids of *Agrobacterium* and with their development into efficient and reliable gene vectors. These plasmids can mediate the specific transfer and integration of the constructed DNA segment into the DNA of a large variety of plants. For many species it is possible to regenerate the transformed plant cell into a normal and fertile plant. The newly inserted DNA is then inherited in a Mendelian fashion. For this, appropriate marker genes had to be constructed. They were obtained as hybrid or chimeric genes by linking plant regulatory sequences to bacterial (or mammalian) coding sequences. These chimeric marker genes allowed the direct selection of the transformed cells as well as the identification of the molecular signals determining the tissue or organelle specificity of gene expression in plants.

In the near future we will see the "practical" results of this work under the form of plant cultivars engineered for a new trait, such as insect resistance, herbicide resistance, or increased nutritional value. The availability of these genetic engineering techniques will simultaneously stimulate plant molecular biology.

From this research can come the knowledge needed to identify and transfer the genes which more substantially alter plant properties and which will allow the construction of economically important varieties.

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One of the first commercially important results has been the construction of a tobacco plant synthesizing its own insecticide. This was obtained by introduction of the gene for the *Bacillus thurigiensis* "toxin", and its expression in an adult plant at a high enough level to protect the plant against the larvae of *Lepidoptera*.

Other results of fundamental research confirmed the usefulness of the Ti plasmid as a tool for plant molecular biology. It has been possible to identify secondary metabolites of plants that are synthesized in wounded plant cells and that induce the bacterial genes for virulence. Study of the regulation of the expression of chimeric genes transformed by the Ti plasmid showed the presence of plant enhancers and silencers.