TRANSGENE SILENCING IN PLANTS: MECHANISMS, APPLICATIONS AND NEW PERSPECTIVES

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ABSTRACT

The review aims to describe the state-of-the-art and the progress in the knowledge of RNA silencing in transgenic plants, including the experimental applications and the new perspectives opened by the most recent studies. Modern plant breeding involves new technical approaches, and genetic transformation is undoubtedly a powerful tool in plant biology and plant pathology. However, genetic engineering does not always result in efficient transgene expression and often transgene copy number does not correlate with transgene expression level. Research in the past decade has shed light on the importance of RNA silencing as a mechanism of virus resistance in transgenic plants. Several plants resistant to viruses have been obtained to date, and some have been commercially applied for crop protection on field. Transgene silencing is part of a broad host defence system, the RNA silencing, a process leading to homologous RNA degradation, widely observed in animals, plants, and fungi. A key feature of RNA silencing is the presence of small RNAs, such as microRNAs (miRNAs) and small interfering RNAs (siRNAs), that are processed by a member of the RNAse III-like enzyme family, known as DICER. In plants, several distinct RNA silencing pathways operate to repress gene expression at transcriptional or post-transcriptional level. Transcriptional silencing is associated with DNA methylation, in which DNA homologous to a dsRNA is methylated *de novo*. In addition to defence responses against viruses and transposons, short RNAs have been demonstrated to have a role in a diverse range of functions, including regulation of gene expression, development and chromatin structure. RNA silencing is also a powerful tool for functional genomic studies in several species. Transgene-mediated gene silencing through tissue-specific, partial and/or total gene inactivation is a convenient approach to study

target genes functions, in particular in species for which mutant collections are not available. We review various strategies for small RNA-based gene silencing: viral expression vectors (virus-induced gene silencing, VIGS), transgenes containing hairpin RNA structures and a recently introduced approach, based on artificial microRNAs (amiRNAs).