RIDL technology

Subjects: Biotechnology

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An interesting application of genetic engineering in agriculture is the called RIDL (release of insects carrying dominant lethal) technology. This technique, employed for creating sterile offspring in insect vectors of diseases, has revealed very encouraging results in the treatment of agricultural insect pests and vectors of diseases.

The technically but not conceptually equivalent version of the terminator technology in the animal kingdom is the so-called RIDL (Release of Insects carrying a Dominant Lethal) technology. This technique, under development by the Oxford Insect Technologies (Oxitec), was employed for creating sterile offspring in insect vectors of diseases (such as dengue fever and malaria) or agricultural insect pests. Even though the genetic engineered insects are not sterile, RIDL is considered a variant of the Sterile Insect Technique (SIT).

The classical SIT is a species-specific pest control method that relies on the mass rearing, chemical, biological (e.g. by use of Wolbachia) or radiation (by γ or x-rays) sterilization to carry dominant lethal mutations in their gametes (zygotic lethality), sex separation and release in the environment of large numbers of insects. As an alternative, the RIDL system requires that a strain of the target insect carries a conditional, dominant, sex-specific lethal gene activated by the expression of the tetracycline-repressible transactivator fusion protein (tTA), in turn, under the control of a suitable (constitutive, female-specific, embryo-specific, etc) promoter[1] . tTA is a hybrid, synthetic transcription factor resulting from the fusion of the prokaryotic (bacterial) Tet repressor -TetR a sequence-specific DNA binding protein-, with a eukaryotic transcriptional transactivation domain (most widely used so far is the acidic domain of herpes simplex virus VP16). In the absence of tetracycline tTA binds, by mean of its tetR domain, a short, specific, DNA sequence called tet operator (tetO) and acts as a transcriptional activator of the lethal gene through the VP16 transcriptional activation domain, leading the insect to death. Tetracycline, generally added in the diet, prevents the tTA-tetO bound, allowing the insects to be reared in manufacturing facilities. Once the transgenic tTA insects are released in the environment the permissive condition (tetracycline) is not encountered by the wild population so that the expression of the lethal gene will cause mortality in the early developmental stages of the heterozygous progeny but will not affect the viability of the GE parent [2] provoking an effective control of the wild pest population. Specifically, an ingenious (still potential) variant is based on the release of GE male insects presenting a female-specific lethal genotype that will provoke, after mating with wild females, the subsequent death of the female progeny only and the survival of the males able to pass this lethal trait on to other wild females. Other inducible autocidal systems (whereas RIDL is a repressible system) have been proposed[3] exploiting the activation under triggering circumstance (eg cold, heat treatment) of a lethal a gene introgressed into the wild population.

References

1. M. Gossen; H. Bujard; Tight control of gene expression in mammalian cells by tetracycline-responsive promoters.. *Proceedings of the National Academy of Sciences* **1992**, *89*, 5547-5551, 10.1073/pnas.89.12.5547.
2. Manfred Gossen; Angelika L Bonin; Sabine Freundlieb; Hermann Bujard; Inducible gene expression systems for higher eukaryotic cells. *Current Opinion in Biotechnology* **1994**, *5*, 516-520, 10.1016/0958-1669(94)90067-1.
3. K. J. Fryxell; T. A. Miller; Autocidal Biological Control: A General Strategy for Insect Control Based on Genetic Transformation with a Highly Conserved Gene. *Journal of Economic Entomology* **1995**, *88*, 1221-1232, 10.1093/jee/88.5.1221.

Keywords

RIDL;Sterile Insect Technique;pests