New method prevents unwanted gene flow of GM plants

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BASEL – A new study shows that a special two component system represses the gene flow from GM plants to related plant species. The system consists of two complexes, one containing the new desired gene and a lethal factor gene, the second one containing a gene that codes for a protein to suppress the lethal factor gene.

One major concern of environmental groups and some farmers is that newly introduced genetic material can be passed on from genetically modified plants to the gene pool, where it can persist even if it is not functional. To prevent this, a team, led by Dr. Johann P. Schernthaner at the Eastern Cereal and Oilseed Research Center, in Ottawa, Canada, recently developed a method that reduces the probability of gene flow between GM plants and sexually compatible wild types or related plants, by producing a system that helps ensure that if a GM plant in-crosses or out-crosses, the next generation will not survive. The publication of their results can be found in the May 27th issue of the Proceedings of the National Academy of Sciences (PNAS).

In order to prevent the flow of inserted genes to other plants, the scientist inserted the gene of interest (trait gene) with an specific lethal factor gene. The lethal factor gene used in this experiment uses a embryo-specific starting sequence (phaseolin promoter), which subsequently leads to the plant's death due to overproduction of the naturally occurring plant hormone (phytohormone) auxin. Thus, if a plant produces hybrid seeds on account of cross-pollination, they will not lead to any adult plants, but instead die during germination caused by an overproduction of auxin.

Now that the possibility of gene dispersal is prevented, the problem of producing a functional plant must be solved, since the lethal factor gene by itself will also cause the target plants to die. Therefore, the research group introduced another gene into the target plants, which codes for a protein that prevents the lethal factor gene from being expressed in the target plant.

As an example, a crop with a fungicide gene could be produced in order to prevent chemical fungicide use. To this gene two more genes (the lethal factor gene and the repressor gene) would have to be added to prevent the desired fungicide gene from in-crossing or out-crossing. Thus, in the target plant the product of the repressor gene blocks the expression of the lethal factor gene and thereby prevents the overproduction of auxin. In consequence, the desired fungicide gene is correctly expressed, giving the plant resistance to a certain fungal infection.

To insure that the trait gene/lethal factor gene complex is never passed on together with the repressor gene, they are inserted at specific sites on the chromosome, which are known areas of recombination. Recombination occurs during the production of pollen, which nature uses to increase variability in the gene pool. Inserting the genes at specific sites will ensure that the lethal gene is passed on without the repressor gene. Thus, should in-crossing or out-crossing occur, only the trait gene/lethal factor gene complex will be passed on, causing the germ to die, and thus preventing the flow of new DNA material.

The new method developed by Dr. Johann P. Schernthaner and his team has the potential of becoming a major mechanism in preventing gene flow with the use of GM plants. Once the GM plant is produced it requires no more intervention, such as the use of chemical sprays to activate the lethal factor gene, for example. It's general functionality and easy to use applicability will help this system to establish a new generation of GM plants that will ensure an unrivalled safety level.

For special applications that require bacterial (prokaryotic) genes to be introduced, Dr. Schernthaner's method may be combined with another recently developed system that makes use of the chloroplast's genome.