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Thematic Issue on Horizontal Gene Transfer

Guest Editorial

Presentation of the Thematic Issue on Horizontal Gene Transfer

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Questions concerning the fate and potential biological activity of transgenes from transgenic plants in bacteria have motivated considerable research that attempts to provide some answers. Some of the scientific difficulties with this research are due to the relatively low (if at all) frequencies of gene transfer from transgenic plants to environmental bacteria. Therefore, a range of different model systems have been constructed and tested in order to try to determine possible scenarios of transgene transfer to bacteria in the environment. One such model is the fate of transgenes from transplastomic plants to environmental micro-organisms, which was investigated in the frame of a European Union-funded project TRANSBAC. The objectives of this project were to understand and quantify gene transfer under optimum conditions and develop tools for reducing (or augmenting) gene transfer. A range of conditions and biological models were examined for a better overview of the probability of gene transfer. Gene transfer is expected to be a function of the genetic environment of the gene, the number of copies, its persistence in the environment, and physical conditions that increase selective pressure and enhance gene transfer. When experiments do not demonstrate measurable gene transfer, the tendency is to avoid publication. Negative results are seldom appreciated, but in a rigorous evaluation of the likelihood of different transfer events, one must recognize that the detection limits are not always sufficiently low. This was in part the motivation for engineering experimental systems to increase the likelihood of gene transfer in order to have at least a baseline (albeit maybe not an environmentally validated one).

With this context in mind, we decided to organize a special issue related to the work funded by the European Union in the TRANSBAC project and to invite some other participants working on horizontal gene transfer to contribute papers. This special issue of *Environmental Biosafety Research* covers a range of ideas related to the overall question of the fate, transfer and effect of plant transgenes on environmental bacteria. Reviews of horizontal gene transfer between bacteria, transgenic DNA in the environment, and the persistence of DNA in the environment provide the scientific background for the research papers (whose authors have already contributed extensively to this research area). The closest contact between transgenic plants and environmentally relevant bacteria occurs either in the rhizosphere or on and in the plant. Therefore, these are the areas of the most intense study, and have led to a number of studies that explored the ability of these bacteria to take up free bacterial DNA, as is required for transgene uptake, and incorporate it in the bacterial genome. The possible effect of the transgene on the microbial community has also been explored. In addition to the close contact between the transgenic plant and plant-associated bacteria, the plant material may find its way into the intestine (or guts) of insects and animals, where other microbial communities would be exposed to the transgenes. Finally, parameters controlling gene transfer frequency associated with the transgene size and homology are critical in evaluating the detection limit of the reported experiments.

We believe that this collection of articles will help understand and define the potential for transgenes to be transferred to environmental bacteria. This work does not, of course, address the potential risk of gene transfer, which includes not only the probability of gene transfer,

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which was the subject of these studies, but also the notion of hazard, *i.e.* the negative effects that could occur if a given gene is indeed transferred to bacteria. Horizontal gene transfer is an important mechanism fostering bacterial adaptation and diversity. While horizontal gene transfer by means of mobile genetic elements occurs at measurable frequencies under environmental condition, the different studies compiled in this thematic issue showed that the proportion of transformed plant- and insect-associated bacteria was surprisingly low. Thus, although transgenic plant DNA might persist in soil for some time, the frequency of transgene transfer to and stable integration in bacteria must be considered to be very low.

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