

## Letter from the Guest Editor

In a sense, there is nothing novel about transgenic insects because different strains of these genetically modified (or genetically engineered) insects have been developed and experimented upon in leading laboratories around the world since the early eighties. Gerald M. Rubin and Allan C. Spradling (1982) were the first to report the genetic transformation of an insect (*Drosophila melanogaster*), using transposable element vectors. Since then, transgenic insects have been examined for numerous potential applications – basic molecular biology research (e.g. *Drosophila*), protein production and disease resistance (e.g. Silkworm), as well as control of pest insects that are damaging to agriculture, livestock and human health (e.g. Pink Bollworm, New World Screwworm, Mosquitoes). Recently, some strains of modified insects have shown sufficient promise in laboratory and semi-field trials that a few of them could soon progress into small- and large-scale open field trials. This is why the use of transgenic insects has become a ‘hot’ topic – not just amongst scientists and NGOs, but also with the press, policymakers, politicians, and members of the public.

In general, strategies can be classified into ‘population suppression’ (suppressing the populations of target insect pests to such low levels that they can no longer cause damage) or ‘population replacement’ (changing the insect into a less harmful form). A well-established method to achieve population suppression is through the ‘Sterile Insect Technique’ (SIT) (Bushland *et al.*, 1955), which won its inventors Edward F. Knippling and Raymond C. Bushland the 1992 World Food Prize. In SIT, sustained releases of large numbers of sterile male insects lead to suppression or local eradication of pest populations in subsequent generations. Genetic enhancements to SIT have resulted in success stories such as ‘temperature-sensitive lethal’ (*tsl*) strains of Medfly (Franz 2005), and may soon enable SIT to be implemented against other important insects such as mosquitoes (Wilke *et al.*, 2009). Parallel to these developments, a consortium funded by the ‘Grand Challenges in Global Health’ initiative sponsored by the Bill and Melinda Gates Foundation and others, is developing transgenic mosquitoes which are refractory to transmission of the dengue virus. A major challenge to overcome in the application of this population replacement strategy is the development of an appropriate gene-drive system so that these mosquitoes can establish and spread themselves in the wild (Alphey 2009, James 2005).

A related topic is paratransgenic insects (in which transgenesis has been carried out on a symbiont rather than the insect itself), which could play a major role in mankind’s fight against African trypanosomiasis, Chagas’ disease, Pierce’s disease, etc. The ubiquitous endosymbiont *Wolbachia*, first described as a *Rickettsia*-like microorganism in *Culex pipiens* mosquito by the entomologist Marshall Hertig and the eponymous Samuel Burt Wolbach (1924), is now thought to be able to infect up to 70% of insect species (Kozek and Rao 2007). A strain called *wMelPop* or *popcorn* has been recently shown to halve the adult lifespan of female *Aedes aegypti* mosquitoes under laboratory conditions (McMeniman *et al.*, 2009). As *wMelPop Wolbachia* is a naturally occurring mutant, mosquitoes infected with it are neither transgenic nor paratransgenic; however, it is important to include them in this discussion because they do share key features such as species-specificity and self-propagation respectively with population suppression and replacement strategies involving genetically modified mosquitoes. A lucid discussion of *Wolbachia*-induced cytoplasmic incompatibility has been presented by Brelsfoard and Dobson (2009) – both as a form of sterility (for a mass male release strategy analogous to SIT) and to provide a reproductive advantage for a population replacement strategy (to drive wanted phenotypes into natural populations).

Before these exciting techniques could benefit mankind, it is very important to follow a step-wise approach to deployment which is tiered to the potential risks identified, e.g. laboratory trials, semi-field trials, small- and large-scale open field trials, followed by pilot- and full-scale deployment. Gaining ethics and regulatory approvals from competent authorities is as crucial as earning the trust of the community who participate in trials. As the law and regulations are catching up with science, it is important to follow the spirit of the law and guidance documents that are now being developed by various bodies. A number of initiatives, 14 at the last count, have been set up to look into regulatory and biosafety aspects of innovative genetic vector control strategies, capacity building and development of best-practice guidance. These initiatives can be national, regional or international in scope, and legal, guidance or guidelines in status. Their remit can be purely regulatory, or purely ethical-social-cultural, or both. Beech *et al.* (2009a) provides a summary of these initiatives, some of which have been elaborated by Rose (2009), Mumford *et al.* (2009) and Fontes (2009). Whether to a competent authority or a community, it is very important to communicate risks and benefits of any novel technology for it to gain acceptance. Science-based, case-by-case risk analysis plays a central role in this exercise, and comprises of risk assessment, risk management and risk communication. Proceedings are now available from a UNDP-sponsored risk assessment workshop on transgenic insects, which was perhaps the first such workshop on transgenic mosquitoes in the world (Beech *et al.*, 2009b). It is hoped that these proceedings will trigger more events around the world to engage with all key stakeholders.

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