Ecological Applications, Volume 11, No 6, December 2001, Evaluating the risks of engineering viruses: Modeling pathogen competition.

Baculoviruses can have significant effects on the health of their hosts, and it has been suggested that genetically engineered viruses could be used as pesticides.

The usual requirement of acceptable GM releases is that they are effective at their chosen task but then die out, leaving no trace, unless artificially maintained.

Genetically modified baculoviruses have the advantage of a high level of host specificity, which reduces their impact on non-target species. However, in order for these viruses to be safely used in this way, we would need to know that would die out under field conditions.

This study develops a mathematical model of competitive interactions between genetically engineered and wild-type baculoviruses. The study found that the interactions were characterised by dominance of one strain or the other (that is, only one of the strains survives), and that the chance of one out-competing the other depended on the speed of kill and infectiousness. The basis for this is that a virus can compete sooner if it kills more quickly, as it cannot become infectious until this point, but generally the host will produce fewer baculoviruses the more quickly it is killed.

Generally, it is found that the increased specificity of the genetically modified baculoviruses results in reduced transmissibility of the introduced type relative to the wild type. As a result of this, it has been suggested that the release of genetically modified baculoviruses would have little ecological effect, as the population would die out within a matter of generations. However, this is not always the case, as the faster killing time sometimes means that the modified baculovirus can reach more generations in the time it takes the wild-type to complete a life cycle and it could, potentially, out-compete the wild-type and persist in the ecosystem.

Overall, the study concludes that one cannot easily summarise the relationships between two such viruses, and that interactions may be significantly more complicated than expected.

Comment

Baculoviruses exhibit great potential as a possible use of biotechnology as a method of pest control in the agricultural industry and are therefore their development is very attractive to bioengineers. However, as this paper clearly illustrates, there is the need for further research into the relationships between modified and natural baculoviruses. Overall, the paper serves as a warning against the assumption (currently endorsed by practical experimental work) that genetically engineered viruses are not competitive enough to out-compete wild-type baculoviruses and thereby become dominant in the ecosystem. The model produced suggests that genetically modified baculoviruses may not be as poor in competition as expected and warns against underestimating their potential effects on the environment.

Representative field trials would seem to be an essential feature of a full risk assessment