

The importance of genetic fitness costs in strain replacement and autocidal control strategies

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Recent empirical work indicates that the reduction in fitness of a transgenic insect strain (i.e. fitness cost) is in part determined by the specific transgenic DNA sequence carried by the insect and in part by the site on the genome where that sequence is inserted. Therefore, molecular biologists have the ability to limit fitness effects through choice of transgenes and through development of many independent insertion lines.

However, the question remains of how much is gained by efforts to reduce fitness costs compared to efforts put into other aspects of strain development. In this presentation we report on the results of computer simulation models that were used to examine the quantitative relationship between the extent of fitness costs and the efficiency of a number of strain replacement and autocidal control strategies. The autocidal control strategies examined are conditional lethality and sex specific mortality. The strain replacement methods are transposon drive and engineered underdominance.

We find that the impacts of fitness costs vary among strategies but that even costs of less than 10% can significantly decrease efficiency. Altering the degree of dominance in the expression of a fitness cost can have a major impact on the success of strain replacement strategies. The efficiency of strategies involving release strains with multiple insertions of a DNA sequence can be substantially affected by the degree to which epistatic interactions among inserted copies impact fitness. Although success of transgenic release strategies can be very sensitive to a number of components of fitness cost we currently lack quantitative data on these components from laboratory or field experiments with target pest species.