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Fitness Characteristics of Transgenic Strains of Cochliomyia Hominivorax, the New World Screwworm

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Interpretive Summary: Sterile insect technique (SIT) programs are designed to eradicate pest species by release of mass-reared, sterile insects into an infested area. The first large-scale implementation of SIT was the New World Screwworm Eradication Program, which successfully eliminated the New World screwworm (NWS), Cochliomyia hominivorax (Coquerel) (Diptera: Calliphoridae) from the Continental US, Mexico, and most of Central America. Ionizing radiation is currently used for sterilization, but transgenic insect techniques could hypothetically replace this method, providing a safer, more cost-effective alternative. Genetic transformation methods have recently been demonstrated in NWS. Some key issues involved in mass release of sterile insects revolve around fitness. Transgenic insects must be highly productive in mass rearing, and equally capable of surviving and mating with wild insects in order to be truly effective. Therefore it is critical to analyze fitness characteristics of transgenic insects. Eight transgenic strains of C. hominivorax were compared with the wild-type parental laboratory strain. None of the transgenic colonies exhibited significantly lower adult fitness characteristics than the control parental colony. Overall, the presence of the transgene used to produce the tested strains did not incur a fitness cost to the colonies of laboratory-reared C. hominivorax. Therefore genetically manipulated strains of NWS may be effective in SIT programs.

Technical Abstract: Over the past ten years genetic transformation of insects has matured as a method to a stage at which realistic expectations concerning implementation of transgenic insect control strategies may now be considered. Sterile insect technique (SIT) programs are designed to eradicate pest species by release of mass-reared, sterile insects into an infested area. The first large-scale implementation of SIT was the New World Screwworm Eradication Program, which successfully eliminated the New World screwworm (NWS), Cochliomyia hominivorax (Coquerel) (Diptera: Calliphoridae) from the Continental US, Mexico, and most of Central America. Ionizing radiation is currently used for sterilization, but transgenic insect techniques could hypothetically replace this method, providing a safer, more cost-effective alternative. Genetic transformation methods have recently been demonstrated in NWS. Some key issues involved in mass release of sterile insects revolve around fitness. Transgenic insects must be highly productive in mass rearing, and equally capable of surviving and mating with wild insects in order to be truly effective. Therefore it is critical to analyze fitness characteristics of transgenic insects. Eight transgenic strains of C. hominivorax were compared with the wild-type parental laboratory strain (P95) in culture. Measurements of fecundity, fertility, larval biomass productivity, adult emergence, male ratio, and mating

competitiveness were analyzed. The parental strain control colony was sub-cultured and subjected to handling procedures equivalent to transgenic strains for valid comparisons of overall colony fitness. Two of the eight transgenic strains were significantly less fertile than the controls, but most strains were significantly more fecund. None of the transgenic colonies exhibited significantly lower adult fitness characteristics than the control parental colony, although one transgenic strain had a significantly higher ratio of adults emerging from pupae, and four transgenic strains had higher average pupal weight. Males of one transgenic strain were shown to mate with equal frequency when compared to males of the controls. Overall, the presence of the transgene used to produce the tested strains did not incur a fitness cost to the colonies of laboratory-reared C. hominivorax.

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