

WEB VERSION EXECUTIVE SUMMARY - CSE1201

“The characterisation of Vip3A resistance in *Helicoverpa* spp.”

Researcher: Dr Tom Walsh

The three-gene product Bollgard 3 is expected to be available commercially in 2015. However it is of concern that a pre-emptive study of variability for susceptibility to Vip3A toxin isolated alleles conferring resistance within both *H. armigera* and *H. punctigera*. Heterozygotes for resistance in both species occur at frequencies (5% in *H. armigera* and 3% in *H. punctigera*) that are well above expected mutation rates and above the current frequencies for Cry2Ab.

The magnitude of the threat posed by Vip3A resistance to the Australian cotton industry will be determined by factors intrinsic to the resistance alleles as well as the frequency of the resistance allele. The results from this work suggest that there is one gene involved in resistance to Vip3A, has several direct impacts on the industry.

1) We have detected a single gene involved and the different resistant alleles isolated are allelic and largely recessive at the discriminating dose, the strategy of detecting these Vip3A alleles using F1 tests in the monitoring project is justified by the evidence for both species.

2) In both *H. armigera* and *H. punctigera* reproductive success is reduced when they are not under selection, this suggests that there could be a delay in the development of resistance if there are enough susceptible moths generated from refuges and non-structured refuges. This effect could be in addition to the dilution caused by mating with susceptible individuals.

3) Vip3A resistance allele frequency in *H. armigera* will not be affected by resistant individuals or individuals carrying a resistance allele undergoing diapause. This has particular relevance for the southern cotton region where facultative diapause is a fundamental part of the biology, particularly of *H. armigera*. For *H. punctigera* there was an increase in mortality associated with resistance to Vip3A though no other effects could be observed relative to emergence percentage (assuming successful entry into diapause), weight or sex.

4) The fact that Vip3A resistant individuals are able to survive on conventional cotton suggests that they would be able to survive in conventional cotton refuges and most likely on other potential host species. In addition both species are able to reproduce successfully after developing on cotton. There was a fitness cost identified in homozygous resistant *H. armigera* and while relatively small, the developmental delay observed in conventional cotton suggest that the larvae would be exposed to predation, disease or alternative control methods for longer, reducing their chances of surviving and passing on the resistance genes.

This work represents a comprehensive analysis of the fitness effects of Vip3A resistance. Possessing resistance alleles to Vip3A can have some deleterious effects but most of these were observed in homozygous resistant strains. Heterozygotes did as well or even better than the susceptible strains in direct comparisons. However, without selection, the resistant phenotype declined in a relatively small number of generations in both species. This adds to the weight of evidence that refuges and non-structured refuges will play a vital role in controlling the frequency of Vip3A alleles in the population.