Plain English Summary

Recent research on the mechanisms by which plants defend themselves against insect attack has suggested a novel approach to crop protection that could be adopted for control of *Helicoverpa* on cotton. *Helicoverpa* feed on the growing tips and reproductive tissues of cotton throughout all growth phases of the plant. Late season infestations of *H. armigera* in particular cause significant economic losses. Currently *Helicoverpa* control relies on the use of a variety of chemicals, usually applied several times during the season. Most of these chemicals have been lost through the development of multi-resistant strains of *H. armigera* and although new generation chemicals are becoming available, they will be significantly more expensive than endosulfan and the synthetic pyrethroids. The advent of Ingard® cotton will provide some respite in the short to medium term, but Bt resistance will inevitably develop. To reduce reliance on chemical control, alternative *H. armigera* resistance genes are urgently required to support the development of sustainable IPM strategies for the cotton industry.

The project objective was to contribute to production of *Helicoverpa*-resistant cotton cultivars by identifying proteins capable of blocking insect digestion. Plants normally attempt to protect themselves from insect feeding by making protein inhibitors which block the action of essential digestive enzymes. Recent work has shown that insects are able to overcome the effects of these inhibitors by producing new enzymes that are less sensitive to the inhibitors. This project characterised the digestive proteinases of *H. armigera* and investigated the effects of different classes of proteinase inhibitors on the types proteinases produced by the insect larvae. The effects on insect growth and survival of combining multiple proteinase inhibitors were also determined.

It was shown that *H. armigera* produces a very large number of subtly different proteinases and is able to adjust the composition of the total complement of enzymes in response to inhibitors in its diet. Although the more effective inhibitors had some effects on insect growth, these were not sufficient to provide effective levels of plant protection. In light of the extreme genetic diversity present in these proteolytic enzymes it was concluded that a transgenic anti-nutritional strategy relying solely on this class of digestive enzymes was not likely to provide stable resistance against *H. armigera.*