Summary

Cotton plants expressing the Cry1Ac toxin from Bt are near to commercial release. These plants have been developed to aid in the control of heliothis caterpillars, the primary target of insecticide usage in cotton production. Despite initial hopes, the plants will not give season-long control of heliothis. Late in the season, heliothis grubs can survive and grow on transgenic cotton plants. Thus, in these mature plants either the amount of Bt toxin is lower than it was earlier in the season, or the Bt toxin is partially inactivated by the leaf. The decline in the efficacy of plants late season makes resistance management more difficult than if expression of the toxin was maintained at a high level.

This project examined the potential of transgenic Bt plants to select for resistance to the insect pest *Helicoverpa armigera*. We have focused on gaining an understanding of why the plants are able to control heliothis caterpillars late in the season. It is at this time that selection for resistance may well be at a maximum. At the beginning of our study nothing was known about the cause of the decline in toxin levels, nor were techniques available that would enable us to quantify those levels. Thus, we have had to focus on developing the necessary techniques to study the performance of transgenic plants grown under field conditions.

We have successfully developed a leaf bioassay test that can measure relative changes in toxicity of Bt leaves. We observed a 3-fold decline in toxicity of the plants from young plants, before budding, to mature plants with bolls. This decline is only small so it suggests that the level of Bt toxin in young cotton plants may not be much above the level to kill heliothis.

A number of additional factors were observed to affect the efficacy of the Bt. The potency of Dipel 2X™ was reduced to half when it was fed to larvae in a soy bean based diet, compared with one of chickpea. Some component of older leaves also appears to reduce the availability of Bt toxin to larvae feeding on a mixture. Preliminary experiments also indicate that stressing plants may also affect Bt levels, although further experiments are being carried out to elucidate the precise factors.

In a second phase of the project we have attempted to develop a strain of *H. armigera* resistant to Bt. We have modified and developed a technique that produces mutant *H. armigera*. These mutants have been screened for individuals carrying Bt resistant genes. One candidate resistant strain has been established. Although its level of resistance to Dipel is low, it appears to survive better on transgenic plants compared with controls. We are investigating this strain further.