

0.0 Introduction

0.1 Issues and objectives

Transgenic cotton (INGARD®) expressing the Cry1A(c) δ -endotoxin gene from Bacillus thuringiensis subsp. Kurstaki, with efficacy against Helicoverpa species was released for limited commercial production for the first time in parts of Australia at the beginning of the 1996-97 season. The limited commercial release was confined to New South Wales and southern parts of Queensland.

The decision by the National Registration Authority (NRA) to exclude central Queensland (CQ) from the commercial release area was based on two main reasons. The first reason was the concern expressed by the Genetic Manipulation Advisory Committee (GMAC) that the likelihood of the gene escaping into native Gossypium species was higher in CQ than in the release areas because of the greater abundance of native Gossypium species in northerly latitudes.

The second reason for excluding CQ from the limited INGARD registration was the concern that the national INGARD resistance management strategy for Helicoverpa spp. (*heliiothis*¹ hereafter) would be ineffective under CQ conditions. The strategy is based on the concept of gene dilution through the production of susceptible moths using 'refuge' crops, and post-harvest tillage of the soil to destroy diapausing pupal stages.

Under CQ conditions, destruction of diapausing pupae is thought to be ineffective as a means of eliminating end-of-season resistant individuals from the population for two reasons. First, the incidence of diapause in *heliiothis* is thought to be low in any given year, generally somewhat less than 50% of the total population. Second, simulation modelling and somewhat limited field data reveal that cotton is picked in CQ well before the onset of diapause. Thus, INGARD-resistant moths would be likely to migrate out of cotton, searching for alternate hosts, before post-harvest tillage operations to destroy pupae under cotton could be undertaken.

In response to requests by local grower organisations in CQ, the Cotton Research & Development Corporation (CRDC) commissioned research project DAQ81C to address GMAC and NRA concerns regarding the effectiveness of the national INGARD resistance management strategy in CQ. The challenges facing the CQ cotton industry for securing INGARD registration were manifold. First, the field parameters of the product had to be quantified for the local environment. The second and more difficult challenge was to develop a novel mechanism for end-of-season resistance management specific to CQ. Before such a mechanism could be developed, the ecology and population dynamics of *heliiothis* spp. as related to INGARD cotton needed to be studied and quantified.

The trials were designed to address the following main issues:

1. The effectiveness of INGARD cotton, i.e., changes in insecticidal efficacy over the season.

¹ For traditional reasons, the more familiar generic name *Heliothis* is retained here in preference over the correct name *Helicoverpa*.

2. Identification of suitable 'refuge' crops (crops that produce substantial numbers of heliothis pupae or moths) that could be planted with INGARD cotton as part of strategic resistance management.
3. The 'refuge value' of conventional cotton and non-cotton crops grown commercially within the irrigation area in terms of pupae or moths per hectare.
4. The extent of diapause in populations of heliothis across CQ.

In addition to addressing the above four issues, the research protocols and plan of work were designed to provide some information on the distribution of native Gossypium species in the region and the impact of INGARD cotton on local invertebrate fauna relative to conventional cotton.

A key objective of the trials was also to establish a framework of research activities that would facilitate the identification of novel resistance management options. The hope was that such options could be developed into a resistance management strategy specific to CQ.