Part 1 - Summary Details

CRDC Project Number: **CRDC 252**

Project Title: Impact of predation on emerging cotton pests

Project Commencement Date: **Project Completion Date:** 2005

CRDC Program: On-Farm

Part 2 – Contact Details

Administrator:	(Name & position of officer responsible for all correspondence).		
Organisation:	(Organisation administering the research project).		
Postal Address:			
Ph:	**Fax:**	**E-mail:**	
Principal Researcher:	Dr Mary E.A Whitehouse		
Organisation:			
Postal Address:			
Ph:	**Fax:**	**E-mail:**	
Supervisor:	Mrs Judy Nobilo		
Organisation:			
Postal Address:			
Ph:	**Fax:**	**E-mail:**	

Signature of Research Provider Representative: _____

Part 3 – Final Report Guide (due 31 October 2008)

Objectives

1. Adapt the rabbit IgG protein marker method to assess predation on mirids and cotton aphids using laboratory and glasshouse studies.
2. Use the rabbit IgG protein marker method to assess seasonal variation in predation of mirids, aphids and *Helicoverpa* amongst the most commonly occurring invertebrate predators in cotton fields, under varying management regimes.
3. To determine if super-predation (predation of predators) can confound the outputs from rabbit IgG – based assessments, given the apparent sensitivity of the marking method.

Results

Little is known about the main predators of emerging pests in Bt cotton. To fill this gap a marking technique using ELISA (enzyme-linked immunosorbent assay), was adapted to assess predation on mirids, *Helicoverpa* eggs, and cotton aphids. The technique involves marking target pests with rabbit IgG protein and then using ELISA to detect the presence of the protein in predators who may have consumed the pest. The technique was first tested under laboratory conditions, and then applied under field conditions.

Testing the effectiveness of rabbit IgG protein at marking mirids, Helicoverpa eggs, and aphids.

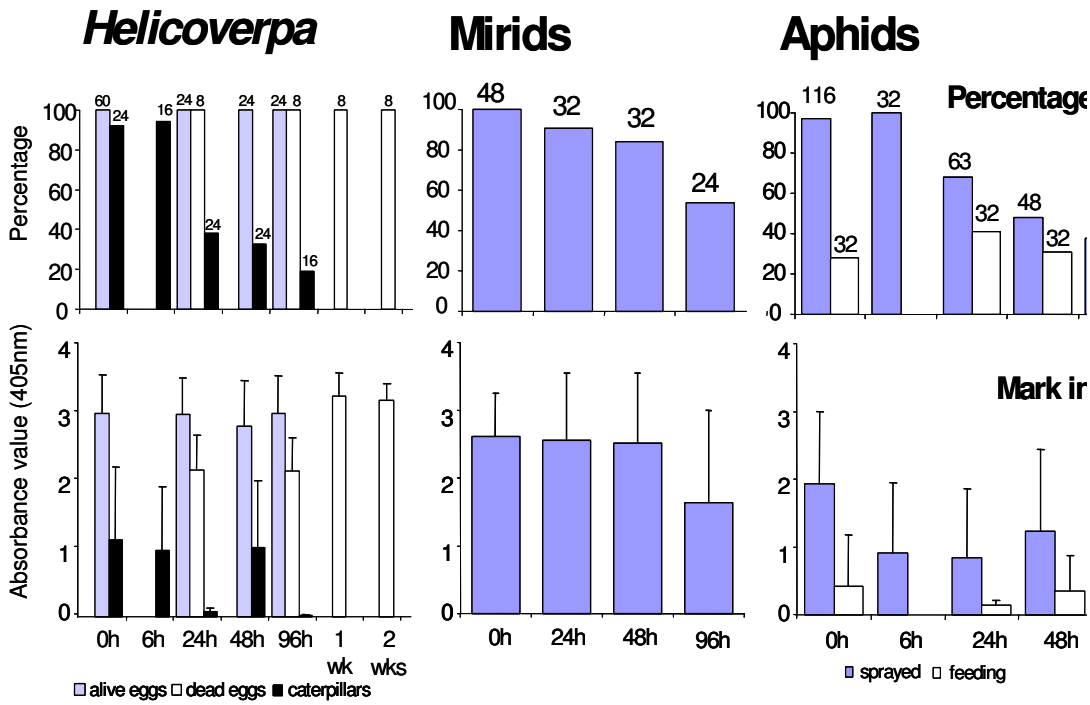

Fig. 1. Percentage of *Helicoverpa* eggs, mirids and aphids that remained marked, and the intensity of the mark, after various time intervals. All animals were marked with rabbit protein by spraying, except "feeding" aphids, which were marked with rabbit protei allowing them to feed off a sugar solution containing the protein. The number above the percentage columns are the total number o animals tested. The time interval refers to the time since marking for the eggs, mirids and aphids (and the time since hatching for tl caterpillars). The mark intensity was calculated using only samples that recorded a positive mark.

Our laboratory results indicated that eggs were easily marked and stayed marked indefinitely, with high absorbance values (Fig. 1) indicating high concentrations of the rabbit IgG protein marker. Mirids were easily marked, but the proportion marked and the mark intensity declined after a few days. Aphids were difficult to mark. External marking was the most effective, but the proportion of animals marked and the mark intensity dropped off after 6 hours (Fig. 1). Given these results we decided to leave marked eggs and mirids in the field for 24 hours, and leave marked aphids in the field for only 6 hours.

We tested 800 predators belonging to seven species groups for their likelihood to become marked after eating aphids, mirids or *Helicoverpa* eggs. We found that predators such as lynx spiders and yellow night stalkers, jumping spiders, and red & blue beetles were marked strongly when they ate prey; ladybirds and ants were less well marked, while Damsel bugs were poorly marked. We suspect that the differences could be in part due to differences in the foraging behaviour of the predators – those that manipulate their prey may be more easily marked than those that don't. Marking the pests internally as well as externally may reduce this bias.

Predators of mirids, Helicoverpa eggs, and aphids identified using ELISA techniques under field conditions.

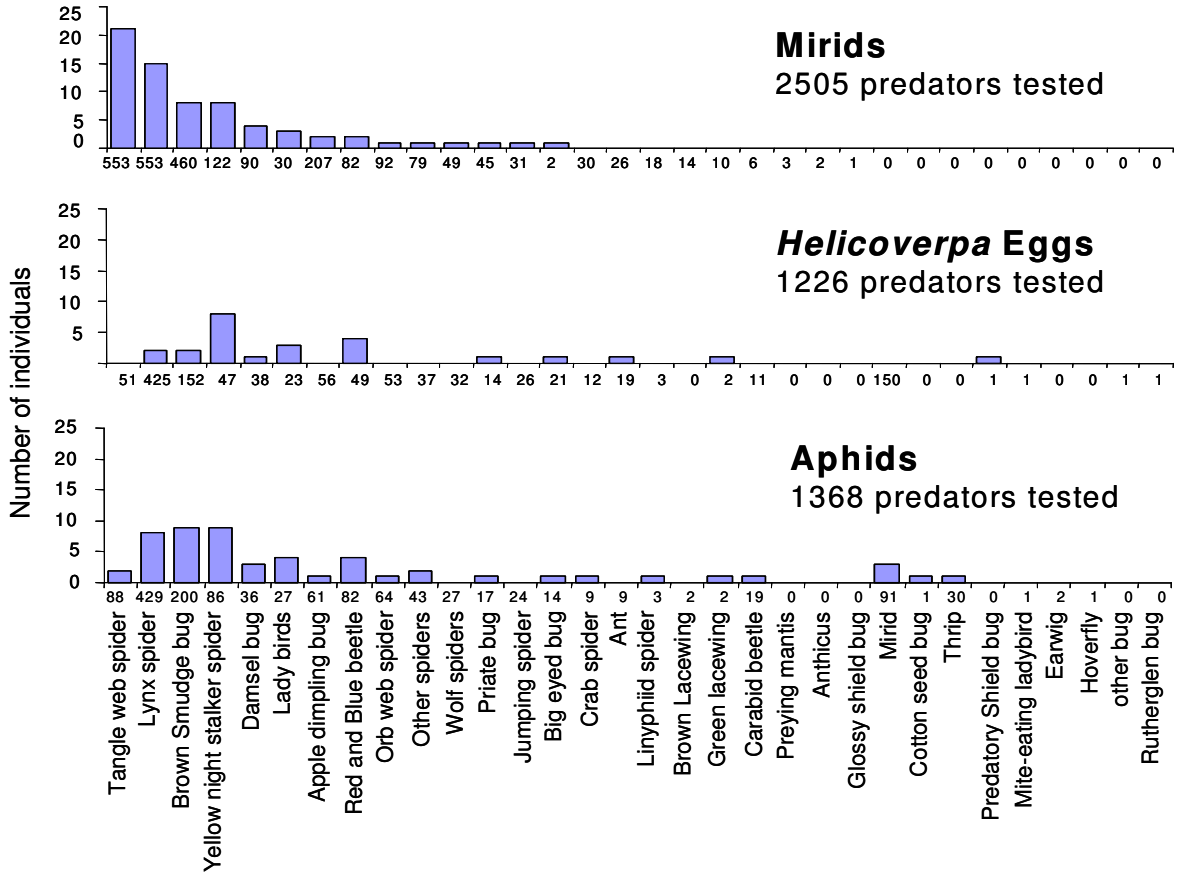

Fig. 2. The number of marked predators collected throughout the season around the release sites of marked mirids, *Helicoverpa* eggs, and aphids

We collected and tested using ELISA techniques over 5000 potential predators of mirids, aphids and *Helicoverpa* eggs. Through testing marked controls and recaptured mirids, we estimated that about half of all the aphids and mirids that predators encountered at the study site were marked, while 99% of all eggs were marked. 3.5% of all predators we collected were marked.

We found that there was a significant difference in the predators that attacked the three prey types, with tangle web spiders and lynx spiders the main predators of mirids, yellow night stalkers, brown smudge bugs, and lynx spiders the main predators of aphids, and yellow night stalkers the main predators of *Helicoverpa* eggs (Fig. 2).

The dominance of spiders as important predators of these pests may partially reflect their numerical dominance in the field, and a bias in the ELISA technique revealed by our laboratory experiments which showed that spiders are more easily marked than some other animals.

Nevertheless, we were not surprised to find lynx spiders as major mirid predators. Work undertaken by our summer scholarship student, Mark Barnett, indicated that the presence of adult female lynx spiders (*Oxyopes amoenus*) reduces the number of mirids and damage to cotton bolls in cage experiments (but that the effect is reduced when damsel bugs are included in the cages). His work also indicated that female lynx spiders prefer larger adults or 4-5th instar mirids.

Even though aphids were difficult to mark, were only tested in the field half as many times as the mirids, and only exposed to predation for 6 hours, they recorded the highest number of predator species. This bodes well for their control in unsprayed Bt fields.

Overall, these results indicate that in Bt crops with low spray regimes there will be many predators on hand to control aphids, and spiders have an important role to play in the control of mirids.

These findings increase our understanding of the predator community in Bt cotton on hand to control emerging pests such as mirids and aphids.

Outcomes

1. *Establish a Helicoverpa and a mirid culture for provision of insects for lab & field experiments by spring 2004. Experiments conducted, drawing upon the culture. January Progress and Final report delivered accordingly.*

This milestone was achieved. We were able to use *Helicoverpa* eggs from other projects (DAN 173C, CSE 102C) and so did not need to develop a *Helicoverpa* culture. We had healthy and thriving mirid and aphid cultures all season.

We drew on our cultures to conduct experiments to test and modify the ELISA technique with mirids, *Helicoverpa* eggs, and aphids.

2. *Conduct early, mid and late season field experiments to measure incidence of predation amongst common predators, using rabbit IgG protein marker. Results of early season's experiment reported in January Progress Report; results of all three seasonal experiments documented in Final Report.*

This milestone was surpassed. Experiments were conducted throughout the season testing the predators of mirids, aphids and *Helicoverpa* eggs. Over 5000 predators were sampled.

3. Conduct experiment on super-predation by January 2005. Document results in Final Report.

This milestone was not achieved. Due to the large number of predators collected during the season, laboratory analysis using ELISA techniques were still continuing into late May. Consequently we were unable to conduct experiments to test super-predation directly. We do have some anecdotal findings.