



**PROF. SILVIA DORN - SCIENTIFIC EXCHANGE
Final Report, 12 April 2011**

Part 1 - Summary Details

Cotton Catchment Communities CRC Project Number:

**Project Title: SCIENTIFIC EXCHANGE PROGRAM APPLICATION -
FINANCIAL YEAR 2010/2011
Project CRC 5.10.10.47**

Project Commencement Date: 5 February 2011

Project Completion Date: 12 February 2011

Research Program: Farm program

Part 2 – Contact Details

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Other Staff & Collaborators – Please list

Signature of Research Provider Representative: _____

Part 3 - Travel Report

The points below are to be used as a guideline when completing your final report.

1. What were the major goals:

- (A) To make a general science-based contribution to the Australian Research Community striving to prolong the lifetime of Bt cotton.
- (B) To contribute to the supervision of a PhD student project investigating the flight characteristics of *Helicoverpa* spp. in relation to the efficacy of transgenic cotton refuges.

1.2 Major findings, outcomes and highlights.

1.2.1 Realization of Goal A

Presentation

A 45 min. presentation was prepared addressing scientists involved in research for cotton pest management. It was presented at the University of Queensland (U-Q) and at ACRI Narrabri. It attracted approximately 50 participants at U-Q in Brisbane, coming from different units of U-Q, CSIRO and DEEDI, and approximately 30 + 20 participants at ACRI Narrabri, combined with video broadcasting to CSIRO Canberra and Long Pocket Laboratories in Brisbane. The topic was: *Herbivore behaviour matters: insect flight performance and host switch*. Resistance management of *Helicoverpa* spp. on transgenic cotton crops in Australia are based on well-functioning refuges which are host plants of *H. armigera* other than Bt-cotton. The size, location and management of the refuge crops are mainly based on population genetics models, which predict that such refuges will substantially decrease the rate at which pest populations evolve resistance to Bt.

Prof. Dorn's presentation emphasized the importance of insect flight and choice behaviours between the refuge and the crop. Based on studies carried out at by Prof. Dorn in ETH Zurich in Switzerland, mainly on the codling moth *Cydia pomonella* and its interaction with phylogenetically distant host plants, dispersal and host switch needs to be addressed as relevant insect behaviours. She indicated that dispersal, i.e. movement of individuals between breeding habitats, depends on the flight capacity and mobility of individuals within a population. Host switch addresses insect dispersal from the natural host to a different host plant species, often involving chemically-mediated interactions. Empirical evidence shows a high degree of intraspecific variation of the codling moth (and further species) regarding flight performance, rendering various advanced pest control methods more complex. In the codling moth, flight traits are heritable, and certain conditions select for sedentary traits. Despite its relatively wide diet breadth, this (and other) species can evolve adaptations to distinct host plants, limiting the gene flow between populations from different host plant species. Knowledge of such inadvertent behavioural adaptations can provide the basis for adequate counteractions.

Remarks:

There was a broad interest in Prof. Dorn's presentation particularly the documented evidence that agricultural practices often select for undesirable traits. She concluded that awareness of such inadvertent selection will be very useful, when it is based on sound research data. Recent literature with potential implications on the project Silvia Dorn (SD) prepared a literature update on Bt cotton and resistance yielding 24 important papers, of which most were published between 2007-2010.

Meeting with the Bt Technical Committee

Prof. Dorn met with the Cotton Industry's Bt Technical Committee during her scientific exchange in ACRI. The Bt Technical Committee meeting was attended by several members of the Bt Technical Committee including Dr. Robert Mensah (RM), Prof Rick Roush, Tracey Leven, Prof. Peter Gregg. Major topics were interpretations of the recent field observations of *Helicoverpa spp.* on Bt crops, and recent and upcoming papers on the issue. The experience from the US includes the following particularly relevant papers, which have been controversially discussed at the meeting; it was concluded that more research is required:

Tabashnik BE, Carriere Y, 2010. Field-evolved resistance to Bt cotton bollworm in the US and pink bollworm in India. *Southwestern Entomologist* 35: 417-424.

Tabashnik, BE, Van Rensburg, JBJ, Carriere,Y, 2009. Field evolved resistance to Bt crops: definition, theory, and data. *Journal of Economic Entomology* 102: 2011-2025.

1.2.2 Realization of Goal B

Discussions with project supervisors and Jason Callander (JC)

Prof. Dorn is a co-supervisor of Mr Jason Callander (JC) a PhD student enrolled in the School of Biological Sciences in the University of Queensland in Brisbane. JC's other supervisors are Assoc. Prof. Gimme walter (academic supervisor) and Dr Robert Mensah (co-supervisor). Jason's project is on flight characteristics of *Helicoverpa spp.* in relation to the efficacy of transgenic cotton refuges. The student's project was discussed with all supervisors directly involved in the project with JC. For example, the paper published by Addison SJ, 2010 (*Agricultural Ecosystems & Environment* 135: 328-335) states that there was no immigration of ovipositing *H. armigera* from pigeon pea into BT cotton in the trials carried out in 2005. Thus, the pigeon pea refuges would not function as an effective source of sensitive *H. armigera* that should mate in the Bt cotton field with potentially resistant individuals, to generate heterozygous offspring, which would then be killed upon feeding on

Bt cotton. This contrast with the original concept to render Bt cotton a powerful dead end trap crop.

The project supervisors also held a discussion to discuss potential trials for Jason's PhD project years. These included:

(i) Field cage and greenhouse experiments:

This is to determine optimal combinations of plant growth stage in refuge and of the Bt crop, to ensure significant movement of *Helicoverpa* spp. from refuge to Bt cotton crop occur.

(ii) Actograph studies

The objective for the studies is to provide a comparative and quantified information of insect physiological state eg matings, biotic environment on flight parameters. Discussions were made on flight mills, actographs considering non-tethered movement of insects, biotic and physiological states of the insect.

The test of the physiological state of the insect was discussed in detail with the student. Discussions to get access to CSIRO and Monsanto Bt resistance strains at ACRI for tests on physiological state was initiated with Dr Sharon Downes. Sharon agreed that the strains will be provided to Jason Callander under CSIRO Material Transfer Agreement for his studies. Methodological recommendations for the studies were also discussed and this included gaining experience in gluing insects to flight mill, using several dozens of specimens prior to the start of the physiological state experiments

(iii) Project duration

The original project duration was planned to comprise the period from September 2009 to August 2012, and Prof. Silvia Dorn agreed on support for this period to UQ. However, delays in signing contracts with the funding body resulted in the project commencing in February 2010, and together with flood-related events, this will likely lead to an extension of the PhD until mid 2013. Consequences were discussed. A concept on efficient communication between the supervisors to support the student project across the continents was developed during the visit.

(iv) Annual telephone conference:

By end of July each year, Jason Callander will send an agenda, with an attachment including achievements and planned topics to discuss (detailed Objectives, Expected (or Realized) Output) of the project for discussion.

2. Detail the persons and institutions visited, giving full title, position details, location, duration of visit and purpose of visit to these people/places.

Dates	Destination	Activities
5 Feb, 2011	Arrive in Brisbane	Picked up by Mr Jason Callander to Hotel
6 Feb 2011	UQ Brisbane	Meeting with PhD student Jason Callander for updates on project progress;
7 Feb 2011	UQ-Brisbane	<ul style="list-style-type: none"> • Project meeting with co-supervisors and PhD student • Give a presentation in the School of Biological Sciences, UQ
8 Feb 2011	ACRI-Narrabri	<ul style="list-style-type: none"> • Flight from Brisbane-Sydney-Narrabri • Picked up from Narrabri Airport to Motel
9 Feb 2011	ACRI	<ul style="list-style-type: none"> • Meeting with the Bt Technical Committee • Give a presentation to ACRI research staff on insect flight phenology and resistance management in relation to refuges
10 Feb 2011	ACRI	<ul style="list-style-type: none"> • Field visit with PhD student (Jason Callander) and Dr Robert Mensah to discuss field trials • Final discussion with Project supervisory team and wrap up of project directions and methodologies
11 Feb 2011	ACRI – UQ Brisbane	<ul style="list-style-type: none"> • Meeting with Research staff working on Bt resistance refuges. Advise on project objectives and refine project methodologies etc • Field visit with Mr Jason Callander and Dr Robert Mensah to discuss field trials
12 Feb 2011	Sydney – Zurich	Return to Zurich

3. a) Are there any potential areas worth following up as a result of the travel?

Prof. Dorn's presentation emphasized the importance of insect flight and choice behaviours between refuge and the primary crop. Based on studies she carried out on the codling moth *Cydia pomonella* and its interaction with phylogenetically distant host plants, she indicated that dispersal and host switch needs to be addressed as relevant insect behaviours that can limit gene flow between *H. armigera* populations in Australia. Knowledge of such inadvertent behavioural adaptations will provide the basis for adequate counteractions.

b) Any relevance or possible impact on the Australian Cotton Industry?

H. armigera flight traits may be heritable, and certain conditions may enhance selection for sedentary traits. Therefore, despite *H. armigera* relatively wide diet breadth, these species can evolve adaptations to distinct host plants, limiting the gene flow between populations from different host plant species. If this occurs, then movement and mating of *Helicoverpa* moths developed in refuge and Bt cotton crops may not occur as expected resulting in the development of *H. armigera* resistance to the Bt toxins.

How do you intend to share the knowledge you have gained with other people in the cotton industry?

Mr David Larsen videoed the presentations given by Prof. Dorn and this have been sent to growers and consultants as well as researchers and cotton industry representatives.

5. Executive summary. Provide a one paragraph summary of the scientific exchange, suitable for posting on the Cotton CRC web site.

Prof. Dr. Silvia Dorn, Professor of Applied Entomology from ETH Zurich in Switzerland was on a scientific exchange to the Australian Cotton Research Institute (ACRI) in Narrabri from 5 – 12 February 2011. The exchange was organized by Dr Robert Mensah (NSW Department of Industry & Investments, Australian Cotton Research Institute Narrabri, NSW) and Assoc. Prof. Gimme Walter (School of Biological Sciences, University of Queensland, Brisbane). Prof. Dorn gave two presentations during the visit to staff of University of Queensland (UQ), NSW DII, CSIRO and DEEDI. The presentations were titled "*Herbivore behaviour matters: insect flight performance and host switch*" The presentations emphasized the importance of insect flight and choice behaviours of *Helicoverpa* spp. between Bt cotton and refuge crops. According to Prof. Dorn, insect species can evolve adaptations to distinct host plants, limiting the gene flow between populations from different host plant species and this will have implications on *Helicoverpa* spp. resistance management in transgenic cotton crops in Australia