# The Silverleaf Whitefly Management Challenge: A New Pest in Central Queensland

Dave Kelly[1], Paul Grundy[2] & Richard Sequeira[1]
Queensland Department of Primary Industries and Fisheries
The Australian Cotton Cooperative Research Centre
[1]LMB 6, Emerald Qld., 4720.
[2]LMB 1, Biloela Qld., 4715.

## Summary

Silverleaf whitefly (SLW) is an introduced pest to Australia, having first been discovered in the early 1990's. It was not until the 2001-02 season that a serious outbreak occurred on the Central Highlands and to a lessor extent the Dawson Valley, impacting on a variety of crops including cotton, peanuts, melons, sunflower, soybeans and nursery plants. It also diminished air quality (from clouds of insects) thereby affecting quality of life of townsfolk and destroyed numerous varieties of garden plants.

The outbreak occurred partly due to the inability of local cropping industries to control the pest in a number of situations, especially cotton. To address this issue, the Central Queensland cotton industry and QDPI&F invested much time and effort to rapidly develop a management strategy for the pest.

Paramount to the success of any SLW management strategy was to have:-

- Cross industry collaboration between local growers, consultants, extension and research staff and international experts. This was made possible through investments from the Cotton Research and Development Corporation (CRDC) and relevant Government agencies.
- A high level of communication within the cotton industry though facilitated Area Wide Management group meetings and specific grower meetings.
- The adaptation of existing information from international sources to fit the needs of the local industry.
- Local collection of data on changes within the SLW pest populations from which the impact of the strategy could be assessed and enable improvements or modifications to be made.

The implemented SLW management strategy has worked reasonably well on both the Central Highland and Dawson Valley regions in the ensuing 2002-03 and 2003-04 seasons. Despite the initial success of the SLW management strategy, it is recognised that this pest will be an ongoing issue for the CQ cotton industry and it has become evident that the management of this pest will require further changes. In all other parts of the world SLW has continued to be a problematic pest which leaves little room for complacency. For cotton producing areas in Australia that have not experienced a SLW outbreak, the model

developed and implemented in CQ could serve as an appropriate template for management. Whilst strategies will need to be tailored to suit varied cropping systems and pest spectrums, the key concepts of sampling, communication and strategic insecticide use will still be appropriate. This paper provides a background to this pest problem and describes the processes that were conducted to arrive at what has so far been the successful implementation of a management strategy for this new pest.

## Background

The past three seasons have seen the cotton industry of Central Queensland face one of its largest challenges, Silverleaf Whitefly (SLW). An introduced, sap-sucking insect, SLW had the potential to put major constraints on producing cotton in this region.

The silverleaf whitefly (SLW), *Bemisia tabaci* B Biotype was first discovered in Australia in 1994, and was thought to be introduced on live poinsettia cuttings imported from the USA. The insect has been identified as a major pest on nearly every continent in the world and has a host range of at least 500 crops and ornamental plants.

When SLW was inadvertently introduced into Australia, it brought with it resistance to most organophosphate, carbamate and synthetic pyrethroid insecticides. Since then, SLW has also developed resistance to additional compounds including imidacloprid, endosulfan, bifenthrin, insect growth regulators and amitraz in some areas of Australia.

SLW was known to be present in irrigated crops around Central Queensland during the second half of the previous decade. The warm climate of the area and the year-round abundance of suitable host plants for the pest highlighted this district as one theoretically suited to SLW outbreaks. Despite this, SLW populations didn't reach problematic levels in crops until autumn of 2000-01 (April) when high numbers were found in a very late maturing cotton crop close to the town of Emerald.

In response to this minor outbreak, monitoring began in August, and through to November, it appeared that there would not be a problem in the 2001-02 cotton season. At this stage there were a small number of fields with low populations, and these were predominantly adjacent to alternative hosts such as melons and pumpkins. By December populations had increased significantly, particularly in the fields where the pest had been found initially. In addition, the SLW populations had spread to the point where they were present in almost every field in the district by the end of the month.

At that time, there were no pesticides registered for SLW on cotton in Australia. Therefore, in mid December the CRDC, on behalf of the cotton industry, applied to the National Registration Authority (NRA) for emergency use permits for a number of products. By early January, permits had been approved for diafenthiuron (Pegasus®) and buprofezin (Applaud®) for use in the Emerald Irrigation Area. Pegasus® was already registered on aphids and mites in cotton and has some activity against all life stages of SLW. Applaud® is an Insect Growth Regulator (IGR) registered on some horticulture crops. It is a chitin synthesis inhibitor, preventing nymphs from moulting. It cost about AUD$170/ hectare, approximately double that of any other products registered on cotton.

Through January and early February populations continued to escalate and crops were being treated regularly for the pest. Pegasus® was used quite widely (60% of the area) achieving adequate results, although given the nature of the pest, the effects of the product were short-lived. Pegasus® use was also limited by a 35 day withholding period and a label requirement of six weeks between applications. Some knock-down products such as pyrethroid mixes (with PBO or organophosphates), used to control *Helicoverpa spp.*, offered limited control of SLW adults but provided very little residual or activity on nymphs.

Defoliation began in early February causing major migration from defoliated crops to later planted crops or those delayed by hail damage sustained in November. By mid to late February, these non-defoliated crops were receiving extreme pressure and in many cases attempts at control seemed pointless given the lack of residual control and the immediate reinfestation.

In 2001-02 it was estimated that cotton growers spent in the order of $AUD 110 per hectare on additional insect control for SLW. This equates to approximately $AUD 2.4 million across the Central Highlands. The widespread use of broad-spectrum insecticides for SLW late in the season decimated natural predator and parasite populations, which are very important for integrated pest management of all pests.

Successful control of SLW was not achieved. This resulted in a situation where the problem was moved to other industries in the district, especially around the time of defoliation when large areas of cotton rapidly became an unattractive host. The knock-on effects are surmised in the following:

- Several local soybean crops developed massive infestations with some having to be destroyed and others being useful only for hay. Yields of crops taken to harvest were generally at non-profitable levels. Soybean is a preferred host of SLW.
- Irrigated and dryland sunflower crops in the region received large populations of SLW during January and February. This resulted in large reductions in yield.
- Growers of autumn rock melon experienced increased insect control costs as their crops received high populations of SLW throughout February. The earliest planted crops also suffered lower sugar (brix) levels in the fruit (affecting sweetness), caused by the removal of sugars from the plant by the insect.
- Despite being a non-preferred host, local peanut crops developed high populations throughout January and February. Growers found lower yields in areas that harboured highest insect numbers.
- Local Nursery stores experienced high populations of the insect after Christmas, which were worst during February and March. When infested in high numbers it made presentation of plants in the nursery difficult. There were concerns about the potential spread of the pest around the district on live plants. Some nurseries had to destroy quantities of live plants. Furry leafed plants were worst affected especially, scented

gums, hibiscus, geraniums, durantra (which is a smooth leafed plant), roses (some species), tomatoes, pumpkins, and eggplant. Control in nurseries was achieved by a number of different options including imidacloprid (Confidor®) and white oils.

- During January and February, large numbers of air-borne SLW moved through the township of Emerald affecting quality of life of townsfolk who complained of deaths of ornamental plants and diminished air quality (from clouds of insects). There were reports of people trying various insecticide options in vain to try and control the populations within their gardens.

There were also populations of SLW in the Dawson and Callide cotton growing areas in Central Queensland during 2001-02, although not to the same extent as the Central Highlands. In the Dawson valley, around the Theodore irrigation area, crops on 2-3 farms developed significant populations very late in the season. In the Callide, some rock melon and cotton crops developed significant populations during March and April.

At the completion of the 2001-02 season, the industry held a number of meetings to determine what exactly went wrong and what needed to be achieved before the start of the next season. Significantly, it was painfully obvious that this pest could not be managed like this again in the future.

## Development of a Management Strategy

In preparation for the 2002-03 season a strategy for controlling the insect on a regional basis needed to be developed. Several important steps were taken in developing a strategy for the region. It was evident from the outset that a strategy would need to incorporate ways to prevent an outbreak from occurring as well as managing local populations, should numbers become problematic. Preventative measures would include **narrow planting window** for cotton and the minimisation of alternative whitefly host plants. In crop management would depend on having **new insecticides** available to control SLW, **defined thresholds** to determine when these products be best used, **an integration model** for these products that considered the **needs of each industry and resistance issues**, **population modelling** to assess the effects of implemented changes and a large **communication effort** to extend the strategy and bring together various stakeholders under a common cause. It was realised that the best starting point for developing a strategy would be to examine management programs that had been used to control the pest in other parts of the world.

***Study Tour of the USA.***

Cotton Research & Development Corporation, Cotton Seed Distributors, and the cotton grower associations of the Central Highlands, Theodore and Biloela sponsored a fact finding tour for 12 people involved in the cotton industry in Central Queensland to visit regions in the United States of America that had experienced and managed problematic SLW populations.

The tour covered three distinct areas that shared similarities with the cotton production system of Central Queensland in terms of crop dynamics and climate; Rio Grande Valley, Texas; Low Desert Areas, Arizona; and Imperial Valley, California. In each of these areas the tour group spoke to producers, consultants, researchers, extension staff, and aerial operators to gain an understanding of the pest and its management.

From this tour is became fundamentally clear that any strategy for SLW had to be widely adopted across and within the industries concerned. For a strategy to work in CQ it would need to be developed at a **'grass roots'** level with all affected stakeholders included at the onset. The strategy had to be built around people.

***The Development and Implementation of a Strategy***

The management strategy for SLW in CQ was based on programs being successfully utilised in the cotton industries of southern Texas and Arizona. The key points of the strategy would be:

- **Sampling:** The ability to identify and monitor SLW populations before they reach outbreak levels is crucial in the effective management of this insect.
- **IPM-friendly chemical usage:** Management of other pests was altered to avoid the use of broad-spectrum insecticides that will impact on natural enemy (predators and parasites) populations. When correct thresholds were reached, populations were treated with efficacious insecticides (usually Insect Growth Regulators IGRs first), to prevent the population spreading.
- **Cultural:** A strong emphasis was placed on removing on-farm SLW hosts (weeds and ratoon crops), especially during the off-season to limit overwintering populations and additional point sources for reinfestation.

Specific details on the management plan developed for silverleaf whitefly in cotton can be located in the Australian Cotton CRC Research Reviews 'Management of Silverleaf Whitefly in Australian Cotton' and Silverleaf Whitefly in Australian Cotton'. These publications are available on the Australian Cotton CRC website www.cotton.crc.or.au

The **foundation** of this strategy was the high level of regular internal **communication** within the local industries which included growers, consultants, researchers, extension staff, spray applicators, and resellers.

Based on the experiences from the USA study tour, the local cotton industry also made it a priority to get other industries involved in the area-wide management of SLW. A group called the 'Central Highlands Cross Industry Whitefly Action Group' was formed. The group included, representatives from the grains, horticulture, cotton and nursery industries, local shire and QDPI& F staff. The group produced a brochure for householders on SLW whitefly and how it could be managed in the home garden, and how householders can contribute to the area-wide management of the pest. The brochure was distributed throughout the cotton producing communities in Central Queensland

***Confirmation of the Implemented Strategy***

Dr Peter Ellsworth is an entomologist with the University of Arizona whom the study tour group had met during their July visit to the USA. Peter visited Central Queensland in December 2002 as part of a tour sponsored by the CRDC.

During his week long visit, Peter met with many people in the industry in CQ, both individually and in larger groups. He talked about how the management strategy had worked in Arizona. The timing of his visit coincided very well with the population development of SLW during the 2002-03 season. Peter was able to spend time with a number of consultants who were preparing to make decisions on applications of insect growth regulators.

At the completion of his visit, Dr Ellsworth was impressed with the deployment of the management strategy in Central Queensland and appeared confident that it would work.

*"I cannot tell you how impressed I was with the interactions I had with the growers and consultants there. The Central Queensland cotton industry has achieved in less than 1 year what we spent over 5 years trying to do here in Arizona. And further, what we saw transferred so successfully to clientele in my short 2 weeks in Australia has yet to be adopted at as high a rate in Arizona after 7 years!"* Dr Peter Ellsworth, January 2003.

## Outcomes from the Adoption of the SLW Strategy

The industry wide adoption of the SLW management strategy has successfully curtained pest populations below damaging levels the 2002-03 and 2003-04 seasons. It has become evident though in the 2003-04 season that the strategy will require further fine tuning to fit local conditions as whitefly built up rapidly towards the end of the season suggesting that the current approach may require some modification.

Whilst it is still early days a number of industry wide changes in terms of pesticide use, SLW population activity and industry attitudes have occurred as a result of this new pest and associated management strategy.

***Reduced use of broad spectrum insecticides.***

It was highlighted that the practice of using the organophosphate (OP) products dimethoate (eg Rogor®) and omethoate (eg Folimat®) early in the 2001-02 season for green mirid control may have been a contributing factor in flaring SLW populations. Whilst these products were generally used at lower rates, it was decided that every effort should be made to avoid their use.

Insecticide use data from both the Dawson Valley and Central Highlands indicate that the use of OP products was all but eliminated, dropping from 80% of both areas in the 2001-02 season. Indications are that this use pattern was also repeated during the 2003-04 season.

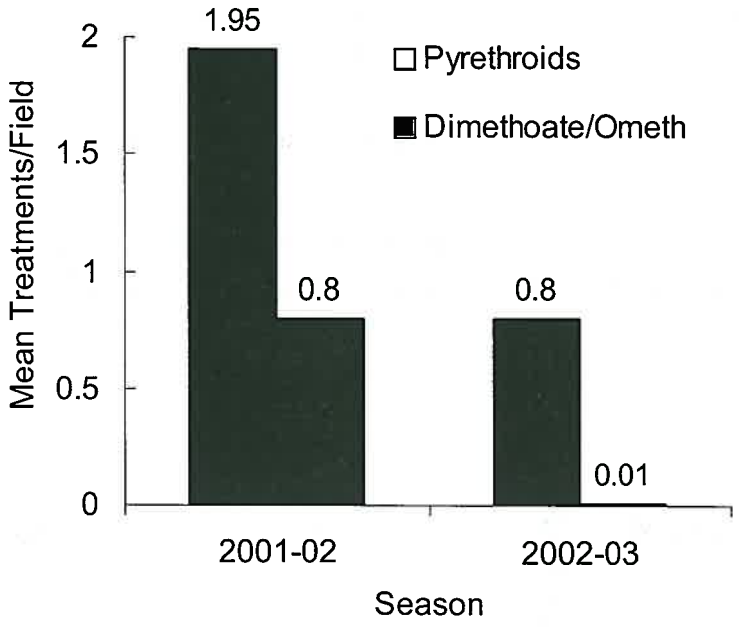


**Fig.1** The mean number of pyrethroid, dimethoate and omethoate treatments per cotton field for central Queensland.

***Strategic treatment with Insect Growth Regulators***

On behalf of the cotton industry, the CRDC successfully applied for emergency use permits for the IGR products pyriproxifen (Admiral® from Sumitomo Chemicals) and buprofezin (Applaud® from Dow). These products formed an integral part of the SLW management strategy employed successfully in Arizona when used in conjunction with correct sampling and appropriate thresholds.

Cotton consultants in both the Central Highlands and Dawson Callide valleys readily adopted the sampling strategy developed by the University of Arizona and the United Stated Department of Agriculture. The use of these products relied upon a specific sampling strategy for the pest to determine when the IGR is best deployed.

Thresholds for IGRs were first reached in mid December in both the Central Highlands and Dawson Valley during the 2002-03 season. Approximately 40% of both districts were treated with these products between mid December and early February. This approximate usage level was repeated during the 2003-04 season although applications were made later in the season during January and February. This aspect has raised the question about the best timing for these products use. Both IGR products offered excellent control of SLW populations, preventing outbreak situations within fields and spreading the problem to other crops.

***A Large Regional Reduction in SLW Population Density***

Monitoring of SLW was carried out across the Central Highlands and Dawson Valley by QDPI&F entomology teams. Sites were selected around CQ with a variety of host plants

including crops and weeds. Populations were assessed regularly for adult and nymph SLW. Comparisons of SLW populations on cotton showed that despite a higher base population of the insect in August 2002 and 2003 than in August 2001, the abundance of the pest never reached the same outbreak levels due to the successful adoption of the management strategy (Fig 2).

On a district level, this meant fewer insects migrating out of cotton crops and affecting other crops or the community of Emerald, as had occurred in 2001-02.

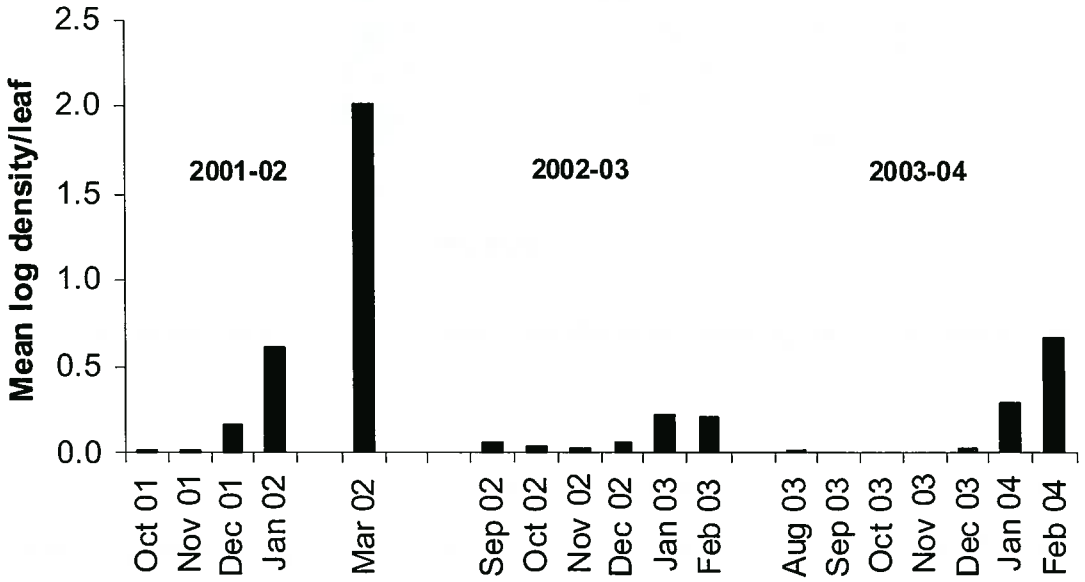


**Figure 2.** SLW adults on cotton. Average across the Central Highlands for seasons 2001-02, 2002-03 and 2003-04. Monitoring done by DPI&F entomology team and Paul DeBarro (CSIRO).

### *Advent of High Parasitism Rates by Native Parasites*

A major contributing factor for the reduction in SLW populations in cotton in 2002-03 and 2003-04 compared to 2001-02 was the level of insect parasitism from native *Encarsia spp* and *Eretmocerous spp*. Monitoring of parasitism in the 2001-02 season by Dr Paul DeBarro (CSIRO) had shown no major impact from parasitism in that season with levels never reaching higher than 5% (data not shown). Monitoring conducted during the 2002-03 and 2003-04 seasons (Fig 3) showed parasitism escalated throughout the cotton season, and was sustained on other host plants during the autumn. The advent of higher parasitism levels was again due in part to the successful deployment of the management strategy that curtailed the use of disruptive organophosphate insecticides.

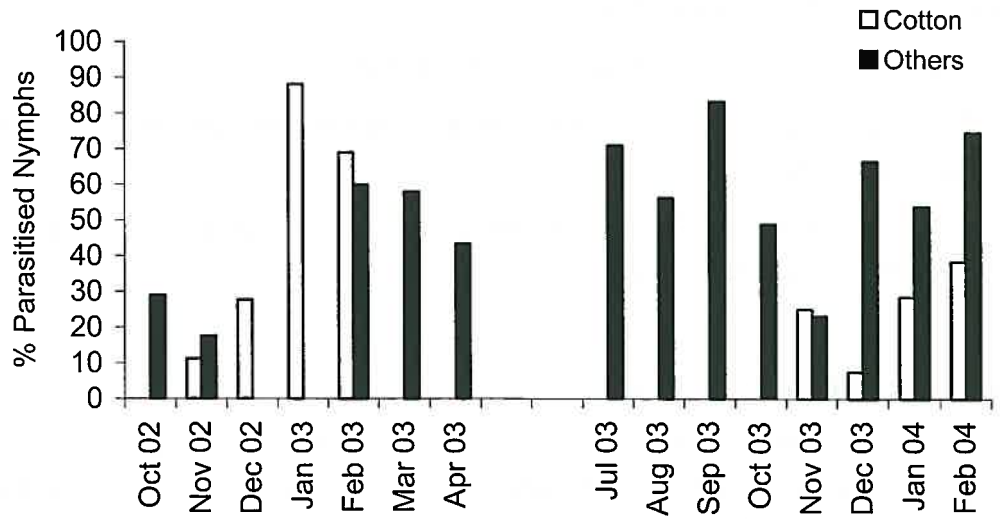


**Figure 3.** Parasitism of SLW nymphs on cotton and other crops across the Central Highlands for seasons 2002-03 and 2003-04. Monitoring done by DPI&F entomology team and Paul DeBarro (CSIRO).

## Conclusions

Through a management strategy that was developed, promoted and implemented from a 'grass roots' level in collaboration between growers, consultants, research and extension, the ability to manage silverleaf whitefly in cotton has been improved greatly since 2001-02.

This was demonstrated in a detailed evaluation of this management strategy carried out by QDPI&F after the 2002-03 season. Cotton Growers and consultants in CQ felt the ability to manage SLW had improved through the development of a clear and defined management strategy that includes sampling procedures, thresholds, conservation of predator/ parasite insects, access to efficacious chemistry, and importantly collaboration between industries.

The sources cited as being important to generating this management strategy are:

- Information brought back from the study tour of the USA undertaken by local industry personnel.
- Ongoing QDPI&F extension and research efforts.
- Information given by Peter Ellsworth on his visit.

Despite this, the evaluation also highlighted that industry is acutely aware that whitefly will be an ongoing problem and it's another challenge that will need to be addressed every year.

The key challenges from now will be:

- To maintain the momentum of area wide IPM in CQ.
- Promote the potential for SLW to become a serious problem in other vulnerable regions outside CQ.
- Continued Extension and Research to address new or changing issues associated with SLW and the management strategy.

**For more detailed information see:**

Kelly D, Sequeira R, Grundy P, Parlato D, & Noone A (2003) Management of Silverleaf Whitefly in Central Queensland 2001-2003. Report presented to CRDC and Australian Cotton CRC.

Available on

http://www.cotton.crc.org.au/assets/pdffiles/reports/OccPaper/SLWDK03.pdf