

Area Wide Pest Management on the Darling Downs –

Has it worked?

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Introduction

Area-wide pest management (AWM) has had a high profile introduction to the cotton and grains industries on the Downs since 1998 and prior to that in the cotton industry in Emerald. All cotton-growing valleys in Australia now have at least one group taking an area-wide approach to their insect pest management. To a large extent, this movement has been as a result of the work undertaken on the Darling Downs.

Why has AWM been successful?

The success of AWM on the Downs is as a result of a combination of factors. First, the timing was right. Growers and consultants were facing a crisis situation, current management options were failing, *Helicoverpa* pressure was extreme, and the profitability of cotton, in particular, was under threat. As a result, growers and consultants were receptive to new ideas that offered an alternative to current practices. Second, the project combined a team of researchers and extension staff from the Department of Primary Industries. This combination made coordination and continuity possible, important both for the project and the participating growers and consultants. Thirdly, the AWM 'experiment' was supported by an enthusiastic band of consultants and agronomists. The high level of involvement growers and consultants had in the project from the beginning has meant there is a high level of ownership of AWM amongst the participating growers.

Implementing AWM on the Downs – an overview

History (what happened 'at the start')

The 1997-98 cropping season in southern Queensland was characterised by a severe, sustained and damaging outbreak of *Helicoverpa armigera*. The impact of this season on the economic viability of most crops resulted in a widespread realisation within the farming community that a change in the current approach to *Helicoverpa* management was needed to ensure a farming future in this region. There were also increasing concerns about the impact on the local community, environmental and human health associated with increasing insecticide use. The Darling Downs Heliothis Working Group was formed as a reference group, comprised of members from a range of grower stakeholder groups

The concept of introducing AWM to the Downs was first conceived in early 1998, with farmers in the Brookstead-Cecil Plains area formulating a draft strategy based on the area-wide management strategy being implemented in Emerald by Richard Sequeira. In conjunction with this group, DPI and University of Queensland entomologists also formulated a draft strategy, (Miles *et al.*, 1999). It was proposed to have two pilot study areas, the predominantly cotton-growing region between Cecil Plains and Brookstead and the predominantly dryland grain-growing region on the Jimbour flood plain.

The proposal for a pilot AWM project was taken to a meeting of growers and consultants in each of the proposed study areas in February/March 1998. Those involved in drafting the proposal had resolved that unless there was broad-based support from the farming community for the trial, that it would not succeed, and the trial would not proceed. Support from the farming community was unanimous, and the strategies were revised into a final draft called the '*Heliothis Regional Management Strategy*'. This Strategy proposal

was then taken to small group meetings within each of the study areas for discussion and to start fostering a sense of ownership of the project amongst the farmers who would be involved. In July 1998 the project was funded for a three year term (Jul 1998-Jun 2001) (Miles *et al.*, 1999). The project received funding from both the Grains Research and Development Corporation (GRDC) and the Cotton Research and Development Corporation (CRDC) – a reflection of the realisation that the *Helicoverpa* problem required involvement by all growers in a region, not just cotton growers.

In addition to participating growers and consultants, the project brought together resources and ideas from many different stakeholders; DPI, GRDC, CRDC, Agforce, Cotton Australia, the Darling Downs Cottongrowers Association, and agribusiness.

Project goals

One of the key goals was to empower farmers and consultants to make a change, from a *Helicoverpa* management system that was largely dependent on insecticides, to a sustainable system based on Integrated Pest Management (IPM). To achieve this outcome all farmers would need to work cooperatively and take a regional, rather than a paddock-by-paddock approach. With this approach, the size of the local *H. armigera* population could be reduced, giving non-chemical tools such as virus and beneficials a greater chance of being effective.

The strategy is based on three main components that aim to reduce (1) the survival of over wintering, insecticide-resistant *H. armigera* pupae, (2) the early season build-up of *Helicoverpa* on a regional/district scale, and (3) the mid-season population pressure on *Helicoverpa*-susceptible crops (Murray *et al.* 1998). The implementation of the strategy was to be achieved through the participation of growers and their advisers in the study areas.

Implementation of the project (how we did it)

The extension component of the project was central to the acceptance of the AWM concept, and the implementation of the key components. The Development Extension Officer (DEO) provided assistance to participating groups in the form of technical advice, group facilitation, coordination of activities and links with the research entomologists involved in the project. The monthly newsletter the '*Heliothis Hotline*' was published which provided timely reminders, immediate feedback on research and meeting reports. Regular group meetings were held 3-4 times per year (depending on the needs of the groups). These meetings discussed groups' aims and expectations, and provided a forum for discussion options as the season progressed. Group meetings were venues for providing support, exerting "peer" pressure on members to comply with group aims, to suggest research directions, and for conflict resolution.

Technical information and updates were disseminated more widely than the pilot grower groups via press releases, conferences, field days, radio announcements and video.

Regular evaluation was carried out during the project, by recording discussions at meetings, and with individual participants. On two occasions surveys were conducted to gauge attitude and practices of growers and consultants.

Communication between neighbours, spray contractors and consultants was encouraged and fostered, especially during the small group meetings. This communication contributed to changing the attitudes of individuals, particularly in relation to the management choices of other group members. One of the major flow-on benefits of the project, as described by grower participants, has been the opportunity for increased grower to grower communication at group meetings. In the group environment, grain and cotton growers are talking to each other about their different approaches to *Helicoverpa* management, their basic pest management philosophies and aspirations.

Where are we at now? – Indicators of success

Reduction in *H. armigera* pressure

Through implementation of pupae busting and spring trap cropping, the goal was to reduce the size of the *H. armigera* population, and consequently pressure on susceptible crops. Over the duration of the trial (1998-01) *H. armigera* pressure was lower early season in 99-00 and 00-01, than in the preceding season (Figure 1).

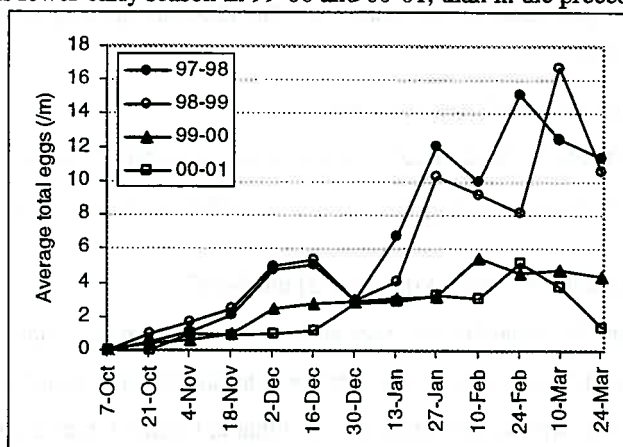


Figure 1. Average *Helicoverpa* egg pressure in cotton, Brookstead on the Darling Downs, 1997-2001. Data collected from sampling records of consultants.

It is difficult to quantify the contribution of AWM activities, and other factors in this change. Major influences on *H. armigera* pressure have been the very dry spring in 99-00 and 00-01, which influenced both the survival of emerging moths, and saw a greatly reduced commercial chickpea planting (an early source of moths in some seasons). However, many growers increased their compliance with pupae busting, and planted spring trap crops. In the 2000/01 many growers and consultants began monitoring and conserving beneficial insects. Resulting in a reduction in survivorship of the 'escape' large larvae, particularly early season, as reported by many consultants. The contribution of these activities, in seasons of moderate pressure, are likely to have an impact on the population.

Changes in grower attitude, knowledge and skills

Through involvement in AWM groups there has clearly been a change in knowledge, attitude and skills of the growers and consultants in relation to *Helicoverpa* management, and IPM generally. These changes can be best demonstrated by the following examples from the pilot study areas.

Changes in attitude

AWM has been a catalyst for a widening discussion on insect pest management and building on individual grower and consultant experience. Group discussion and sharing of experiences has helped in developing confidence, for example, with biopesticides and beneficial insects. The emphasis on local experience and local data was important in the changing of attitude to what could be achieved in relation to pest management.

Two seasons of relatively low *Helicoverpa* pressure, involvement in AWM groups, and opportunities to try various IPM tactics, contributed to the change in attitude of growers. In March 2001 an on-farm agronomist in the Brookstead pilot study area summed up the change in attitude when he said, "We originally thought that the new ideas were all pie in the sky, but now we realise that we can have an impact. It isn't all just good luck. We are creating our own luck."

The change in attitude has significant benefits because it is driving a movement away from reliance on insecticides, towards the implementation of integrated pest management (IPM). At the beginning of the project growers did not consider that beneficial insects made a significant contribution to *Helicoverpa* control, so they could see little reason to preserve them. It has been rewarding to see this attitude change during the course of the project to the stage now where growers are monitoring and using beneficials in pest management. They are incorporating them into pest management decisions and actively trying to augment them in the farming systems. Some grower comments that illustrate the state of beneficial-related discussion at grower meetings include.

- “Thrips are acting as beneficials against mites”,
- “Numbers of beneficials dropped off late in the season, especially due to the sprays in cotton”,
- “If we loose our beneficials mid-season it is hard to recover, we need to look at importing beneficials from other areas”
- “Planting into stubble helps build up [beneficial] numbers”,
- “There are predatory shield bug in the crops and some parasitic wasps” and
- “Is it worth putting \$1-2/ac of cotton across the area to fund an area-wide release of *Trichogramma*?”

There were a number of growers in the Jimbour region that did some inundate releases of the egg parasitic wasp *Trichogramma* during the summer of 2000/2001, illustrating how far they have progressed along the IPM path.

Increases in grower knowledge and skills

The focus on implementing the various components of the AWM strategy raised issues about how and why each tactic worked. For example, a Jimbour Flood Plains grower stated in April 1998 that he didn't know that *Helicoverpa* spent part of its lifecycle under the ground. With an increased understanding of the *Helicoverpa* lifecycle the practice of pupae busting became relevant, and an important part of *Helicoverpa* management.

Another area that saw a rapid change in knowledge was in relation to beneficial insects. Early in the project, these sorts of comments were common at meetings “beneficials aren't important” and “we don't have any beneficials on the Downs”. This knowledge changed after a number of meetings and demonstrations. By October 1998 growers were making comments at meetings such as, “pyrethroids were used in winter cereals (a good host for beneficials), will the beneficials come back?” and “Barley and sorghum will contribute to beneficials”. A growing appreciation of the interactions between pests, beneficials, crops and management strategies was clearly developing in the minds of growers.

As grower knowledge of beneficials increased, they wanted to know what they looked like and how to sample and identify them in the field. In response, growers were introduced to identification tools and beneficial identification secessions were conducted with a number of the groups.

Changes in management practices

Participants in the AWM were quick to adopt some of the tactics and slower in adopting others. Trap cropping was one of the new technologies in the strategy, and it was one that growers quickly increased their knowledge about. This was achieved by asking many questions at the early meeting, and determining for themselves, on the basis of what they understood trap cropping to be, that it was a technique well worth trying. To encourage growers trap crop seed purchased via sponsorship and delivered in first 2 years, year 3 co-ordination but no sponsorship and in year 4 they were on their own. The rate of adoption of trap cropping was very high from the beginning of the project at Jimbour in 1998, 27 growers (33%) participated and at Brookstead 48 growers (43%) participated.

Pupae busting was another key component of the strategy that saw a high rate of adoption from the beginning of the project. In February 1999 growers in the Brookstead area believed that all irrigated growers were pupae busting, but there were some dryland growers that were not, most likely for soil moisture and erosion risk reasons. In the mid-project review October 1999 growers in the Brookstead area thought that the pupae busting and trap cropping would continue past the life of the project, illustrating that the participants were already implementing and satisfied with the perceived contribution of these key components to *Helicoverpa* management.

AWM groups were a catalyst for wider discussion of pest management, and particularly IPM, given the anticipated outcome of AWM being lowered *Helicoverpa* pressure; an environment in which IPM would be viable for *Helicoverpa* management.

AWM activities facilitate communication (building social capital)

AWM have achieved some unexpected successes also. It was discovered that we were building social capital. Growers value the meetings and they will make farm management decisions at a group level. For example one farmer in the 2000/01 season had wanted to use a pyrethroid spray on a particularly bad tipworm epidemic, but waited until the AWM meeting later that week to discuss options. He decided by the end of the meeting to leave the paddock unsprayed, because of the potential damage to beneficial insects that it could do to the rest of his farm and his neighbours. The end of season analysis was the badly tipped out paddock yielded the same as the rest of the farm due to compensation and a water shortage late in the season, (Kreig *pers. comm.*, 2001). Growers and consultants are making group decisions aware of the effect each individual can have upon the group.

Expanding AWM

Observations on the concept and applicability to other regions

The basic AWM strategy for the Downs (Murray *et al.*, 1998) is theoretically sound. It contains a number of tried and tested tactics that can be implemented in other regions ie. pupae busting, trap cropping, using biological insecticides, promoting and augmenting beneficials and delaying the use of disruptive insecticides. Groups in all cotton-growing regions are using combinations of these tactics, and implementing AWM in one form or another. There are questions about whether it is possible to simply transfer the Downs strategy to other regions and be successful. Based on our experience with the pilot project, the following are some comments on expanding the range of AWM beyond the region for which it was devised.

The strategy is not a simple recipe for AWM. An understanding of *Helicoverpa* ecology (particularly the timing of diapause, the emergence of moths in spring, and the range of host use) is critical. It is this information that is used to determine the timing of trap cropping, pupae busting, and focuses effort on containing populations in susceptible crops.

AWM, in the form implemented on the Downs will not be appropriate for all regions. For example, in Bourke, *H. punctigera* is the major *Helicoverpa* species early in the season. This means that spring trap cropping is not appropriate as it is designed to capture the *H. armigera* population as it emerges from diapause.

Implementation of AWM, and continued participation by growers, is dependent on meeting their expectations of what it can deliver. Because it is difficult to quantify in research terms how much impact a trap crop will have or how much the *Helicoverpa* population has been reduced by pupae busting, AWM is still to a certain extent a 'have faith' strategy. Growers and consultants in the pilot study areas were prepared to be involved in the project, hoping that it would have an impact. Some growers were disappointed that they

didn't get an immediate reduction in *Helicoverpa* pressure in cotton adjacent to their trap crops. Some growers have stopped growing trap crops for this reason.

Ongoing education and evaluation of the regional impact of AWM activities is needed to keep expectations realistic, and to prevent participants becoming disillusioned with AWM. Working in groups, where discussion with peers has proven to be central in influencing attitude will be a means of setting realistic goals and expectations for AWM participants.

Can AWM be expanded on what already exists? Yes, research will continue into finding more tools for growers and consultants, and participants will explore new ideas themselves. As each season passes, confidence and experience develops at both an individual and a group level.

Getting an AWM group going (formation and operation)

When forming an AWM group there are some things that should be carefully thought through.

- Decide which area and who will be involved – growers, consultants, agronomists, contractors
- Set goals
- Identify specific activities for the group – avoid meeting for meetings sake
- Keep notes – use for revising and resetting goals and to keep non-attendees informed

Activities for groups with minimal support can include:

- Using pheromone traps to generate information about *Helicoverpa* activity (species and time) in the local area. This information forms a basis for determining the appropriate time for planting and destruction of trap crops.
- Seeking guest speakers
- Gather and discuss pest and beneficial pressure and management options

Contributions that Cotton Industry Development Officer can make without being the group co-ordinator:

- Introduce the group to unfamiliar options and new techniques
- Challenge the attitudes and perceptions of the group
- Use their network in the cotton industry to gather information for the group

Be aware of group development processes. There are many different theories on group development and stages of group development, but I have found Tuckman's four stages as described by Johnson and Johnson (1997) useful – forming, storming, norming and performing. *Forming* is the beginning stages when people are sorting out their place in the group and how things will run. *Storming* entails the time when group members may experience conflict as individuals resist the influence of the group and oppose group direction and consensus. *Norming* occurs when group cohesiveness and commitment is achieved. The participants discover ways to work together to achieve goals and objectives. Finally the *performing* stage is when a group develops proficiency in reaching the desired goals and is also more flexible about ways of working together (Johnson and Johnson 1997).

It is useful to realise that all groups go through these stages. Remember, especially in the beginning, that some people will be drivers and innovators and others will take more time to want to work together. Ensure that all participants are given the opportunity to share their ideas and concerns and don't try to push too hard too quickly, otherwise problems will arise.

Maintaining momentum, interest and progressing learning are major challenges for AWM groups. Once groups have been operating for two to three seasons they run the risk of becoming stale and burnt out if they aren't providing a challenging and stimulating learning environment. Groups should embark on a process of

continual improvement – revising and resetting goals each year. Aim to achieve more each season, and don't be too disappointed if you fall short in any particular year, but do reflect on why.

When not everyone wants to be involved

The participation level required for effective AWM was not specified during the pilot project on the Downs, (Murray *et al.*, 2000). AWM groups are voluntary and should remain so. As pointed out above all groups go through a process of development. Groups should progress through these stages at their own pace, allowing everyone to contribute. If this is done effectively many of the potential “non-participants” and “problem neighbours” may be persuaded into action.

If a neighbour doesn't want to participate initially, don't force the issue. Instead, ensure that they receive all meeting notices and are informed of the outcomes of the meeting and group goals. This is best done by a near neighbour or group spokesperson, and you may be surprised at how effective a bit of encouraging peer pressure can be in the long term.

It is easy to use ‘non-participants’ as an excuse for opting out of AWM. Everyone involved in AWM will have thought at some stage, if my neighbour isn't going to be involved then what is the point of my doing anything.

The potential for disruption of AWM in a region is really from two sources. First, is the potential for a *Helicoverpa* outbreak from local nurseries as a result of poorly, or uncontrolled, infestations. Second, disruptive product drift, as in the in the example from the Boggabilla AWM group in 1997/98 (Coulton 2000). In contrast to what occurred at Boggabilla in 1997/98, the monitoring of *Trichogramma* (a species highly susceptible to many insecticides) in the pilot study areas suggests that drift hasn't caused major area-wide disruption during the life of the project. This is evidenced by the continued presence of *Trichogramma* in various crops, during the cotton season, presented in Figure 2.

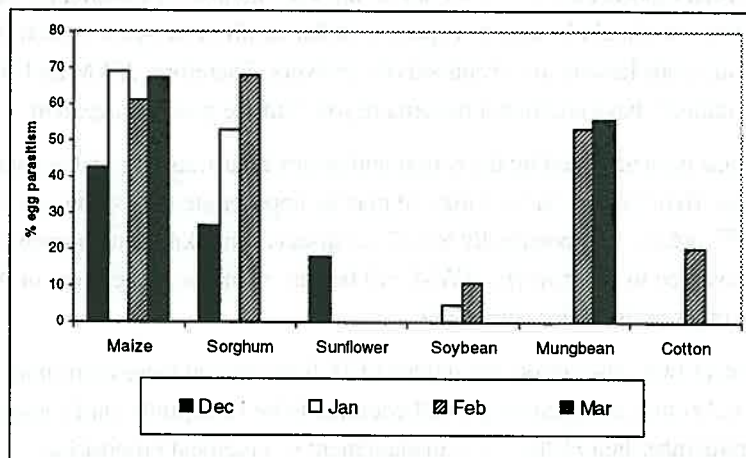


Figure 2. Average level of egg parasitism recorded, on a monthly basis, from a range of crops in the Jimbour and Brookstead regions of the Darling Downs 1999-00.

The likelihood of significant disruption due to drift has reduced in recent seasons as a result of improved application (both ground and aerial) and a general reduction in the number of pesticide applications. The reality is there has never been a better environment for trying IPM in the cotton industry. Combine that with an AWM group and it has to be a winning combination!

AWM into the future

Sustainability

AWM for *Helicoverpa* population management is not yet fully developed. Research is still needed to develop additional tactics to contain the *Helicoverpa* population mid season, and minimise the likelihood of severe late season population increases. The ongoing involvement of growers, consultants and industry will be necessary to effect this outcome. Sustaining interest and enthusiasm for the concept will be one of the key challenges for the future. As the components of AWM eg trap cropping, pupae busting become part of routine *Helicoverpa* management perhaps ongoing participation in groups may not be necessary for continued participation of individuals in AWM. We can expect to see existing groups evolve over time in order to sustain themselves. An important part of this evolution will be the inclusion of other issues of interest in the groups' activities.

In the absence on an ongoing attempt to manage the size of the local *Helicoverpa* population the future of grain production, and the production of conventional cotton, will not be economically viable in many of our agricultural regions. Hence the intimate relationship that exists between AWM, IPM and sustainable broad acre crop production throughout the cotton belt of eastern Australia.

AWM in a two-gene cotton environment

The introduction of two-gene cotton has been promoted as turning cotton from a major source of *Helicoverpa* in the local environment, into a sink - a silver bullet for the *Helicoverpa* problem you might think. However, recall that the basic premise of AWM is that *Helicoverpa* management is not a crop-by-crop proposition. Rather it is, and will remain, best addressed by a regional, farming systems approach.

Resistance management in transgenic cotton is assisted by the activity of beneficial insects in these crops. Ingard® cotton has been reported having two to three times the number of beneficials than conventional cotton (Fitt, 2000), thus we should be able to expect a similar result in two-gene cotton. Loss of eggs and larvae from transgenic crops lessens the likelihood of survivors. Therefore, AWM and IPM activities that promote beneficial numbers have additional benefits beyond simple pest management.

The AWM concept has been accepted by the cotton and grains industries as a viable approach to managing a mobile insect pest like *Helicoverpa*. In the future, it may be appropriate to develop AWM strategies for other pests eg GVB, SLWF, aphids, and potentially beneficial insects. The skills and knowledge that growers have gained from being involved in *Helicoverpa* AWM will be very valuable in the event of AWM strategies being developed for other pests and/or beneficials.

With the introduction of two gene cotton, the impact of *Helicoverpa* on these crops may be reduced, however, conventional cotton and grain crops will continue to be susceptible, and consequently AWM remains relevant – remember that *Helicoverpa* management is a regional proposition.

Summary

AWM has come a long way in the four years since its inception. It is an exciting example of what a farming community can achieve in terms of changing attitude, knowledge and practice. The AWM experience on the Darling Downs has proven that research, working hand in hand with development extension, is an effective model for the introduction of new concepts into the farming community.

We still have some way to go before we can be confident that AWM is reliably achieving significant reductions in the *H. armigera* population season after season. Further research to develop additional tools to achieve population management of *Helicoverpa*, and potentially other insect pest species, is ongoing.

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