IPM: Good knowledge and communication are the keys

By Matt Holding, Crop Consultant, Darling Downs

PROMOTING IPM (Integrated Pest Management) for insect control in Australian cotton has always been a very challenging task. There are many reasons for this, but for me, contrary to some beliefs that it is the "easy way out", the main reason that IPM is not used as widely as it should be is that it is highly scientific and requires a great degree of understanding.

The weather and insect situations we find ourselves in change year by year, so there is no set formula for IPM. 2016–17 was a wet winter followed by a hot dry summer of high mirids and whitefly. 2017–18 was a drier winter, and mirid pressure was much lower to start, generally resulting in lower whitefly spraying.

So for us to be able to have the knowledge to understand how we can use IPM for insect control under many different circumstances and then communicate this to a nervous farmer, is not any easy thing to do. Try communicating to a grower that spraying is not necessary if they have sold cotton for $600 per bale and retention to node 12 is only 30 per cent. You had better know what you are talking about.

Ultimately, as agronomists, it is our role to provide our farming clients with the best economic returns possible. But this also ideally needs to be based on a scientifically sustainable, long term goal. Historically IPM has been used more out of necessity than preferred practice. Heliothis resistance in the 90s became so bad that we had no choice but to try and change. Then Bollgard came along and all was good again. But as we know, nature is too clever, and ultimately She finds a way to challenge us again.

I suggest that IPM, with the benefits of Bollgard, offers a highly profitable long term pathway forward. And in modern society it is probably really the only way forward. The cotton industry has fought so hard to regain its reputation. We always need to remember that our customers are watching and they want economics and environment in the same sentence. Let's not wait for dire situations like previous heliothis resistance in the 80s and 90s or USA weed resistance, before we are ultimately forced to change to IPM. Let's use foresight and recognise the new danger signals earlier and do it pre-emptively.

So what are some of the danger signals that are out there? Here are some that we read or hear about now:

- Bt crops are not a silver bullet. Sally Ceeney (*The Australian Cottongrower* February-March 2017) reported globally 16 cases of "Practical Bt resistance" in 2016.
- We have reported whitefly resistance to the Admiral insecticide now. The sheer numbers of whitefly we deal with makes resistance a greater (inevitable?) possibility.
- Heavy spray regimes are showing severe damage areas from mealybugs which are very hard to control with insecticides.
- Biosecurity incursions of new pests are always a continuing threat. Many of these are reported to be very difficult to control with insecticides.

A 2016–17 season case study – A high spraying year.

The following is a practical case study on how a good understanding of IPM likely provided assistance in 2016–17.

Characteristics of the season:

- It began with an average wet winter followed by a cool spring followed by a very hot summer.
- Early square loss was high and was generally blamed on mirids. So mirid spraying was well above average.
- Whitefly spraying was also above average.
- There were reports of mealybugs doing significant damage.

How did insect IPM help in this situation?

- Mirid spraying was no different to normal
- There was no spraying for whitefly
- There were no mealybugs seen
- There were no yield or quality penalties

So the big question is how can this happen?

I can divide this into three discussion points.

A. Temperature influences on plant protein expression. Was it just mirids causing square loss or did the temperature variations cause problems as well?

What evidence is out there to support temperature and environment over mirids?

1. The literature

Olsen *et al.* (2005) found that "In pre-square plants there were significant changes in Cry1Ac expression, with warmer conditions enhancing control of Helicoverpa spp. Larvae and cooler conditions decreasing larval mortality."

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Photo A: Insect damage close-up (January 2017).

Photo B: Bollgard cotton near corn showing extreme tipping out (January 2017).

(Addison and Rogers (2010), similarly found "the expression of Cry2Ab in Bollgard II was reduced by low temperatures (<14°C) during the flowering/fruiting growth period for up to six days after the initial stress event."

So the research is there to show that Bt expression levels vary with the environment. The question therefore is; If they had studied the 2016–17 season, what would they have found?

2. Some field evidence

Cotton near corn. See Photos A and B of cotton growing close to corn on the Darling Downs. The cotton all looked like this for about 50 metres away from the corn. The corn in this year was devastated by heliothis so badly that many crops grown for quality were actually removed. The cotton photos you see were sent to Lewis Wilson and others for comment. All agreed that the damage looks more like that from a 'chewing' insect rather than a 'sucking' one. Considering this, along with the fact that the corn was destroyed by heliothis, it is highly likely that heliothis (and possibly also tipworm) caused this damage in the cotton.

Rob Weinthal exclusion tent trials. Also in 2016–17 exclusion tent trials were conducted on cotton paddocks where Rob Weinthal was consulting. These tents meant that no mirids, for example, were present inside these tents early season. The results indicated almost no difference in square retention inside the tents compared to outside. Rob's summary was that the environment was having a much greater influence on square retention than mirids.

B. Plant 'tolerance'

The word 'compensation' is used quite frequently to describe situations where an insect pest might have removed a square but then the plant can then 'compensate' with another. I have never liked the term, feeling it sounds like the insects have initially won, but luckily you get a second chance. It also implies that it will mean a season extension. None of this sounds very professional to me.

A more correct description is plant 'tolerance' with zero to minimal season extension. A plant will simply always put on many more squares than it will ever need for maximum yields.

Note the rapid onset of squares once the plants get going in the following table example of our plant mapping.

"Warrawee" – planted October 21			
Date	**Height**	**Nodes**	**Total Fruit**
December 18	40	12	**132**
December 31	62	16	**250**
January 5	80	18	**450**

So an understanding of natural plant tolerance is important to minimise excess spraying.

C. Understanding what you are doing when you do spray – 'contact' and 'residual' chemical activity

A critical component of IPM is understanding what you are actually doing when you do spray. Talking to some younger agronomists who want to practice IPM, this is probably the area that creates the most confusion in their thinking. Many products are marketed to us as being "soft on beneficials" or "IPM compatible."

But to what extent are they? Some might actually be soft on one type of beneficial but then be very hard on some other, more critical types. For example, the whitefly parasitoids.

Also of critical importance is an understanding of the residual

activity of these products on top of the contact activity. Refer to the table below. This is an example of contact and residual activity against the *Encarsia Formosa* parasitoid from the insect order Hymenoptera, the order which also contains our critical whitefly parasitoid, *Eretmocerus hyati*;

Residual toxicity on *Encarsia Formosa* (Hymenoptera) – lab study

Example products	Days after treatment				
	1 DAT	4 DAT	7 DAT	14 DAT	28 DAT
Transform (Sulfloxafor)	100% death	98.4%	75.9%	12.2%	
Confidor (Imidacloprid)	69% death	76.5%	39%		
Starkle (Dinotefuron)	100% death	83.5%	56.7%	41.3%	
Mainman (Flonicamid)	87.4% death	48.3%	29.1%	4.4%	
Success (Spinosad) Tracer!	100% death	90.9%	81.6%	62.1%	51%
Regent (Fipronil)	Not in this paper but field observations suggest cumulative Regents are also very damaging				

Source: Kim *et al.* (2017)

Please note that this is a lab study, not a field study, but the trends are probably similar. It shows how dangerous it might be to apply certain products every one to two weeks against mirids. Commonly used "IPM" products might be giving near 100 per cent initial control of critical parasitoids as well as significant residual control for weeks. If constantly spraying, you might never give the parasitoids the critical time they need to build up to assist. Before you know it you are now also spraying for whitefly and seeing mealybugs in your crops by creating your own beneficial desert.

So the key message from this is to only spray when it is really necessary and understand the impacts and different results of contact vs. residual if you do have to spray.

To summarise IPM in the 2016–17 season

- It is highly likely that a lot of what was blamed on mirids in 2016–17 was actually environmental. That is, either square loss primarily due to short term survival of heliothis and tip worm or due to variable plant Bt protein levels; or, naturally reduced fruiting branch development early due to cooler temperatures.
- Natural plant tolerance means that ultimately plants will put on far more squares then they will ever need for maximum possible cotton yields.
- When spraying was done, excessive use of residual products could have damaged the natural whitefly parasitoids.

Overall conclusions

- The understanding and communication of IPM is not easy. But it can be highly rewarding, profitable, and ultimately essential.
- It's a tough point, but growers may sometimes be employing their agronomists and consultants to reduce their gross margins by spraying excessively and creating their own problems. Rather than a consultant feeling they need to justify their invoice by spraying they should actually be justifying their invoice by having the knowledge and collecting the correct field data to minimise spraying.
- But this can only be done with good communication with the growers. Growers are paying us to have the knowledge but also to have the communication skills to explain the situation very clearly.

To finish with a picture

The following photo shows a paddock with severe mealybug damage. The photo was taken from another paddock right next door with a reduced mirid spray regime. The paddock with the reduced spray regime did not have any signs of mealybugs like the photo below.

So it is up to us to increase our understanding of IPM and learn from the problems of the past. I have no doubt we can do this and maybe the current concerns with whitefly might speed the process along. This will give us a long term highly profitable cotton industry which our customers will be very proud to be associated with.

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A paddock with severe mealybug damage.