Better pupae busting decisions in sprayed conventional cotton

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Pupae busting (full surface cultivation to a depth of 10 cm) is an effective non-chemical means of managing resistance in *Helicoverpa armigera*, but not all sprayed conventional cotton fields will contain diapausing pupae. The opportunity to make better pupae busting decisions in sprayed conventional cotton means that savings could be made in some crops through reduced consumption of fuel, fewer labour costs, and less wear and tear on machinery. There are also benefits in terms of reduced tillage, soil moisture conservation and the opportunity to double crop.

The TIMS committee recently approved a change to the Post Harvest Pupae Destruction statement for the 2007–08 IRMS. The revised statement considers the likelihood that larvae will enter diapause before a certain date, which allows for removal of pupae busting operations in field-specific situations.

The estimated commencement date of diapause is based on the Helicoverpa Diapause Induction and Emergence Tool. This tool includes a diapause model which is used to predict the incidence of diapause and is based on field research conducted on the Darling Downs by QDPI&F. It also has broad application to farming systems in eastern Australia.

What is the amendment?

Previous Post Harvest Pupae Destruction statement: Cultivate to destroy over-wintering pupae as soon as possible after picking and no later than the end of August.

New Post Harvest Pupae Destruction statement: Sprayed conventional cotton crops defoliated after March 9 are more likely to harbour insecticide resistant diapausing *Helicoverpa armigera* pupae and should be pupae busted as soon as possible after picking and no later than the end of August.

The variation to the IRMS statement is based on a scientifically validated expected date for the commencement of diapause for *H. armigera* in central cotton growing regions. It implies that the majority of pupae under crops that are defoliated on or before March 9 will not be in diapause. They are likely to emerge as moths before post harvest pupae destruction can take place.

Why was this change made?

We know from extensive research by Dave Murray and others, that we can be more discriminating in terms of which fields of conventional cotton actually pose a risk, in terms of hosting overwintering pupae, and which do not. This means that pupae busting does not need to be a 'one size fits all' recommendation.

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FIGURE 1: The opening page of the Helicoverpa Diapause Induction and Emergence tool

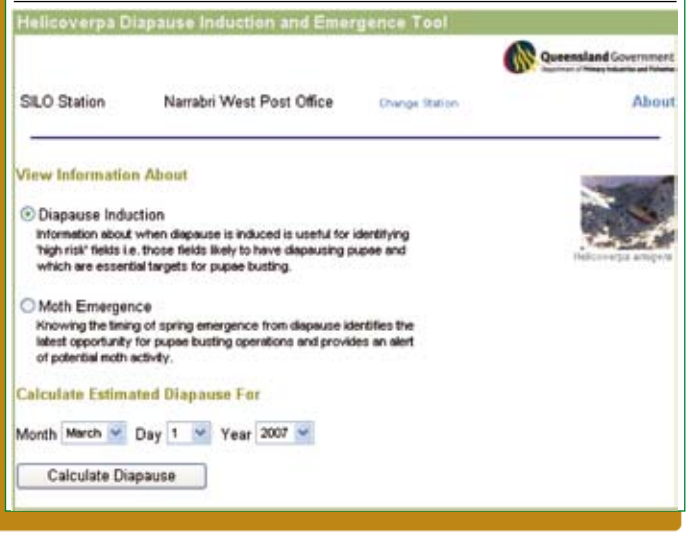
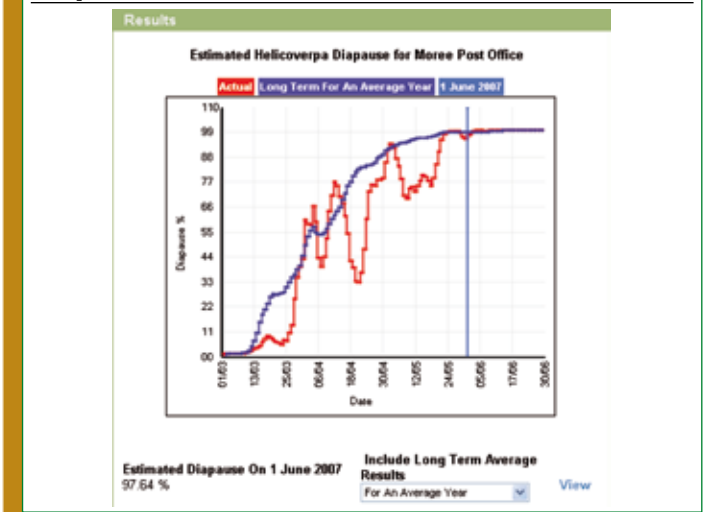


FIGURE 2: Example of diapause information output



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Fields can be treated individually, depending on the likelihood of carrying overwintering pupae, without compromising Helicoverpa resistance management. An ability to distinguish between fields that do, and fields that do not, require pupae busting offers growers benefits in terms of operational and cropping opportunities without increasing the risk of resistance to insecticides or Bt.

Will this change impact on insecticide resistance management?

The diapause model predicts that a very low percentage of larvae (less than two per cent) will potentially have entered diapause on or before March 9 in central cotton growing regions. The risk posed to insecticide resistance management by this small proportion of larvae is considered low because conventionally sprayed cotton currently represents less than 15 per cent of the total cotton growing area.

Does this change apply to my Bollgard II crop?

It remains a mandatory requirement of the RMP to pupae bust Bollgard II regardless of the date of defoliation. This requirement is critical for managing resistance against Bt.

With approximately 85 per cent of the Australia cotton crop being Bollgard II, even allowing a small proportion of larvae to enter diapause and not be pupae busted is a high risk for Bt resistance management. In addition, the latest results from the Bt Resistance Monitoring Program confirm that there is an unexpectedly high baseline frequency of alleles that confer resistance to Cry_2Ab in natural populations of Helicoverpa.

Will this statement be reviewed in the future?

The new guidelines regarding pupae busting in conventionally sprayed cotton apply while the cotton system is dominated by Bollgard II cotton. The TIMS Committee was able to consider a revised Post Harvest Pupae Destruction statement for inclusion in the 2007–08 IRMS because of information produced from the on-going Insecticide and Bt Resistance Monitoring Programs for Helicoverpa funded by CRDC, GRDC, NSW DPI and CSIRO Entomology. These programs show no increases in resistance to the Bt proteins in Bollgard II, and a stabilisation or decline in resistance levels for most insecticides.

Continued monitoring of insecticide resistance frequencies and the ongoing assessment of the proportion of sprayed conventional cotton by region are important aspects of the IRMS change, and will be reviewed annually as part of assessing the impact and risk posed by this change.

Features of the helicoverpa diapause induction and emergence tool

This tool is located on the Cotton Catchment Communities CRC website (*http://tools.cotton.crc.org.au/cl2/diapause/index.aspx*). The opening page (see Figure 1) allows the user to select a location and run the tool. An information page can be accessed by clicking the 'About' button.

Diapause induction

The incidence of diapause generally increases from low levels in early March to high levels (approaching 100 per cent) by late April–early May. The Diapause Induction tool predicts the proportion of pupae forming on any day between March 1 and June 30 that will enter diapause (Figure 2). Predictions can be made for a wide range of user-defined locations. The real time (actual) estimate uses current temperature data (maximum and minimum temperatures), but also allows predictions into the future using long term averages. These can be further manipulated for hotter or cooler than average conditions.

Pupae busting may not always be necessary.

Moth emergence

The second part of the tool predicts when diapausing pupae will emerge as moths during spring. The first date on which moths emerge from diapausing pupae represents the latest date by which pupae busting cultivation should be completed. But it is preferable to complete pupae busting as soon as possible after harvest to maximise mortality from all factors — predation, soil disturbance, rainfall.

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