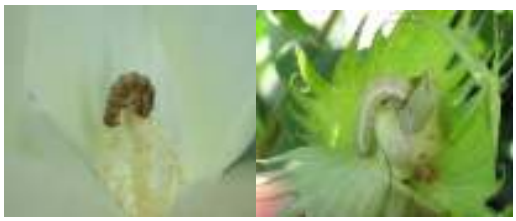
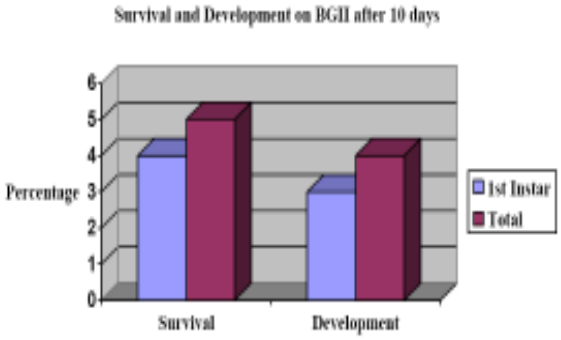
Bollgard II® Cotton Technology Update

Helicoverpa spp. infestations during the peak flowering period need to be monitored more carefully. Previous data collected through mortality assays conducted at Monsanto Toowoomba facility have demonstrated the ability of some neonates to survive and feed for a period of time before dying.



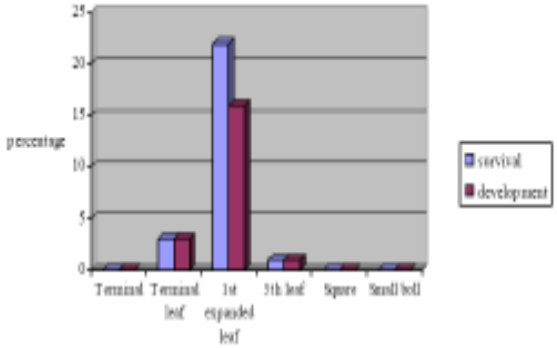
Bioassay results

Results from previous Monsanto mortality bioassays have shown a 5% total survival of all larvae on Bollgard II, with only 4% of these larvae developing to the next instar. Virtually no larvae developed beyond the 2nd instar. Each bioassay was conducted over a ten day period. Within this timeframe Helicoverpa spp. in conventional cotton would normally develop into a 4th instar.



This low survival in Bollgard II bioassays was concentrated on the upper leaves of the plant as illustrated by the following graph:

Fig 2 : Survival and development on BG II after 10 days



As the graph shows the only plant tissue that has been able to support the extended survival and development of Helicoverpa has been the young leaves; the 1st opening leaf and fully expanded leaf in particular. It was significant that no other plant tissue could support the survival or development of 1st instar larvae.

These surviving larvae emerging from eggs and feeding on squares, terminals or small bolls will die, however, there is the opportunity for a very low proportion of neonates to survive on young leaves which may then migrate to squares and cause some damage prior to dying. There is the opportunity for them to move to floral parts which express Bt toxin at a lower level.

Resistance monitoring conducted by Monsanto and CSIRO to date have confirmed field survivors have not been resistant to either Cry1Ac or Cry2Ab proteins in Bollgard II.

Survival of *Helicoverpa spp.* can be influenced by inherent factors:

- Inherent plant physiology affecting rate of protein production in the plant.
- Spatial distribution of protein production within the cotton plant – some plant parts produce more and some produce less Bt proteins.
- Inherent genetic variability of the cotton plants i.e. Some plants produce more than others.
- Inherent genetic variability of Helicoverpa, some are more susceptible to Bt than others.
- Behavioural response of *Helicoverpa spp* to the Bt proteins – larvae try to remove themselves from the presence of Cry1Ac when in high concentrations.

Controllable factors

- Management practices are controllable by the grower. Such factors as the nutritional status of the field and when to spray and what to spray can have a major influence on how well a Bollgard II variety performs.
- Monitoring: the in field variability in the level of production of the Bt proteins between plants means that adequate monitoring is essential to truly reflect the overall condition within a field.

It is hoped that the BGII Threshold Postgraduate project that Monsanto is funding through the CRC , will give growers greater understanding in sampling methodology and economic spray thresholds.

Factors to keep in mind when managing Bollgard II

- Bollgard II **does not impact eggs**, you will need to allow these eggs to hatch to neonates and allow these larvae to begin feeding on the plant tissue to ingest Cry proteins before the technology can be effective.
- Industry recommends that sucking pests are monitored using beat sheets. However, this method is unsuitable in assessing levels of *Helicoverpa* hidden in flowers, small squares, or bolls. **Visual checks** are required to do this, and also give an idea of egg pressure.
- **Scouting frequencies** employed on conventional cotton plants **MUST** be employed in plants containing Bollgard II technology. Minimum frequency for scouting larvae in BGII crops should be every 3rd or 4th day.
- The level of protein expression in pollen is low. Larvae can be found surviving in flowers; however once they move out of the flower cap and feed they will die in most cases. Be vigilant when scouting in **peak flower period**.
- In some situations where there are high egg numbers with neonates present, a **Follow-up check,** one or two days later, will ensure the technology is working as expected.
- The **use of selective insecticide** chemistry to control secondary pests will assist to maintain high beneficial numbers including predatory insects that can aid in controlling any surviving larvae.
- Know the crop's **fruit retention**. In instances of low retention a decision to provide supplemental larval control may be triggered earlier than in situations with very high retention
- **Environmental stresses** such as hot temperatures or water stress that affect the plant metabolic rate and daily photosynthate requirement can impact the production and expression of the Cry proteins.

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