Management changes for Bollgard II and new technology

Greg Constable, CSIRO Plant Industry, Narrabri

Bollgard II is simply cotton with better control of *Helicoverpa* and the same principles of management apply to Bollgard II as for conventional cotton. This paper highlights a few specific issues to consider for optimum Bollgard II management.

Bollgard II cotton contains two different (Monsanto) Bt genes which provide control of *Helicoverpa*. Our eight years of Ingard were practice for what is to follow. The better efficacy of Bollgard II compared with Ingard is important for *Helicoverpa* control, but the prime objective is to have better *Helicoverpa* resistance management with two Bt genes. This change now allows a far greater proportion of Bt cotton.

Bollgard II offers the potential for us to finally make some real changes to *Helicoverpa* pesticide use. Ingard had 50% reduction in sprays on a maximum of 30% of area – that was only a 15% reduction over the whole industry. Bollgard II offers the potential for 75% reduction on up to 90% of area – that is about 67% reduction compared with conventional cotton spray systems. Of course there have been changes to Integrated Pest Management (IPM) and to pesticide chemistry, but the total system change is now approaching research and industry targets from ten years ago.

We have been conditioned to significant *Helicoverpa* damage in our cotton crops. The debate over thresholds and compensation has raged for more than 25 years, with no unanimous resolution: some could not accept that even small loss of fruit did not constitute a delay in yield or maturity. In contrast, one of the more common fears with Bollgard II was rapid crop setting and early cutout leading to lower yield potential and premature senescence. This fear is understandable and does happen with inappropriate varieties (including Ingard and conventional) or management in full-season areas, but the fear is ironic considering our long debate over retention. Now we have potential high retention it should not necessarily be a fear.

One way to consider the question of managing Bollgard II cotton is to remember it is more normal or typical than what we have been doing for 40 years: most cotton in the world has less *Helicoverpa* damage than what we have been living with all this time. Of course we need to maintain our yield advantage.

Important issues

Irrigation. Cotton roots and bolls compete for nutrients from leaves, especially lower leaves. Under circumstances with high boll retention and rapid boll set, theory says that root growth may be reduced (compared with lower retention). Under this circumstance, the deficit for irrigation may need to be reduced and irrigation dates for Bollgard II brought forward, especially under high evaporative demand weather conditions or on lighter soil types.

It is important to measure and monitor water extraction to identify these circumstances and to modify irrigation schedules of Bollgard II crops if required.

Fertilizer. If Bollgard II has more rapid boll set and earlier maturity, the demand for nutrients on a daily basis will be increased. This means having more nutrients available, or having good soil health (structure, fertility, biology) to enable release of nutrients to plants at the higher rate and possibly earlier. This point

emphasises all the good management points for soil – rotation, minimum tillage, etc. If an option, Bollgard II should be sown on the best fields.

It is important to measure soil fertility before sowing and to monitor plant nutrient status to apply any corrective fertilizer requirements before productivity is affected. NUTRIpak contains recommended critical soil and nutrient levels.

Other considerations

Sowing date. In central regions where it is common to sow in mid September, Bollgard II offers more flexibility. In fact sowing date can be a management tool to make sure plant size is adequate for expected boll load. In systems where plant size is restricted, a later sowing achieves bigger plants and provides a bigger "factory" of leaves for later boll growth. The later sowing may also avoid some problems with Fusarium wilt and with seedling diseases such as Black Root Rot. More rapid setting of the crop in Bollgard II crops would ensure harvest is the same time as earlier-sown conventional crops.

The sowing date option is not relevant for long season areas as plant size differences are not as obvious with different sowing dates. Late season pests like white fly are also a consideration in central Qld. Short season areas also cannot afford to sow late.

Fibre quality. There have been high micronaire problems in recent years, especially in warm seasons and northern areas. This has occurred in conventional, Ingard and Bollgard II cotton varieties. High temperatures are known to increase micronaire, but boll setting patterns can also influence crop micronaire if later bolls (with lower micronaire) comprise a lower proportion of the crop. Later sowing dates (see above) and more intermediate micronaire varieties are options for avoiding high micronaire.

Plant population. High fruit retention crops may have shorter fruiting branches and less vegetative branches and be less able to fill gaps in plant rows. Low plant density (less than 8/m) and gappy stands should be avoided in Bollgard II crops. Appropriate Bollgard II varieties for each region / production system are also important.

Principles do not change

Existing guidelines for most management issues will apply to Bollgard II crops. As usual, growth regulators will have a place for managing excessive vegetative growth at flowering or at cutout in some varieties under hot and fertile conditions. Waterlogging events should be avoided in all cotton and such events during early boll fill of Bollgard II crops will cause a set back and reduce yields.

The same thresholds for thrips, mirids, aphids and other pests will apply to Bollgard II and *Helicoverpa* sprays will not suppress these pests, as was the case with conventional cotton.

Conclusion on Bollgard II management

Monitoring and scouting Bollgard II crops will be an important management process. This attention will enable identification of potential problems such as early cutout and allow corrective measures to be put in place before any reduction in potential yield has occurred. The most important monitoring will be for irrigation scheduling, plant nutrient status and for plant vegetative development. Tools are available to help growers and consultants to monitor these factors.

Other technology

The importance of crop protection from insects and weeds has driven the adoption of Bt and herbicide resistance in Australian cotton. Competition for Bollgard II and Roundup Ready is possible in the medium term. The principle and management of cotton containing the new traits will be similar.

Cotton growers have enthusiastically taken up Roundup Ready technology. Management of cotton containing this trait has been similar except for the obvious difference in herbicide programs. Care has been required in application date or placement of Roundup because of the short window between emergence and four leaf stage when Roundup can be applied directly to the crop. Resistance management conditions are important and are worthwhile to ensure we do not select for Roundup resistant weeds. Although there is little direct data, better seedling health from less residual herbicides and better soil tilth, can contribute to better production in cooler areas.

Future technology offers possibilities in modified oil quality, fibre quality and tolerance to stresses such as heat, cold, salt and waterlogging. Most of these are more than ten years away. Some of the output traits of oil or fibre quality may be specialists in being used with contract crops for specific products. Management of these crops will need to ensure the trait is achieved – enhanced fibre quality traits should have proper attention to agronomic inputs, defoliation, picking and ginning for example.

Heat, drought and cold stress will be of considerable benefits to certain regions to at least stabilise production between seasons. Salt tolerance could be of significant benefit to crop nutrition in our sodic soils.

Combinations of these new traits could be interesting. At present, the high retention of Bollgard II means plant types need to be full-season and less determinate, especially for full season locations. However, if new technology allowed for more rapid growth (either from increased photosynthesis or from stress tolerance), it may be that we would need to have more compact growth habit. Plant breeders need to have a wide diversity of germplasm to cater for future possibilities.

The future should be interesting. Many aspects of molecular biology are changing and developing rapidly, so today's predictions will miss many possibilities. Successful industries like ours will attract ideas and attention.