

# Refining the Bollgard II formula

By John Barber, Consultant, St George

**B**ollgard II has been grown commercially in the Australian cotton industry for four years. It has generally been successful but there have also been good reasons to be unhappy with the product and unhappy with the lack of service from Monsanto.

There are scientific and agronomic challenges when growing Bollgard II, but there should be social and monetary benefits, provided that resistance is contained. After some period, Bollgard II without significant resistance must inevitably reduce the resident population of *Heliothis* in all regions, but what benefit is that if only Bollgard and not conventional cotton is grown?

Since Bollgard has not consistently out-yielded conventional cotton in four years across many locations, and cost more to produce, drought or no drought, the sooner we develop a farming system which uses the benefits of Bollgard and the profits of conventional cotton to maximise farm returns, the better.

The gains from growing Bollgard II, such as reducing insecticide usage and convenience, could also be lost if the cost of controlling sucking pests like mites, mirids,

green vegetable bugs, whiteflies and aphids escalates. It need not. These pests will almost certainly not be a problem when some best bet practices are adopted.

Bollgard should not be considered as another means by which growers can practice integrated pest management, or IPM, on the farm. On the contrary, Bollgard II needs IPM to be successful. That IPM includes growing some conventional cotton, using some insecticides which are presently not used and not using others which presently are used.

## Ground preparation

This is no different for Bollgard or conventional cotton but due to the need for pupae busting, it has added importance for Bollgard. Whether following cotton, bare fallow or a cereal rotation, there are three considerations. These are moisture conservation, pupae busting and seedbed preparation.

It takes only one or two passes to renovate beds after the prior cotton crop with pupae busting occurring at the same time. Then they can be left to accumulate rain moisture if and when it falls.

The most important consideration is seedbed preparation.

Too often I hear growers say, "I'm planting 12 seeds per metre and I will be happy if I establish eight." That is a 66 per cent success rate and is a waste of seed. What happens if 10 out of 12 or 82 per cent establish? That is way above the optimum population of six plants per metre. The seed bed should be prepared so that after watering, establishment will be as close as possible to sowing rate.

## Insecticide seed dressings

These are totally unnecessary. CSD data show that after a decade of testing the only reason to use a seed dressing is to maintain seedling vigour, if that is considered necessary. Controlling wireworms with Temik is the only possible exception. My experience supports this conclusion.

We never used seed dressings on conventional cotton. Now that larvae are controlled by Bollgard we certainly do not need to control early sucking pests. But there is a better reason.

In 2008 there was a fair amount of wheat in the St George area, both irrigated and dry, so that thrips were abundant as the wheat hayed off. The thrips caused obvious damage to the young cotton seedlings and at the time it seemed that this was the one year when a seed dressing would have been useful to improve seedling vigour.

But the cotton seedlings grew through the thrip damage, as bad as it was, and the thrips predated any seedling mites. We have never had early spider mites since excluding insecticide seed dressings and organophosphates like dimethoate from our programs many years ago.

It is better to encourage early seedling vigour by sowing into good moisture or watering up followed by an early cultivation, rather than using a seed dressing. Of course it would also be desirable to have good seedling vigour inherent in our varieties, and this is a possible shortcoming of Sicot 71BRF when compared to Sicot 71BR.

## Plant population

In order to minimise the cost of seed and maximise yield potential it is most important to sow into a seedbed with good tilth at a modest rate, about eight seeds

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per metre, then never replant. Even an established population of five seedlings per metre, as variable as it might seem, is close to optimum. According to the CSD Replanting Guide, which quotes data of Greg Constable (1997), under the best circumstances maximum yield is achieved at five to seven plants per metre.

Using the CSD Guide, a stand of five plants per metre with moderate variability might have two per cent less yield potential than a uniform stand of five plants per metre. The same stand with higher variability, which is extremely unlikely across the whole farm, might lose 10 per cent in yield potential. Established stands of 12 plants per metre, which are probably fairly common in the industry, lose five per cent in yield potential compared to the optimum but can double the cost of seed.

I suspect that the yield advantage at about six plants per metre is probably due to less early interplant competition for both light and nutrients which would favour the setting of bolls low on the plant. This is extremely important for Bollgard which

normally has high early retention. At low populations there are also up to 33 per cent of total bolls on vegetative branches and often two or more bolls on most fruiting branches.

#### **Early sucking pest management**

This is usually unnecessary and even undesirable in Bollgard. It is almost unnecessary in conventional cotton. The cotton only needs to average about 1.3 bolls per fruiting branch in order to maximise yield but will initiate three or more squares on each branch. Many will be lost. Therefore early sucking pests like mirids should be sprayed when they are over threshold in order to keep early retention above 60 per cent, but the spray is not urgent.

Early thrips might reduce early vigour but in most cases should be tolerated since they are predators of spider mites. Provided seed has no insecticide dressing there should be plenty of early thrips to keep mites in check. Mirids can be managed by using an endosulfan/Canopy oil mix with oil up to two litres per hectare, or several sprays of straight oil if endosulfan is not desired.

Regent, possibly Shield, which is the new sucking pest insecticide from Sumitomo, and certainly dimethoate if used before Christmas will induce mites due to their broad spectrum activity on some beneficial insects as well as pests. Therefore their use should be delayed as long as possible, at least until the new year. Endosulfan, Regent and Shield are all reasonably priced at \$12 to \$20 per hectare at common use rates so should be chosen according to their fit in an IPM program. There are no circumstances when pyrethroids should be used.

#### **Whitefly management**

Once they have arrived in an area whiteflies will be endemic. Cool temperatures will minimise their impact but at the same time will limit cotton's yield potential. There is no point aiming to control whiteflies in Bollgard with sprays of Pegasus or Admiral. The total cost could be up to \$150 per hectare in addition to the licence fee of \$315 per hectare and perhaps other costs.

Instead whiteflies should be suppressed by endosulfan and Canopy oil, sprayed whenever it is convenient. Particular attention should also be given to controlling weeds, such as chinese lantern, which are alternate hosts for whiteflies.

My clients' early planted conventional cotton in 2008–09 is totally free of whiteflies while in Bollgard, which was not treated with endosulfan and oil, they have definitely needed control. They have also been abundant in an unsprayed cotton refuge.

So beneficial insects in Bollgard and unsprayed cotton will not control or deter whiteflies. The Bollgard must either be sprayed or possibly interplanted with late sunflowers as a trap crop.

The last date for aerial endosulfan usage in the Balonne Shire is December 31. When sprayed on Bollgard at this date in 2008–09 it has given season long suppression of whiteflies. Earlier endosulfan sprays targeting other sucking pests have also given whitefly suppression, but it has not lasted the full season.

Paraffinic oil is a registered whitefly suppressant and also gives excellent control of aphids so we add Canopy oil at one to two litres per hectare in all sprays. It mixes easily with all forms of Roundup and other contact herbicides. Due to its mode of action, insects cannot become resistant to it.

Regent does not suppress whiteflies but reports from Emerald and experience at St George suggest that Shield, even at 125 mls per hectare, will do. It also controls green vegetable bugs and other sucking

pests as well as spur throated locusts, so will be very useful after the endosulfan cut off date.

### Pix and plant growth rate

The discussion on these matters is the same for Bollgard and conventional cotton. Pix has been used throughout the industry for a quarter century to reduce vegetative growth and enhance maturity. It is indispensable when growing very indeterminate varieties from the Sicot 289 family and still indispensable, although used at lower rates, when growing the more determinate Sicot 70 and 71 types.

Bollgard has not consistently out-yielded conventional cotton. Therefore it cannot have higher final retention. Any advice that Bollgard, because of its high retention will probably not benefit from Pix, is incorrect. It probably will.

The best indicators of the need for Pix are soil type, seasonal temperatures, water availability and fertility. Varieties from the Sicot 71 family growing on soils with less clay and more silt and sand always benefit from midseason Pix, especially in hot years.

Pix also makes the crop less attractive to pests including heliothis moths and whiteflies, first, by giving leaves a harder, leathery feel and second, by advancing maturity. Moths and whiteflies are more attracted to younger, softer growth.

Plant growth rate should be maximised at all times. All stresses which delay the rate of square production or boll filling potentially expose the plant to more pest pressure, a declining water supply and eventually delay picking.

### Conventional cotton

Provided there is no environmental need, growing full Bollgard will not be the most profitable and certainly not the most sustainable total farm plan. Bollgard will rarely outyield conventional cotton in comparable situations unless the Bollgard gets substantial early damage from sucking pests.

Early tip damage to the seedling increases yield. The damage causes the seedling to initiate more shoots just behind the apical meristem, which later give the plant the appearance of having several mainstems. Each 'mainstem' can be almost as productive as a single stemmed plant so that more bolls can be produced from a tip damaged plant than from a non tip damaged plant. At low populations these 'mainstems' effectively fill gaps in the stand, so early larval pressure on poor stands of conventional cotton is desirable,

sometimes even necessary to maximise yield.

Later damage also increases yield provided it is managed. New stems, and therefore more potential fruiting points, are initiated just below the point of damage. Of course they are later, but maturity can be recovered with Pix.

Provided larvae are controlled post squaring and Pix is used to promote boll filling in favour of vegetative growth, Bollgard can only be earlier but rarely, if ever, higher yielding than conventional cotton. Conventional cotton crops commonly have seven to 10 tip damaged plants per 10 plants compared to nil, one or two in Bollgard. It follows that the more sucking pest damage to Bollgard seedlings the better.

It follows also that hail damage, depending on when it occurs, has the potential to increase yield.

For the majority of the season it has never been easier to grow conventional cotton. The soft larvacides Affirm, Steward and Altacor are very effective because they work by ingestion, not contact, and have excellent beneficial conservation profiles so can be used without inducing mites. These three, and endosulfan, are the only larvicides which should be used in modern cotton production.

It is important to stress again that there is no place for pyrethroids because they have broad spectrum activity which kills all beneficial insects and spiders. During the mid season the beneficials are excellent predators, of both eggs and larvae, of sucking pests in both conventional and Bollgard cotton fields.

The insecticide costs of my clients' conventional cotton at St George in 2008–09 will range from a minimum \$120 per hectare to a maximum of about \$240 per hectare. It has been much cheaper than Bollgard.

The other advantage for conventional cotton growers across the industry is that the majority of cotton growers, I suspect, will still plant full Bollgard. This will continue to decrease the density of the Heliothis infestations in all districts and therefore continue to lower the costs of the conventional cotton growers.

### Resistance management

If resistance of either *H. punctigera* or *H. armigera* to either of the Bollgard genes increases through 2008–09, as it did in 2007–08 then the Insecticide Resistance Management Plan may need to be changed. The best resistance management occurs when the area of Bollgard is minimised and the area of conventional cotton

is maximised. A good compromise would be to grow 50 per cent of each type. Otherwise the requirement for pigeon peas would probably be doubled to 10 per cent of the total farm cotton area.

For growers wishing to maximise the area of Bollgard, an alternative might be to grow 50/50 Bollgard per conventional cotton on half the farm and 10 per cent pigeon peas per 90 per cent Bollgard on the other half. This would keep the amount of pigeon peas at five per cent of total cotton area and therefore keep the cost of this refuge at its present level.

### Larvae in Bollgard II

After four years of growing and research the occurrence of heliothis larvae on Bollgard late in the season does not seem to be predictable. There was a massive eggglay across the industry in mid January 2009 with reports of 50 to 100 eggs per metre and based on the previous three years experience it should have resulted in widespread failure of the Bollgard.

This does not appear to have happened. Perhaps the use of N Buggies by my clients to supply nitrogen to the crops at the time of the heliothis eggglay averted the potential problem. This would have increased the nitrogen content of plant sap. In any case, growers should budget on spraying Bollgard with a larvacide at least once. Not spraying is a bonus.

### CONCLUSIONS

Growing Bollgard will not make cotton production a more sustainable enterprise if it does not include a resistance management strategy which gives both the strongest resistance management and maximises returns to growers. That strategy must include conventional cotton.

The most profitable Bollgard farming system will include preventive measures rather than just adherence to known pest thresholds, particularly when the cost of control is substantial. In the hotter areas at least, whitefly will probably be a serious pest in the future but it can be minimised by using endosulfan with Canopy oil as an adjuvant both on Bollgard and conventional cotton through the season until the endosulfan cut off date.

Endosulfan has lost popularity in recent years due to the paperwork required for its use but compared to the potential gains, paperwork is not a burden. Shield will also be a useful whitefly suppressant when used against other sucking pests.

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