Can high yield potential crops recover from pest damage?

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Past research on compensation in cotton has suggested the possibility that at very high yield potentials, even a small amount of damage to fruit will result in a yield loss. The pattern of declining compensation with higher yields was first observed by Dr Brian Hearn and his colleagues in the 1980s as shown in Figure 1.

But this trend has not been tested with the more recently developed higher yielding varieties and management practices. If we find that such a limitation exists, then it is critical to account for it in future development of IPM strategies. If not, then we can use compensation to help reduce insecticide use regardless of the crop's yield potential.

We also need to refine the cotton simulation model (OZCOT) in order to make better yield predictions on recovery following pest damage in high yielding cotton crops.

FIGURE 1: **Declining yield recovery (damage yield) with increasing yield potential (control yield)**

FIGURE MISSING

The heavy line represents the regression line for all data points and the light 1:1 line. The crossing over point at about 6 bales ha-1 suggests that plants are unable to fully compensate from damage at higher yield potential. Data taken from Brook, Hearn and Kelly (1992).

FIELD TRIALS

We conducted a field trial replicated at five commercial farms in the upper and lower Namoi Valley in 2002–03. The five participating farms were selected because of their track record of producing high yields. The farms, location and the cultivar planted is as follows:

- "Dorren" Doreen Lane, lower Namoi, (Sicot 189);
- "Greenbah" Spring Plains Rd, lower Namoi (Sicot 71);
- "Merinda" Spring Plains Rd, lower Namoi (Sicot 71);
- "Riverstone" Baan Baa, upper Namoi (Sicot 70); and,
- "Waverley" Merah North, lower Namoi (Sicot 71).

At each farm, we established experimental plots in a field where high yield was expected. Sowing time was late September to early October for all farms.

The plots contained three treatments each replicated five times laid out in a complete random block design.

1) Early damage: Damage once at three weeks after first flower;

2) Early plus mid damage: Damage twice at three weeks and six weeks after first flower; and,

3) Control: No damage.

The 'early' damage was imposed in about the first week of January and the 'mid' damage in the last week of January. The two damage treatments involved the removal of fruit which simulates the damage caused by three Helicoverpa larvae per metre once (early damage treatment) or twice (Eearly + mid damage treatment). The total number of fruit removed was about 20 per metre.

WHY THREE LARVAE?

The reason for choosing three larvae per metre is that evidence suggests that for crops at lower yield potentials, this level of damage will result in no yield loss (that is, full compensation), even when two damage events are imposed.

So, if higher yields are associated with reduced recovery, we would expect a proportional decrease in yield in damaged crops with increasing yield of undamaged plants. We would also expect a proportional reduction in yield at two damage events (early + mid damage) than at one damage event.

The fields were managed by the grower as per normal until open bolls. During harvest, we conducted maturity picks to quantify the delay in maturity, and weighed the total seed cotton yield.

High yielding crops also have good compensation potential.

RESULTS AND DISCUSSION

Unlike the earlier findings of Brook, Hearn and Kelly (Figure 1), we found no evidence of reduction in yield following either the early or the early + mid damage treatments (Figure 2). Yield from all farms fell along the 1:1 line which indicates full yield recovery from the two damage treatments within a range of seven to 12 bales per hectare in undamaged yield.

There was no significant difference in the yield of crops damaged once versus twice. The difference in yield among farms, however, was significantly different.

The ranking of the farms is shown in Table 1. Farm 5 sustained some hail damage which affected about 30 per cent of plants. The resulting lower plant density contributed to the yield reduction.

There was a 17 day spread in crop maturity between sites (Table 1).

Among treatments, the control was significantly earlier compared with the two damage treatments (no difference between E and EM). Even though the delay in maturity was significant for damage treatments, the delay was a modest one to three days.

CONCLUSION

An examination of the compensation potential in cotton following simulated Helicoverpa damage found no evidence of a decline in high yielding crops. The five farms produced a range of yield potentials from seven to 12 bales per hectare but all recovered completely in yield from either one or two fruit damage events simulating that caused by three small larvae per metre.

A modest but significant delay (one to three days) in crop maturity of damaged plants should have no real impact on the picking of the crops. We conclude from these findings that recovery from fruit damage remains strong even for high yielding crops.

Perhaps improvements in cotton genotypes and management practices in recent years have conferred greater ability to recover from fruit loss in recent years compared to 15 years ago when the initial concern was raised.

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We are very grateful for the participation and cooperation of the following five farms in this trial: Steve Brown at"Riverstone", Dougall Burke at "Dorren", Andrew Greste at "Waverley", Richard Jackman at "Greenbah" and Mike Logan at "Merinda".

FIGURE 2: Comparison of control (undamaged) yield against that of the two damage treatments for the five farms

FIGURE MISSING

The solid line is the 1:1 line

TABLE 1: Yield (boll numbers and seed cotton wt) and maturity outcomes from simulated Helicoverpa damage

Farm	Average boll no.(/m)			Average SC wt (g/m)			60% open bolls (DAS)		
	C	E	EM	C	E	EM	C	E	EM
1	126.9	132.7	132.6	676.5	705.4	720.0	157.4	160.4	158.8
2	120.8	114.7	115.9	649.2	611.8	631.9	168.2	169.8	169.6
3	108.1	102.5	108.4	595.1	573.1	598.3	153.2	154.4	156.8
4	96.1	94.4	95.3	514.6	507.9	519.0	164.0	165.6	165.8
5	86.0	86.9	79.8	427.5	442.6	397.7	—	—	—