

A COMPARISON OF DIFFERENT SIRATAC SYSTEMS OF PEST MANAGEMENT- INITIAL RESULTS

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This paper reports the initial results from testing different versions of the SIRATAC pest management system in the Namoi Valley for two seasons. The experiments were designed to investigate the ability of the program to manipulate crop earliness according to criteria set by the crop manager.

In our cotton production systems, the term "economic threshold" refers to the point at which insecticides should be applied to stop the population reaching the economic injury level. This applies the basic dictum of economics: one should not incur costs unless a greater gain results. In simple terms a threshold is a level or limit at which an effect is said to become important.

The necessity to assess the performance of the crop throughout the season was considered to be very important by the original designers of the SIRATAC program. SIRATAC uses the novel concept of a crop threshold as well as more conventional pest thresholds. The crop threshold, or yield development threshold, is a measure of the number of bolls needed at any date during the season for a specified yield to be achieved by the end of the season.

This yield development threshold (YDT) is described by three parameters: a target yield; a date defining the start of boll setting; and a date by which boll setting should be completed. A target yield for a SIRATAC management unit should be set realistically, dependent on field history and water availability, etc. The date of first boll setting is the anticipated date of first flowering. The date for the end of boll setting is the date when it is desired that the crop will have set the fruit load necessary to achieve the target yield. Of course, the dates have to be realistic in respect to the general growth and development of the crop in the particular environment being considered.

The earliest date for the start of boll setting can be determined from

climatic records by using 750 day degrees, from sowing to first flower. In temperate regions, the latest date of completion of boll setting is calculated by going back from the average date of first frost by the number of day degrees that a boll needs to mature. The climatic limits of boll setting recommended by the SIRATAC program are the dates at which there is a 50% probability of a frost preventing a boll contributing to harvest. Figure 1 shows an example of a full season YDT used in the Namoi Valley by SIRATAC in 1982/83.

The SIRATAC pest management system uses the YDT to dynamically adjust Heliothis pest thresholds throughout the fruiting period of the crop. Instead of using counted bolls, predicted numbers of surviving bolls (computed by the SIRATAC fruit model) are compared with the YDT in order to see whether pest control can be relaxed or needs tightening; the greater the excess of bolls there are over the YDT, the more relaxed the control can be i.e. the greater the Heliothis threshold can be. The earliness or lateness of the crop compared to the YDT is measured in days. If the plant can compensate for fruit damage, then Heliothis thresholds are made a function of this earliness in the fruiting phase of the crop. However, if a yield loss is predicted by the SIRATAC fruit model as a result of Heliothis feeding over the next three days, then Heliothis thresholds come back to base level. Figure 2 shows the dynamic thresholds used in the fruiting phase.

In the 1983/84 version of SIRATAC, Heliothis and thrips thresholds were also made dynamic before the crop commenced fruiting on the basis of seasonal timeliness. Actual and predicted day degrees (adjusted for "cold shock") were accumulated until 750 day degrees, the time from sowing to first flower, were reached. This date was compared to the value of the start of boll setting specified by the manager's YDT. If this date was before the boll setting date (Figure 3a) the threshold was increased, whereas if it was after the boll setting date, i.e. the crop was late, the threshold was reduced (Figure 3b). Terminal damage will cause a delay to the development of young cotton of about 7 days. A further requirement was that the crop had to be at least 7 days early to be considered "on time". The upper limit of dynamicism of the threshold is determined by assessment of the crop's seedling disease and herbicide damage status. Figure 4 shows the presquaring Heliothis threshold calculation.

FIGURE 1. 1982/83 Full season YDT

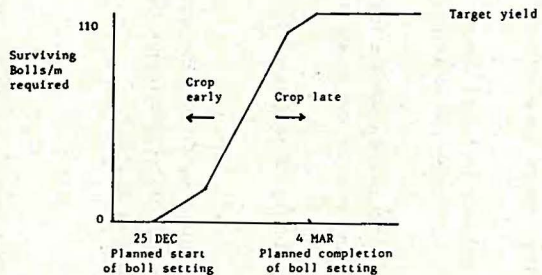


FIGURE 2. Fruiting phase dynamic *Heliothis* thresholds

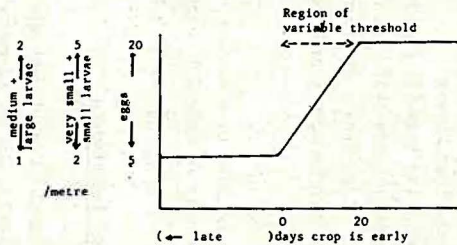


FIGURE 3.

(a) warm season - crop early

(b) cool season - crop late

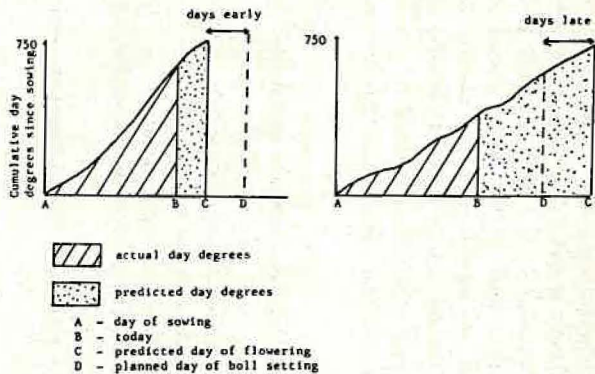
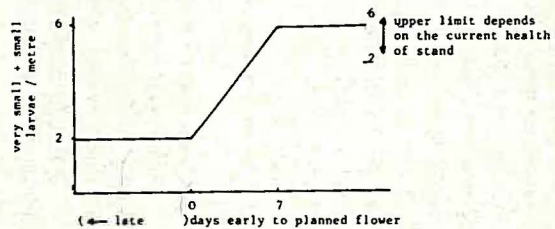


FIGURE 4. Presquaring dynamic *Heliothis* threshold



By manipulation of the YDT the manager can select a pest management strategy anywhere in the spectrum between a very early or short season strategy and a full or long season strategy (utilizing the ability of cotton to compensate for early damage). Earlier crop setting can be achieved by specifying an earlier or steeper YDT. On average, crops with earlier YDTs will have a lower Heliothis thresholds and usually then will receive more insecticide applications early in the fruiting cycle (Figure 5). This should result in a higher percentage of earlier fruit set resulting in earlier maturity of the crop.

An early season strategy has the following possible advantages:

- (a) allows earlier harvest and thereby possibly avoids poorer quality resulting from either late ripening or autumn rainfall
- (b) earlier harvest also allows more time for land preparation
- (c) it may partly or wholly avoid the "classic" late season upsurge in Heliothis armigera
- (d) it may help minimize rankness in systems of high nitrogen and water input

On the other hand, a full season strategy offers the advantages of:

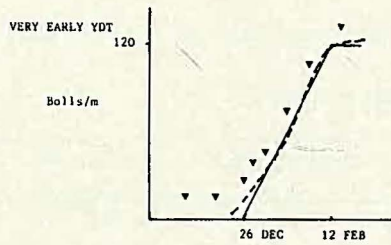
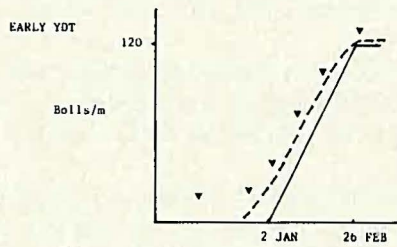
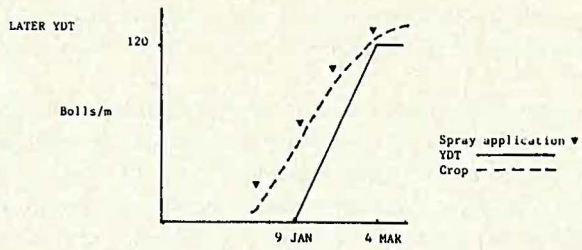
- (a) yield increases from the compensatory response to insect damage
- (b) the means of reducing pesticide usage by utilizing the beneficial effects of predators
- (c) removing the need for some early sprays through compensation (in many seasons it seems that pest pressure is low later in the season so overall less sprays are required)
- (d) minimizing secondary pest resurgence e.g. mites from early "hard" sprays

A compromise or a mixture of the strategies would allow the manager to hedge his bets on seasonal conditions or better deploy his labour and machinery by having crops at different stages of maturity.

Details of Experiments

The 1982/83 experiment was sown with Deltapine 61 on October 4th, 1982 at the CSIRO property "Burrenda" in the western Namoi Valley. Four

FIGURE 5. Early season control with different YDT's



treatments were replicated twice. Each plot was 102m wide, but only the middle 42 rows of each plot were sampled. This allowed 30m on each side of the plot as a buffer for spray drift. 140 kg N/ha was applied presowing. The growing conditions were favourable for cotton production in 1982/83.

The 1983/84 experiment was sown with Deltapine 61 on October 23, 1983 in the CSIRO lease area near the Myall Vale Research Station. Three earliness treatments were replicated three times. The plots were 45m wide and bordered by 35m of unsprayed buffers, and fertilized with 125 kg N/ha. The experiment was subject to prolonged waterlogging after the first irrigation (7th January), hail damage of 15% (14th February), defoliant drift and nitrogen striping. Although seasonal conditions were poor, yields produced were still quite comparable with other local fields.

In both experiments, pests were sampled three times a week and fruit counts once a week by the SIRATAC method. This information was processed by the SIRATAC computer program for analysis and decision making.

Although the treatment YDTs differed somewhat in each season, as dictated by sowing date and yield expectations, all treatments can be considered as tests of the early crop setting mechanisms of the SIRATAC system.

Table 1: The different SIRATAC treatments used in each season.

1 (a) 1982/83 SIRATAC treatments

<u>Code</u>	<u>Treatment</u>	<u>Start of boll setting</u>	<u>Completion of boll setting</u>	<u>Target Yield (bales/ha)</u>
BURRA	Dynamic thresholds till first flower	1 Jan	4 Mar	6.5
BURRB	No dynamic thresholds	1 Jan	4 Mar	6.5
BURRC	Dynamic threshold till fruit model predicts yield loss	1 Jan	4 Mar	6.5
BURRD	Early season SIRATAC with dynamic thresholds	20 Dec	14 Feb	6.5

1 (b) 1983/84 SIRATAC treatments

(Dynamic thresholds dependent on fruit model in all treatments)

Code	Treatment	Start of boll setting	Completion of boll setting	Target Yield (bales/ha)
MYALLO	Average earliness	9 Jan	4 Mar	7.5
MYALLI	Early season SIRATAC	2 Jan	26 Feb	7.5
MYALLX	Very early season SIRATAC	26 Dec	12 Feb	7.5

Results

Table 2 presents the insecticide usage, yield and maturity data for both experiments. Only one pick was done on the "Burranda" experiment, whereas two picks were made on the Nyall Vale experiment. Figure 6 shows the Heliothis densities on the BURRC and MYALLO (the treatments sprayed latest).

1982/83

The 1982/83 experiment shows that SIRATAC can be used to produce an earlier crop of similar yield (9 days earlier to 60% boll opening) albeit at the expense of two extra sprays (BURRD vs BURRC). The treatment using dynamic thresholds on the basis of the fruit model (BURRC) yielded more than the average yield of the treatment which used dynamic thresholds to only first flower (BURRA). However, one of the plots in BURRA yielded the second highest in the experiment and the low yield in the other plot was surprising (pre-harvest rainfall on one plot may have been a factor). The treatment without dynamic thresholds (BURRB) proved to be similar to the early treatment (BURRD). The later treatments were affected by heavy rainfalls experienced in May and consequently were downgraded by a light grey colour penalty and for reduced staple length. Although the yields of all the treatments were not significantly different, differences in quality between early and late treatments were significant. A difference in quality from middling plus to middling light grey was worth over \$100/ha. The reduction in spray costs were not enough to compensate for this loss.

Table 2. Insecticide use, yield and maturity data

2 (a) 1982/83 experiment

	BURRA - Dynamic till 1st flower	BURRB - No dynamic thresholds	BURRC - Dynamic threshold till fruit model predicts yield loss	BURRD - Early season SIRATAC with dynamic thresholds	
<u>Sprays</u>					
Pre-January	0	2	0	2	
Post-January	5	5	5	5	
<u>Sprays applied</u>					
Dec 11		Dp+C		Dp+C	
23		E		E	
Jan 8		Dp+C		Dp+C	
11	E				
18			E		
29	C		C	C	
Feb 1		E			
2	Dp+C		Dp+C		
8		E		E	
17	E+M	E+M	E+M	E+M	
Mar 3	E+Dm	E+Dm	E+Dm	E+Dm	
.....					
Date 60% boll opening - March	22	14	23	14	
Yield (ba/ha)	5.45	5.74	5.90	5.70	
Individual plot yields -	5.97	5.73	6.40#	5.75	
-	4.93#	5.76	5.40#	5.65	
<u>Quality</u>					
- Grade	M #* to SM	SLM+ to M+	M #* to SM#*	M to M+	# - rain affected * - light grey
- Staple	1 1/16"	1 3/32"	1 1/16"	1 3/32"	
- Micronaire	5.1	5.0	4.9	5.1	

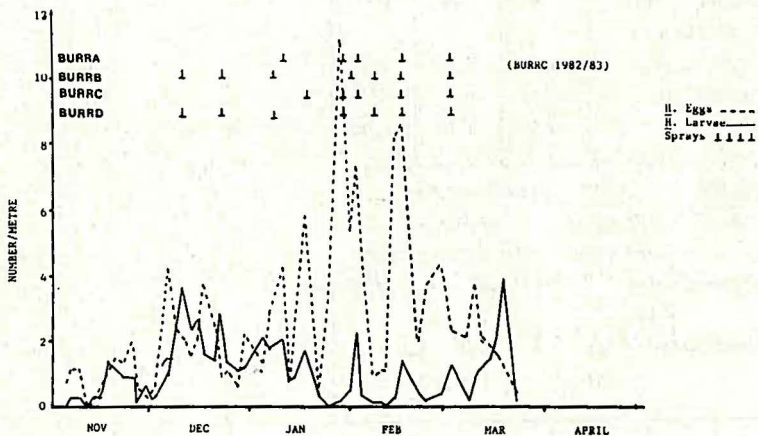
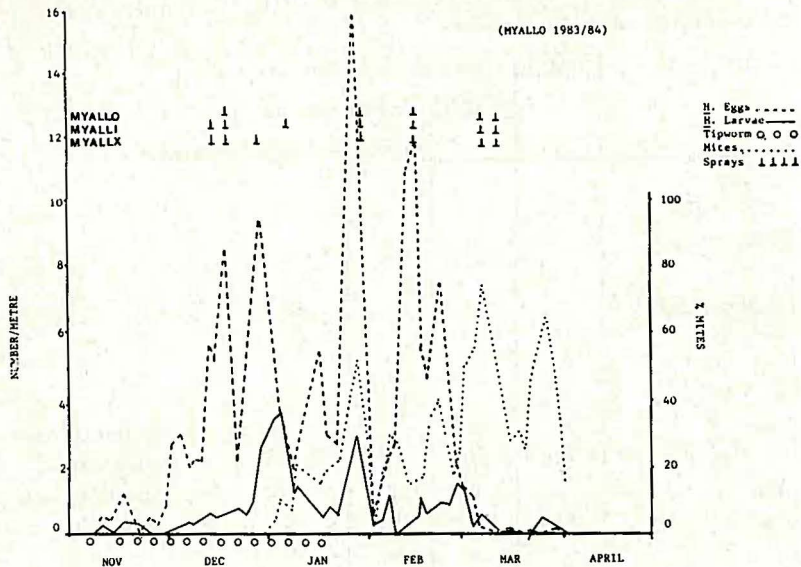
Table 2. Insecticide use, yield and maturity data

2 (b) SIRATAC treatment results.

	MYALLX - Very early season	MYALLI - Early season	MYALLO - Average earliness
<u>Sprays</u>			
Pre-January	3	2	1
Post-January	4	5	4
<u>Sprays applied</u>			
Dec 16	E	E	
20	Mo	Mo	Mo
29	E+C		
Jan 8		E	
30	P+C	P+C	P+C
Feb 15	C	C	C
Mar 8	Mo+C	Mo+C	Mo+C
13	P	P	P
.....			
Date 60% boll opening - April	9	13	13
Yield (ba/ha)			
First pick	4.70	4.58	4.66
Second pick	0.24	0.31	0.26
Total	4.99	4.89	4.92
.....			
<u>Quality</u>all similar.....		
- Grade - 1st pick	SM White		
- 2nd pick	SLM White to SLM+		
- Staple - 1st	1 1/16" - 1 3/32"		
- 2nd	1 1/32"		
- Micronaire - 1st	3.8 - 4.9		
- 2nd	2.7 - 3.2		

C - Chlordimeform
 E - Endosulfan
 Mo - Monocrotophos
 P - Profenofos

FIGURE 6. Pest Densities



1983/84

In 1983/84, all treatments received a spray for a combination of cotton tipworm and Heliothis. This monocrotophos spray appeared to induce a later mite problem. The very early treatment (MYALLX) received the most sprays at early squaring with the crop finally being 4 days earlier than the other treatments. There was no discernable difference in maturity between the early and the average SIRATAC treatments even though the early treatment received one more early spray application. There was no significant difference in the yields of the first pick nor the quality of the treatments. The 1984 harvest conditions were excellent and rainfall did not complicate picking.

Conclusion

Two seasons results have shown that pest management can exercise some control over the pattern of crop development. However, insect pressure was only moderate in both seasons and more extreme responses may be demonstrated with greater Heliothis abundance. The economic effect of the record amount of autumn rainfall experienced in 1982/83 on the quality of later crops was important. Environmental conditions and field variability appeared to be major determinants of yield in both seasons. It is interesting to note that despite last year being one of the worst seasons ever encountered in the Namoi Valley, that the later treatment (MYALLO) compensate enough to match the yield of the very early treatment although it had two less sprays. A long term perspective on the different strategies of pest control will only be achieved after a number of seasons of experimentation.

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