***Despite yield variability risk, early termination appears most profitable practice***

# Economics of pest control alternatives for Imperial Valley cotton

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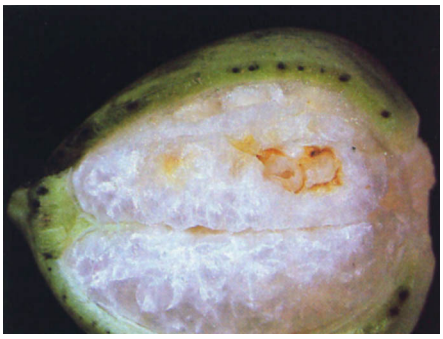

It costs Imperial Valley cotton growers $300 per acre per year to control the pink bollworm, and the cost is rising steadily.

Since the mid-1960s, the pink bollworm and outbreaks of associated secondary pests have been responsible for annual costs averaging more than one-fourth of the annual value of cotton grown in the Imperial Valley. Insecticide and application plus a variety of other costs attributable to pink bollworm, *Pectinophora gossypiella* (Saunders), average approximately $300 per acre per year for a total cost to Imperial Valley farmers exceeding $250 million during 1966-80.

The problem of pink bollworm has grown more serious during recent years, because the pest is developing resistance to insecticides and requires frequent insecticide treatments. The real costs of pink bollworm control have risen at a 6 percent annual rate. The situation is a classic example of a pesticide treadmill — continually rising costs that must be incurred to maintain a given or declining level of control. Due to the pervasiveness of the pink bollworm in the Imperial Valley and the magnitude of the resulting control costs, it is reasonable to consider alternatives to conventional growing practices in this region.

## Alternative controls

One possible alternative to conventional practices is host plant resistance. Nectariless cotton has been demonstrated to be less attractive to pink bollworm than the standard nectaried variety, probably because nectar-producing glands are not present in the leaves and at the base of the flower. However, the reduction of food may also reduce the number of beneficial insects. Furthermore, lint from the current commercial nectariless variety is sometimes downgraded, and it has a tendency to stick to the hairier leaves of that cultivar during picking. The net economic effect of all these factors must be examined before the practice can be recommended.

Another possible alternative is alteration of cultural practices. Researchers have observed that the most serious pest problems occur during the last weeks of summer. Therefore, pest problems might be largely avoided by terminating production early, during the middle of August, rather than in late September as is currently done. Although some reduction in yield due to early termination would be expected, we hypothesized that reduction in pest control, irrigation, and fertilizer costs would more than compensate for that loss.

For the economic evaluation of each alternative, we used a series of paired comparisons for the years 1978-80. There were 16 pairs of nectaried and nectariless fields with an average of 54 acres each; there were 15 pairs of early-termination and long-season fields with an average of 33 acres each. Other than variety planted or termination date, all farm management practices were the conventional procedures followed in the area at the time of the study. In most cases, each member of a pair consisted of adjacent fields to minimize the differences due to soil types, pest infestations, and the like. In the early-termination group, irrigation stopped on August 15.

**TABLE 1. Difference in profit per acre for nectariless and nectaried cotton.**

| Item | Nectariless | | Nectaried |
|---|---|---|---|
| Crop value/acre (lint) | $1045.62 | | $1134.42 |
| Costs/acre: | | | |
| Insect control | $121.28 | $117.16 | |
| Bale tax* | 1.73 | 1.87 | |
| Aflatoxin† | 5.72 | 6.23 | |
| Harvest | 154.86 | 168.30 | |
| Loan charges‡ | 7.02 | 6.99 | |
| Partial variable costs/acre | $ 290.71 | | $ 300.55 |
| Partial profit/acre | $ 754.91 | | $ 833.87 |
| Profit difference (in favor of nectaried) = $78.96 | | | |

NOTE: For sources of costs other than those described below, see text.
* The bale tax is levied on each bale of cotton to finance pink bollworm research and suppression in the Imperial and San Joaquin Valleys of California.
† This represents 60% of the cost of processing cotton seed in order to reduce levels of aflatoxin, a carcinogen produced when the *A. flavus* fungus enters the boll through pink bollworm exit holes.
‡ This represents the cost of additional loans necessary to finance insect control and harvest costs.

**TABLE 2. Difference in profit per acre for early and long-season cotton**

| Item | Early season | Long season |
|---|---|---|
| Crop value/acre (lint) | $ 968.51 | $1101.12 |
| Costs/acre: | | |
| Insect control | $ 43.05 | $127.68 |
| Bale tax* | 1.67 | 1.91 |
| Aflatoxin† | 8.91 | 10.12 |
| Harvest | 143.24 | 162.86 |
| Loan charges | 3.35 | 9.14 |
| Marginal irrigation cost | — | 18.23 |
| Marginal fertilizer cost | — | 21.10 |
| Marginal defoliation cost | — | 4.27 |
| Partial variable costs/acre | $ 200.22 | $ 355.31 |
| Partial profit/acre | $ 768.29 | $ 745.81 |
| Profit difference (in favor of early termination) = $22.48 | | |

* See (*) footnote, table 1.
† See (†) footnote, table 1.
‡ This represents the cost of additional loans necessary to finance insect control, harvest, irrigation, fertilizer, and defoliation.

The effect of each alternative on grower profit is summarized in tables 1 and 2. We derived average harvest costs per bale and control costs per application from Cooperative Extension Cotton Production Budgets and then multiplied them by actual bales harvested and the actual number of insecticide applications, respectively, as taken from the experimental data. Harvest interest cost is based on the timing suggested in the production budgets and is calculated under the same assumptions made for the tables.

In a similar manner, we determined irrigation costs, multiplying Extension cost averages by the actual number of additional irrigations for long-season cotton. Defoliation costs are assumed to be 25 percent less under early termination, because plants are smaller; we estimated these costs using Extension averages. We assumed early-termination cotton would require one less fertilizer application, which was determined using county averages.

The revenue calculation includes that for lint only, since income from seed sales usually is exactly offset by ginning costs. An average price over the three-year period of 74 cents per pound is used to calculate revenue. The resulting difference between revenue and cost is only a partial profit per acre, since we have not included overhead expenditures or variable costs, which are the same for both technologies.

The conventional nectaried cotton is much more profitable than the nectariless variety: it earns the grower an average of $78.96 more per acre, primarily because it gives higher yields. This is a conservative estimate of the profit difference: the lint quality of nectariless is generally not as high as that of the nectaried, and we did not take this difference into account.

Our results indicate that early termination is $22.48 more profitable per acre than the long season. This conclusion probably underestimates the true profitability of this alternative for two reasons: first, the top crop (for the long season) is of lesser quality than the first crop; second, it is not possible to calculate the savings to growers from an areawide early termination program that presumably would result in smaller overwintering populations and hence a lower pink bollworm infestation in the following year.

Of the two alternatives to the conventional cotton production practices, it appears that early termination may be the most promising for the Imperial Valley. A question that remains unanswered, however, is why so many growers prefer the relatively uneconomical long-season practice.

As seen in table 2, the mean partial profit of $758.29 for early-terminated cotton exceeds that of $745.81 for the long-season strategy. However, an analysis that considers only average, or expected, profit is incomplete in that two different technologies may produce the same average, yet one may have a wider range of realized profit than the other. It can be argued that, in such a case, many growers would prefer the technology producing the narrower range, since their actual profit would be more likely to be close to the average. Growers of this type are said to be risk-averse, and will not accept added variability of yield unless they are compensated in the form of a higher average.

This may explain why Imperial Valley growers generally prefer not to terminate early, even though profit is, on average, greater than that available from the long-season practice. In fact, the standard deviation of yield (a measure of its variability) for early-terminated plots (SD = 268.67 pounds of lint per acre) exceeds that of the long-season fields (SD = 237.59 pounds of lint per acre), implying that a grower can achieve the increase in expected profit associated with the former only by accepting greater variability or risk.

## Summary

For the Imperial Valley, the nectariless variety used in this study is definitely not a profitable alternative; early termination is more profitable but is also subject to greater yield variability. The decision to adopt this latter strategy therefore depends on grower attitudes toward risk. Given the effect on the following season of a large late-season pest buildup (which could not be costed here), a case may yet be made for a strategy such as shorter season cotton. This may be particularly true if control costs for other pests possibly unrelated to the pink bollworm complex are considered, since they, too, do the greatest amount of damage late in the season.

Perhaps the ultimate solution to all of these pest problems lies in the adoption of an integrated pest management strategy, in which early termination might be just one element combined with others such as field sanitation, cultivation of resistant varieties, crop residue destruction, the use of pheromones (either to disrupt pest reproduction or to monitor population levels), and biological control. At present, it appears that early termination of cotton in the Imperial Valley is desirable from an economic standpoint, and that continued research on short-season production practices should be undertaken. In particular, finding a means of reducing the variation inherent in early termination of cotton might make it a more acceptable alternative to growers and ultimately lead to its adoption.

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