# ECONOMIC IMPLICATIONS OF ALTERNATIVE COTTON PRODUCTION PRACTICES: TEXAS LOWER RIO GRANDE VALLEY

**Glenn S. Collins, Ronald D. Lacewell, and John Norman**

Cotton producers in the Lower Rio Grande Valley (LRGV) of Texas face continuing economic pressures arising from increasing costs of productive inputs, yield-reducing infestations of insecticide-resistant pests, and often adverse climatic conditions. The input price increases in the LRGV are similar to those in other production regions of the U.S. However, insect problems arising from the LRGV climate are unique. LRGV farmers have been unable to control late-season tobacco budworm infestations which often reach damaging levels when beneficial insects are destroyed by insecticide treatments for boll weevils [3]. These late-season insect infestations are a result of the predominantly excessive rainfalls which occur during the harvest months of August and September. Moreover, high rainfall during harvest reduces both the quality and level of cotton yields [1].

Recent research for the Texas Wintergarden production region supports the contention that short-season production techniques contribute to reducing the risks, as measured by level and variation of yield and level of costs, of late-season weather and insect infestation problems [5]. The term "short-season" implies a reduction in length of the growing season. Short-season production techniques are based on higher plant populations and acceleration of fruiting by limiting water and fertilizer applications [3]. The short-season production strategy results in an early fruit set and a reduction in the growing season from the conventional 160-180 days to 120-140 days. This reduction in the growing season circumvents the disadvantages associated with late-season insect infestations and undesirable weather conditions. In essence, the short-season concept enables producers to reduce the growing season by 20 days or more and to decrease production inputs. Major questions associated with the new cotton production technique relate to effect on yield, net returns, and risk under dryland and irrigated conditions. These factors are examined for short-season versus conventional production practice in the LRGV.

## STUDY AREA AND DATA

The LRGV is characterized by a subtropical, semiarid climate with short, mild winters and long, hot summers. The growing season averages 333 days/year. Average annual rainfall is 25 inches near the Gulf Coast and 20 inches in the southwestern part of the valley. Total cropland is 1.7 million acres of which 0.6 million acres is irrigated [8].

Irrigation water diverted from the Rio Grande River is provided principally by irrigation districts. Land that can be irrigated must be linked to water district systems. Thus, irrigated acreage is reasonably stable.

Approximately 65 percent of the average annual 270,000 acres of cotton in the valley is irrigated. About 66 percent of the irrigated land and 85 percent of the dryland areas are light to medium textured soil types. Gerald et al. [1] found that on these light soils, cotton yields are not always increased with irrigation. In fact, they report that rainfall in excess of 8-10 inches can cause significant yield reductions in irrigated cotton.

The data used in this study were obtained from the pest management program operated by the Texas Agricultural Extension Service in the LRGV from 1973-1975. This is the first detailed information based on actual farmer experience with the short-season production system. Previous studies were based either on research plots or a single year [2, 5].

Farm input and production records were collected during this period on a total of 115 fields of irrigated cotton and a total of 88 fields of dryland cotton on light to medium textured soils. The fields are near Harlingen, McAllen, Mission, Raymondville, and Weslaco, Texas. The analysis is not applicable to LRGV soils other than the light to medium textured types.

Glenn S. Collins is Research Associate and Ronald D. Lacewell is Professor, Department of Agricultural Economics, Texas Agricultural Experiment Station at College Station. John Norman is Area Entomologist, Texas Agricultural Extension Service (stationed at Weslaco), Texas A&M University.

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Rainfall data were collected from the area towns for the four-year period 1972-1975 to ensure that 1972 fall and winter rainfall records were included [4]. The fall and winter records were necessary because that period accounts for most of the moisture needed for planting and early growth of dryland and some irrigated cotton. During this period, late-season rainfall was 0.2 inches greater during August and 1.6 inches greater during September than the mean average.

The major cotton varieties included Tamcot SP-37, Stoneville 256, and Deltapine 16. An annual average of 1075 acres of irrigated land and 1025 acres of dryland were included in the study. This land area represents 1 percent of the average total acres of cotton planted each year in the LRGV.

## METHOD

To evaluate the economic implications of alternative production practices, area producers were classified by short-season and conventional production practices. These production classifications were made by consulting with area agronomists who are familiar with production practices of farms used in the study. The analysis involved (1) collecting cotton production input data for both cotton production systems, (2) building crop budgets with the aid of the crop budget generator [6], (3) calculating relevant statistical estimates for yields of dryland and irrigated cotton under the alternative production techniques, and (4) determining the sensitivity of production practices to cotton prices and yields through breakeven analysis.

Per-acre budgets for irrigated and nonirrigated cotton production by conventional and short-season techniques were developed by using partial budgeting techniques and modifying published cotton enterprise budgets for the LRGV [7]. These budgets provided the base data for the analysis.

The data used to modify the published crop budgets for the region between short-season and conventional techniques for irrigated and dryland production included yields, insecticide application, quantity of insecticide material, plant densities, number of irrigations, and fertilizer. These data were available from the records of each field included in the study. The prices of products and inputs were assumed to be constant.

Breakeven analysis was used to estimate (1) the price of lint that would just cover variable costs of production for average yields and (2) the yields at which net returns would be zero at a cotton price of $0.50/lb. The breakeven analysis is useful for indicating relative advantages of alternative cotton production systems.

## RESULTS AND IMPLICATIONS

Because water is an important input to cotton production, an analysis of variance was computed on the rainfall records to form a basis for comparing dryland and irrigated cotton yields. Rainfall data for the months of September through November preceding the production seasons of 1973, 1974, and 1975 plus the rainfall amounts for the cotton growing season February through July were averaged by location. The analysis of variance showed no statistical difference in mean rainfall by area over the period.

An annual per-acre comparison of yields an net returns with and without irrigation is presented in Table 1 for the period of 1973-1975 by year and over all years. No statistical difference is found between dryland and irrigated cotton yields for 1973 and 1975. However, for 1974 and all years in aggregate, irrigated cotton yield is statistically higher than dryland yield.

TABLE 1. AN ANNUAL PER-ACRE COMPARISON OF MEAN YIELDS AND NET RETURNS BETWEEN DRYLAND AND IRRIGATED COTTON, LRGV, 1973-1975

| Year | Item | Lint Yield[a] | C.V. of Yield | Net Returns[b] |
|---|---|---|---|---|
| | | - - lbs - - | - % - | - - $/ac - - |
| 1973 | Irrigated | 456.7(A) | 38.7 | -38.83 |
| | Dryland | 459.1(A) | 38.9 | 71.76 |
| 1974 | Irrigated | 595.1(A) | 26.9 | 57.72 |
| | Dryland | 486.8(B) | 18.8 | 114.31 |
| 1975 | Irrigated | 618.8(A) | 34.1 | 69.25 |
| | Dryland | 649.8(A) | 39.5 | 203.68 |
| 1973-1975 | Irrigated | 550.5(A) | 34.0 | 25.07 |
| | Dryland | 496.3(B) | 31.9 | 108.65 |

[a]Means with the same letter are not statistically different at the .05 level.

[b]Net returns above variable costs; a cotton lint price of $0.50/lb and cottonseed price of $100.00/ton were used.

Net returns by irrigation practice were computed by considering only variable costs. Fixed costs are basically the same for irrigated and dryland cotton because the machinery complement is the same and many operations such as insecticide application and harvesting are calculated on a custom basis. The results indicate that dryland cotton production is on the average $83.58/ac more profitable than irrigated cotton production for the period 1973-1975. Dryland production for 1973-1975 is also less variable as shown in a more than 2 percent reduction in the coefficient of variation in comparison with irrigated production. Irrigated production has the lowest return of $-38.83/ac in 1973. The greatest profitability for both dryland and irrigated production is in 1975, when dryland cotton made $203.68/ac and irrigated cotton had a net return of $69.25.

Sensitivity analysis shows that for the years 1973-1975, the price of cotton would need to rise to $2.03/lb before irrigated cotton on the average would be as profitable as dryland cotton. The relationship between breakeven lint yields indicates that at a cotton price of $0.50/lb, the breakeven yield is 277 lbs/ac for dryland compared with 488 lbs/ac for irrigated cotton. The breakeven lint price (based on variable costs) is $0.28/lb for dryland compared with $0.45/lb with irrigation at mean yields for the 1973-1975 period. The implication of these results is that dryland cotton production on medium to light textured soils in the LRGV is more profitable with less yield variability than irrigated production.

Analysis of data for short-season versus conventional production techniques is summarized in Table 2. An evaluation of lint yield for conventional and short-season production systems with and without irrigation shows that only the lint yield for irrigated cotton grown by conventional techniques is statistically different from all other yields. As expected, insecticide use and number of applications are substantially higher for conventional techniques for both dryland and irrigated production. The coefficient of variation shows that relative variation of short-season production, regardless of the water practice, is lower than that of conventional cotton production. However, even with lower levels of insecticide use and fewer insecticide applications for short-season irrigated cotton production, the net returns favor conventional management by $21.97/ac.

Dryland short-season production best typifies the short-season technique. Because only negligible levels of insecticide are used, dryland short-season production has the highest average net returns of all dryland and irrigation options ($126.31/ac). The coefficient of variation for dryland short-season cotton is slightly higher than that for irrigated short-season cotton but the net returns are $116.79/ac more via dryland. Dramatic cost, energy, and pesticide implications are associated with dryland short-season cotton production in the LRGV.

Breakeven analysis shows that irrigated cotton produced by conventional techniques has a breakeven price of $0.44/lb compared with $0.48/lb for irrigated cotton produced by short-season techniques (Table 3). At a cotton price of $0.50/lb, irrigated conventional production is associated with a breakeven yield of at least 502 lbs/ac whereas the conventional dryland production breakeven yield is 433 lbs/ac. Short-season dryland production covers variable costs when yields are 162 lbs/ac and the price is $0.50/lb or at a lint price of $0.23/lb and average yield of 475 lbs/ac. Conventional techniques with dryland production require a lint price of $0.31/lbs, based on mean yield, to cover variable costs.

TABLE 2. LINT YIELDS, INSECTICIDE APPLICATIONS AND USE, AND NET RETURNS OF SHORT-SEASON AND CONVENTIONAL PRODUCTION TECHNIQUES WITH AND WITHOUT IRRIGATION, LRGV, 1973-1975

| | Lint Yield[a] | C.V. of Yield | Insecticide Applications | Insecticide Use | Net Returns[b] |
|---|---|---|---|---|---|
| | lbs | % | no | lbs. | $/ac |
| Irrigated | | | | | |
| Conventional | 580.6(A) | 33.8 | 13 2 | 22.1 | 31.49 |
| Short-Season | 457.0(B) | 25.1 | 11.0 | 14.1 | 9.52 |
| Difference | 123.6 | 8.7 | 2.2 | 8.0 | 21.97 |
| Dryland | | | | | |
| Conventional | 512.7(B) | 33.0 | 5.79 | 12.32 | 94.98 |
| Short-Season | 474.9(B) | 30.1 | .44 | .15 | 126.31 |
| Difference | 37.8 | 2.9 | 5.35 | 12.17 | -31.33 |

[a]Means with the same letter are not statistically different among all groups at the .05% level.

[b]Net returns above variable costs; a cotton lint price of $0.50/lb and cottonseed price of $100.00/ton were used.

TABLE 3. BREAKEVEN COTTON PRICE AND YIELD FOR SHORT-SEASON AND CONVENTIONAL PRODUCTION TECHNIQUES, LRGV

| Classification of Production Techniques | Breakeven Values: Price of Lint | | Lint Yield[a] | |
|---|---|---|---|---|
| | Dryland | Irrigated | Dryland | Irrigated |
| | $/lb | | lb/ac | |
| Conventional | .31 | .44 | 433(513) | 502(580) |
| Short-Season | .23 | .48 | 162(475) | 442(457) |

[A]Based on a cotton lint price of $0.50/lb. Values in parenthesis are average yields for 1973-1975.

## CONCLUSIONS

The incidence of pest populations and development of resistance to insecticides in the LRGV have caused concern about levels of insecticide use and costs of production for cotton. Furthermore, conventional cotton production practices prolong crop maturation and thus delay harvesting until late August when rainfall levels increase. These factors affect yield, costs, risk, quality of lint, and farmer profit [1, 2]. An alternative cotton production system, a short-season production technique, has been used by several LRGV producers in recent years. Data on cotton fields managed under conventional and short-season strategies were collected for the 1973-1975 period. Analysis of the data for cotton production by short-season and conventional techniques in the LRGV indicate that short-season techniques provide (1) greater net returns on the average for dryland production and (2) a reduction in the variation of yield of both dryland and irrigated production in comparison with the conventional production strategy.

The implications of the study are that, in general, dryland production, regardless of management technique, is more profitable than irrigated production. Average net returns above variable production costs are highest with short-season dryland management. This outcome is primarily due to the reduced levels of irrigation, insecticide use, and insecticide applications. However, supplemental irrigation may be needed in the LRGV. In years when subsoil moisture normally created by fall rains and subsequent spring rainfalls is inadequate, the addition of properly timed irrigations may result in yields significantly higher than those on dryland fields without delaying crop maturity or increasing insect populations.

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