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ECONOMIC POTENTIAL OF A COTTON-CORN ROTATION

Steven W. Martin and Fred Cooke, Jr.
Delta Research and Extension Center
Stoneville, MS
David Parvin
Department of Agricultural Economics
Mississippi State, MS

Abstract

Farmers are constantly trying to improve economic returns. Several studies have been conducted to investigate the potential yield benefits of cotton-corn rotations. None of these studies, however, addressed the issues of returns to the producer for performing these rotations. In other words, does the producer make any more money with rotations or would the producer receive higher returns planting continuous cotton? Interviews were also conducted with individual producers geographically dispersed throughout the Delta region of Mississippi. The producers interviewed suggested cotton lint yield increases ranging from 150-400 pounds per acre the first year following corn. This analysis allows comparison between base cotton yields and selection of break-even cotton and corn prices. By selecting a yield level and either a cotton or corn price, the break-even price of the other crop is easily determined. The results suggest that corn should be included in all rotations.

Introduction

Farmers are constantly trying to improve economic returns. A common practice for many producers is to rotate crops. Crop rotation has been shown to increase agronomic yields for many crop combinations (Spugeon and Grissom, Ebelhar and Welch, Kurtz, Snipes, Ebelhar, and Cooke, Funchess, and Boquet). This rotation has been used for various reasons among them are; possible yield increases, nematode reduction, improved weed control and increased returns (Spugeon and Grissom, Ebelhar and Welch, Kurtz, Snipes, Ebelhar, and Cooke, Boquet, Parvin and Cooke, Bechel et. al., and Lawrence and McLean).

Several studies have been conducted to investigate the potential yield benefits of cotton-corn rotations in the Mississippi Delta. Spurgeon and Grissom were some of the first to document cotton yield responses to crop rotations. Their study, conducted in the 1950's and 1960's, showed an increase in cotton yield of greater than 8% following a corn crop on a Bosket very fine sandy loam soil. Additionally, Spurgeon and Grissom reported on a Dubbs silt loam soil a 12% increase the first year following corn and a 7% increase in cotton yield the second year. Spurgeon and Grissom also evaluated a Sharkey clay soil and reported a 6% increase in cotton yield following corn the first year with a greater than 4% increase the second year.

Ebelhar and Welch also investigated the response of cotton to various crop rotation patterns. Their study, conducted in the 1980's with early maturing cotton varieties showed a 12% increase in yield the first year following a corn crop and a 2% increase the second year on a mixture of Bosket very fine sandy loam soil and Dubbs silt loam soil.

The Louisiana State University Agricultural Center's Northeast Research Station in St. Joseph, LA has an on-going crop rotation study that began in 1980. Their results have shown yield increases averaging 12% the first year following corn and 5% the second year for the period 1980 to 2000 (Boquet).

Materials and Methods

None of these studies, however, addressed the issues of returns to the producer for performing these rotations. In other words, does the producer make any more money with rotation, given the above mentioned yield increases, or would the producer have larger net returns planting continuous cotton? The authors have developed preliminary corn/cotton price analysis tables to address this issue. The tables show returns above specified costs at various cotton and corn prices. Specified costs were based on the 2000 Delta Area, Mississippi State Planning Budgets (MSPB) and include fixed and variable costs but exclude land and management charges. The MSPB costs of production were $587 for irrigated cotton and $315 for irrigated corn. The corn budget was based on irrigated production under conventional tillage utilizing 8-row equipment on 40-inch row spacings. Returns to the corn crop are based on the budgeted yield of 135 bu/acre. The cotton budget was based on irrigated cotton production under conventional tillage using 8-row equipment and 40-inch row spacings.

Preliminary Results

Tables for three different cotton yields; 750, 850, and 1000 lb lint/acre are presented. These yields could be considered as "base"or "normal" yields if no rotation was conducted. These are also the yields used for the continuous cotton returns presented with each table. Tables 1-3 are presented for a three-year (corn-cotton-cotton) rotation and tables 4-6 show a two-year (corn-cotton) rotation. The tables show average per acre returns for either two or three years of the rotation. The tables assume corn is produced the first year with a 12% increase in yield for the first year after corn (second crop year). The three-year tables assume a 6% increase in yield for the second cotton crop following corn.

A few points should be made concerning the tables. The returns from continuous cotton are given in the last row of each table. Each column of the tables presents results from the selected cotton prices. By choosing a cotton price and following it down the column the returns for the rotation can be compared at each corn price (listed in the left column of each table) to the continuous cotton returns in the last row.

Each column in the tables has a return that is highlighted and underlined. The highlighted return corresponds with the corn price that makes the rotation at least break-even when compared to continuous cotton at that respective cotton price. Some of the returns in the tables are negative (shown in red). Often the rotation is advantageous to continuous cotton due a reduction in losses. It should be remembered that these returns do not consider any governmental support in the form of either market or transition assistance. Where governmental assistance is known, the prices for corn and cotton should be adjusted accordingly and these adjusted prices used for comparisons. At lower cotton yield levels, most corn prices provide economic advantages over continuous cotton. As cotton yields increase, higher corn prices are needed. At the highest yield levels and cotton prices, continuous cotton provides the highest returns. Figures 1 and 2 combine the results from the tables for a three and a two year rotation respectively. This graphical representation allows comparison between base cotton yields and selection of break-even cotton and corn prices. By selecting a yield level and a point on the graph for either a cotton or corn price, the break-even price of the other is easily determined.

Producer Interviews

These preliminary results suggest the need for further research in this area. The cost of production for the analyses in the tables is based on the 2000 MSPB. However, for producers engaged in a cotton-corn rotation, costs of production may vary significantly for either corn or cotton or both. Additionally, some local producers have suggested greater yield responses and higher per acre corn yields than those used in these preliminary analyses. Therefore in the spring of 2001, producers with cotton-corn rotation experience were identified. These producers were interviewed in order to determine production practices and costs for a cotton-corn rotation. Where possible, data was obtained on yield response to the rotation. Also, an attempt was made to identify producers practicing cotton crop rotations other than corn (i.e. rice, grain sorghum, soybeans, wheat, etc).

Interview Results

Interviews were conducted with eleven individual producers geographically dispersed throughout the Delta region of Mississippi. The results of the interviews were used to develop summarized enterprise budgets for both corn following cotton and cotton following corn. These budgets are listed in the appendix.

The producers interviewed suggested cotton lint yield increases ranging from 150-400 pounds per acre the first year following corn. Yield increases as compared to continuous cotton dropped to approximately one half the above mentioned numbers during the second year after corn. Producers also reported corn yields ranging from 135-225 bushels per acre. Based on these interviews, tables 7-10 were developed to show break–even price combinations for the rotations. For irrigated production, a base cotton yield of 825 pounds per acre was used. A conservative 15% increase in cotton lint yield the first year following corn was used. For the three year rotations, a 7% yield increase was used for the second year following corn. For the irrigated rotations, a 165 bushel per acre corn yield was used for the comparisons. For non-irrigated production, a 750 pound per acre cotton yield was used. A corn yield of 135 bushels per acre was used for the non-irrigated rotation comparisons. Figures 1 and 2 include a graphical presentation of these results as well.

The enterprise budgets from the interviews show significant cost reductions from the standard budgets. Table 11 and 12 compare the budgeted costs of the individuals interviewed to the standard budgets for irrigated and non-irrigated production respectively. These cost reductions are primarily a result of tillage practices. One of the individuals interviewed practiced complete no-till production and the remaining 10 practiced some form of reduced tillage. These reductions in tillage help to offset some of the added expenses associated with the rotation such as increased plant bug insecticide applications on cotton adjacent to corn. Some producers suggested the need for additional tillage to remove corn stubble prior to cotton planting. However, overall tillage expenses were still less than conventional budgets. Most of the producers interviewed suggested

some reduction in equipment and labor savings due to the timing of corn planting and harvest compared to a continuous cotton operation. These savings are not documented in this study. However, they are part of a larger research project which the authors have on-going which addresses whole farm analysis.

The results from the interviews suggest that corn should be included in all rotations. The break-even price for corn would have to be less than the corn loan rate in any of the situations for the rotation not to be advantageous. Again, these prices do not include any type of governmental assistance. The prices do not consider any discounts at the elevator or gin. Any prior knowledge of these premiums or discounts should be used to determine the price(s) used when making the comparisons.

Further Research

Further research is needed in documenting cotton and/or corn yield response to rotations. Other crop mixes also need identifying and researching (i.e. grain sorghum). These research projects need to be conducted over varying soil types and moisture situations. Additionally, the whole farm approach needs to be addressed. For example, if it takes X tractors to farm 3000 acres of continuous cotton, can X-1 be used to farm 2000 acres of cotton and a 1000 acres of corn? This report is written as a guide and as a prompt to hopefully stimulate interest into the potential of these and other crop rotations.

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Table 1. Average annual returns above budgeted costs per acre for continuous cotton and a corn-cotton-cotton rotation (three years) at selected prices; corn yield of 135 bu/acre and cotton yield of 750 lb/acre.

	Cotton prices				
Corn price	$0.50	$0.55	$0.60	$0.65	$0.70
$1.50	**$-114**	**$-86**	**$-59**	**$-32**	**$-5**
$1.60	$-109	$-82	$-55	$-27	$0
$1.70	$-105	$-77	$-50	$-33	$4
$1.80	$-100	$-73	$-46	$-18	$9
$1.90	$-98	$-68	$-41	$-14	$13
$2.00	$-91	$-64	$-37	$-9	$18
$2.10	$-87	$-59	$-32	$-5	$22
$2.20	$-82	$-55	$-28	$0	$25
$2.30	$-78	$-50	$-23	$4	$31
$2.40	$-73	$-46	$-19	$9	$35
$2.50	$-69	$-41	$-14	$13	$39
Continuous Cotton	$-154	$-116	$-95	$-57	$-14

- Returns in red represent negative net returns
- Highlighted returns correspond to the corn price needed for the rotation to break-even as compared to continuous cotton for each respective cotton price.

Table 2. Average annual returns above budgeted costs per acre for continuous cotton and a corn-cotton-cotton rotation (three years) at selected prices; corn yield of 135 bu/acre and cotton yield of 850 lb/acre.

	Cotton prices				
Corn price	**$0.50**	**$0.55**	**$0.60**	**$0.65**	**$0.70**
$1.50	**$-71**	**$-40**	**$-10**	$21	$51
$1.60	$-65	$-36	$-5	$26	$56
$1.70	$-62	$-31	$-1	$30	$60
$1.80	$-58	$-27	$4	**$35**	$65
$1.90	$-53	$-22	$8	$39	$69
$2.00	$-49	$-18	$13	$44	**$74**
$2.10	$-44	$-13	$17	$48	$78
$2.20	$-40	$-9	$22	$52	$83
$2.30	$-35	$-4	$26	$56	$87
$2.40	$-31	$0	$31	$61	$92
$2.50	$-26	$5	$35	$65	$96
Continuous Cotton	$-96	$-54	$-11	$32	$74

- Returns in red represent negative net returns
- Highlighted returns correspond to the corn price needed for the rotation to break-even as compared to continuous cotton for each respective cotton price.

Table 3. Average annual returns above budgeted costs per acre for continuous cotton and a corn-cotton-cotton rotation (three years) at selected prices; corn yield of 135 bu/acre and cotton yield of 1000 lb/acre.

	Cotton prices				
Corn price	**$0.50**	**$0.55**	**$0.60**	**$0.65**	**$0.70**
$1.50	**$-9**	$25	$63	$99	$135
$1.60	$4	$32	$67	$104	$140
$1.70	$0	$36	$72	$108	$144
$1.80	$5	**$41**	$76	$113	$149
$1.90	$9	$45	$81	$117	$153
$2.00	$14	$50	$85	$122	$158
$2.10	$18	$54	$90	$126	$162
$2.20	$22	$58	**$94**	$131	$167
$2.30	$27	$62	$99	$135	$171
$2.40	$32	$67	$103	$140	$176
$2.50	$36	$71	$108	**$144**	$180
Continuous Cotton	$-9	$41	$91	$141	**$191**

- Returns in red represent negative net returns.
- Highlighted returns correspond to the corn price needed for the rotation to break-even as compared to continuous cotton for each respective cotton price.

Table 4. Average annual returns above budgeted costs per acre for continuous cotton and a corn-cotton rotation (two years) at selected prices; corn yield of 135 bu/acre and cotton yield of 750 lb/acre.

	Cotton prices				
Corn price	**$0.50**	**$0.55**	**$0.60**	**$0.65**	**$0.70**
$1.50	**$-107**	**$-85**	**$-64**	$-43	$-22
$1.60	$-99	$-78	$-57	**$-36**	$-15
$1.70	$-93	$-72	$-51	$-30	$-9
$1.80	$-86	$-65	$-44	$-23	**$-2**
$1.90	$-80	$-59	$-38	$-16	$4
$2.00	$-73	$-52	$-31	$-10	$11
$2.10	$-66	$-46	$-25	$-3	$17
$2.20	$-60	$-39	$-18	$3	$24
$2.30	$-53	$-33	$-12	$10	$30
$2.40	$-47	$-26	$-5	$16	$37
$2.50	$-40	$-20	$1	$23	$44
Continuous Cotton	$-154	$-117	$-79	$-41	$-3

- Returns in red represent negative net returns.
- Highlighted returns correspond to the corn price needed for the rotation to break-even as compared to continuous cotton for each respective cotton price.

Table 5. Average annual returns above budgeted costs per acre for continuous cotton and a corn-cotton rotation (two years) at selected prices; corn yield of 135 bu/acre and cotton yield of 850 lb/acre.

	Cotton prices				
Corn price	**$0.50**	**$0.55**	**$0.60**	**$0.65**	**$0.70**
$1.50	**$-75**	**$-51**	$-27	$-3	$21
$1.60	$-68	$-44	$-20	$4	$28
$1.70	$-62	$-38	$-14	$10	$34
$1.80	$-55	$-31	**$-7**	$17	$41
$1.90	$-48	$-25	$-1	$23	$48
$2.00	$-42	$-18	$8	$30	$54
$2.10	$-35	$-12	$12	**$36**	$61
$2.20	$-29	$-5	$19	$42	$67
$2.30	$-22	$1	$25	$49	$74
$2.40	$-16	$8	$32	$55	$80
$2.50	$-10	$14	$39	$62	**$87**
Continuous Cotton	$-96	$-54	$-11	$31	$82

- Returns in red represent negative net returns.
- Highlighted returns correspond to the corn price needed for the rotation to break-even as compared to continuous cotton for each respective cotton price.

Table 6. Average annual returns above budgeted costs per acre for continuous cotton and a corn-cotton rotation (two years) at selected prices; corn yield of 135 bu/acre and cotton yield of 1000 lb/acre.

	Cotton prices				
Corn price	**$0.50**	**$0.55**	**$0.60**	**$0.65**	**$0.70**
$1.50	$-27	$1	$29	$58	$86
$1.60	$-20	$8	$35	$64	$92
$1.70	$-14	$15	$41	$71	$99
$1.80	**$-7**	$19	$50	$78	$106
$1.90	$0	$28	$57	$85	$113
$2.00	$6	$35	$63	$91	$119
$2.10	$13	$42	$70	$98	$126
$2.20	$20	**$49**	$77	$105	$133
$2.30	$26	$56	$84	$112	$140
$2.40	$33	$62	$90	$118	$146
$2.50	$40	$69	**$97**	$125	$153
Continuous Cotton	$-9	$44	$91	**$141**	**$191**

- Returns in red represent negative net returns.
- Highlighted returns correspond to the corn price needed for the rotation to break-even as compared to continuous cotton for each respective cotton price.

Table 7. Average annual returns above survey costs per acre for continuous cotton and an irrigated corn-cotton rotation (two years) at selected prices; corn yield of 165 bu/acre and a base cotton yield of 825 lb/acre.

	Cotton prices				
Corn price	**$0.50**	**$0.55**	**$0.60**	**$0.65**	**$0.70**
$1.50	**$4**	**$25**	**$49**	$73	$96
$1.60	$11	$33	$57	**$81**	$105
$1.70	$18	$42	$65	$89	$113
$1.80	$26	$50	$74	$97	**$121**
$1.90	$34	$58	$82	$106	$129
$2.00	$43	$66	$90	$114	$138
$2.10	$51	$75	$98	$122	$146
$2.20	$59	$83	$107	$130	$154
$2.30	$67	$91	$115	$139	$162
$2.40	$78	$102	$123	$147	$171
$2.50	$84	$108	$131	$155	$179
Continuous Cotton	$-48	$-6	$35	$76	$118

- Returns in red represent negative net returns.
- Highlighted returns correspond to the corn price needed for the rotation to break-even as compared to continuous cotton for each respective cotton price.

Table 8. Average annual returns above survey costs per acre for continuous cotton and a non-irrigated corn-cotton rotation (two years) at selected prices; corn yield of 135 bu/acre and a base cotton yield of 750 lb/acre.

	Cotton prices				
Corn price	**$0.50**	**$0.55**	**$0.60**	**$0.65**	**$0.70**
$1.50	**$8**	**$30**	**$51**	**$73**	$94
$1.60	$15	$36	$58	$79	$101
$1.70	$21	$43	$65	$86	**$107**
$1.80	$28	$50	$71	$93	$115
$1.90	$35	$57	$78	$100	$121
$2.00	$44	$63	$85	$106	$128
$2.10	$49	$70	$92	$113	$135
$2.20	$55	$77	$98	$120	$144
$2.30	$62	$84	$105	$127	$147
$2.40	$69	$90	$112	$133	$155
$2.50	$76	$97	$119	$140	$162
Continuous Cotton	$-44	$-7	$31	$69	$106

- Returns in red represent negative net returns.
- Highlighted returns correspond to the corn price needed for the rotation to break-even as compared to continuous cotton for each respective cotton price.

Table 9. Average annual returns above survey costs per acre for continuous cotton and an irrigated corn-cotton cotton rotation (three years) at selected prices; corn yield of 165 bu/acre and a base cotton yield of 825 lb/acre.

	Cotton prices				
Corn price	**$0.50**	**$0.55**	**$0.60**	**$0.65**	**$0.70**
$1.50	**$-4**	**$26**	**$57**	**$87**	**$118**
$1.60	$1	$32	$62	$93	$123
$1.70	$7	$37	$68	$98	$129
$1.80	$12	$43	$73	$104	$134
$1.90	$18	$48	$79	$109	$140
$2.00	$23	$54	$84	$115	$145
$2.10	$31	$59	$90	$120	$151
$2.20	$34	$65	$95	$126	$156
$2.30	$40	$70	$111	$131	$162
$2.40	$45	$76	$116	$137	$167
$2.50	$51	$81	$122	$142	$173
Continuous Cotton	$-48	$-6	$35	$76	$118

- Returns in red represent negative net returns.
- Highlighted returns correspond to the corn price needed for the rotation to break-even as compared to continuous cotton for each respective cotton price.

Table 10. Average annual returns above survey costs per acre for continuous cotton and a non-irrigated corn-cotton-cotton rotation (three years) at selected prices; corn yield of 135 bu/acre and a base cotton yield of 750 lb/acre.

	Cotton prices				
Corn price	**$0.50**	**$0.55**	**$0.60**	**$0.65**	**$0.70**
$1.50	**$0**	**$28**	**$56**	**$84**	**$112**
$1.60	$5	$33	$61	$88	$117
$1.70	$9	$37	$65	$93	$121
$1.80	$14	$42	$70	$97	$125
$1.90	$18	$46	$74	$102	$130
$2.00	$23	$51	$79	$106	$134
$2.10	$27	$55	$83	$111	$139
$2.20	$32	$60	$88	$115	$143
$2.30	$36	$64	$92	$120	$148
$2.40	$41	$69	$97	$124	$152
$2.50	$46	$73	$101	$129	$157
Continuous Cotton	$-44	$-7	$31	$69	$106

- Returns in red represent negative net returns.
- Highlighted returns correspond to the corn price needed for the rotation to break-even as compared to continuous cotton for each respective cotton price.

Table 11. Irrigated Budget Comparisons.

Budget Comparisons- Irrigated Production			
Standard Cotton Budget	Cotton Following Corn Producer Budget	Standard Corn Budget	Corn Following Cotton Producer Budget
$587	$517	$317	$270

Table 12. Non-Irrigated Budget Comparisons.

Budget Comparisons – Non-Irrigated Production			
Standard Cotton Budget	Cotton Following Corn Producer Budget	Standard Corn Budget	Corn Following Cotton Producer Budget
$538	$477	$235	$209

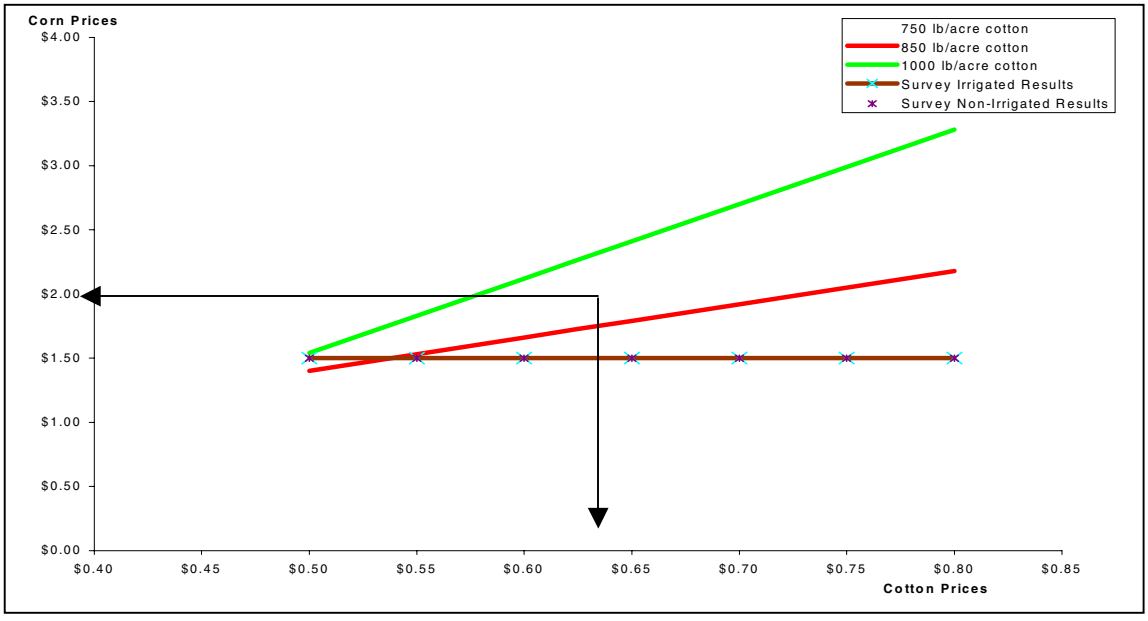

Figure 1. Prices needed for a three year (corn-cotton-cotton) rotation to break even.

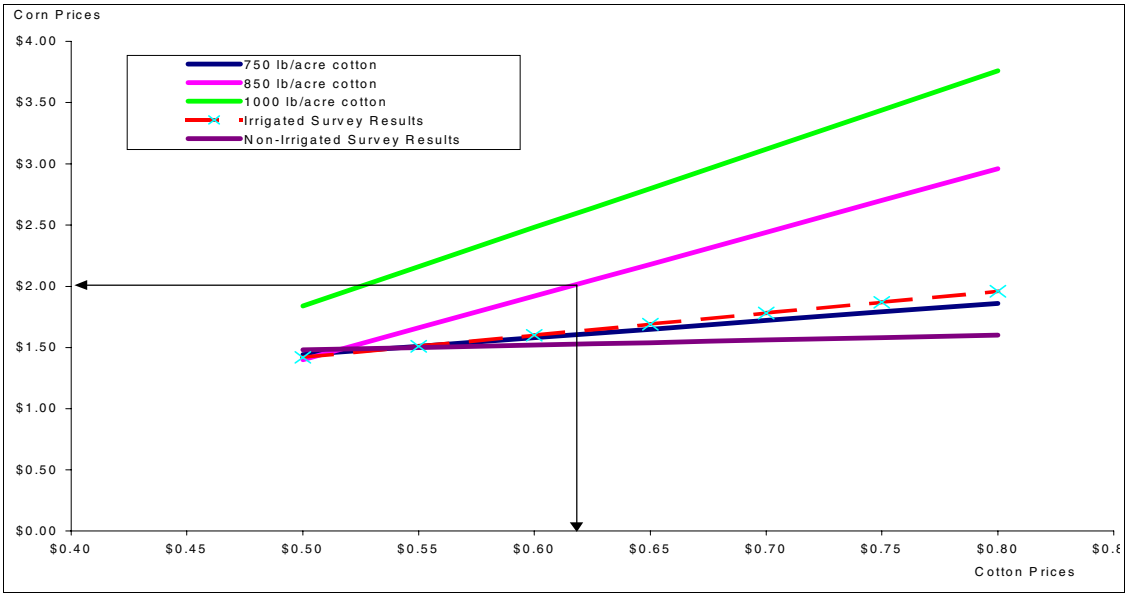

Figure 2. Prices needed for a two year (corn-cotton) rotation to break even.