# Gin Lint Cleaning to Maximize Producer Net Returns Revisited

J. Nelson, S. Misra, B. Bennett, G. Barker

**Abstract.** *This study examined simulated net returns to gin lint cleaning in the Southern High Plains of Texas during the 1993, 1994, and 1995 crop years to determine the number of lint cleaners required to maximize producer net returns. Net returns for five stripper harvested cotton varieties with different management practices, including the use of irrigation and field cleaners, were evaluated in this study. Results indicated that net returns were consistently higher for one stage of lint cleaning for all of the management practices evaluated. It was found that producers could have saved approximately $4.00/bale by lint cleaning cotton once.*
**Keywords.** *Cotton ginning, Lint cleaning, Net revenue.*

Eighty-five percent of the cotton produced in Texas is currently stripper harvested (Glade et al., 1996). Harvested cotton contains a mixture of lint, seed, and foreign matter, which includes burs, sticks, leaves, and non-plant materials such as sand and rocks. The cotton cleaning process to remove this foreign matter consists of several different stages. This process has recently been broadened to include field cleaning, with the remainder of the extraneous matter being removed in the ginning process. The seed cotton cleaning configuration can greatly vary from gin to gin, as well as the number of lint cleaners used. Most gin plants have the option of using zero to three lint cleaners (Looney et al., 1963).

Previous studies have suggested that the number of lint cleaners is directly related to producer net revenues. Ethridge et al. (1995) found that the use of two lint cleaners were optimum when considering price effects, lint loss, and the cost of lint cleaning. However, the cost estimates used by Ethridge et al. (1995) considered only the energy costs of lint cleaning, and the estimated price per pound of lint was based on a pre-HVI market price structure that existed in 1992. Mangialardi (1993) found that the highest monetary returns for spindle-harvested cotton resulted from one or two stages of lint cleaning depending on the initial trash level and type of cotton. A study by Bennett et al. (1997) found that one stage of lint cleaning consistently provided higher producer net returns for cotton varieties with three harvest dates in the 1994-1995 cotton crop. Bennett et al. (1997) considered the total ginning cost associated with sequential stages of lint cleaning and the cost of lint loss. In addition, the estimated prices were based on the HVI measurements of fiber attributes and the pricing structures that existed in 1994.

This study expands on Bennett et al.'s (1997) study by examining the net revenues of five cotton varieties commonly grown in the Southern High Plains of Texas with various management practices. Currently, much of the Southern High Plains cotton is irrigated. Producers also have the option of incorporating field cleaners in the stripper harvesting process. The objective of this study is to determine the optimum number of lint cleaners that should be used in the gin plant to maximize producer net returns for cotton varieties that were commonly grown in the Southern High Plains of Texas during the 1993, 1994, and 1995 crop years and management practices including dryland, irrigated, non-bur-extracted, and bur-extracted.

## Methods and Procedures

Five Southern High Plains cotton varieties, including Paymaster HS200, Paymaster HS26, Paymaster 145, All-Tex Atlas, and Deltapine 2156, were used for the purpose of this analysis. Four combinations of management practices for each variety were examined at three stages of lint cleaning. The combinations included non-bur-extracted/dryland, non-bur-extracted/irrigated, bur-extracted/dryland, and bur-extracted/irrigated. Thus, 20 different scenarios were considered for each year, or a total of 60 different scenarios for the three-year study period.

### Cotton Quality Attributes

Changes in color and leaf grade, staple length, fiber strength, length uniformity, and micronaire resulting from 0, 1, 2, and 3 successive stages of lint cleaning were determined using the GINQUAL simulation model. The turnout percentage of lint was also derived using GINQUAL.

Initial values used in GINQUAL for the micronaire, length, strength, and uniformity of each irrigated and dryland cotton variety were obtained from the 1993, 1994, and 1995 *Cotton Performance Tests* (Gannaway et al.,

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1994, 1995, 1996). The non-bur-extracted stripper-harvested cotton was simulated through the GINQUAL model at a rate of 15 bales/h (Misra et al., 1997). The bur-extracted simulation ginning rate varied from 16.65 to 19.8 bales/h in order for the pounds per minute to remain constant between the bur-extracted and non-bur-extracted varieties. The simulated machinery sequence consisted of an airline cleaner, a tower dryer, an incline cleaner, a stick machine, a tower dryer, an incline cleaner, a stick machine, and an extractor feeder. All of the seed cotton cleaning machinery was simulated at 2.4 m (96 in.) wide. Three 2.2-m (88-in.) wide ginstands were used. The lint cleaning simulation used zero to three 2.2-m (88-in.) wide lint cleaners with a combing ratio of 25:1 and 0.4-m (16-in.) diameter saws operating at 900 rpm. The drying temperatures of the first and second tower dryers were held constant at 149 and 66°C (300 and 150°F), respectively, and the atmospheric temperature and relative humidity at 16°C (60°F) and 30%, respectively. The values for initial trash and moisture content for the non-bur-extracted cotton were provided by GINQUAL. The values for bur-extracted hull and stick percents were decreased by 62.85 and 28.66%, respectively, based on Bennett et al.'s (1994) finding.

### Price Estimates

Market prices, premiums and discounts for cotton after one, two, and three stages of lint cleaning for the 1993, 1994, and 1995 crops were calculated by using the yearly cotton pricing equations that were generated by the Daily Price Estimation System (DPES). The 1993 price equation (Hudson et al., 1994) used was:

$$\ln P = 1.756522 - 0.00135LF^2 - 0.00204C1^2 - 0.00516C2^2 + 0.080045STA - 0.00105STA^2 + 0.001769STR + 0.342792M - 0.0414M^2 - 0.01761LB - 0.21302HB - 0.04405LO - 0.14982HO + 0.00213R \quad (1)$$

where P is the lot price in cents per pound, LF is the leaf grade (1-7), C1 is the first digit of the color grade, C2 is the second digit of the color grade, STA is the staple length in 32nds of an inch, STR is the strength of cotton in grams/tex., M is the micronaire reading, LB and HB are the level 1 and 2 bark percentages, LO and HO are the level 1 and 2 other extraneous matter percentages, respectively, and R is the binary indicator for the region (R = 0 if the market region is West Texas, R = 1 for East Texas/Oklahoma).

The 1994 price equation (Hudson and Ethridge, 1995) used was:

$$\ln P = 2.7847 - 0.00082LF^2 - 0.00109C1^2 - 0.00705DUM1 - 0.03206DUM2 - 0.05592DUM3 + 0.056945STA - 0.00076STA^2 + 0.001088STR + 0.211416M - 0.0255M^2 - 0.00036LB - 0.01335HB - 0.02346LO - 0.07774HO - 0.07323R \quad (2)$$

where DUM1, DUM2, and DUM3 are the binary indicators for the second digit of the color grade (if the second digit = 2, DUM1 = 1; DUM2 = DUM3 = 0, if the second digit = 3, DUM2 = 1: DUM1 = DUM3 = 0, and if the second digit = 4, DUM3 = 1; DUM1 = DUM2 = 0) and all other variables were previously defined.

The 1995 price equation (Floeck et al., 1996) used was:

$$\ln P = 1.92205 + 0.00646LF - 0.00149LF^2 - 0.00120C1^2 - 0.00625DUM1 - 0.01050DUM2 - 0.01144DUM3 + 0.08344STA - 0.00116STA^2 + 0.00178STR + 0.44533M - 0.05574M^2 - 0.01620LB - 0.07677HB - 0.04290LO - 0.14088HO - 0.00162R \quad (3)$$

where all variables were defined earlier.

The level 1 and 2 bark percentages and level 1 and 2 other extraneous matter percentages were not accounted for in the price equations. It was assumed that the price associated with the levels of color grade, leaf grade, staple length, fiber strength, and micronaire accounted for all changes in price as quality varied with each sequential stage of lint cleaning.

### Cost Estimates

The simulated ginning costs were estimated for three main categories of gins. These include gin plants with the capacity of processing 14, 18, and 21 bales/h. Each of these were broken down into one, two, and three stages of lint cleaning. Total and per bale costs, which were separated into fixed and variable components, were derived from GINMODEL (Childers, 1995). The per bale ginning cost estimates (fixed and variable costs per bale) were used for the purpose of this study.

The lint loss for each level of lint cleaning was found by subtracting the amount of lint at the current level of lint cleaning from that of prior stages of lint cleaning. The lint loss was derived by dividing the total lint loss for each level of lint cleaning by the amount of lint cotton and then multiplying by 218 [1 bale = 218 kg (480 lb)]. The total lint loss was calculated by summing the lint loss for each stage of lint cleaning.

The lint loss cost for all varieties, management practices, and years was derived by multiplying the price from the DPES by the total lint loss from GINQUAL for zero to three stages of lint cleaning. The total ginning cost to the producer for each scenario was calculated by adding the cost of ginning from the GINMODEL and the lint loss cost.

### Revenue Estimates

Net revenues were examined in order to determine the optimum number of lint cleaners for each scenario considered. The amount of lint produced after each stage of lint cleaning was determined by multiplying the turnout percent from GINQUAL by 1045 kg (2,300 lb) of initial harvested cotton, which was assumed to produce one bale of lint.

Total revenues associated with each level of lint cleaning were estimated by multiplying the price per pound obtained from the DPES by 218 kg. Net revenues associated with lint cleanings were calculated by subtracting the total ginning cost (ginning cost per bale plus the cost of total lint loss per bale) from the total revenues.

## Results and Implications

The following sections present the cotton quality attributes, price estimates, and revenue estimates averaged across cotton cultivars for the 1993, 1994, and 1995 crop years. Results for each variety, management practice, and crop year are available from the author upon request.

### Cotton Quality Attributes

Output from GINQUAL for five main quality attributes were examined in regard to changes between sequential stages of lint cleaning for dryland, irrigated, bur-extracted, and non-bur-extracted cotton varieties. The five quality attributes examined were fiber strength, staple length, leaf grade, color grade, and micronaire.

The three year average quality attributes for bur-extracted and non-bur-extracted cotton are presented in table 1. Results indicated that the average quality attributes improved between successive stages of lint cleanings. The quality attributes were similar between bur-extracted and non-bur-extracted cotton for the three crop years examined.

**Table 1. Average micronaire, fiber strength, staple length, trash, and color grade for irrigated and dryland varieties grown in the 1993, 1994, and 1995 cotton crop seasons**

| Lint Cleanings (No.) | Micronaire | Strength | Length | Leaf Grade | Color Grade |
|---|---|---|---|---|---|
| | | Irrigated | | | |
| Bur-extracted | | | | | |
| 1 | 4.08 | 26.35 | 33.27 | 5.13 | 4.80 |
| 2 | 4.08 | 27.02 | 33.14 | 4.13 | 4.60 |
| 3 | 4.08 | 27.70 | 32.87 | 4.13 | 4.20 |
| Non-bur-extracted | | | | | |
| 1 | 4.08 | 26.35 | 33.27 | 5.13 | 4.80 |
| 2 | 4.08 | 27.02 | 33.14 | 4.13 | 4.40 |
| 3 | 4.08 | 27.70 | 32.87 | 4.00 | 4.20 |
| Irrigated average | | | | | |
| 1 | 4.08 | 26.35 | 33.27 | 5.13 | 4.80 |
| 2 | 4.08 | 27.02 | 33.14 | 4.17 | 4.50 |
| 3 | 4.08 | 27.70 | 32.87 | 4.07 | 4.20 |
| | | Dryland | | | |
| Bur-extracted | | | | | |
| 1 | 3.66 | 25.96 | 31.84 | 5.67 | 4.80 |
| 2 | 3.66 | 26.56 | 31.66 | 4.87 | 4.73 |
| 3 | 3.66 | 27.15 | 31.43 | 4.60 | 4.20 |
| Non-bur-extracted | | | | | |
| 1 | 3.68 | 25.97 | 31.84 | 5.60 | 4.80 |
| 2 | 3.68 | 26.56 | 31.66 | 4.67 | 4.60 |
| 3 | 3.68 | 27.16 | 31.43 | 4.40 | 4.20 |
| Dryland average | | | | | |
| 1 | 3.67 | 25.97 | 31.84 | 5.63 | 4.80 |
| 2 | 3.67 | 26.56 | 31.66 | 4.77 | 4.67 |
| 3 | 3.67 | 27.15 | 31.43 | 4.50 | 4.20 |

The fiber strength increased at a fairly constant rate between lint cleanings for each management practice (table 1). Average fiber strength for irrigated and dryland varieties were found to increase by 0.67 and 0.59, respectively, for successive stages of lint cleaning.

An improvement in leaf grade and color grade were observed between sequential stages of lint cleaning. Results indicated that the average leaf grade was greater for dryland cotton varieties than irrigated varieties (table 1). Decreases in average leaf grades of 0.96 and 0.10 for irrigated cotton and 0.86 and 0.27 for dryland cotton were experienced for sequential lint cleanings. The average color grade decreased with successive stages of lint cleaning by 0.13 and 0.47 for dryland cotton and at a constant rate of 0.30 for irrigated cotton. The staple length decreased with increasing amounts for successive lint cleanings. The average staple length for irrigated cotton was consistently higher than dryland cotton for the three years (table 1).

### Price Estimates

The pricing equations shown previously were used to derive the price effects resulting from differences in quality attributes due to various management practices. The lint prices, averaged across the three years, for the irrigated cultivars were found to be \$1.44/kg (65.2¢/lb), \$1.46/kg (66.1¢/lb), and \$1.46/kg (66.2¢/lb) for one, two, and three lint cleanings, respectively. The lint prices for the dryland cultivars were \$1.37/kg (62.2¢/lb), \$1.39/kg (62.8¢/lb), and \$1.39/kg (63.2¢/lb) for one, two, and three lint cleanings, respectively (table 2). There was not much difference between bur-extracted and non-bur-extracted cotton for either irrigated or dryland cultivars. The dryland cotton prices were found to be slightly lower than the irrigated cotton prices.

The estimated average prices for each management practice of the three crop years increased with successive stages of lint cleanings. The average irrigated cotton price increased from one to two and two to three lint cleanings

**Table 2. Average lint loss, cost of lint loss, ginning cost, total cost, price, total revenue, and net revenue for irrigated and dryland varieties grown in the 1993, 1994, and 1995 cotton crop seasons**

| Lint Cleanings (No.) | Lint Loss (kgs/bale) | Cost of Lint Loss ($/bale) | Ginning Cost ($/bale) | Total Cost ($/bale) | Price ($/kg) | Total Revenue ($/bale) | Net Revenue ($/bale) |
|---|---|---|---|---|---|---|---|
| | | | Irrigated | | | | |
| Bur-extracted | | | | | | | |
| 1 | 19.56 | 28.13 | 50.83 | 78.96 | 1.44 | 313.14 | 234.18 |
| 2 | 24.27 | 35.29 | 51.21 | 86.50 | 1.46 | 316.65 | 230.15 |
| 3 | 26.10 | 38.07 | 51.66 | 89.73 | 1.46 | 317.64 | 227.90 |
| Non-bur-extracted | | | | | | | |
| 1 | 19.23 | 27.67 | 57.48 | 85.15 | 1.44 | 313.14 | 227.99 |
| 2 | 23.92 | 34.88 | 58.00 | 92.88 | 1.46 | 317.43 | 224.55 |
| 3 | 25.76 | 37.69 | 58.51 | 96.20 | 1.46 | 318.29 | 222.09 |
| Irrigated average | | | | | | | |
| 1 | 19.40 | 27.90 | 54.16 | 82.05 | 1.44 | 313.14 | 231.09 |
| 2 | 24.10 | 35.09 | 54.61 | 89.69 | 1.46 | 317.04 | 227.35 |
| 3 | 25.93 | 37.88 | 55.09 | 92.96 | 1.46 | 317.96 | 225.00 |
| | | | Dryland | | | | |
| Bur-extracted | | | | | | | |
| 1 | 19.25 | 26.32 | 49.81 | 76.13 | 1.37 | 297.87 | 221.74 |
| 2 | 23.95 | 33.07 | 50.19 | 83.26 | 1.38 | 300.57 | 217.31 |
| 3 | 25.81 | 35.90 | 50.62 | 86.51 | 1.39 | 302.81 | 216.30 |
| Non-bur-extracted | | | | | | | |
| 1 | 20.29 | 28.12 | 56.67 | 84.79 | 1.38 | 299.29 | 214.50 |
| 2 | 25.01 | 34.99 | 57.18 | 92.17 | 1.39 | 302.62 | 210.45 |
| 3 | 26.82 | 37.74 | 57.68 | 95.42 | 1.40 | 304.27 | 208.85 |
| Dryland average | | | | | | | |
| 1 | 19.77 | 27.22 | 53.24 | 80.46 | 1.37 | 298.58 | 218.12 |
| 2 | 24.48 | 34.03 | 53.69 | 87.71 | 1.38 | 301.59 | 213.88 |
| 3 | 26.31 | 36.82 | 54.15 | 90.97 | 1.39 | 302.54 | 212.57 |

by about \$0.0198/kg (0.90¢/lb) and \$0.0022/kg (0.10¢/lb), respectively (table 2). The average dryland cotton price increased by about \$0.0132/kg (0.60¢/lb) from one to two lint cleanings and about \$0.0088/kg (0.40¢/lb) from two to three lint cleanings (table 2).

### Cost Estimates

The ginning cost was estimated by incorporating secondary data into the ginning cost simulation model, GINMODEL, for successive stages of lint cleanings for three main categories of gins. These categories include those gins with the processing capacity of 14, 18, and 21 bales/h.

Results indicated that non-bur-extracted cotton experienced a ginning cost of \$6.50 to \$7.00/bale higher than bur-extracted cotton. Ginning cost for irrigated cotton was about \$54.16/bale, \$54.61/bale, and \$55.09/bale for one, two, and three lint cleanings, respectively (table 2). Ginning cost for dryland cotton was about \$1/bale cheaper than for irrigated cotton at \$53.24/bale for one lint cleaning, \$53.69/bale for two lint cleanings, and about \$54.15/bale for three lint cleanings (table 2). However, the average ginning costs for both irrigated and dryland cotton increased by about \$0.45/bale from one to two lint cleanings and \$0.46/bale to \$0.48/bale from two to three lint cleanings, respectively (table 2). The fixed cost of additional lint cleaners and the additional required energy to operate additional lint cleaners is the cause for the increase in ginning costs for successive stages of lint cleanings.

The amount of lint loss and cost of lint loss increased at a decreasing rate with sequential stages of lint cleanings. The irrigated cotton varieties generally experienced a slightly lower lint loss than the dryland cotton varieties (table 2). However, the loss of saleable lint for both irrigated and dryland cotton varieties increased at about the same rate of 4.71 kgs/bale (10.39 lbs/bale) during the second lint cleaning and 1.83 kgs/bale (4.04 lbs/bale) during the third lint cleaning (table 2). The amount of lint loss for irrigated cotton was slightly higher for bur-extracted cotton, while more lint was lost for non-bur-extracted cotton for dryland cotton. The cost of lint loss was generally higher for irrigated cotton than for dryland cotton. The average lint loss cost for irrigated cotton varieties increased from one to two lint cleanings by \$7.20/bale and by \$2.80/bale from two to three lint cleanings. For dryland cotton varieties, the lint loss cost increased by about \$6.80/bale and \$2.80/bale with successive lint cleanings.

The total ginning cost (ginning cost plus cost of lint loss) for irrigated cotton was slightly higher than for dryland cotton. However, the total costs were similar between bur-extracted and non-bur-extracted cotton. The total ginning cost for irrigated and dryland cotton increased from one to two lint cleanings by about \$7.64/bale and \$7.25/bale, respectively, and from two to three lint cleanings by about \$3.30/bale.

### Revenue Estimates

Results indicated that net returns for irrigated cotton were consistently higher than for dryland cotton. Net returns for bur-extracted cotton were also consistently higher than the non-bur-extracted management practice (figs. 1 and 2). Net returns for the bur-extracted

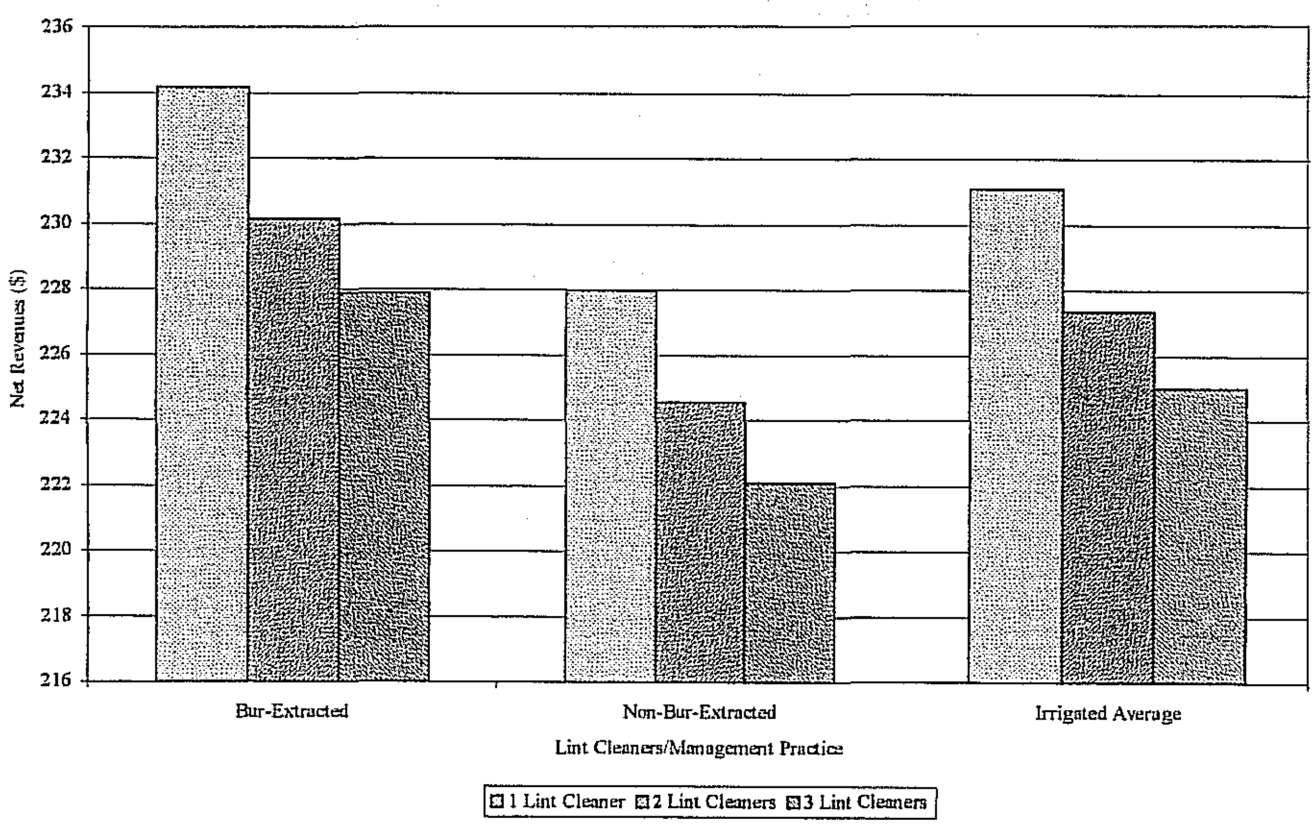


Figure 1–Net revenues for irrigated varieties.

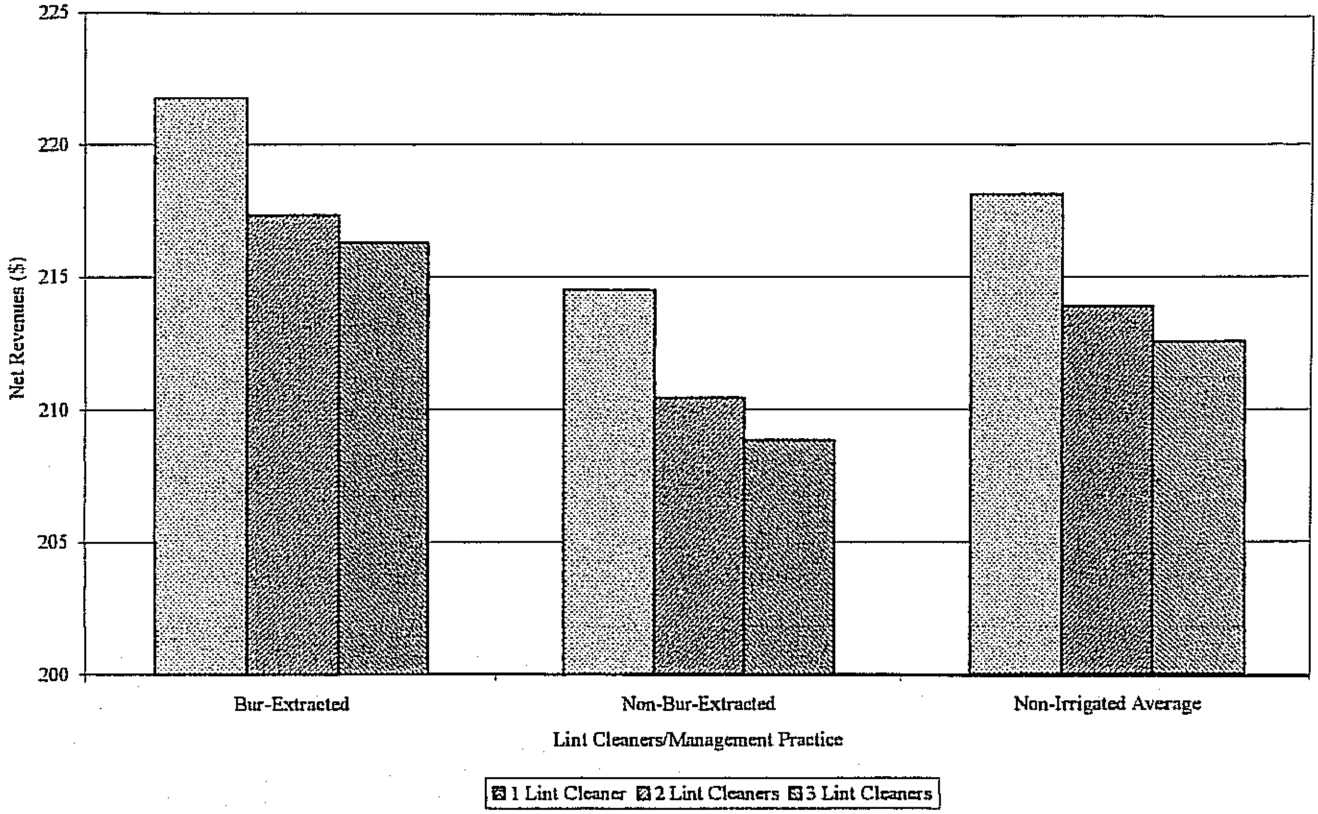


**Figure 2–Net revenues for non-irrigated varieties.**

management practice were about $6.20/bale higher for irrigated cotton varieties and about $7.20/bale higher for dryland varieties than the non-bur-extracted management practice (table 2). Average net returns for irrigated cotton varieties was about $13.00/bale higher than dryland cotton varieties.

Results further indicated that net returns for producers were consistently the highest for one lint cleaning in the gin plant (figs. 1 and 2). For irrigated cotton varieties, producer net returns decreased by an average of $3.74/bale from one to two lint cleanings in the gin plant. Producer net returns for dryland cotton varieties decreased by an average of $4.24/bale when cotton was lint cleaned twice in the gin plant. Thus, on average, it was found that producers could possibly save about $4/bale by lint cleaning cotton once in the gin plant.

## Summary and Conclusion

Two lint cleanings in the gin plant are currently called for in the industry. Bennett et al. (1997) examined the optimum number of lint cleanings for the 1994 crop year and found that one lint cleaning maximized producer net returns for all cases examined. This study expanded on the research of Bennett et al. (1997) to determine the optimum number of lint cleanings for different management practices, which included the use of irrigation and field cleaners.

This study further reinforces Bennett et al.'s (1997) finding that one lint cleaning in the gin plant maximizes producer net returns. Results clearly indicate that producers could save about $4/bale using only one stage of lint cleaning. This is because producers benefit more from a lower lint loss in the gin plant than a smaller increase in price from one to two lint cleanings.

The results of this study should be used with caution. The results were based on the quality attributes corresponding to the 1993, 1994, and 1995 crop years. If the quality attributes differed considerably from those of the years examined in this study, the results could be expected to be different. The results are limited by the estimated prices of the Texas/Oklahoma market and to the simulated conditions of GINQUAL and GINMODEL. Also, the results of this study were based on the market structures that existed in the 1993-1994, 1994-1995, and 1995-1996 crop years.

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