Economic Models for Cotton Ginning

by

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College of Agricultural Sciences Publication No. T-1-158 / August 1977

ABSTRACT

As plant size increases, operating costs per bale decline, revealing economies of size in ginning throughout the range of gin sizes studied. This and other findings were noted in an analysis of capital investment requirements and operating costs for 5 ginning models ranging in hourly rated capacities from 7 to 35 bales. For a given annual volume, per bale costs are lowest for the smallest plant capable of handling that volume, due to economies of utilization outweighing economies of size. Assembly distance and costs increase as model size increases. Combined ginning and assembly costs still favor the larger plants as economies in ginning more than offset the increase in assembly costs. Increasing the number of trailer trips per season could decrease average assembly costs substantially.

Keywords: Cotton ginning, economic-engineering model, capacity, economies of size, gin operating costs.

PREFACE

This report is one in a continuing series of studies designed to develop and report the cost of ginning cotton in the United States. Equipment recommendations and operating cost estimates were developed for a series of 5 model gin plants, ranging in hourly ginning capacities from 7 to 35 bales. These capacities reflect major gin equipment manufacturer's most recent technological advances.

Size and power requirements for ginning machinery and equipment are specified in sequential order for each gin model. Primary and secondary gin construction and operating costs, combined with estimates based on observations made in previous studies, are used as the bases for costs shown in this report.

Special thanks are due to Oliver L. McCaskill and Roy V. Baker, Agricultural Engineers, Agricultural Research Service for their assistance in developing power requirements and machinery specifications. A note of appreciation is due Don E. Ethridge, Economic Research Service, Lubbock, for directions and valuable suggestions throughout this study. Review of an earlier draft by Thomas R. Owens and Sujit K. Roy, Agricultural Economics Department, and Milton L. Smith, Industrial Engineering Department, Texas Tech University, Lubbock, Texas, provided many useful comments. The authors also wish to thank Suniti Ponkshe for assistance in making computer runs and developing tables and Beverly Cowan for preparing the manuscript.

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SUMMARY

Individuals interested in the construction of new gin plants will find the greatest cost advantage with a plant producing 35 bales an hour provided sufficient volume is available to achieve full seasonal utilization. Researchers found that operating costs declined as plant size increased for 5 model gins having hourly capacities starting at 7 bales and ending with 35.

When operating at full seasonal capacity, the 7-bale gin models had a per bale cost of $35.04 in the West. Cost declined to $23.26 for the 35-bale model in the same region. Per bale cost dropped from $30.53 (7-bale) to $21.54 (35-bale) in the South and from $34.20 to $22.66 in West Texas. Costs at 70, 50, and 30 percent of full utilization increased by about one-fourth, one-half, and double, respectively, over full utilization costs. For a given annual volume, per bale costs are lowest for the smallest plant capable of handling that volume due to economies of utilization outweighing economies of size.

Average per bale assembly costs increase with gin size due to greater average haul distance being required to maintain the same seasonal rates of plant capacity utilization. Volume increases four fold with only a doubling in mileage as plant capacity is increased from 7 to 28 bales per hour. Assembly costs increase at a rate of $0.07 per bale per mile.

The economies of size in ginning more than outweigh the increase in assembly costs as developed in this study. Combined ginning and assembly costs are minimum for the 35-bale model and maximum for the 7-bale per

hour model. Making more use of individual trailers can reduce unit assembly cost. Increasing seasonal trailer use from 7 to 8 trips results in an $0.87 per bale savings in seed cotton assembly cost.

ECONOMIC MODELS FOR COTTON GINNING

by

Dale L. Shaw, O. A. Cleveland, Jr. and Joseph L. Ghetti [1/]

BACKGROUND

The rates gin operators pay for both fixed and variable ginning inputs continue to climb, while fees received for ginning services increase much more slowly. Greater use of more sophisticated ginning machinery has been accompanied by a rise in the general price level affecting all goods purchased. Hence, not only does it take more machinery to completely equip a modern gin plant, but the purchase price of each capital item included in the ginning array is higher. Energy, repair parts, wages and most other input costs have also advanced rapidly during recent years.

The number of active gins in the United States declined about 40 percent in the past 10 years from about 5,000 in 1966-67 to less than 3,000 in 1976-77. Remodeling of old gins and new gin construction have both been greatly curtailed. However, there are situations in which new gin construction may be warranted and should be considered.

PURPOSE AND PROCEDURE

This report was prepared to assist those faced with the decision of either replacing existing plants or constructing new ginning complexes. The specific purposes were to develop theoretical models that incorporate

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the latest proven technologies and to estimate investment and operating costs for each model over a wide range of annual volumes ginned.

In updating earlier reports, a series of only 5 models were employed rather than 10 as in previous reports (4, 9). [2/] The current models range from 7 to 35 bales per hour ginning capacity in increments of 7 bales per hour. These capacities reflect the major gin equipment manufacturers' recent technological advancements. Specifications of size and power requirements for ginning machinery and equipment in the models were derived from information furnished by gin manufacturers, ginning engineers and other unpublished information. Costs were synthesized from primary data furnished by industry sources and from data estimated in other studies (2, 3, 6, 8).

Input costs were found to differ among geographic areas across the Cotton Belt. Capital investment requirements in machine stripped regions exceeded those of the machine picked regions enough to justify separate discussion. Likewise, differences in major cost items between the West and South also merit a separate discussion. Accordingly, the Belt was divided into three geographic areas--West Texas (High Plains and Rolling Plains of Texas, western Oklahoma, and eastern New Mexico), the West (machine picked areas of New Mexico, Arizona, California, and Nevada) and the South (the Midsouth and Southeast plus areas of Texas where cotton is machine picked).

INTERPRETATIVE QUALIFICATIONS

Adequately describing differences in operating costs throughout the

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[2/] Underscored figures in parentheses refer to items in Literature Cited.

United States among three broad geographic areas is difficult. Land values, for example, may vary widely within a radius of a few miles. Energy rate schedules for gins may differ with each utility company. Crew makeup, wages, and salaries may vary widely from plant to plant within a region and between states. Many other examples of locational variations among input factor costs could also be cited. Where local costs deviate from those used in this study the reader may wish to make adjustments. The explanations accompanying the tables should be adequate for making such adjustments.

Crew sizes and hours of employment were based on the assumption that adequate seasonal labor would be available for both day and night shifts. However, the increasing difficulty of obtaining qualified gin labor for such a short period of time is recognized. If labor is not available to supply two full crews when needed, plants are forced to operate at less than full seasonal capacity, thereby increasing unit costs. Guaranteed employment for longer periods of time than are actually necessary to process the crop or providing other employee benefits might assure the availability of an adequate supply of labor but would also increase per bale operating costs.

Gin employees were brought under the Fair Labor Standards Act in 1967, an act that provided for a statutory minimum wage of $2.30 an hour as of January, 1977. Employers may be exempt from portions of the overtime provision of the Act during the active season for a period not to exceed 14 weeks. Although hourly rates used for labor cost estimates in this study exceed the current minimum, further increases which may be

specified under this legislation will almost certainly necessitate upward revisions of these labor input costs. Removal or continued reductions in the overtime exemption would also result in increased labor costs.

Only one set (West Texas) of average cost estimates for assembling seed cotton was developed. For readers who feel that certain rate substitutions are necessary to make these findings more representative of their needs, sufficient detail has been included to facilitate these changes.

This report assumes no seed cotton storage to extend the ginning season. It does include a bulk unloading and feeding system capable of handling trailers and modules in the 21-, 28-, and 35-bale per hour models in addition to the conventional suction system. This specification was based on limited research results and on discussions with industry representatives (2). Additional research is needed to determine the full impact of seed cotton storage, extended ginning seasons, and module handling and feeding on harvesting, assembly and ginning costs under various volumes, input costs and other conditions.

EQUIPMENT SPECIFICATIONS

Cotton gins vary appreciably in physical characteristics even among plants of comparable capacities and of the same manufacture. Occasionally, plants are erected or modified on the basis of preferences of individual operators rather than on the basis of engineering principles. Engineers representing the manufacturers may try to appease the purchasers of their equipment by honoring equipment arrangement preferences even though they may not fully agree with them.

Ginning engineers with the USDA cotton ginning research laboratories and those employed by the gin manufacturers are continually experimenting with new ways and means of increasing the efficiency of handling and processing equipment. New techniques, principles, and designs are usually not released until they are fully tested and proven to be reliable. Therefore, it is generally more satisfactory and less costly to rely on the judgement of these specialists and follow their recommendations as closely as possible.

Ginning machinery and equipment specifications vary throughout the Belt primarily because of differences in methods of seed cotton harvest. In the U.S., two principal harvesting methods are used -- machine picking and machine stripping. Hand picking and snapping, formerly common practices, have declined to the point that their impact on processing is no longer of importance in determining gin specifications.

Mechanical picking, which dominates in all areas except the High Plains and the Rolling Plains of Texas, western Oklahoma and eastern New Mexico, differs from mechnical stripping mainly in the method by which the seed cotton is removed from the plant. The mechanical picker has two counter-rotating, vertical cylinders with mechanical fingers or spindles which grab and twist the locks of seed cotton from the open bolls. The mechnical stripper literally strips the plant through the use of rotating brushes. Bolls, leaves, branches, pieces of bark, some sand, and stems are deposited in the basket or trailer along with the seed cotton. The higher ratio of trash to lint resulting from machine stripping operations requires gins to have additional as well as larger equipment for materials handling and trash extraction.

The integrated processing and materials-handling line in a conventional cotton gin consists of a somewhat standarized array of machines and equipment. The sequential order of major operational items is as follows: unloading system (suction fan and pipes and/or bulk unloader), automatic feed control assembly, push fan to No. 1 dryer, No. 1 incline cleaner, pull fan through No. 1 cleaner, stick machine, push fan to No. 2 dryer, pull fan through No. 2 cleaner, overflow fan, trash fan, conveyor-distributor, extractor-feeder over each gin stand, gin stands, two stages of line cleaning (in tandem), condenser exhaust fan, gin press, and seed-handling equipment. The additional extracting equipment required to handle the extra foreign material in the stripper-harvest areas includes an airline separator with a green boll trap which is installed ahead of the automatic feed control, and a modified bur machine which is incorporated just before the second dryer.

Capacity of the overhead equipment is generally determined by the width of the equipment. For a gin plant with a rated capacity of 7 bales an hour processing machine-picked cotton, 50-inch incline cleaners, separators, droppers, and automatic feed control unit, and a 72-inch stick machine are specified (app. table 21). For the stripper-harvest areas, cleaners, separators, droppers, and feed control unit are increased to 72-inch and a 96-inch stick machine is specified due to the additional materials handled (app. table 22). A 72-inch airline separator and a 14-foot bur machine constitute the additional equipment requirements. For gins rated at 14 bales an hour or greater, the overhead cleaning

and drying network should be split. [3/] For these latter gins each side of the split-stream incorporates equipment identical to that in the 7-bale plants. Each side of the overhead for 21- and 28-bale plants is increased proportionally until the width of all overhead equipment in the 35-bale gin is increased to 120 inches.

A universal density press, automated mechanical strapping, mechnical sampler, and an automated bagging system was specified for each model. Previous research indicates that universal density presses are economically feasiable for all model sizes (5).

Equipment specifications and costs developed in this publication incorporate equipment necessary to meet requirements of most Federal and State air pollution control standards specified in previous research (7). However, cotton dust standards such as those proposed by the Occupational Safety and Health Administration (OSHA) and published in the Federal Register on December 28, 1976 could not be met by these gin models.

CAPITAL REQUIREMENTS

The cost of erecting new gin plants has increased in recent years at a rapid rate. A decade ago, an expenditure of $250,000 for construction of a single-battery gin would have been considered excessive. Today, larger and more elaborate gins costing in excess of $2 million are in existence. This increase in construction costs has been due not only to

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[3/] Two separate cleaning and drying systems are installed in parrallel positions, essentially doubling the seed cotton cleaning capacity of the plant. This is referred to as a "split-stream" system. In machine-picked areas, this split usually occurs following the automatic feed control. In machine-stripped areas it commences at the trailer with the use of two suction pipes instead of one.

the continuing upward spiral in the general price level but also to the gradual increase in the sophistication of ginning machinery and increasing demands for faster ginning rates. Gin machinery is the single largest cost item in new plant construction (table 1). In cost estimates developed for the five model plants, machinery costs ranged between 66 and 72 percent of the total plant investment (excluding land). Estimated costs for the West Texas models, containing additional as well as larger equipment required to properly gin machine-stripped seed cotton, were $18,800 to $36,300 higher than models of comparable size for the West and South.

Gin buildings represent 20 to 25 percent of the total capital outlay. Much of this cost is accounted for by the concrete foundation, which must be sufficiently strong to withstand the vibrational stresses induced by heavy ginning equipment operating at high speeds.

Careful planning of land requirements is necessary in selecting each gin plant site. Acreage needs will vary depending on whether baled lint is to be moved directly from the gin to the warehouse or stored on the yard indefinitely. Storage of large quantities of seed cotton at the gin yard for an extended period of time would require additional acreage.

OPERATING COSTS

Operating costs in the following discussions are based on full seasonal capacities. Similar costs for each model at reduced seasonal capacity levels (90, 80, 70, 50, 40, and 30 percent) are shown in appendix A (app. tables 1-10). The procedures used to develop full and reduced seasonal capacity levels are discussed in the plant labor section. Supplemental tables have also been included to help explain the derivation

Table 1--Estimated capital requirements for model ginning plants, by rated capacity, capital item and harvest method, United States, 1976-77

Harvest method and capital item	Bale capacity per hour 1/				
	7	14	21	28	35
	1,000 dollars				
Machine picked:					
Land 2/	12.0	14.0	18.0	22.0	26.0
Gin buildings 3/	118.0	160.0	295.0	332.5	434.5
Gin machinery 4/	395.5	499.0	827.0	916.5	1,123.5
Outside equipment 5/	30.0	44.0	58.5	76.5	107.5
Tools	2.0	3.0	4.0	5.0	6.0
Office buildings and equipment 6/	12.6	12.6	17.6	17.6	29.4
Total	570.1	732.6	1,220.1	1,370.1	1,726.9
Machine stripped:					
Land 2/	12.0	14.0	18.0	22.0	26.0
Gin buildings 3/	118.0	160.0	295.0	332.5	434.5
Gin machinery 4/	414.3	517.8	863.3	952.8	1,159.8
Outside equipment 5/	30.0	44.0	58.5	76.5	107.5
Tools	2.0	3.0	4.0	5.0	6.0
Office buildings and equipment 6/	12.6	12.6	17.6	17.6	29.4
Total	588.9	751.4	1,256.4	1,406.4	1,763.2

1/ Manufacturers' rating.
2/ Estimated at $1,000 per acre.
3/ Includes foundation.
4/ Conventional telescopes, universal density (UD) press, dual head, automatic strapping, automatic sampler, and automatic bagging system for 7- and 14-bale per hour plants; conventional telescopes and bulk unloader, UD press, dual head for 21- and 28-bale per hour plant; conventional telescopes and bulk unloader, UD press, quad head automatic strapping, automatic sampler, and automatic bagging system for 35-bale per hour plant.
5/ Includes cyclones, piping and seed hopper.
6/ Includes furniture, fixtures and scales.

of costs for specific items.

Fixed Costs

Fixed costs accrue regardless of volume ginned. Items treated as fixed were depreciation, interest, property insurance and taxes, management, permanent gin labor, and permanent office help.

Depreciation

The single most important fixed cost item was depreciation. Ginning firms frequently depreciate their machinery out in 10 to 20 years. However, the useful life of this equipment is usually at least 20 years. Even at this rate, and operating at full seasonal volume, depreciation cost per bale varied from $5.18 for the smallest model gin to $3.16 for the largest in both the West and South; and from $5.35 to $3.22 for comparable models in West Texas (app. table 11 and tables 2, 3, and 4).

Interest

Interest on borrowed capital, or the opportunity cost of non-borrowed capital invested in the ginning operation, was calculated at nine percent of the investment in land and nine percent on average investment in machinery, buildings, and equipment (app. table 12). Average investment over the total useful life of the plant was assumed equal to one-half the initial capital investment. Interest cost per bale varied from $4.86 for the 7-bale model to $2.93 for the 35-bale model in both the West and South. Costs in West Texas were slightly higher, varying from $5.02 to $2.99 per bale, respectively, reflecting the higher capital investment requirement for processing machine-stripped seed cotton.

Table 2--Estimated annual operating costs for model ginning plants, by rated capacity and cost item, the West 1/ 1976-77

Cost item	Bale capacity per hour 2/				
	7	14	21	28	35
	Dollars per bale				
Fixed costs:					
Depreciation	5.18	3.33	3.72	3.13	3.16
Interest	4.86	3.12	3.45	2.91	2.93
Insurance	1.16	0.75	0.84	0.70	0.71
Taxes	2.54	1.63	1.81	1.52	1.54
Management	2.04	1.34	1.11	1.00	0.93
Permanent gin labor	0.00	1.21	0.93	0.79	0.70
Permanent office help	0.00	0.78	0.52	0.39	0.31
Total fixed costs	15.78	12.16	12.38	10.44	10.27
Variable costs:					
Office help	0.77	0.29	0.26	0.24	0.23
Plant labor	6.55	3.79	3.20	2.91	2.54
Electrical energy	2.17	1.45	1.51	1.51	1.57
Bagging and ties	3.55	3.55	3.55	3.55	3.55
Repairs	3.36	2.89	2.86	2.65	2.55
Miscellaneous	2.87	2.73	2.65	2.58	2.55
Total variable costs	19.26	14.69	14.04	13.44	12.99
Total, all costs	35.04	26.85	26.42	23.88	23.26
Seasonal volume in bales 3/	5,391	10,781	16,172	21,563	26,953

1/ Machine picked areas of New Mexico, Arizona, California and Nevada.

2/ Manufacturer's rating.

3/ Operation at full capacity assumed for entire season.

Table 3--Estimated annual operating costs for model ginning plants, by rated capacity and cost item, the South 1/ 1976-77

Cost item	Bale capacity per hour 2/				
	7	14	21	28	35
	Dollars per bale				
Fixed costs:					
Depreciation	5.18	3.33	3.72	3.13	3.16
Interest	4.86	3.12	3.45	2.91	2.93
Insurance	0.67	0.43	0.48	0.41	0.41
Taxes	1.80	1.16	1.28	1.08	1.09
Management	1.20	0.89	0.79	0.74	0.71
Permanent gin labor	0.00	0.65	0.49	0.46	0.45
Permanent office help	0.00	0.00	0.00	0.31	0.24
Total fixed costs	13.70	9.58	10.20	9.02	8.98
Variable costs:					
Office help	0.30	0.22	0.20	0.15	0.15
Plant labor	4.11	2.39	2.04	1.86	1.62
Electrical energy	2.64	1.88	2.02	2.04	2.13
Bagging and ties	3.55	3.55	3.55	3.55	3.55
Repairs	3.36	2.89	2.86	2.65	2.55
Miscellaneous	2.87	2.73	2.65	2.58	2.55
Total variable costs	16.83	13.65	13.32	12.82	12.56
Total, all costs	30.53	23.23	23.52	21.84	21.54
Seasonal volume in bales 3/	5,391	10,781	16,172	21,563	26,953

1/ Machine-picked areas of Texas, the Midsouth and the Southeast.

2/ Manufacturer's rating.

3/ Operation at full capacity assumed for entire season.

Table 4--Estimated annual operating costs for model ginning plants, by rated capacity and cost item, West Texas 1/ 1976-77

Cost item	Bale capacity per hour 2/				
	7	14	21	28	35
	Dollars per bale				
Fixed costs:					
Depreciation	5.35	3.42	3.83	3.21	3.22
Interest	5.02	3.19	3.55	2.98	2.99
Insurance	0.63	0.40	0.45	0.38	0.38
Taxes	1.53	0.98	1.09	0.91	0.92
Management	2.04	1.34	1.11	1.00	0.93
Permanent gin labor	0.00	1.02	0.80	0.70	0.63
Permanent office help	0.00	0.00	0.48	0.36	0.29
Total fixed costs	14.56	10.36	11.31	9.54	9.36
Variable costs:					
Office help	0.65	0.41	0.22	0.20	0.20
Plant labor	6.13	3.87	3.12	2.55	2.20
Electrical energy	2.59	2.08	2.00	1.96	1.87
Bagging and ties	3.55	3.55	3.55	3.55	3.55
Repairs	3.85	3.36	3.25	3.02	2.92
Miscellaneous	2.87	2.73	2.65	2.58	2.55
Total variable costs	19.64	16.01	14.79	13.86	13.30
Total, all costs	34.20	26.37	26.10	23.40	22.66
Seasonal volume in bales 3/	5,391	10,781	16,172	21,563	26,953

1/ High Plains and Rolling Plains of Texas, western Oklahoma and eastern New Mexico.

2/ Manufacturers' rating.

3/ Operation at full capacity assumed for entire season.

Insurance

The cost of fire and comprehensive property insurance for gin plants varies appreciably throughout the Cotton Belt. Estimates were based on information obtained from firms in each of the respective areas (app. table 13). Insurance was highest in the West, varying from $1.16 per bale for the smallest model to $0.71 per bale for the largest, and lowest in West Texas, ranging from $0.63 to $0.38 per bale, respectively.

Taxes

The cost of real estate and personal property taxes, including licenses for gin-owned pickup trucks and automobiles, were estimated from data developed in other studies and from information provided by tax assessors in each of the three areas studied. (2, 3, 6, 8). Again, the West had the highest rates and West Texas the lowest (app. table 13). Tax costs per bale varied from $2.54 for the 7-bale plant to $1.54 for the 35-bale plant in the West, and from $1.53 to $0.92, respectively, in West Texas.

Management

It could be argued that management is not truly a fixed cost item. However, during the span of one ginning season, presumably most managers would be retained at their contracted salaries regardless of seasonal ginning volumes. This assumption was made in this study, except for the 7- and 14-bale per hour gins in the South. Management costs at these two model plants were decreased at volumes less than full seasonal utilization.

The manager's salary tends to increase as plant size increases, but

is lower in the South than in other areas. Estimates used ranged from $6,450 for the smallest model in the South to $25,000 for the largest in the West and West Texas (app. table 14). The resulting cost range was $1.20 to $0.71 per bale for the 7- and 35-bale models in the South and $2.04 to $0.93 for the corresponding models in both the West and West Texas.

Permanent Gin Labor

Many gin plants hire some labor on a yearly basis in addition to the manager. These employees normally are referred to as an assistant manager, plant manager, or superintendent. They work on non-specific crew assignments during the ginning season and on general repair and maintance during the non-ginning season. Many gins in the West also have one or more salaried ginners and other gin employees. Gins in the South tend to have fewer year around salaried employees than do gins in the West and West Texas.

In this report all models except the 7-bale per hour plants have a salaried (permanent) superintendent. It was further assumed that all ginners and other crew members are hourly seasonal employees. Like the manager's salary, the superintendent's salary was assumed to increase with increases in gin size and to be lowest in the South. Superintendents' annual salaries were estimated to range from $7,000 for the 14-bale per hour model in the South to $19,000 for the 35-bale per hour plant in the West (app. table 14). Permanent gin labor costs per bale varied from $1.21 to $0.70 for the 14- and 35-bale models, respectively, in the West and from $0.65 to $0.45 for the same models in the South.

Permanent Office Help

Larger gins tend to have permanent office managers or bookkeepers. Their salaries tend to be highest in the West and lowest in the South, but generally do not increase with plant size. This study assumed an annual permanent office salary of $8,400 for 14- to 35-bale models in the West, $7,800 for the 21- to 35-bale models in West Texas and $6,600 for the 28- and 35-bale per hour models in the South (app. table 14). The resulting per bale costs ranged from a low of $0.24 for the 35-bale model in the South to a high of $0.78 for the 14-bale gin in the West.

Variable Costs

Variable costs accrue as output increases and are non-existent at the zero level of production. In this analysis office help, plant labor, electrical energy, bagging and ties, repairs, and miscellaneous, are considered as variable costs. However, as developed in this study all of these items except bagging and ties were assumed to include a small fixed cost component that did not vary with production. Therefore, at reduced volumes per bale variable costs increased but not nearly as rapidly as per bale fixed costs.

Office Help

Estimated seasonal office employee requirements, hours worked, wage rates and costs are given in appendix table 15. Resulting costs range from $0.77 to $0.23 per bale for the 7- and 35-bale models in the West, and $0.30 to $0.15 for the same models in the South. Comparable costs for West Texas models are $0.65 and $0.20 per bale respectively. Office labor requirements are lower in the South because incoming seed cotton

is typically not weighed, whereas gins in the West and in West Texas usually require a weigher as part of the office work force.

Plant Labor

The ginning operation can be divided into three specific crew functions: receiving, conditioning and ginning, and bale packaging. It should be noted that often times an employee may rotate between functions or have responsibilities in more than one area. Crew size for a specific gin model was determined by the rated hourly capacity and harvest method. The number of employees required for each crew was based on observations made in gins during normal operations in the three major cotton-producing areas. For gins designed to process machine-picked seed cotton, six employees were specified for the smallest model and 12 for the largest (table 5). In machine-stripped areas one additional employee was specified for model gins with rated capacities of 7, 28, and 35 bales an hour, and two more crew members were needed at the 14- and 21-bale per hour models.

The receiving and ginning-conditioning functions requires additional crew members at gins designed for machine-stripped cotton. Because of the greater volume of material which must be handled through gins processing machine-stripped cotton compared to machine-picked, double suction unloading pipes requiring one extra employee was specified for the 14- and 21-bale per hour plants. Double suction was specified for the 28- and 35-bale gins regardless of the harvest method. Also the additional gin machinery and equipment required in processing machine-stripped seed cotton dictates the need for one additional crew member in the conditioning

Table 5--Crew size for model ginning plants, by rated capacity, function, and harvest method, United States, 1976-77 1/

Harvest method and gin crew function	Bale capacity per hour 2/				
	7	14	21	28	35
	Number of employees				
Machine picked:					
Receiving	3	3	3	4	5
Conditioning and ginning	1	2	3	3	3
Bale packaging	2	2	3	4	4
Total	6	7	9	11	12
Machine stripped:					
Receiving	3	4	4	4	5
Conditioning and ginning	2	3	4	4	4
Bale packaging	2	2	3	4	4
Total	7	9	11	12	13

1/ Crew requirement based on needs in gin plants specified in this study. Older, less automated gin plants may require larger crews.

2/ Manufacturers' rating.

and ginning crew for each model size.

Similarities assumed for the harvesting-ginning periods throughout the Belt were length of season and percentage of crops ginned during peak periods. The commencing date varies among geographic areas and from year to year within a specific area. The harvest pattern also varies, but the season is usually completed within 14 to 16 weeks and roughly one-third of the crop is ginned during the peak 2 weeks. The seasonal distribution of receipts and hourly crew requirements assumed in this study were developed on that basis (table 6).

An average of 84 days and 38 nights was considered typical for a gin operating without seed cotton storage. A 12 hour day and 12 hour night shift was assumed except during the very early and late stages of the harvest when receipts are light. This amounts to 864 hours during which the day crew is on duty and available for ginning and 456 hours of night crew availability, for a total of 1,320 crew hours.

Total crew-hours to be charged to the ginning operation ranged from a low of 7,920 for the 7-bale plant in the machine-picked areas to a high of 17,160 for the 35-bale plant in the machine-stripped areas (app. table 16). In the South, an hourly rate of $2.80 was assumed for ginners and $2.40 for other gin labor. Comparable rates were $4.50 and $3.20 in the West, and $4,25 and $2.75 in West Texas. An allowance to cover the gin's contribution to social security and workmen's compensation was included in the labor cost estimates. Wage rates and allowances were assumed to cover required overtime costs when full use is made of allowable exemptions during the 14 week season.

Table 6--Typical seasonal distribution of seed cotton receipts and estimated distribution of hourly gin crew requirements, by 2-week periods of harvesting-ginning season, United States, 1976-77 1/

Item	2-week periods							Estimated season total
	1	2	3	4	5	6	7	
Percentage of crop ginned 2/	2	14	33	25	16	6	4	100
Day crew:								
Days worked	12	12	12	12	12	12	12	84
Hours per day	8	12	12	12	12	8	8	---
Day-hours	96	144	144	144	144	96	96	864
Night crew:								
Nights worked	--	6	14	12	6	--	--	38
Hours per night	--	12	12	12	12	--	--	---
Night-hours	--	72	168	144	72	--	--	456
Total crew hours 3/	96	216	312	288	216	96	96	1,320
Processing hours required 4/	18	127	299	227	145	54	36	906
Excess crew hours 5/	78	89	13	61	71	42	60	414

1/ Assumes allowance of 12 days during first 2-week ginning period to train new crew members and to make final repairs and adjustments; 6 night shifts during second ginning period to train new crew members and 6 night shifts during 5th ginning period to handle departure from normal ginning distribution, clean up and repairs.

2/ Based on average for series of years taken from U.S. Department of Commerce, Cotton Ginning in the United States.

3/ Number of duty hours for which crew is paid.

4/ Processing hours required to gin specified percentage of crop during each period. Assumes ginning at 85 percent of rated capacity with one-half hour shut-down for each shift.

5/ Green, wet, early cotton and rough, poor quality late cotton usually cannot be ginned at near 85 percent of rated capacity; therefore, some of the excess crew hours may be spent ginning.

It is generally agreed that over a season, gin plants should be capable of operating at 85 percent of their rated hourly capacity when seed cotton is available. Some plants are capable of operating without interruption for indefinite periods; however, most operators find it advisable to shut down for a short time during each shift to clean up and carry out preventive maintenance. In this study, one-half hour was so allocated from each 12-hour shift. Also, a considerable number of crew hours are available to train new crew members, make repairs and adjustments and allow for times when seed cotton is unavailable. Thus, actual processing time for the season was reduced to 906 hours although the crew was paid for a total of 1,320 hours. Actual hours of processing activity multiplied by the average hourly processing rate provided the seasonal estimate for each model. For example, full seasonal capacity or 100 percent utilization for the 7-bale per hour model amounts to 906 X 7 X .85 = 5,391 bales. Reduced seasonal capacity levels were based on actual operating time of less than 906 hours. A capacity utilization rate of 90 percent for a 7-bale per hour model was calculated as 906 X 7 X .85 X .90 = 4,852 bales. Actual operating time was reduced to 815 hours (.90 X 906) and total crew hours to 1,229 (815 + 414) at 90 percent capacity utilization.

Electrical Energy

Electrical energy costs vary among geographic areas, mainly because of differences in utility-rate schedules. Costs per bale were based on rate schedules employed by utility companies selected as representative of the respective areas. Costs were highest in the South, ranging from

$2.64 a bale for the 7-bale model to $1.88 for the 14-bale model. They were lowest in the West, where the same range was $2.17 to $1.45 a bale. In the machine-picked areas electrical energy requirements and costs per bale increased slightly from the 14- to 35-bale models. Energy consumption per bale and associated cost for models designed for machine-stripped cotton decreased as gin size increased (app. table 17).

Bagging and Ties

Costs of bagging and ties depends on materials used and fluctuate somewhat from year to year but do not appear to vary substantially among geographic areas. Neither is there evidence of any appreciable quantity discount favoring the larger plants. A rate of $3.55 per automatically strapped and bagged universal density bale was adopted for all models and areas (tables 2,3, and 4).

Repairs

Repair costs were assumed to be similar in the South and West, where seed cotton is harvested by spindle pickers. The estimated cost in these two areas ranged from $3.36 per bale for the smallest plant to $2.55 for the largest. Repair requirements in West Texas are higher because of the additional stress placed on elbows, fan shrouds, and other processing equipment. Therefore, repairs costs were estimated to range from $3.85 per bale for the 7-bale plant to $2.92 for the 35-bale plant.

Miscellaneous

Other variable costs include dryer fuel, supplies, other utilities, advertising, seed cotton insurance, pickup and yard tractor operating

expenses and office expenses as well as other items. Individually, these items comprise a relatively minor part of the total ginning cost and no attempt was made to distinguish variations among geographic areas. A range of $2.87 for the smallest model to $2.55 for the largest was used for all areas.

Total Costs

Total fixed costs per bale for the smallest through the largest of the five models ranged from $15.78 to $10.27 in the West, $13.70 to $8.98 in the South, and $14.56 to $9.36 in West Texas (tables 2, 3, and 4).

Total fixed costs per bale are higher for the 21-bale per hour models than for the 14-bale models in all areas. This is due mainly to addition of the bulk unloading system, as well as conventional suction system, at the 21-bale models. These additional investment requirements increase relatively faster than per hour capacity, resulting in higher per unit costs for depreciation, interest, insurance and taxes. For example, the gin machinery capital investment cost per bale of hourly rated capacity for the 14- and 21-bale per hour models processing machine picked cotton is $35.64 and $39.38, respectively. The resulting higher fixed costs for the 21-bale per hour model are partially offset by decreased labor requirements and costs.

Total variable costs per bale for the 7- through 35-bale models ranged from $19.26 to $12.99 in the West, $16.83 to $12.56 in the South and $19.64 to $13.20 in West Texas. The three largest variable cost items, bagging and ties, repairs, and plant labor or miscellaneous, depending on area and model size, account for 65 to 70 percent of total

variable costs. In the West, plant labor, bagging and ties, and repairs are the most important items. Due to lower wage rates in the South, miscellaneous cost was higher than plant labor except for the 7-bale per hour model. Plant labor cost was greater than miscellaneous cost in West Texas at the 7-, 14-, and 21-bale models but lower for the 28- and 35-bale models due to larger crews and wage rates falling between those of the South and West. These same general relationships hold at reduced volume levels but average total variable cost are higher.

Economies of size available in ginning become evident as plant size increases. At full rated seasonal capacities, estimated total cost per bale ranged from $35.04 to $23.26 in the West, $30.53 to $21.54 in the South, and $34.20 to $22.66 in West Texas for the 7- through the 35-bale models (tables 2, 3, and 4).

Total fixed costs per bale at 50 percent utilization are double full utilization costs, while total variable costs per bale increase by only 12 to 24 percent with the largest increases being in the smaller plants and in the West and the smallest increases being in the larger plants and in the South.

Fixed costs account for 40 to 45 percent of total costs at full seasonal utilization. As utilization rates decrease, fixed costs as a proportion of total costs increases, reaching 50 and 65 percent of total costs at 70 and 30 percent utilization rates, respectively.

ECONOMIES OF SIZE

Two major concerns of cotton gin management are the costs relationships of (1) plant size (rated capacity) to the average cost of ginning with

fixed rates of capacity utilization and (2) short run changes in volume ginned to average cost with size of gin fixed. Figure 1 shows the individual gin plant short run average cost curves for model plants when operated from 30 to 100 percent of capacity, assuming a 14 week season as developed in the plant labor section (pp. 17).

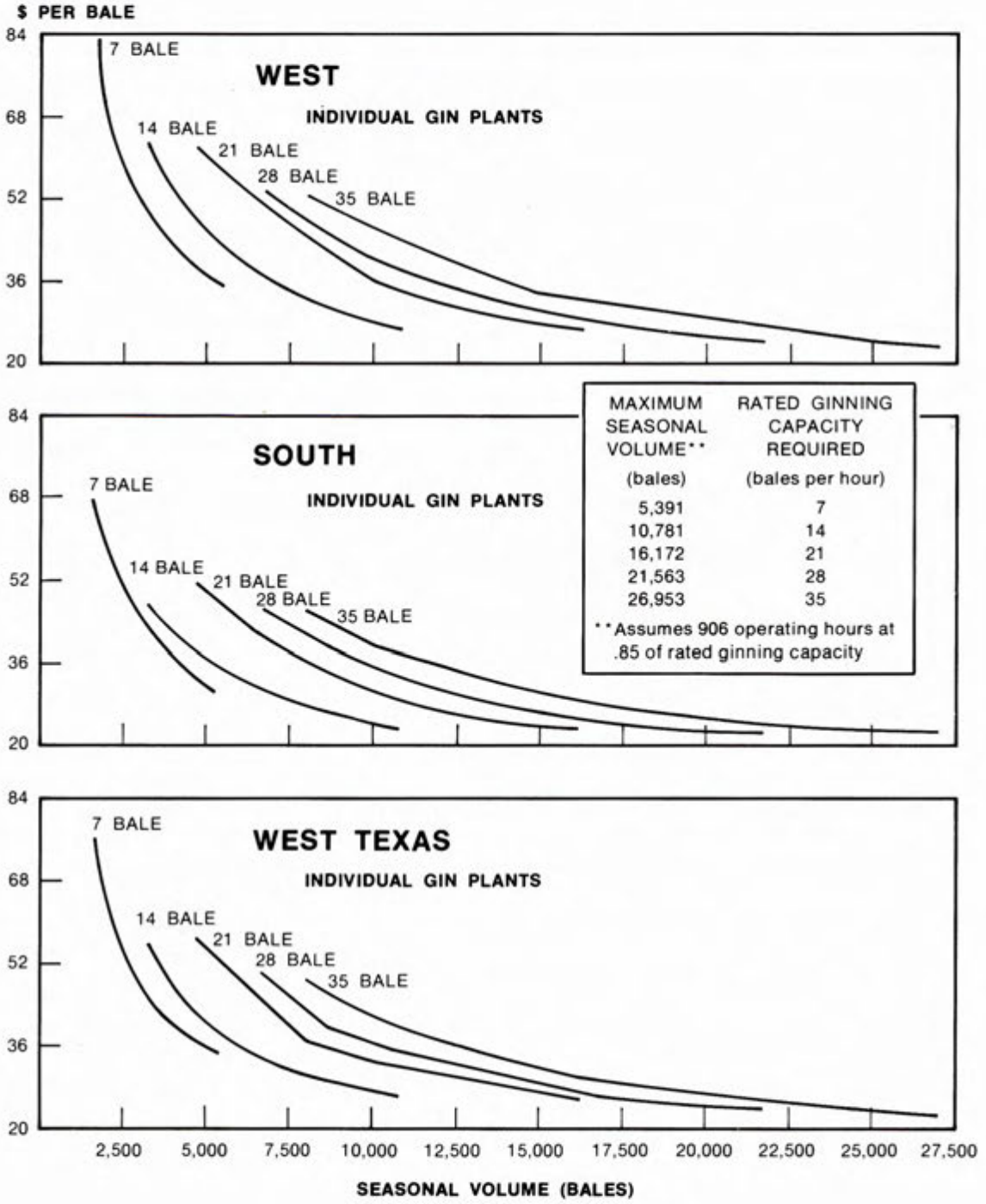
As plant size increased average total cost per bale decreased as plants approached capacity operation. The only exception was the 21-bale per hour model in the South. Economies result from the increased efficiency in the use of both fixed and variable resources. There are greater economies in some components than in others as capacity increases. Economies were evident in all items except bagging and ties. The greatest percentage reduction in average cost occured when one moved from a 7- to a 14-bale per hour plant and was due to the relatively small additional input required to double capacity.

Short Run Average Costs

Acreage and production are subject to yearly variations and thus cause fluctuations in annual processing volumes. In years of low volumes, operating costs per bale rise because fixed costs of plant ownership and salaried employees remain constant and efficiency in the use of labor and other inputs is impaired. The effects of such short run changes in volumes on average cost per bale for each plant size are shown in figure 1.

Plant size and utilization rate are the two dominant factors influencing unit operating costs. For a given size plant, reduced rates of utilization result in rapidly increasing costs (see appendix tables 1-10). Diseconomies resulting from less than full utilization generally overshadow

INDIVIDUAL COST CURVES FOR 5 MODEL GIN PLANTS* 1976-77



MAXIMUM SEASONAL VOLUME** (bales)	RATED GINNING CAPACITY REQUIRED (bales per hour)
5,391	7
10,781	14
16,172	21
21,563	28
26,953	35

**Assumes 906 operating hours at .85 of rated ginning capacity

*with capacities ranging from 7 to 35 bales per hour, showing effects on unit costs of ginning of operating at levels of less than maximum seasonal volumes.

Figure 1

any economies of size. Therefore, for a given annual volume, per bale costs are lowest for the smallest plant capable of handling that volume. For example, in the West, a 14-bale per hour gin at full utilization processes 10,781 bales at an average cost of $26.85 per bale. Processing this same volume at a 21-bale per hour plant would result in a 67 percent utilization rate with an estimated cost of $34.12 per bale (interpolating between 50 percent utilization, appendix table 8, and 70 percent utilization, appendix table 3). This represents an increase of $7.27 per bale, a 27 percent increase in cost. Processing only 10,781 bales through the 28-bale per hour model (50 percent utilization) would increase costs to $36.68, a $9.83 (37 percent) per bale increase in cost. Further, the 35 bale per hour plant could gin this volume operating at only 40 percent utilization; however, per bale costs would increase to $42.02, or $15.17 per bale increase in cost. This represents a 57 percent increase over the cost of ginning this same volume in a 14-bale per hour model plant.

Although there is some variation between model size and geographic area, average total cost per bale tends to increase six percent when capacity utilization falls from 100 to 90 percent. Average total cost increases at an increasing rate as utilization levels decrease. At 70, 50, and 30 percent utilization, average total costs increase by about one-fourth, one-half, and double, respectively, compared to full utilization cost.

FACTORS AFFECTING GIN PLANT SIZE DETERMINATION

In addition to operating costs, other factors enter into the selection of optimal gin size. Among the more important are production density,

concentration of harvest, seed cotton storage, and assembly costs.

Production Density

Production density is a measure of the total supply of seed cotton available for ginning. In estimating this, careful consideration must be given to the amount of land utilized by roads, railroads, rivers, lakes, wooded areas, buildings and non-cotton production uses.

Concentration of Harvest

The harvesting-ginning seasonal pattern generally takes the form of a bellshaped curve (see table 6). Gin receipts of seed cotton are slow to arrive at first but build up rather rapidly as the season progresses to a midseason peak. Receipts then drop off gradually as the harvest is completed. Approximately one-third of the total crop throughout the Belt is ginned during a peak two-week period.

Seed Cotton Storage

Total seasonal volume for a specific cotton gin is normally determined by the gin's capacity at the peak of the season. If all receipts which arrive during this critical period can be ginned with a minimum of delay, the risk of losing gin customers to competition is minimized. This requires that extra ginning capacity be available during a relatively short period, the two-week peak receipt period; capacity which will not be utilized throughout the remainder of the year.

The remaining alternative is seed cotton storage to enable the excess of a gin's capacity to be held and ginned later. Since this alternative for increasing ginning capacity has many ramifications, it was not considered further in this study.

Assembly Cost

Larger gin plants have to reach greater distances for seed cotton to maintain the same seasonal rate of capacity utilization as their smaller counterparts. The cost and responsibility of assembling seed cotton at the gin have traditionally been placed on the producer. Currently an increasing number of gins are performing some or all of the assembly function.

Input factors required in assembling seed cotton are hauling equipment, labor and fuel. A four-wheel, rubber-tired trailer hooked to a one-half-ton pickup truck is a favorite combination with cotton farmers across the Belt. Trailer capacities of four bales of lint from machine-stripped and six bales from machine-picked cotton are typical. Annual operating costs of these input factors were computed for West Texas. Similar computations can be made for the other areas.

The annual operating cost for a 4-bale trailer, which was considered fixed, was estimated at $194.56 in West Texas (app. table 18). Fixed and variable costs were both considered in the operation of a one-half-ton pickup. Annual costs totaled $3,407.22, or $0.17 a mile (app. table 19). The labor cost for one employee, a truck driver, was charged to assembly. This cost was split between fixed and variable costs. The fixed component was based on an estimate of one hour consumed at the field and 20 minutes at the gin for each trip. The variable portion was based on an average round-trip road speed of 25 miles per hour. At a wage rate of $2.50 an hour, the fixed cost was $3.33 a trip, of $0.83 per bale; the variable labor cost was $0.10 a mile (app. table 20). Variable labor and variable

pickup operating costs increased by $0.0676 per bale with each mile increase in round trip distance [($0.1000 + $0.1704) ÷ 4 = $0.0676].

APPLICATION OF FINDINGS

Increased assembly costs for larger gins, due to greater average haul distances being required to maintain the same seasonal rates of plant capacity utilization, can be weighed against the economies of size accruing to the larger gins. The average haul for each gin model size and the corresponding assembly costs per bale were calculated for various numbers of trailer trips per year (table 7). As model size increased, average round trip mileage increased but not proportionately to volume. Volume doubled between the 7-bale and 14-bale per hour plants while mileage increased by only 41 percent. Between the 7- and 28-bale per hour models, volume increases four fold with only a doubling in average round trip mileage. Increases in cost are related to mileage increases and are equal to $0.07 per bale mile. Costs for various combinations of travel distance and trailer trips are presented in table 8.

A comparison of combined ginning and assembly costs reveals minimum cost at the 35-bale per hour model and maximum at the 7-bale per hour model (table 9). Economies of size in ginning more than outweighed the increase in assembly cost. Combined ginning and assembly cost at the 35-bale per hour model are $10.96, $3.33, $3.21 and $0.63 per bale less than at the 7-, 14-, 21-, and 28-bale models, respectively.

Assembly costs per bale decrease considerabley with an increase in the number of trailer trips per season. Making more intensive use of an individual trailer can be extremely important in the control of unit

Table 7--Estimated assembly cost by number of trips per trailer and average distance for each specified gin model, West Texas, 1976-77 1/

Item	Bale capacity per hour				
	7	14	21	28	35
Seasonal bale volume	5,391	10,781	16,172	21,563	26,953
Average round trip mileage 2/	6.92	9.79	11.99	13.84	15.48
Trips per trailer:	Dollars per bale				
1	49.94	50.13	50.28	50.41	50.52
2	25.62	25.81	25.96	26.09	26.20
3	17.51	17.71	17.85	17.98	18.09
4	13.46	13.65	13.80	13.93	14.04
5	11.03	11.22	11.37	11.49	11.60
6	9.40	9.60	9.75	9.87	9.98
7	8.25	8.44	8.59	8.71	8.82
8	7.38	7.57	7.72	7.85	7.96
9	6.70	6.90	7.04	7.17	7.28
10	6.16	6.36	6.50	6.63	6.74
11	5.72	5.91	6.06	6.19	6.30
12	5.35	5.55	5.69	5.82	5.93
13	5.04	5.23	5.38	5.51	5.62
14	4.77	4.97	5.11	5.24	5.35
15	4.54	4.73	4.88	5.01	5.12
16	4.34	4.53	4.68	4.81	4.92
17	4.16	4.35	4.50	4.63	4.74
18	4.00	4.19	4.34	4.47	4.58
19	3.86	4.05	4.20	4.33	4.44
20	3.73	3.92	4.07	4.20	4.31
21	3.61	3.81	3.96	4.08	4.19
22	3.51	3.70	3.85	3.98	4.09
23	3.41	3.61	3.76	3.88	3.99
24	3.32	3.52	3.67	3.79	3.90
25	3.24	3.44	3.59	3.71	3.82

1/ Based on full seasonal volume with a production density of 100 bales per square mile. Per bale cost equal trailer cost ($194.56 ÷ 4 bales ÷ number of trips) plus fixed labor cost ($0.83 per bale) plus variable labor cost ($0.10 ÷ 4 bales X round trip mileage) plus truck cost ($0.17 ÷ 4 bales X round trip mileage).
2/ See Appendix B for discussion.

Table 8--Estimated seed cotton assembly cost by number of trips per trailer and distance traveled, West Texas, 1976-77 1/

Number of trips per trailer	Travel distance in miles (round trip)									
	2	4	6	8	10	12	14	16	18	20
	Dollars per bale									
1	49.61	49.74	49.88	50.01	50.15	50.28	50.42	50.55	50.69	50.82
2	25.29	25.42	25.56	25.69	25.83	25.96	26.10	26.23	26.37	26.50
3	17.18	17.31	17.45	17.58	17.72	17.85	17.99	18.12	18.26	18.40
4	13.13	13.26	13.40	13.53	13.67	13.80	13.94	14.07	14.21	14.34
5	10.69	10.83	10.96	11.10	11.23	11.37	11.50	11.64	11.77	11.91
6	9.07	9.21	9.34	9.48	9.61	9.75	9.88	10.02	10.15	10.29
7	7.91	8.05	8.18	8.32	8.45	8.59	8.72	8.86	9.00	9.13
8	7.05	7.18	7.32	7.45	7.59	7.72	7.86	7.99	8.13	8.26
9	6.37	6.50	6.64	6.78	6.91	7.05	7.18	7.32	7.45	7.59
10	5.83	5.96	6.10	6.23	6.37	6.51	6.64	6.78	6.91	7.05
11	5.39	5.52	5.66	5.79	5.93	6.06	6.20	6.33	6.47	6.60
12	5.02	5.15	5.29	5.42	5.56	5.69	5.83	5.96	6.10	6.24
13	4.71	4.84	4.98	5.11	5.25	5.38	5.52	5.65	5.79	5.92
14	4.44	4.57	4.71	4.85	4.98	5.12	5.25	5.39	5.52	5.66
15	4.21	4.34	4.48	4.61	4.75	4.88	5.02	5.15	5.29	5.42
16	4.01	4.14	4.28	4.41	4.55	4.68	4.82	4.95	5.09	5.22
17	3.83	3.96	4.10	4.23	4.37	4.50	4.64	4.77	4.91	5.04
18	3.67	3.80	3.94	4.07	4.21	4.34	4.48	4.61	4.75	4.88
19	3.53	3.66	3.80	3.93	4.07	4.20	4.34	4.47	4.61	4.74
20	3.40	3.53	3.67	3.80	3.94	4.07	4.21	4.34	4.48	4.61
21	3.28	3.42	3.55	3.69	3.82	3.96	4.09	4.23	4.36	4.50
22	3.18	3.31	3.45	3.58	3.72	3.85	3.99	4.12	4.26	4.39
23	3.08	3.22	3.35	3.49	3.62	3.76	3.89	4.03	4.16	4.30
24	2.99	3.13	3.26	3.40	3.53	3.67	3.80	3.94	4.07	4.21
25	2.91	3.05	3.18	3.32	3.45	3.59	3.72	3.86	3.99	4.13

Continued-----

--Continued

Table 8--Estimated seed cotton assembly cost by number of trips per trailer and distance traveled, West Texas, 1976-77 1/

Number of trips per trailer	Travel distance in miles (round trip)									
	22	24	26	28	30	32	34	36	38	40
	Dollars per bale									
1	50.96	51.09	51.23	51.36	51.50	51.63	51.77	51.90	52.04	52.17
2	26.64	26.77	26.91	27.04	27.18	27.31	27.45	27.58	27.72	27.85
3	18.53	18.67	18.80	18.94	19.07	19.21	19.34	19.48	19.61	19.75
4	14.48	14.61	14.75	14.88	15.02	15.15	15.29	15.42	15.56	15.69
5	12.05	12.18	12.32	12.45	12.59	12.72	12.86	12.99	13.13	13.26
6	10.42	10.56	10.69	10.83	10.96	11.10	11.24	11.37	11.51	11.64
7	9.27	9.40	9.54	9.67	9.81	9.94	10.08	10.21	10.35	10.48
8	8.40	8.53	8.67	8.80	8.94	9.07	9.21	9.34	9.48	9.61
9	7.72	7.86	7.99	8.13	8.26	8.40	8.53	8.67	8.80	8.94
10	7.18	7.32	7.45	7.59	7.72	7.86	7.99	8.13	8.26	8.40
11	6.74	6.87	7.01	7.14	7.28	7.42	7.55	7.69	7.82	7.96
12	6.37	6.51	6.64	6.78	6.91	7.05	7.18	7.32	7.45	7.59
13	6.06	6.19	6.33	6.46	6.60	6.73	6.87	7.01	7.14	7.28
14	5.79	5.93	6.06	6.20	6.33	6.47	6.60	6.74	6.87	7.01
15	5.56	5.70	5.83	5.97	6.10	6.24	6.37	6.51	6.64	6.78
16	5.36	5.49	5.63	5.76	5.90	6.03	6.17	6.30	6.44	6.57
17	5.18	5.31	5.45	5.58	5.72	5.85	5.99	6.12	6.26	6.40
18	5.02	5.15	5.29	5.43	5.56	5.70	5.83	5.97	6.10	6.24
19	4.88	5.01	5.15	5.28	5.42	5.55	5.69	5.82	5.96	6.09
20	4.75	4.88	5.02	5.15	5.29	5.43	5.56	5.70	5.83	5.97
21	4.63	4.77	4.90	5.04	5.17	5.31	5.44	5.58	5.71	5.85
22	4.53	4.66	4.80	4.93	5.07	5.20	5.34	5.47	5.61	5.74
23	4.43	4.57	4.70	4.84	4.97	5.11	5.24	5.38	5.51	5.65
24	4.34	4.48	4.61	4.75	4.88	5.02	5.16	5.29	5.43	5.56
25	4.26	4.40	4.53	4.67	4.80	4.94	5.07	5.21	5.34	5.48

1/ Per bale cost equal trailer cost ($194.56 ÷ 4 bales ÷ number of trips) plus fixed labor cost ($0.83 per bale) plus variable labor cost ($0.10 ÷ 4 bales X round trip mileage) plus truck cost ($0.17 ÷ 4 bales X round trip mileage).

Table 9--Estimated combined ginning and assembly costs for each specified gin model, West Texas, 1976-77

Item	Bale capacity per hour				
	7	14	21	28	35
	Dollars per bale				
Ginning [1/]	34.20	26.37	26.10	23.40	22.66
Assembly [2/]	9.40	9.60	9.75	9.87	9.98
Combined	43.60	35.97	35.85	33.27	32.64

[1/] Ginning cost at full seasonal utilization from table 4.

[2/] Assembly cost with production density of 100 bales per square mile and an average of 6 trailer trips per year from table 7.

assembly cost. For example, an increase in the average number of trips per trailer from seven to eight per season would result in a savings of $0.87 per bale in seed cotton assembly cost (table 10).

Table 10--Estimated savings per bale with each successive increase per seasonal trip per trailer, West Texas, 1976-77 1/

Number of trips per season	Savings with 1 additional trip
	Dollars per bale
1	----
2	24.32
3	8.11
4	4.05
5	2.43
6	1.63
7	1.15
8	.87
9	.68
10	.54
11	.44
12	.37
13	.31
14	.27
15	.23
16	.20
17	.18
18	.16
19	.14
20	.13
21	.12
22	.11
23	.10
24	.09
25	.08

1/ See table 8 for actual costs; differences may vary slightly due to rounding.

APPENDIX A--GIN OPERATING COSTS

Appendix table 1--Estimated annual operating costs for 7-bale model ginning plant, at reduced rates of capacity utilization, 1/ by cost item and geographic area, 1976-77

Cost item	West 2/			South 3/			West Texas 4/		
	Rate of capacity utilization, in percent								
	90	80	70	90	80	70	90	80	70
	Dollars per bale								
Fixed costs:									
Depreciation	5.75	6.47	7.40	5.75	6.47	7.40	5.95	6.69	7.64
Interest	5.40	6.07	6.94	5.40	6.07	6.94	5.57	6.27	7.17
Insurance	1.29	1.46	1.66	0.75	0.84	0.96	0.70	0.78	0.89
Taxes	2.82	3.17	3.63	2.00	2.25	2.57	1.70	1.91	2.18
Management	2.27	2.55	2.92	1.24	1.29	1.36	2.27	2.55	2.92
Permanent gin labor	0	0	0	0	0	0	0	0	0
Permanent office help	0	0	0	0	0	0	0	0	0
Total fixed costs	17.53	19.72	22.54	15.13	16.92	19.22	16.18	18.20	20.80
Variable costs:									
Office help	0.80	0.83	0.88	0.31	0.32	0.34	0.68	0.70	0.74
Plant labor	6.78	7.06	7.43	4.26	4.43	4.66	6.34	6.61	6.95
Electrical energy	2.27	2.40	2.55	2.66	2.68	2.71	2.63	2.67	2.72
Bagging and ties	3.55	3.55	3.55	3.55	3.55	3.55	3.55	3.55	3.55
Repairs	3.47	3.61	3.80	3.47	3.61	3.80	3.97	4.12	4.31
Miscellaneous	2.91	2.96	3.03	2.91	2.96	3.03	2.91	2.96	3.03
Total variable costs	19.78	20.42	21.24	17.16	17.56	18.09	20.08	20.60	21.30
Total, all costs	37.31	40.14	43.78	32.29	34.48	37.31	36.26	38.80	42.10
Seasonal volume in bales	4,852	4,313	3,773	4,852	4,313	3,773	4,852	4,313	3,773
Seasonal operating hours	815	725	634	815	725	634	815	725	634

1/ Ratio of volume ginned to estimated total seasonal capacity. 2/ Machine-picked areas of New Mexico, Arizona, California, and Nevada. 3/ Machine-picked areas of Texas, the Midsouth, and the Southeast.
4/ High Plains and Rolling Plains of Texas, western Oklahoma, and eastern New Mexico.

Appendix table 2--Estimated annual operating costs for 14-bale model ginning plant, at reduced rates of capacity utilization, 1/ by cost item and geographic area, 1976-77

Cost item	West 2/			South 3/			West Texas 4/		
	Rate of capacity utilization, in percent								
	90	80	70	90	80	70	90	80	70
	Dollars per bale								
Fixed costs:									
Depreciation	3.70	4.17	4.76	3.70	4.17	4.76	3.80	4.27	4.89
Interest	3.46	3.90	4.45	3.46	3.90	4.45	3.55	3.99	4.56
Insurance	0.83	0.94	1.07	0.48	0.54	0.62	0.44	0.50	0.57
Taxes	1.81	2.04	2.33	1.28	1.44	1.65	1.08	1.22	1.39
Management	1.49	1.68	1.92	0.92	0.96	1.01	1.49	1.68	1.92
Permanent gin labor	1.34	1.51	1.72	0.67	0.70	0.74	1.13	1.28	1.46
Permanent office help	0.87	0.97	1.11	0	0	0	0	0	0
Total fixed costs	13.51	15.20	17.36	10.52	11.71	13.23	11.50	12.95	14.80
Variable costs:									
Office help	0.30	0.31	0.33	0.23	0.24	0.25	0.42	0.44	0.46
Plant labor	3.92	4.08	4.29	2.47	2.58	2.71	4.01	4.18	4.40
Electrical energy	1.51	1.59	1.69	1.89	1.90	1.92	2.11	2.14	2.18
Bagging and ties	3.55	3.55	3.55	3.55	3.55	3.55	3.55	3.55	3.55
Repairs	2.96	3.05	3.17	2.96	3.05	3.17	3.44	3.53	3.66
Miscellaneous	2.76	2.80	2.85	2.76	2.80	2.85	2.76	2.80	2.85
Total variable costs	15.00	15.39	15.88	13.86	14.12	14.45	16.29	16.64	17.09
Total, all costs	28.51	30.59	33.24	24.38	25.83	27.68	27.79	29.59	31.89
Seasonal volume in bales	9,703	8,625	7,547	9,703	8,625	7,547	9,703	8,625	7,547
Seasonal operating hours	815	725	634	815	725	634	815	725	634

1/ Ratio of volume ginned to estimated total seasonal capacity. 2/ Machine-picked areas of New Mexico, Arizona, California, and Nevada. 3/ Machine-picked areas of Texas, the Midsouth, and the Southeast. 4/ High Plains and Rolling Plains of Texas, western Oklahoma, and eastern New Mexico.

Appendix table 3--Estimated annual operating costs for 21-bale model ginning plant, at reduced rates of capacity utilization, 1/ by cost item and geographic area, 1976-77

Cost item	West 2/			South 3/			West Texas 4/		
	Rate of capacity utilization, in percent								
	90	80	70	90	80	70	90	80	70
	Dollars per bale								
Fixed costs:									
Depreciation	4.13	4.65	5.31	4.13	4.65	5.31	4.25	4.79	5.47
Interest	3.83	4.31	4.92	3.83	4.31	4.92	3.94	4.43	5.07
Insurance	0.93	1.05	1.19	0.54	0.60	0.69	0.50	0.56	0.64
Taxes	2.01	2.26	2.59	1.43	1.60	1.83	1.21	1.36	1.55
Management	1.24	1.39	1.59	0.88	0.99	1.13	1.24	1.39	1.59
Permanent gin labor	1.03	1.16	1.33	0.55	0.62	0.71	0.89	1.00	1.15
Permanent office help	0.58	0.65	0.74	0	0	0	0.54	0.60	0.69
Total fixed costs	13.75	15.46	17.67	11.34	12.76	14.59	12.57	14.13	16.16
Variable costs:									
Office help	0.27	0.28	0.29	0.20	0.21	0.22	0.23	0.24	0.25
Plant labor	3.32	3.46	3.64	2.11	2.20	2.31	3.23	3.37	3.54
Electrical energy	1.58	1.66	1.76	2.03	2.05	2.07	2.03	2.06	2.10
Bagging and ties	3.55	3.55	3.55	3.55	3.55	3.55	3.55	3.55	3.55
Repairs	2.95	3.05	3.18	2.95	3.05	3.18	3.33	3.44	3.57
Miscellaneous	2.67	2.71	2.75	2.67	2.71	2.75	2.67	2.71	2.57
Total variable costs	14.33	14.70	15.17	13.51	13.76	14.08	15.05	15.37	15.77
Total, all costs	28.08	30.16	32.84	24.85	26.52	28.67	27.62	29.50	31.93
Seasonal volume in bales.	14,555	12,938	11,320	14,555	12,938	11,320	14,555	12,938	11,320
Seasonal operating hours.	815	725	634	815	725	634	815	725	634

1/ Ratio of volume ginned to estimated total seasonal capacity. 2/ Machine-picked areas of New Mexico, Arizona, California, and Nevada. 3/ Machine-picked areas of Texas, the Midsouth, and the Southeast. 4/ High Plains and Rolling Plains of Texas, western Oklahoma, and eastern New Mexico.

Appendix table 4--Estimated annual operating costs for 28-bale model ginning plant, at reduced rates of capacity utilization, 1/ by cost item and geographic area, 1976-77

Cost item	West 2/			South 3/			West Texas 4/		
	Rate of capacity utilization, in percent								
	90	80	70	90	80	70	90	80	70
	Dollars per bale								
Fixed costs:									
Depreciation	3.47	3.91	4.47	3.47	3.91	4.47	3.57	4.01	4.59
Interest	3.23	3.63	4.15	3.23	3.63	4.15	3.31	3.73	4.26
Insurance	0.78	0.88	1.00	0.45	0.51	0.58	0.42	0.47	0.54
Taxes	1.69	1.91	2.18	1.20	1.35	1.54	1.01	1.14	1.30
Management	1.11	1.25	1.42	0.82	0.92	1.05	1.11	1.25	1.42
Permanent gin labor	0.88	0.99	1.13	0.52	0.58	0.66	0.77	0.87	0.99
Permanent office help	0.43	0.49	0.56	0.34	0.38	0.44	0.40	0.45	0.52
Total fixed costs	11.60	13.05	14.91	10.03	11.28	12.89	10.59	11.92	13.62
Variable costs:									
Office help	0.25	0.26	0.27	0.15	0.16	0.17	0.21	0.22	0.23
Plant labor	3.02	3.14	3.31	1.93	2.01	2.11	2.64	2.75	2.89
Electrical energy	1.57	1.65	1.75	2.05	2.06	2.08	1.98	2.01	2.05
Bagging and ties	3.55	3.55	3.55	3.55	3.55	3.55	3.55	3.55	3.55
Repairs	2.71	2.80	2.91	2.71	2.80	2.91	3.09	3.18	3.30
Miscellaneous	2.61	2.64	2.68	2.61	2.64	2.68	2.61	2.64	2.68
Total variable costs	13.71	14.05	14.47	13.00	13.22	13.51	14.08	14.35	14.70
Total, all costs	25.31	27.10	29.38	23.03	24.50	26.40	24.67	26.27	28.32
Seasonal volume in bales.	19,407	17,250	15,094	19,407	17,250	15,094	19,407	17,250	15,094
Seasonal operating hours.	815	725	634	815	725	634	815	725	634

1/ Ratio of volume ginned to estimated total seasonal capacity. 2/ Machine-picked areas of New Mexico, Arizona, California, and Nevada. 3/ Machine-picked areas of Texas, the Midsouth, and the Southeast.
4/ High Plains and Rolling Plains of Texas, western Oklahoma, and eastern New Mexico.

Appendix table 5--Estimated annual operating costs for 35-bale model ginning plant, at reduced rates of capacity utilization, 1/ by cost item and geographic area, 1976-77

Cost item	West 2/			South 3/			West Texas 4/		
	Rate of capacity utilization, in percent								
	90	80	70	90	80	70	90	80	70
	Dollars per bale								
Fixed costs:									
Depreciation	3.51	3.94	4.51	3.51	3.94	4.51	3.58	4.03	4.60
Interest	3.25	3.66	4.18	3.25	3.66	4.18	3.32	3.73	4.27
Insurance	0.79	0.89	1.01	0.45	0.51	0.58	0.42	0.47	0.54
Taxes	1.71	1.92	2.20	1.21	1.36	1.56	1.02	1.14	1.31
Management	1.03	1.16	1.33	0.79	0.88	1.01	1.03	1.16	1.33
Permanent gin labor	0.78	0.88	1.01	0.49	0.56	0.64	0.70	0.79	0.90
Permanent office help	0.35	0.39	0.45	0.27	0.31	0.35	0.32	0.36	0.41
Total fixed costs	11.42	12.84	14.68	9.97	11.23	12.83	10.39	11.69	13.35
Variable costs:									
Office help	0.24	0.25	0.26	0.15	0.16	0.17	0.20	0.21	0.22
Plant labor	2.62	2.74	2.88	1.68	1.75	1.84	2.28	2.37	2.50
Electrical energy	1.63	1.71	1.81	2.14	2.16	2.18	1.89	1.92	1.96
Bagging and ties	3.55	3.55	3.55	3.55	3.55	3.55	3.55	3.55	3.55
Repairs	2.62	2.71	2.82	2.62	2.71	2.82	3.00	3.09	3.20
Miscellaneous	2.58	2.61	2.65	2.58	2.61	2.65	2.58	2.61	2.65
Total variable costs	13.24	13.57	13.97	12.72	12.93	13.21	13.49	13.75	14.07
Total, all costs	24.66	26.41	28.65	22.69	24.16	26.04	23.88	25.44	27.42
Seasonal volume in bales	24,258	21,563	18,867	24,258	21,563	18,867	24,258	21,563	18,867
Seasonal operating hours	815	725	634	815	725	634	815	725	634

1/ Ratio of volume ginned to estimated total seasonal capacity. 2/ Machine-picked areas of New Mexico, Arizona, California, and Nevada. 3/ Machine-picked areas of Texas, the Midsouth, and the Southeast.
4/ High Plains and Rolling Plains of Texas, western Oklahoma, and eastern New Mexico.

Appendix table 6--Estimated annual operating costs for 7-bale model ginning plant, at reduced rates of capacity utilization, 1/ by cost item and geographic area, 1976-77

Cost item	West 2/			South 3/			West Texas 4/		
	Rate of capacity utilization, in percent								
	50	40	30	50	40	30	50	40	30
	Dollars per bale								
Fixed costs:									
Depreciation	10.35	12.94	17.26	10.35	12.94	17.26	10.70	13.38	17.84
Interest	9.72	12.15	16.20	9.72	12.15	16.20	10.03	12.54	16.72
Insurance	2.33	2.91	3.88	1.34	1.68	2.24	1.25	1.57	2.09
Taxes	5.08	6.35	8.46	3.60	4.49	5.99	3.06	3.82	5.10
Management	4.08	5.10	6.80	1.57	1.76	2.07	4.08	5.10	6.80
Permanent gin labor	0	0	0	0	0	0	0	0	0
Permanent office help	0	0	0	0	0	0	0	0	0
Total fixed costs	31.56	39.45	52.60	26.58	33.02	43.75	29.13	36.41	48.54
Variable costs:									
Office help	1.01	1.13	1.33	0.39	0.44	0.51	0.86	0.96	1.13
Plant labor	8.60	9.63	11.34	5.40	6.05	7.12	8.05	9.01	10.61
Electrical energy	3.01	3.41	4.04	2.79	2.87	2.94	2.89	3.04	3.28
Bagging and ties	3.55	3.55	3.55	3.55	3.55	3.55	3.55	3.55	3.55
Repairs	4.39	4.91	5.77	4.39	4.91	5.77	4.92	5.46	6.35
Miscellaneous	3.24	3.43	3.74	3.24	3.43	3.74	3.24	3.43	3.74
Total variable costs	23.81	26.06	29.77	19.77	21.24	23.63	23.51	25.44	28.66
Total, all costs	55.37	65.51	82.37	46.35	54.26	67.38	52.64	61.85	77.20
Seasonal volume in bales	2,695	2,156	1,617	2,695	2,156	1,617	2,695	2,156	1,617
Seasonal operating hours	453	362	272	453	362	272	453	362	272

1/ Ratio of volume ginned to estimated total seasonal capacity. 2/ Machine-picked areas of New Mexico, Arizona, California, and Nevada. 3/ Machine-picked areas of Texas, the Midsouth, and the Southeast.
4/ High Plains and Rolling Plains of Texas, western Oklahoma, and eastern New Mexico.

Appendix table 7--Estimated annual operating costs for 14-bale model ginning plant, at reduced rates of capacity utilization, 1/ by cost item and geographic area, 1976-77

Cost item	West 2/			South 3/			West Texas 4/		
	Rate of capacity utilization, in percent								
	50	40	30	50	40	30	50	40	30
	Dollars per bale								
Fixed costs:									
Depreciation	6.67	8.33	11.11	6.67	8.33	11.11	6.84	8.55	11.40
Interest	6.23	7.79	10.39	6.23	7.79	10.39	6.39	7.99	10.65
Insurance	1.50	1.87	2.50	0.86	1.08	1.44	0.80	1.00	1.33
Taxes	3.26	4.08	5.44	2.31	2.89	3.85	1.95	2.44	3.25
Management	2.69	3.36	4.48	1.17	1.31	1.54	2.69	3.36	4.48
Permanent gin labor	2.41	3.01	4.02	0.85	0.96	1.13	2.04	2.55	3.40
Permanent office help	1.56	1.95	2.60	0	0	0	0	0	0
Total fixed costs	24.32	30.40	40.53	18.09	22.36	29.45	20.71	25.89	34.52
Variable costs:									
Office help	0.38	0.43	0.50	0.29	0.33	0.38	0.54	0.60	0.71
Plant labor	4.97	5.57	6.56	3.14	3.51	4.14	5.09	5.70	6.71
Electrical energy	1.97	2.21	2.59	1.98	2.03	2.08	2.32	2.44	2.63
Bagging and ties	3.55	3.55	3.55	3.55	3.55	3.55	3.55	3.55	3.55
Repairs	3.55	3.89	4.44	3.55	3.89	4.44	4.05	4.39	4.96
Miscellaneous	3.01	3.15	3.38	3.01	3.15	3.38	3.01	3.15	3.38
Total variable costs	17.43	18.79	21.01	15.52	16.46	17.97	18.55	19.82	21.94
Total, all costs	41.75	49.19	61.54	33.61	38.82	47.42	39.26	45.71	56.46
Seasonal volume in bales	5,391	4,313	3,234	5,391	4,313	3,234	5,391	4,313	3,234
Seasonal operating hours	453	362	272	453	362	272	453	362	272

1/ Ratio of volume ginned to estimated total seasonal capacity. 2/ Machine-picked areas of New Mexico, Arizona, California, and Nevada. 3/ Machine-picked areas of Texas, the Midsouth, and the Southeast.
4/ High Plains and Rolling Plains of Texas, western Oklahoma, and eastern New Mexico.

Appendix table 8--Estimated annual operating costs for 21-bale model ginning plant, at reduced rates of capacity utilization, 1/ by cost item and geographic area, 1976-77

Cost item	West 2/			South 3/			West Texas 4/		
	Rate of capacity utilization, in percent								
	50	40	30	50	40	30	50	40	30
	Dollars per bale								
Fixed costs:									
Depreciation	7.43	9.29	12.39	7.43	9.29	12.39	7.66	9.57	12.76
Interest	6.89	8.61	11.48	6.89	8.61	11.48	7.09	8.87	11.82
Insurance	1.67	2.09	2.79	0.96	1.20	1.61	0.90	1.12	1.49
Taxes	3.62	4.53	6.04	2.57	3.21	4.28	2.18	2.72	3.63
Management	2.23	2.78	3.71	1.58	1.97	2.63	2.23	2.78	3.71
Permanent gin labor	1.86	2.32	3.09	0.99	1.24	1.65	1.61	2.01	2.68
Permanent office help	1.04	1.30	1.73	0	0	0	0.96	1.21	1.61
Total fixed costs	24.74	30.92	41.23	20.42	25.53	34.03	22.62	28.28	37.70
Variable costs:									
Office help	0.34	0.38	0.44	0.26	0.29	0.34	0.29	0.32	0.38
Plant labor	4.21	4.71	5.55	2.68	3.00	3.53	4.10	4.59	5.41
Electrical energy	2.04	2.29	2.66	2.13	2.18	2.24	2.23	2.34	2.53
Bagging and ties	3.55	3.55	3.55	3.55	3.55	3.55	3.55	3.55	3.55
Repairs	3.61	3.98	4.60	3.61	3.98	4.60	4.01	4.39	5.03
Miscellaneous	2.89	3.02	3.22	2.89	3.02	3.22	2.89	3.02	3.22
Total variable costs	16.64	17.92	20.02	15.12	16.02	17.48	17.08	18.22	20.13
Total, all costs	41.38	48.84	61.25	35.54	41.55	51.51	39.70	46.50	57.83
Seasonal volume in bales	8,086	6,469	4,852	8,086	6,469	4,852	8,086	6,469	4,852
Seasonal operating hours	453	362	272	453	362	272	453	362	272

1/ Ratio of volume ginned to estimated total seasonal capacity. 2/ Machine-picked areas of New Mexico, Arizona, California, and Nevada. 3/ Machine-picked areas of Texas, the Midsouth, and the Southeast. 4/ High Plains and Rolling Plains of Texas, western Oklahoma, and eastern New Mexico.

Appendix table 9 --Estimated annual operating costs for 28-bale model ginning plant, at reduced rates of capacity utilization, 1/ by cost item and geographic area, 1976-77

Cost item	West 2/			South 3/			West Texas 4/		
	Rate of capacity utilization, in percent								
	50	40	30	50	40	30	50	40	30
	Dollars per bale								
Fixed costs:									
Depreciation	6.25	7.81	10.42	6.25	7.81	10.42	6.42	8.03	10.70
Interest	5.81	7.26	9.68	5.81	7.26	9.68	5.96	7.45	9.94
Insurance	1.41	1.76	2.34	0.81	1.01	1.35	0.75	0.94	1.25
Taxes	3.05	3.81	5.00	2.16	2.70	3.60	1.83	2.28	3.04
Management	1.99	2.49	3.32	1.47	1.84	2.46	1.99	2.49	3.32
Permanent gin labor	1.58	1.97	2.63	0.93	1.16	1.55	1.39	1.74	2.32
Permanent office help	0.78	0.97	1.30	0.61	0.77	1.02	0.72	0.90	1.21
Total fixed costs	20.87	26.08	34.79	18.05	22.56	30.08	19.06	23.83	31.79
Variable costs:									
Office help	0.32	0.35	0.42	0.19	0.22	0.26	0.27	0.30	0.35
Plant labor	3.83	4.29	5.05	2.45	2.74	3.22	3.35	3.74	4.41
Electrical energy	2.02	2.26	2.63	2.15	2.20	2.26	2.18	2.29	2.47
Bagging and ties	3.55	3.55	3.55	3.55	3.55	3.55	3.55	3.55	3.55
Repairs	3.27	3.58	4.10	3.27	3.58	4.10	3.66	3.99	4.52
Miscellaneous	2.81	2.93	3.12	2.81	2.93	3.12	2.81	2.93	3.12
Total variable costs	15.81	16.96	18.88	14.42	15.22	16.52	15.82	16.80	18.43
Total, all costs	36.68	43.04	53.67	32.47	37.78	46.60	34.88	40.63	50.22
Seasonal volume in bales.	10,781	8,625	6,469	10,781	8,625	6,649	10,781	8,625	6,649
Seasonal operating hours.	453	362	272	453	362	272	453	362	272

1/ Ratio of volume ginned to estimated total seasonal capacity. 2/ Machine-picked areas of New Mexico, Arizona, California, and Nevada. 3/ Machine-picked areas of Texas, the Midsouth, and the Southeast.
4/ High Plains and Rolling Plains of Texas, western Oklahoma, and eastern New Mexico.

Appendix table 10--Estimated annual operating costs for 35-bale model ginning plant, at reduced rates of capacity utilization, 1/ by cost item and geographic area, 1976-77

Cost item	West 2/			South 3/			West Texas 4/		
	Rate of capacity utilization, in percent								
	50	40	30	50	40	30	50	40	30
	Dollars per bale								
Fixed costs:									
Depreciation	6.31	7.89	10.52	6.31	7.89	10.52	6.45	8.06	10.74
Interest	5.85	7.32	9.76	5.85	7.32	9.76	5.97	7.47	9.96
Insurance	1.42	1.77	2.37	0.82	1.02	1.36	0.75	0.94	1.26
Taxes	3.08	3.84	5.13	2.18	2.72	3.63	1.83	2.29	3.05
Management	1.86	2.32	3.09	1.41	1.77	2.36	1.86	2.32	3.09
Permanent gin labor	1.41	1.76	2.35	0.89	1.11	1.48	1.26	1.58	2.10
Permanent office help	0.62	0.78	1.04	0.49	0.61	0.82	0.58	0.72	0.96
Total fixed costs	20.54	25.68	34.25	17.95	22.44	29.92	18.70	23.38	31.16
Variable costs:									
Office help	0.30	0.34	0.40	0.19	0.22	0.26	0.26	0.29	0.34
Plant labor	3.33	3.73	4.39	2.13	2.39	2.81	2.89	3.23	3.81
Electrical energy	2.09	2.34	2.72	2.24	2.30	2.36	2.08	2.19	2.36
Bagging and ties	3.55	3.55	3.55	3.55	3.55	3.55	3.55	3.55	3.55
Repairs	3.18	3.50	4.02	3.18	3.50	4.02	3.57	3.89	4.43
Miscellaneous	2.78	2.89	3.07	2.78	2.89	3.07	2.78	2.89	3.07
Total variable costs	15.23	16.34	18.15	14.07	14.84	16.07	15.12	16.04	17.56
Total, all costs	35.77	42.02	52.40	32.02	37.28	45.99	33.82	39.42	48.72
Seasonal volume in bales.	13,477	10,781	8,086	13,477	10,781	8,086	13,477	10,781	8,086
Seasonal operating hours.	453	362	272	453	362	272	453	362	272

1/ Ratio of volume ginned to estimated total seasonal capacity. 2/ Machine-picked areas of New Mexico, Arizona, California, and Nevada. 3/ Machine-picked areas of Texas, the Midsouth, and the Southeast. 4/ High Plains and Rolling Plains of Texas, western Oklahoma, and eastern New Mexico.

Appendix table 11--Estimated annual depreciation for model ginning plants, by rated capacity, capital item and harvest method, 1976-77 1/

Harvest method and major capital item	Bale capacity per hour 2/				
	7	14	21	28	35
	Dollars				
Machine picked:					
Gin building	5,900	8,000	14,750	16,625	21,725
Gin machinery	19,775	24,950	41,350	45,825	56,175
Outside equipment	1,500	2,200	2,925	3,825	5,375
Tools	100	150	200	250	300
Office buildings and equipment	630	630	880	880	1,470
Total	27,905	35,930	60,105	67,405	85,045
Machine stripped:					
Gin building	5,900	8,000	14,750	16,625	21,725
Gin machinery	20,715	25,890	43,165	47,640	57,990
Outside equipment	1,500	2,200	2,925	3,825	5,375
Tools	100	150	200	250	300
Office buildings and equipment	630	630	880	880	1,470
Total	28,845	36,870	61,920	69,220	86,860

1/ Depreciation calculated by straight-line method at 5 percent annually, no salvage value.

2/ Manufacturers' rating.

Appendix table 12--Estimated annual interest for model ginning plants by rated capacity, capital item and harvest method, 1976-77 1/

Harvest method and major capital item	Bale capacity per hour 2/				
	7	14	21	28	35
	Dollars				
Machine picked:					
Land	1,080	1,260	1,620	1,980	2,340
Gin building	5,310	7,200	13,275	14,963	19,552
Gin machinery	17,797	22,455	37,215	41,242	50,557
Outside equipment	1,350	1,980	2,632	3,442	4,838
Tools	90	135	180	225	270
Office buildings and equipment	567	567	792	792	1,323
Total	26,194	33,597	55,714	62,644	78,880
Machine stripped:					
Land	1,080	1,260	1,620	1,980	2,340
Gin building	5,310	7,200	13,275	14,963	19,552
Gin machinery	18,643	23,301	38,849	42,876	52,191
Outside equipment	1,350	1,980	2,632	3,442	4,838
Tools	90	135	180	225	270
Office buildings and equipment	567	567	792	792	1,323
Total	27,040	34,443	57,348	64,278	80,514

1/ Interest calculated at 9 percent on land and 9 percent on average investment in all other capital items shown in table 1. Average investment over the useful life of the plant is equal to one-half of the original cost assuming no salvage value.

2/ Manufacturers' rating.

Appendix table 13--Estimated annual insurance and taxes for model ginning plants, by rated capacity and geographic area, 1976-77

Area and item	Bale capacity per hour [1]				
	7	14	21	28	35
	Dollars				
West [2]					
Insurance	6,279	8,084	13,524	15,166	19,135
Taxes	13,682	17,582	29,282	32,882	41,446
South [3]					
Insurance	3,616	4,657	7,790	8,736	11,022
Taxes	9,692	12,454	20,742	23,292	29,357
West Texas [4]					
Insurance	3,375	4,314	7,245	8,099	10,163
Taxes	8,245	10,520	17,590	19,690	24,685

[1] Manufacturers' rating.

[2] Insurance based on .0125 times 90 percent of capital investment excluding land. Taxes based on .024 times capital investment.

[3] Insurance based on .0072 times 90 percent of capital investment excluding land. Taxes based on .017 times capital investment.

[4] Insurance based on .0065 times 90 percent of capital investment excluding land. Taxes based on .014 times capital investment.

Appendix table 14--Estimated annual salary of management and other permanent personnel for model ginning plants, by rated capacity and geographic area, 1976-77 1/

Area and title	Bale capacity per hour 2/				
	7	14	21	28	35
	Dollars				
West:					
Manager	11,000	14,500	18,000	21,500	25,000
Superintendent	-	13,000	15,000	17,000	19,000
Office manager	-	8,400	8,400	8,400	8,400
Total West	11,000	35,900	41,400	46,900	52,400
South:					
Manager	3/6,450	3/9,600	12,750	15,900	19,050
Superintendent	-	3/7,000	8,000	10,000	12,000
Office manager	-	-	-	6,600	6,600
Total South	6,450	16,600	20,750	32,500	37.650
West Texas:					
Manager	11,000	14,500	18,000	21,500	25,000
Superintendent	-	11,000	13,000	15,000	17,000
Office manager	-	-	7,800	7,800	7,800
Total West Texas	11,000	25,500	38,800	44,300	49,800

1/ Total cost to the gin, includes salary, social security taxes, workmens compensation insurance and other fringe benefits.

2/ Manufacturers' rating.

3/ Assumed to be a variable cost.

Appendix table 15--Seasonal office employees for model ginning plants, by rated capacity, and geographic area, 1976-77

Item and area	Unit	Bale capacity per hour 1/				
		7	14	21	28	35
Employees:						
West	Number	2.0	1.5	2.0	2.5	3.0
South	Number	1.0	1.5	2.0	2.0	2.5
West Texas	Number	2.0	2.5	2.0	2.5	3.0
Time worked: 2/						
West	Hours	1,280	960	1,280	1,600	1,920
South	Hours	640	960	1,280	1,280	1,600
West Texas	Hours	1,280	1,600	1,280	1,600	1,920
Cost: 3/						
West	Dollars	4,160	3,120	4,160	5,200	6,240
South	Dollars	1,600	2,400	3,200	3,200	4,000
West Texas	Dollars	3,520	4,400	3,520	4,400	5,280

1/ Manufacturers' rating.

2/ Estimated to work 8 hours per day, 5 days per week for 16 weeks for a total of 640 hours per season per employee a full capacity utilization. Hours worked and costs are reduced in the same proportion as hours worked by the gin crew at reduced volume levels.

3/ Hourly wage rate including an allowance for social security was estimated at $3.25 for the West, $2.50 for the Delta and $2.75 for West Texas.

Appendix table 16--Estimated total inputs and costs of seasonal labor for model ginning plants, by rated capacity and geographic area, 1976-77

Area 1/ and item	Unit	Bale capacity per hour 2/				
		7	14	21	28	35
West:						
Inputs--						
Ginners..	Man-hours	1,320	1,320	1,320	1,320	1,320
Others...	Man-hours	6,600	7,920	10,560	13,200	14,520
Total...	Man-hours	7,920	9,240	11,880	14,520	15,840
Cost 3/--						
Ginners..	Dollars	7,749	7,749	7,749	7,749	7,749
Others...	Dollars	27,551	33,061	44,081	55,102	60,612
Total...	Dollars	35,300	40,810	51,830	62,851	68,361
South:						
Inputs--						
Ginners..	Man-hours	1,320	1,320	1,320	1,320	1,320
Others...	Man-hours	6,600	7,920	10,560	13,200	14,520
Total...	Man-hours	7,920	9,240	11,880	14,520	15,840
Cost 4/--						
Ginners..	Dollars	4,194	4,194	4,194	4,194	4,194
Others...	Dollars	17,972	21,566	28,755	35,944	39,538
Total...	Dollars	22,166	25,760	32,949	40,138	43,732
West Texas:						
Inputs--						
Ginners..	Man-hours	1,320	1,320	1,320	1,320	1,320
Others...	Man-hours	7,920	10,560	13,200	14,520	15,840
Total...	Man-hours	9,240	11,880	14,520	15,840	17,160
Cost 5/--						
Ginners..	Dollars	6,764	6,764	6,764	6,764	6,764
Others...	Dollars	26,260	35,013	43,767	48,144	52,520
Total...	Dollars	33,024	41,777	50,531	54,098	59,284

1/ West: Machine-picked areas of New Mexico, Arizona, California and Nevada. South: Machine-picked areas of Texas, the Midsouth, and the Southeast. West Texas: High and Rolling Plains of Texas, western Oklahoma and eastern New Mexico. 2/ Manufacturers' rating. 3/ Based on wage rates of $4.50 per hour for the ginner in each crew and $3.20 per hour for other crew members plus 30.45 percent for social security and workmen's compensation. 4/ Based on wage rates of $2.80 per hour for the ginner in each crew and $2.40 per hour for other crew members plus 13.46 percent for social security and workmen's compensation. 5/ Based on wage rates of $4.25 per hour for the ginner in each crew and $2.75 per hour for other crew members plus 20.57 percent for social security and workmen's compensation.

Appendix table 17--Estimated annual electrical energy inputs and unit costs for model ginning plants, by rated capacity and geographic area, 1976-77

Area and item	Unit	Bale capacity per hour 1/				
		7	14	21	28	35
Seasonal volume 2/	Bales	5,391	10,781	16,172	21,563	26,953
West:						
Total energy 3/	Kw-hr.	285,780	406,038	656,011	883,690	1,157,308
Energy per bale	Kw-hr.	53.01	37.66	40.56	40.98	42.94
Cost per kwh 4/	Cents	4.09	3.84	3.73	3.68	3.65
Kw demand 5/	Kilowatt	315	448	724	975	1,277
Cost per bale	Dollars	2.17	1.45	1.51	1.51	1.57
South:						
Total energy 3/	Kw-hr.	285,780	406,038	656,011	883,690	1,157,308
Energy per bale	Kw-hr.	53.01	37.66	40.56	40.98	42.94
Cost per kwh 4/	Cents	4.98	4.98	4.97	4.97	4.96
Kw demand 5/	Kilowatt	315	448	724	975	1,277
Cost per bale	Dollars	2.64	1.88	2.02	2.04	2.13
West Texas:						
Total energy 3/	Kw-hr.	375,636	603,314	870,853	1,134,338	1,355,260
Energy per bale	Kw-hr.	69.68	55.96	53.85	52.61	50.28
Cost per kwh 4/	Cents	3.72	3.72	3.72	3.72	3.72
Kw demand 5/	Kilowatt	415	666	961	1,252	1,496
Cost per bale	Dollars	2.59	2.08	2.00	1.96	1.87

1/ Manufacturers' rating.
2/ Operation at full capacity assumed for entire season.
3/ Kilowatt hours (kw-hr)is obtained by multiplying the product of power needs (app. tables 21,22) and operating hours by 0.7457, the ratio of horse power (hp) to kw-hr.
4/ Season average cost including fuel cost adjustment based on rate schedules in each area, fall of 1976.
5/ Power needs multiplied by 0.7457

Appendix table 18--Estimated trailer cost for assembling seed cotton, West Texas, 1976-77

Item	Cost
	Dollars
Depreciation 1/	100.00
Interest 2/	54.00
Repairs and maintenance 3/	30.00
License and tax	10.56
Total	194.56

1/ Based on 4-bale stripper model trailer purchase price of $1,200, 12-year life and no salvage value. 2/ Calculated as 9 percent of average investment. 3/ Includes tires.

Appendix table 19--Estimated truck cost associated with transporting seed cotton in trailers, West Texas, 1976-77

Item	Cost 1/	
	Annual	Per mile
	Dollars	
Fixed costs:		
Depreciation 2/	1,166.67	.0583
Interest 3/	425.00	.0213
Insurance	193.00	.0097
Taxes, licenses and state inspection	42.55	.0021
Total fixed costs	1,827.22	.0914
Variable costs:		
Gasoline 4/	1,100.00	.0550
Oil	100.00	.0050
Tires 5/	200.00	.0100
Lubrication	20.00	.0010
Repairs and maintenance	160.00	.0080
Total variable cost	1,580.00	.0790
Total fixed and variable cost	3,407.22	.1704

1/ Annual operation estimated at 20,000 miles. 2/ Purchase price of $6,000, 3-year life, and $2,500 salvage value. 3/ Calculated as 10 percent of average investment which is (purchase price + salvage) ÷ 2. 4/ Assumes 10 miles per gallon at $.55 per gallon. 5/ One set every 20,000 miles at $200 per set.

Appendix table 20--Labor cost for assembling and transporting seed cotton in trailers, West Texas, 1976-77 [1/]

Round-trip travel distance	Cost per trip			Cost per bale		
	Fixed [2/]	Variable [3/]	Total	Fixed [2/]	Variable [3/]	Total
Miles	Dollars					
2	3.33	.20	3.53	.83	.05	.88
4	3.33	.40	3.73	.83	.10	.93
6	3.33	.60	3.93	.83	.15	.98
8	3.33	.80	4.13	.83	.20	1.03
10	3.33	1.00	4.33	.83	.25	1.08
12	3.33	1.20	4.53	.83	.30	1.13
14	3.33	1.40	4.73	.83	.35	1.18
16	3.33	1.60	4.93	.83	.40	1.23
18	3.33	1.80	5.13	.83	.45	1.28
20	3.33	2.00	5.33	.83	.50	1.33
22	3.33	2.20	5.53	.83	.55	1.38
24	3.33	2.40	5.73	.83	.60	1.43
26	3.33	2.60	5.93	.83	.65	1.48
28	3.33	2.80	6.13	.83	.70	1.53
30	3.33	3.00	6.33	.83	.75	1.58
32	3.33	3.20	6.53	.83	.80	1.63
34	3.33	3.40	6.73	.83	.85	1.68
36	3.33	3.60	6.93	.83	.90	1.73
38	3.33	3.80	7.13	.83	.95	1.78
40	3.33	4.00	7.33	.83	1.00	1.83

[1/] Based on average wage rates of $2.50 per hour and the equivalent of 4 bales of lint hauled per trailer load of seed cotton.

[2/] Based on estimate of 1 hour preparation time at the field and 20 minutes at the gin point.

[3/] Based on an average round-trip road speed estimate of 25 miles an hour for a labor cost of $0.10 per mile.

APPENDIX B--SEED COTTON ASSEMBLY

Average Travel Distance

The average distance hauled is a function of the type of roads and production density. For the section line road network of West Texas, the least costly area to haul from is a square tilted 45 degrees to the road net. Assuming uniform production density this gives a one-way distance of:

$$.4714 \ \frac{s^{\frac{1}{2}}}{p^{\frac{1}{2}}} \text{ which equals } .4714 \ \sqrt{\frac{s}{p}}$$

where s= seasonal volume in bales

p = production density in bales per square mile.

See (1) for complete derivation of average travel distance relationships. For example, the average hauling distance for a 7-bale per hour gin operating at full seasonal capacity (5,391 bales) with a production density of 100 bales per section is:

$$.4714 \ \sqrt{\frac{5,391}{100}}$$

$$= .4714 \times 7.3423$$

= 3.46 miles one-way distance

or 6.92 miles round trip distance.

APPENDIX C--MACHINERY AND EQUIPMENT SPECIFICATIONS FOR MODEL GINS

Appendix table 21.--Specifications of processing and materials handling equipment for model ginning plants in sequential operating order, by recommended size, actual power requirements, and connected load, machine-picked harvest areas, United States, 1976-77

Ginning equipment	Bale capacity per hour														
	7			14			21			28			35		
	Equipment and size	Power needs: Hp.	Connected load Hp.	Equipment and size	Power needs: Hp.	Connected load Hp.	Equipment and size	Power needs: Hp.	Connected load Hp.	Equipment and size	Power needs: Hp.	Connected load Hp.	Equipment and size	Power needs: Hp.	Connected load Hp.
Unloading fan	1-40	34	40	1-50	52	60	2-45	86	100	2-50	120	150	4-45	156	200
Bulk unloader	--	--	--	--	--	--	1	40	50	1	40	50	1	40	50
Feed control assembly	1-50"	4	5	1-72"	6	10	1-96"	12	15	V-Dr.	14	20	V-Dr.	17	25
Push fan, No. 1 dryer	1-35	25	30	1-40	30	40	1-50	50	60	1-60	75	100	1-70	110	125
No. 1 incline cleaner	1-50"	4	5	2-50"	8	10	2-72"	10	15	2-96"	13	15	2-120"	20	30
Pull fan, No. 1 cleaner	1-40	26	30	1-40	30	40	1-50	52	60	2-45	75	100	2-50	100	120
Stick machine	1-72"	3	5	2-72"	6	10	2-96"	10	15	2-120"	12	15	2-120"	12	15
Push fan, No. 2 dryer	1-35	25	30	1-40	30	40	1-50	50	60	2-45	70	100	2-50	100	120
No. 2 incline cleaner	1-50"	4	5	2-50"	8	10	2-72"	10	15	2-96"	13	15	2-120"	20	30
Pull fan, No. 2 cleaner	1-40"	26	30	1-40	30	40	2-35	52	60	2-50	75	100	2-50	110	120
Distributor and overflow separator	--	4	5	--	6	8	--	7	8	--	10	15	--	12	15
Live overflow fan	1-35	25	30	1-40	26	30	1-40	35	40	1-45	45	50	1-45	45	50
Trash fan (feeders and gin stands)	1-30	12	20	1-30	12	20	1-35	25	30	1-40	35	40	2-35	50	60
Feeding, ginning, doffing	--	70	80	--	95	100	--	137	150	--	192	200	--	280	300
1st stage lint cleaning:															
Lint cleaner	--	14	25	--	28	50	--	47	75	--	68	100	--	84	125
Vane-axial fan	--	9	10	--	18	20	--	36	40	--	45	50	--	54	60
Mote fans	1-30	12	20	1-35	21	25	1-40	30	40	1-45	45	50	1-45	45	50
2nd stage lint cleaning															
Lint cleaner	--	14	25	--	28	50	--	47	75	--	68	100	--	84	125
Vane-axial fan	--	--	--	--	18	20	--	36	40	--	45	50	--	54	60
Mote fans	--	--	--	1-35	21	25	1-40	30	40	1-45	45	50	1-45	45	50
Condenser	--	1	2	--	2	5	--	2	5	--	3	5	--	4	5
Condenser exhaust fan	1-29"	8	10	1-29"	12	15	1-36"	17	20	1-42"	23	25	1-42"	30	40
Lint fly fan	1-30	11	15	1-35	18	20	1-40	25	30	1-40	26	30	1-40	30	40
Air compressor	--	2	5	--	2	5	--	2	10	--	20	25	--	25	30
Kicker and tramper	--	25	30	--	25	30	--	25	50	--	25	50	--	25	50
Press pump	--	50	100	--	50	100	--	75	150	--	75	150	--	125	200
Seed belt and trash auger	--	2	3	--	2	3	--	6	8	--	9	15	--	10	15
Seed blower	--	8	10	--	12	15	--	12	15	--	17	20	--	21	25
Automatic sampler	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Automatic strapper	1	1	2	1	1	2	1	1	2	1	1	2	1	1	2
Automatic bagger	1	3	6	1	3	6	1	3	6	1	3	6	1	3	6
Total	--	423	579	--	601	810	--	971	1,285	--	1,308	1,699	--	1,713	2,144

Appendix table 22.--Specifications of processing and materials handling equipment for model ginning plants in sequential operating order, by recommended size, actual power requirements, and connected load, machine-stripped harvest areas, United States, 1976-77

Ginning equipment	Bale capacity per hour														
	7			14			21			28			35		
	Equipment	Power needs	Connected load	Equipment	Power needs	Connected load	Equipment	Power needs	Connected load	Equipment	Power needs	Connected load	Equipment	Power needs	Connected load
	Number and size	Hp.	Hp.	Number and size	Hp.	Hp.	Number and size	Hp.	Hp.	Number and size	Hp.	Hp.	Number and size	Hp.	Hp.
Airline separator	1-72"	5	10	2-72"	10	20	2-72"	10	20	2-96"	12	25	2-120"	20	30
Unloading fan	1-45-50	39	50	2-45-50	86	100	2-50	86	150	2-50	120	150	4-45	156	200
Bulk unloader	--	--	--	--	--	--	1	70	86	1	70	86	1	70	86
Feed control assembly	1-72"	8	10	2-72"	16	20	2-72"	16	20	V-Dr.	28	40	V-Dr.	34	50
Push fan, No. 1 dryer	1-35-40	33	40	2-35-40	56	75	2-35-40	67	80	1-70	113	150	1-70	120	150
No. 1 incline cleaner	1-72"	8	10	2-72"	16	20	2-96"	22	30	2-120"	35	40	2-120"	38	40
Pull fan, No. 1 cleaner	1-35-40	35	40	2-35-40	56	75	2-35-40	69	80	2-60	113	150	2-60	135	150
Stick machine	1-96"	12	20	1-120"	15	25	2-96"	26	40	2-120"	40	50	2-120"	45	50
Modified bur machine	--	12	15	--	15	20	--	23	30	--	32	40	--	35	40
Push fan, No. 2 dryer	1-35-40	33	40	1-45-50	45	60	2-35-40	67	80	2-60	84	120	2-60	96	120
No. 2 incline cleaner	1-72"	8	10	2-72"	24	30	2-96"	24	30	2-120"	33	40	2-120"	35	40
Pull fan, No. 2 cleaner	1-35-40	35	40	2-35-40	70	80	2-45-50	108	120	2-50	108	120	2-60	135	150
Distributor and overflow separator	--	8	10	--	8	10	--	10	15	--	12	15	--	13	15
Live overflow fan	1-30	12	20	1-40	26	30	1-45	35	40	1-45-50	38	50	1-45-50	42	50
Trash fan (feeders and gin stands)	1-35	12	20	1-40	26	30	1-45	35	40	1-45-50	38	50	1-45-50	42	50
Trash fan	1-35	21	25	1-35-40	34	40	1-45-50	45	60	1-45-50	45	60	1-45-50	50	60
Feeding, ginning, doffing	--	84	100	--	144	150	--	207	225	--	288	300	--	350	375
1st stage lint cleaning:															
Lint cleaner	--	17	30	--	28	50	--	47	75	--	68	100	--	84	125
Vane-axial fan	--	18	20	--	36	40	--	48	60	--	72	80	--	90	100
Mote fans	1-35-40	18	30	1-35-40	25	30	1-45-50	38	50	1-45-50	40	50	1-45-50	45	50
2nd stage lint cleaning:															
Lint cleaner	--	17	30	--	28	50	--	47	75	--	68	100	--	84	125
Vane-axial fan	(incorporated in first stage)														
Mote fans	(incorporated in first stage)														
Condenser	--	1	2	--	2	3	--	2	3	--	3	5	--	3	5
Condenser exhaust fan	1-29"	8	10	1-29"	8	10	1-36"	17	20	1-42"	37	40	1-42"	40	50
Lint fly fan	1-30	11	15	1-35	18	20	1-40	25	30	1-40	26	30	1-40	30	40
Air compressor	--	4	10	--	4	10	--	8	20	--	8	20	--	15	30
Kicker and tramper	--	25	30	--	25	30	--	25	50	--	25	50	--	25	50
Press pump	--	50	100	--	50	100	--	75	150	--	75	150	--	125	200
Seed belt and trash auger	--	5	8	--	5	8	--	8	10	--	9	15	--	10	15
Seed blower	--	12	15	--	12	15	--	24	30	--	34	40	--	34	40
Automatic sampler	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Automatic strapper	1	1	2	1	1	2	1	1	2	1	1	2	1	1	2
Automatic bagger	1	3	6	1	3	6	1	3	6	1	3	6	1	3	6
Total	--	556	769	--	893	1,160	--	1,289	1,728	--	1,679	2,175	--	2,006	2,495

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