B-1116
May 1971

lection of

EQUIPMENT FOR FARMS
n the Texas High Plains

Texas A&M University
The Texas Agricultural Experiment Station
H. O. Kunkel, Acting Director, College Station, Texas

Contents

Summary and Conclusions

An analytical model was developed for use in selecting least-cost combinations of farm machinery for various farm situations. The model was used to construct machinery systems from currently available equipment for representative irrigated farms in the fine-textured soils of the Texas High Plains. Equipment systems, exclusive of harvest machinery, for a 160-, a 500- and a 960-acre farm which were representative for irrigated cotton-grain sorghum farms, were developed for five alternative wage rates ranging from $1.25 per hour through $3.25 per hour. Four-row, six-row and eight-row systems were compared at two levels of implement draft requirements for each farm situation.

Prices and implement specifications were obtained from local farm machinery dealers. The performance characteristics of tractors were obtained primarily from the Nebraska Tractor Tests and the operating characteristics of implements from published data and local estimates. Farm enterprise organization was determined from 1964 Census of Agriculture data. Farm operations, including time available for each operation, were adapted from farm budgets published by the Texas Agricultural Experiment Station.

Total annual costs for the 160-acre farm with the high draft assumptions and wage rate of $1.75 per hour were $2,064.85 for an optimum four-row equipment system. For optimum six-row and eight-row equipment systems, annual costs were increased by $158.30 and $178.22 per year, respectively, at the same wage rate. The annual costs for the least-cost system, which was not a feasible equipment system, were $2,604.85.

The optimum four-row equipment system for the 500-acre farm, with a wage rate of $1.75 per hour and high draft assumptions, had an annual cost of $4,894.61. Use of an optimum six-row equipment system increased annual costs by $41.69, and use of an optimum eight-row equipment system increased annual costs by $173.44. Annual costs for the least-cost system, which was not a feasible system, were $4,798.37. Optimum six-row equipment systems had lower annual costs at a wage rate of $2.25 per hour or above.

Optimum equipment systems for the 960-acre farm contained two tractors and eight-row implements. At a wage rate of $1.75 per hour and high draft assumptions, an optimum eight-row equipment system had annual costs of $8,755.86. An optimum six-row equipment system increased costs by $93.93 per year and an optimum four-row equipment system by $260.23 per year when labor was $1.75 per hour.

Selection of Equipment for Farms in the Texas High Plains

J. E. Osborn and W. C. Barrick*

Aggressive farm operators and managers have developed the Texas High Plains into one of the more productive areas of its size in the world by utilizing a favorable climate, fertile soil and irrigation. Row crops, primarily cotton and grain sorghum, are the most important agricultural enterprises in the High Plains and contribute much to the region's economy. For instance, crop production accounted for approximately 31 percent of the total area income in 1959 (3, p. 1). In recent years approximately 16 percent and 29 percent of the nation's total production of cotton and grain sorghum, respectively, have been produced on the High Plains (10; 11).

Extensive changes have taken place in agriculture over the past few decades. The average farmer's management decisions have been concerned with ever larger operating and investment expenses as a result of increased farm mechanization and increased farm size. Many of these decisions are directly attributable to changes in machine operations.

High Plains farmers have been quick to adopt many new technological developments, perhaps because of relatively high educational levels and high income positions. These factors, together with a highly favorable topography, have led to the acceptance and use of large implements and higher-powered tractors as they have become available.

Various estimates of production costs for farms place machinery expenses from 35 to 50 percent of total operating expenses (6, p. 24; 8, p. 304). About one-third of non-real estate capital on farms is invested in farm machinery (8, p. 304). Therefore, it would seem that relatively small economies obtained in the selection of power and machinery systems could result in major improvements in a farmer's profit position. At present, there are few guidelines available to High Plains farmers for the selection of tractors and implements so as to form a complete farm machinery system which will minimize the annual cost of machine operations.

A knowledge of optimum power and implement systems for farms in a particular area and how components of these systems vary with various farm sizes and wage rates, for instance, would be valuable also to equipment dealers and manufacturers. Such knowledge would help in planning sales campaigns and in controlling inventory. In addition, a manufacturer would have a basis for reevaluating items of equipment never included in a least-cost equipment system.

The development of a method for selecting farm machinery systems and an application of the method to "representative" irrigated High Plains farm situations were the main concerns of this study. Power and equipment systems were developed for three sizes of farms (160, 500 and 960 acres) with specified enterprise combinations and cultural practices.

Objectives

The primary objective of this study was to develop a procedure for selecting combinations of farm machinery for performing specified operations for typical High Plains farms. The specific objectives follow:

1. To develop a systematic method for determining a least-cost, technically feasible combination of tractors and implements for performing specified operations.
2. To select least-cost equipment combinations for three sizes of typical High Plains farms.
3. To evaluate the effects on the least-cost equipment systems selected of alternative wage rates and alternative levels of implement draft requirements.

Mention of a trademark or a proprietary product does not constitute a guarantee or warranty of the product by The Texas Agricultural Experiment Station and does not imply its approval to the exclusion of other products that may also be suitable.

*Respectively, associate professor, Department of Agricultural Economics, Texas Tech University and Texas A&M University-Texas Tech University Cooperative Research Unit, Lubbock; and research assistant, Texas A&M University.

Study Area

Portions of Castro, Crosby, Floyd, Hale, Lamb, Lubbock, Parmer and Swisher counties constituted the study area (Figure 1). The basis for selecting this particular area was that it has similar soil types, farming practices, topography, water resources and crop combinations. The principal soil types are clay loams (Pullman, Lofton and Olton) and loams (Amarillo, Berthound, Portales, Mansker and Zita) termed the fine-textured soils of the Texas High Plains.

Because this study was conducted primarily to provide information useful to commercial farmers, census data (12) were used to estimate an average size commercial crop farm in the study area. Only the data for those farms reporting harvested cropland and only farms larger than 100 acres were used in calculating an average farm size. This average size crop farm for the study area was 485 acres plus 15 acres of non-cropland for a total of 500 acres. In addition, farms of two other sizes were investigated — 160 acres and 960 acres. Approximately 80 percent of all farms in the study area fell within the 160-acre to 960-acre range (with about 7 percent smaller and 13 percent larger). Cropland was used in the following manner: corn, 0.7 percent; sorghum, 30.5 percent; wheat, 11.7 percent; cotton, 25.3 percent; soybeans, 1.1 percent; vegetables, 0.2 percent; pastured cropland, 3.2 percent; and other crops, 1.8 percent.

Procedure

A computer routine was developed for selecting the combination of tractors and implements which satisfied the cultivation practices required. The system finally chosen was the one for which the annual cost was least.

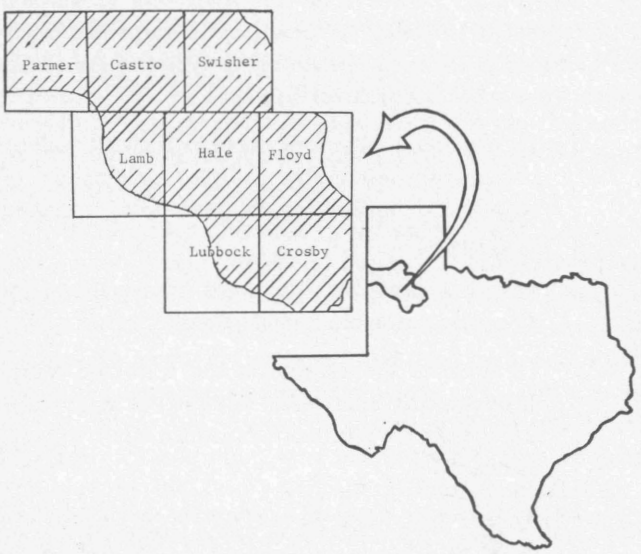


Figure 1. Study area.

Assumptions

Certain assumptions, necessary in any study of this type, must be recognized when applying the results. The assumptions for this study were:

1. Crop yield was independent of equipment system so long as the specified operations were completed.
2. Different types of operations were performed in mutually exclusive time periods.
3. Implement draft requirement and field efficiency were independent of ground speed, and field efficiency was independent of implement width.
4. Farm organization and machine operation were fixed throughout the service life of the equipment selected.
5. There were no economies of size available to the farm firm in the purchase of inputs such as fuel, equipment and labor.
6. Qualitative differences between manufacturers did not affect maintenance costs or productivity of a particular implement type.
7. Design characteristics did not prohibit the use of implements of one manufacturer with tractors of any other manufacturer.
8. Two or more implements were never used simultaneously with one tractor.

Equipment Selection

Selections of implement and power combinations were based on three factors: technical feasibility, time requirements and annual costs. Technical feasibility was determined from tractor drawbar pull, implement draft requirement, ground speed and rate of field work in acres per hour.

A number of different types of operations were performed during a crop year, each of which required a different type of implement. Initial tractor selection was based on the particular operation which appeared to be most restricting. That is, as farm size was increased, a point was reached at which some types of operations required more than one implement (and, therefore, more than one tractor) to complete the operation in the time estimated to be available. The first operation for which more than one implement was required was defined as the most restricting (Appendix Figure 1). When an implement and tractor combination was selected for this operation, the potential ground speed of the combination was compared with specified maximum and minimum speeds. If ground speed requirements were satisfied, the field capacity of the combination was compared with the estimated available time. Each time an implement was selected, annual variable costs for the operation and fixed

costs for the implement were determined. The size of implement for which annual costs (variable cost plus fixed cost) for the operation were smallest was then incorporated into the system.

A power source that satisfied the above criteria was used in the selection of implements for subsequent operations. Selection of implements for these latter operations was based on the same criteria of ground speed, field capacity and cost. Since many different power and implement combinations, each of which satisfied the technical and time requirements, were possible, annual costs were determined for all technically feasible implement and tractor systems, including multi-tractor configurations.

Data Requirements

Selection of a system of equipment for any farm situation requires several types of input data including equipment prices, tractor and implement operating characteristics, operations to be performed and time available for each operation.

Data from the Nebraska test for each tractor considered in this study (diesel tractors) were used to determine fuel use per hour and the drawbar pull at specific ground speeds (Appendix Table 2). Drawbar pull and speeds were assumed to be those listed under the "maximum power with ballast" classification of a tractor's Nebraska test. Tractive and transmission coefficients were used to adjust test data to field conditions (Table 1). Surface conditions were estimated for each operation. Since these coefficients assume that wheel slip is not excessive, the speed associated with a particular drawbar pull was assumed to be the actual ground speed of the tractor and implement in the field.

Draft requirements, in pounds per foot of implement width, were obtained for each implement (Appendix Table 4). Field efficiencies[1] for each type of implement, required for the study, are dependent upon field shape and size, equipment size, speed of operation, reliability of equipment,[2] skill of the operator and other factors. Widths of both tillage and row-crop implements were specified in feet (Appendix Table 3). For most implements, there is a range of ground speeds outside of which performance will not be satisfactory (Appendix Table 4). The lowest speed specified is a factor in determining the minimum tractor size which is technically feasible while the maximum speed places a limit on the acres per unit of time possible with even the largest tractor.

[1] Field efficiency = actual acres per hour divided by theoretical acres per hour. This figure is less than one because of time lost in turning, adjusting equipment, refueling, repairing equipment breakdowns and other factors.

[2] Reliability is the ratio of the time that equipment is operational (that is, not "in the shop" for repairs) to the total time available for using the equipment.

TABLE 1. TRACTIVE AND TRANSMISSION COEFFICIENTS

Surface	Concrete	Firm, untilled field	Tilled, reasonably firm soil	Freshly plowed soil
Coefficient	1	.9	.75	.55

Source: Adapted from Hunt (4, p. 31).

The types of operation performed were assumed constant from farm to farm with the acres covered by a particular implement type varying in direct proportion to changes in farm size, that is, there is 3.1 times as much cotton on the 500-acre farm as on the 160-acre farm (Appendix Table 1). Information from published budgets was used to determine the types of operations to be performed for each category of land use on the study farms and the number of times these operations were to be performed (1).

A total number of hours available during the year was estimated for each operation considered (Appendix Table 1). Budgets published by the Texas Agricultural Experiment Station were consulted to determine the months within which particular operations were performed. The time available for field operations within each month was estimated on the basis of a 10-hour-day and a 5-day week. These hours were then allocated to each operation as near to normal practice as could be determined.

Costs

Selection of the combination of equipment was based on the system with least annual costs, which included both variable and fixed costs. Annual fixed costs included depreciation and interest on investment. The straightline method for estimating depreciation was used. Estimated years of life and salvage value for tractors and equipment were 10 years and 10 percent, respectively. The annual opportunity cost for investment in machinery and power was assumed to be 7 percent of the average annual investment:

$$C = \frac{A + S}{2}$$

where

C represents the average annual investment in machinery and power,

A represents the acquisition value and

S represents the salvage value.

Annual fixed costs (depreciation and cost of capital) were determined in an aggregated amount for each equipment system.

Variable costs were calculated on an hourly basis for each operation. Hourly variable costs included costs for fuel, oil, lubricants, repairs and labor for each machinery and power combination. The total variable costs were

aggregated for each operation based on the hours required to perform the operation.

Findings

Land resources were assumed to be allocated in the same proportion for three farm sizes (160, 500 and 960 acres), and cultural practices were assumed to be identical for each farm size (Appendix Table 1). Two levels of draft requirements were evaluated (low and high; Appendix Table 4). The effects of five alternative wage rates per hour ($1.25, $1.75, $2.25, $2.75 and $3.25) on the equipment systems were determined. Although equipment and power systems were developed for each wage rate per hour, systems developed with wage rates at $1.25 and $1.75 per hour will be discussed more fully.

Selection of row-crop implements is dependent, to an extent, on the size of planter selected. The equipment systems are referred to as optimum four-row equipment systems, optimum six-row equipment systems, optimum eight-row equipment systems, feasible least-cost equipment systems and nonfeasible least-cost equipment systems. Optimum equipment systems include a set of technically feasible equipment for the indicated size that resulted in the lowest annual costs for the system. Feasible least-cost equipment systems had the lowest annual cost for a set of technically feasible equipment. Nonfeasible least-cost equipment systems had the lowest annual cost for a given condition, but the equipment system was not technically feasible.

To determine the technical feasibility of a set of equipment, several factors were considered. For example, an eight-row cultivator is generally not used in a row-crop system planted with either a six-row or four-row planter. Difficulty in spacing the outside rows of these planting systems is critical for subsequent cultural practices. That is, use of a four-row planter requires selection of four-row cultivators and knife sleds. Use of a six-row planter requires selection of six-row cultivators, knife sleds and rotary hoes. Use of an eight-row planter presents no difficulty in the use of four-row implements for subsequent cultural operations since the outside middle will never be spanned by an implement.

160-Acre Farm

Feasible least-cost equipment systems for operating a 160-acre farm in the study area were identical for wage rates of $1.25 per hour and $1.75 per hour for high draft requirements (see Table 2).[3] This system included four-row equipment and a 64 power take-off (PTO) horsepower tractor. For the high draft requirements, optimum four-row equipment systems were uniformly least cost, but equipment components were not identical. Optimum eight-row equipment systems incurred the highest annual costs at all wage rates. An optimum eight-row equipment system with a wage rate of $2.75 per hour had annual costs of about $157.32 more than the feasible least-cost four-

[3]Appendix Tables 5 through 12 include a detailed list of equipment components of each system and hours of use for each wage rate, row system and draft requirement.

TABLE 2. ESTIMATED VARIABLE COSTS, ANNUAL COSTS AND INVESTMENT IN MACHINERY AND POWER FOR ALTERNATIVE SIZES OF EQUIPMENT SYSTEMS AND ALTERNATIVE WAGE RATES AND DRAFT REQUIREMENTS FOR A 160-ACRE FARM, TEXAS HIGH PLAINS, 1969

Item	Tractor and equipment system[1]							
	Four-row		Six-row		Eight-row		Least cost	
	Draft requirements							
	Low	High	Low	High	Low	High	Low	High
	dollars							
	Wage rate of $1.25 per hour							
Variable costs	840.30	866.88	777.37	884.55	838.00	891.54	840.30	866.88
Annual costs	2,319.83	2,451.29	2,422.69	2,624.00	2,469.82	2,642.35	2,319.83*	2,451.29*
Investment	11,794.00	12,300.00	12,804.00	13,540.00	12,699.00	13,625.00	11,794.00	12,330.00
	Wage rate of $1.75 per hour							
Variable costs	951.48	1,020.45	893.64	998.85	965.08	1,032.26	922.21	1,020.45
Annual costs	2,467.01*	2,604.85	2,555.14	2,763.15	2,613.10	2,783.07	2,466.78	2,604.85*
Investment	11,794.00	12,330.00	12,930.00	13,730.00	12,825.00	13,625.00	12,020.00	12,330.00
	Wage rate of $2.25 per hour							
Variable costs	1,104.67	1,174.01	1,024.12	1,134.66	1,106.39	1,172.99	1,058.88	1,174.01
Annual costs	2,610.69*	2,758.42	2,685.62	2,898.96	2,754.40	2,923.80	2,603.45	2,758.42*
Investment	11,720.00	12,330.00	12,930.00	13,730.00	12,825.00	13,625.00	12,020.00	12,330.00
	Wage rate of $2.75 per hour							
Variable costs	1,231.50	1,271.04	1,137.94	1,243.12	1,231.03	1,286.36	1,157.95	1,205.59
Annual costs	2,753.58*	2,905.55*	2,815.51	3,033.13	2,895.11	3,062.87	2,737.86	2,897.94
Investment	11,845.00	12,720.00	13,055.00	13,930.00	12,950.00	13,825.00	12,295.00	13,170.00
	Wage rate of $3.25 per hour							
Variable costs	1,344.72	1,391.93	1,238.17	1,358.46	1,264.78	1,406.61	1,261.69	1,318.42
Annual costs	2,892.51*	3,043.20*	2,941.44	3,165.16	3,031.66	3,199.82	2,867.30	3,027.47
Investment	12,045.00	12,850.00	13,255.00	14,060.00	13,750.00	13,955.00	12,495.00	13,300.00

[1]The feasible least-cost equipment systems are indicated with an asterisk (*).

row equipment system. However, an optimum eight-row equipment system had annual costs about $200 higher than the four-row system with a wage rate of $1.25 per hour. Equipment components for the optimum four-row and eight-row equipment systems were identical at $1.25- and $1.75-per-hour wage rates except for power, planter and chisel.[4] The four-row system used a 64 PTO horsepower tractor for wage rates of $1.25 and $1.75 per hour whereas the eight-row system used an 86 PTO horsepower tractor.

Consideration of lower draft requirements for implements resulted in lower annual costs at all wage rates. Farm situations with high draft requirements had higher operating expenses than those situations with low draft requirements. The difference in variable costs between high and low draft requirements for the 160-acre farm ranged from about $26 at the $1.25-per-hour wage rate to about $142 at the $3.25-per-hour wage rate.

Optimum four-row equipment systems had lower costs for all draft and labor rate combinations than the optimum six-row and eight-row equipment systems. Draft requirements were an important factor in determining the sizes of implements a particular tractor could pull. Soil types which increased the draft requirement of an implement decreased the speed at which the tractor could pull the implement. In order to maintain speed, either a smaller size of implement was used with the same tractor or a larger tractor was used with the same implement. Lower draft requirements usually reduced the tractor size in an equipment system and/or increased the size of at least some of the implements. For a given draft level, an increase in the hourly wage resulted in a change in those equipment components included in the least-cost equipment system. For example, with high draft requirements, the set of equipment constituting the least-cost equipment system at the $1.25-per-hour wage rate was generally different from the set of equipment which was least cost at the $3.25-per-hour wage rate.

[4]"Optimum" means that once the row-system is specified to be four-, six- or eight-row, tractors and implements are chosen such that annual costs are minimized for that row system.

500-Acre Farm

The feasible least-cost equipment system for the 500-acre farm was more dependent on the wage rate than it was for the 160-acre farm.[5] For a wage rate of $1.25 per hour and high draft requirements, an optimum four-row equipment system had least annual cost for a feasible equipment system for the 500-acre farm. However, when wage rates were above $2.25 per hour, an optimum six-row equipment system resulted in least annual costs for the feasible least-cost equipment system. For wage rates of $1.25 and $1.75 per hour, selection of an optimum four-row or an optimum six-row equipment system resulted in a small difference in annual costs, that is, an

[5]Appendix Tables 13 through 20 include a detailed list of equipment components of each system and hours of use.

TABLE 3. ESTIMATED VARIABLE COSTS, ANNUAL COSTS AND INVESTMENT IN MACHINERY AND POWER FOR ALTERNATIVE SIZES OF EQUIPMENT SYSTEMS AND ALTERNATIVE WAGE RATES AND DRAFT REQUIREMENTS FOR A 500-ACRE FARM, TEXAS HIGH PLAINS, 1969

Item	Tractor and equipment system[1]							
	Four-row		Six-row		Eight-row		Least cost	
	Draft requirements							
	Low	High	Low	High	Low	High	Low	High
	Dollars							
	Wage rate of $1.25 per hour							
Variable costs	2,620.53	2,875.70	2,453.22	2,626.59	2,358.84	2,800.97	2,458.26	2,655.21
Annual costs	4,161.76*	4,460.10*	4,149.93	4,542.52	4,221.96	4,632.73	4,076.59	4,383.53
Investment	11,994.00	12,330.00	13,204.00	14,910.00	14,499.00	14,255.00	12,594.00	13,450.00
	Wage rate of $1.75 per hour							
Variable costs	3,083.88	3,134.16	2,861.40	2,739.59	2,422.97	3,236.28	2,843.34	3,036.64
Annual costs	4,631.66	4,894.61*	4,564.67*	4,936.30	4,607.47	5,068.05	4,501.62	4,798 37
Investment	12,045.00	13,700.00	13,255.00	17,095.00	17,000.00	14,255.00	12,905.00	13,710.00
	Wage rate of $2.25 per hour							
Variable costs	3,540.71	3,467.50	2,754.19	3,060.71	2,633.86	3,455.30	2,642.97	3,339.00
Annual costs	5,088.49	5,314.69	4,923.27*	5,267.57*	4,905.09	5,483.03	4,869.87	5,197.62
Investment	12,045.00	14,375.00	16,880.00	17,174.00	17,675.00	15,780.00	17,330.00	14,464.00
	Wage rate of $2.75 per hour							
Variable costs	3,442.21	3,884.30	3,012.94	3,391.28	2,874.90	3,540.90	2,886.23	3,352.16
Annual costs	5,507.21	5,731.49	5,233.42	5,598.14*	5,197.53*	5,849.66	5,164.54	5,578.29
Investment	16,070.00	14,375.00	17,280.00	17,174.00	18,075.00	17,969.00	17,730.00	17,324.00
	Wage rate of $3.25 per hour							
Variable costs	3,705.32	4,290.38	3,307.14	3,678.38	3,066.80	3,748.37	3,164.94	3,634.80
Annual costs	5,864.12	6,147.72	5,537.77	5,928.29*	5,483.24*	6,184.09	5,453.40	5,903.98
Investment	16,800.00	14,454.00	17,359.00	17,509.00	18,805.00	18,955.00	17,809.00	17,659.00

[1]The feasible least-cost equipment systems are indicated with an asterisk (*).

optimum six-row system increased annual costs by $80 and $40 more than an optimum four-row system for wage rates of $1.25 and $1.75 per hour, respectively.

Several factors may influence the selection of the optimum power and implement system. The optimum six-row equipment system required 200 hours less labor and incurred $400 per year less variable costs than did the optimum four-row equipment system for a wage rate of $2.25 per hour and high draft assumptions (Table 3).[6] However, the six-row system required an increased investment of $2,800 over the four-row system. Selection of the system would include an evaluation of the relative opportunity costs of the farmer's variable and fixed capital and of his financial situation. The fact that the six-row system had higher capacity than the four-row system would require some consideration. For example, a total of 105 acres were to be moldboarded annually. The four-row system had 115 acres excess capacity, and the six-row system had 165 acres excess capacity within the time allotted for this operation. Since the difference in annual costs between the optimum four-row and optimum six-row equipment systems is relatively small, a manager may desire to consider the six-row system as additional protection against unusual circumstances.

For low draft requirements, annual variable costs at a particular wage rate were decreased when compared with high draft requirements. However, variable and fixed costs for the least-cost equipment system may not change in the same direction when draft requirements vary. Increasing the wage rate to $2.25 per hour resulted in different components in the optimum six-row equipment systems for the low draft situations. For example, variable costs were higher in the low draft for the optimum six-row equipment system than they were for the high draft situation when the wage rate was $1.75 per hour.

[6]Equipment included in this system (optimum four-row) at $1.25-per-hour labor is identical with that of the 160-acre system.

960-Acre Farm

Two tractors were required for all equipment systems to complete all operations within the allotted time for high draft requirements (Table 4). Optimum eight-row equipment systems used the second tractor only in the floating operation. A second tractor was also necessary for certain row-crop operations with both optimum six-row and four-row equipment systems (Appendix Tables 21 through 28). Optimum eight-row equipment systems were feasible least-cost equipment systems at wage rates above $1.25 per hour, and differences in variable costs from those of other systems steadily increased with increases in wage rates. With labor at $1.25 per hour, the difference in annual costs of the three different optimum row systems was less than $60 with the difference less than $8 between the four-row and eight-row systems. With an upward trend in wage rates, an eight-row system would gain in its least-cost advantage.

Low draft requirements for implements reduced both variable and annual costs. The difference in annual costs

TABLE 4. ESTIMATED VARIABLE COSTS, ANNUAL COSTS AND INVESTMENT IN MACHINERY AND POWER FOR ALTERNATIVE SIZES OF EQUIPMENT AND ALTERNATIVE WAGE RATES AND DRAFT REQUIREMENTS FOR A 960-ACRE FARM, TEXAS HIGH PLAINS, 1969

Item	Tractor and equipment system[1]							
	Four-row		Six-row		Eight-row		Least cost	
	Draft requirements							
	Low	High	Low	High	Low	High	Low	High
	Dollars							
	Wage rate of $1.25 per hour							
Variable costs	4,687.78	5,348.17	4,355.27	4,941.71	4,086.75	4,867.12	4,152.58	4,884.70
Annual costs	7,460.17	8,150.62	7,352.40	8,199.18	6,991.49*	8,142.71*	6,979.58	7,835.67
Investment	21,575.00	21,809.00	23,324.00	25,350.00	22,605.00	25,491.00	22,000.00	23,276.00
	Wage rate of $1.75 per hour							
Variable costs	5,432.61	6,173.67	5,015.32	5,330.82	4,685.60	5,400.00	4,685.60	5,486.51
Annual costs	8,205.00	9,016.09	8,012.46	8,849.79	7,590.34	8,755.86*	7,590.34*	8,520.52
Investment	21,575.00	22,120.00	23,324.00	27,385.00	22,605.00	26,111.00	22,605.00	23,611.00
	Wage rate of $2.25 per hour							
Variable costs	6,006.95	6,537.55	5,658.82	5,943.24	5,267.90	6,005.05	5,267.90	6,137.66
Annual costs	8,928.53	9,782.50	8,670.21	9,490.48	8,186.91	9,360.32*	8,186.91*	9,199.95
Investment	22,736.00	25,256.00	23,435.00	27,605.00	22,716.00	26,111.00	22,716.00	23,831.00
	Wage rate of $2.75 per hour							
Variable costs	6,690.18	7,714.38	6,102.21	6,581.39	5,697.69	6,474.02	5,697.69	6,440.16
Annual costs	9,640.02	10,496.87	9,302.50	10,128.63	8,779.89	9,964.21*	8,779.89*	9,852.61
Investment	22,956.00	25,856.00	24,905.00	27,605.00	23,986.00	27,161.00	23,986.00	26,556.00
	Wage rate of $3.25 per hour							
Variable costs	7,400.82	7,886.86	6,729.00	7,219.56	6,271.63	7,059.61	6,271.63	7,026.87
Annual costs	10,350.77	11,209.35	9,929.29	10,766.80	9,353.83	10,549.80*	9,353.83*	10,439.31
Investment	22,956.00	25,856.00	24,905.00	27,605.00	23,986.00	27,161.00	23,986.00	26,556.00

[1]The feasible least-cost equipment systems are indicated with an asterisk (*).

from low draft to high draft requirements for any particular optimum row system was greater than the difference between the least-cost system and other row systems with high draft requirements. That is, on the 960-acre farm, changes in draft requirements had a more pronounced effect on annual costs than did changes in the row system. Conversely, larger equipment gained in relative cost advantage. As draft requirements were lowered, annual costs for four-row systems and for eight-row systems decreased, but the percent decrease was larger for eight-row systems. The difference in annual costs among four-row, six-row and eight-row systems was greater for low draft situations than for high draft situations. System investment varied directly with the level of draft requirement.

Additional Considerations

The optimum eight-row equipment system for the 500-acre farm contained an 86 PTO horsepower tractor for the high draft assumption and the $1.75-per-hour wage rate. When the wage rate was increased to $2.25 per hour, the tractor size for the optimum eight-row equipment system decreased to 80 PTO horsepower. Furthermore, the 80 PTO horsepower tractor was priced at $6,300 while the 86 horsepower tractor was priced at $6,000. These factors seem to favor the selection of the larger tractor. However, there are differences in rates of work since the two tractors are geared differently. The system using the 80 PTO horsepower tractor reduced labor requirements by about 60 hours by using larger equipment. While the 86 PTO horsepower tractor will pull a four-row shredder at the same speed as the smaller tractor, it cannot do so with a 12-foot flood float. Matching the 86 PTO horsepower tractor with a 12-foot float resulted in an additional 12-hour labor requirement for this operation over that required when using the smaller tractor. In addition, the 80 PTO horsepower tractor obtained better fuel economy. These factors when combined resulted in a system which incurred a lower annual cost than the same system using the 86 PTO horsepower tractor. The difference was less than $30 per year.

Tractors larger than 121 PTO horsepower were not included in a solution regardless of implement draft requirement or wage rate per hour although three larger tractors were available. Tractor prices and the upper operating speed limitation on the various implements were critical for this selection. Under the high draft situation, the 121 PTO horsepower tractor was capable of pulling the largest implement of almost all types considered at the maximum permissible ground speed. On the basis of data available for this study, using larger tractors did not result in any cost reduction. For instance, the 121 PTO horsepower tractor did not develop sufficient drawbar pull to meet the requirements of the largest breaking plow. However, reduction in labor expenses obtained by using this breaking plow and a tractor larger than 121 PTO horsepower did not offset the higher investment expenses of the larger equipment. Under the assumptions of this study, the 121 PTO horsepower tractor was apparently large as necessary, at a labor rate of $5.25 per hour or less, regardless of farm size.

Long-Run Average Cost Curve

The percentage of farmland devoted to each enterprise was the same for each farm size. Consequently, the division of total annual cost by farm size (acres) gave an indication of the comparative efficiency of machinery use

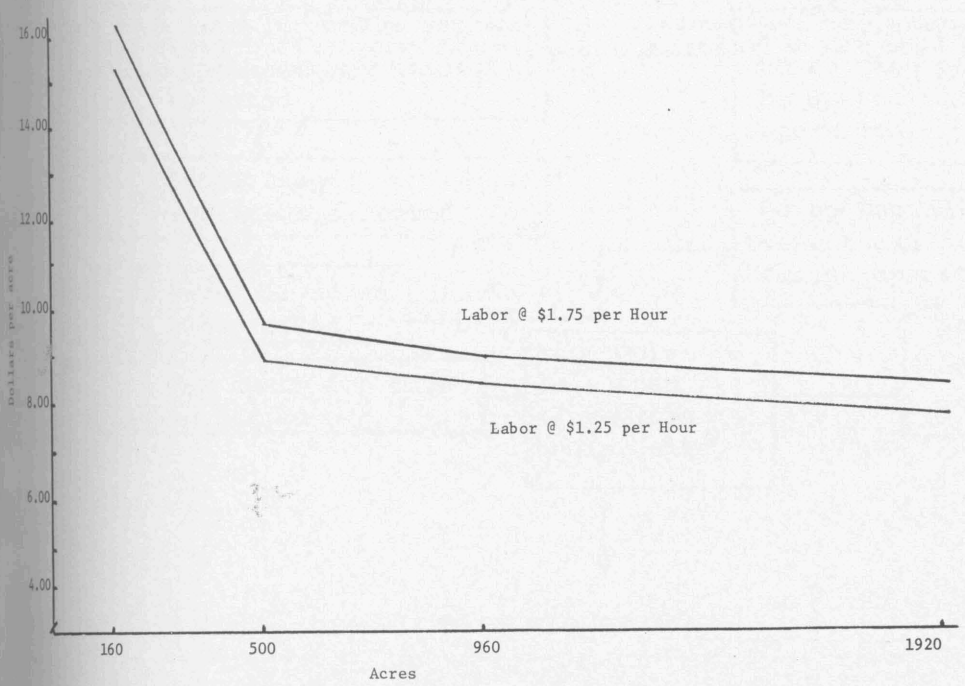


Figure 2. Long-run average equipment cost at two labor rates, high draft situation, Texas High Plains, 1969.

as related to farm size, since cultural practices were assumed to be identical (Figure 2). Average machinery costs computed in this manner were $16.28 per acre for the 160-acre farm. These costs declined to $8.40 per acre as farm size was increased.[7] Much of the variation can be explained by the excess capacity created for the various operations as farm size was increased. As farm size increases, not only does a given acreage of excess capacity represent a smaller portion of required capacity, but it also becomes possible to more precisely match machinery capacity to farm size.

For a large farm, one or more implements could be selected such that no unnecessary capacity was obtained. For a small farm, no implements for several types of operations were available in sufficiently smaller sizes to eliminate excess capacity. For example, systems selected with labor at $1.75 per hour for the 160-acre farm had a maximum excess capacity of 2,064 acres for the discing operation while the maximum excess capacity in any operation for the 500-acre farm was less than 2,000 acres. Although maximum excess capacity on the 960-acre farm amounted to 2,341 acres, this excess was relatively less than for the 160-acre farm.

Some Implications

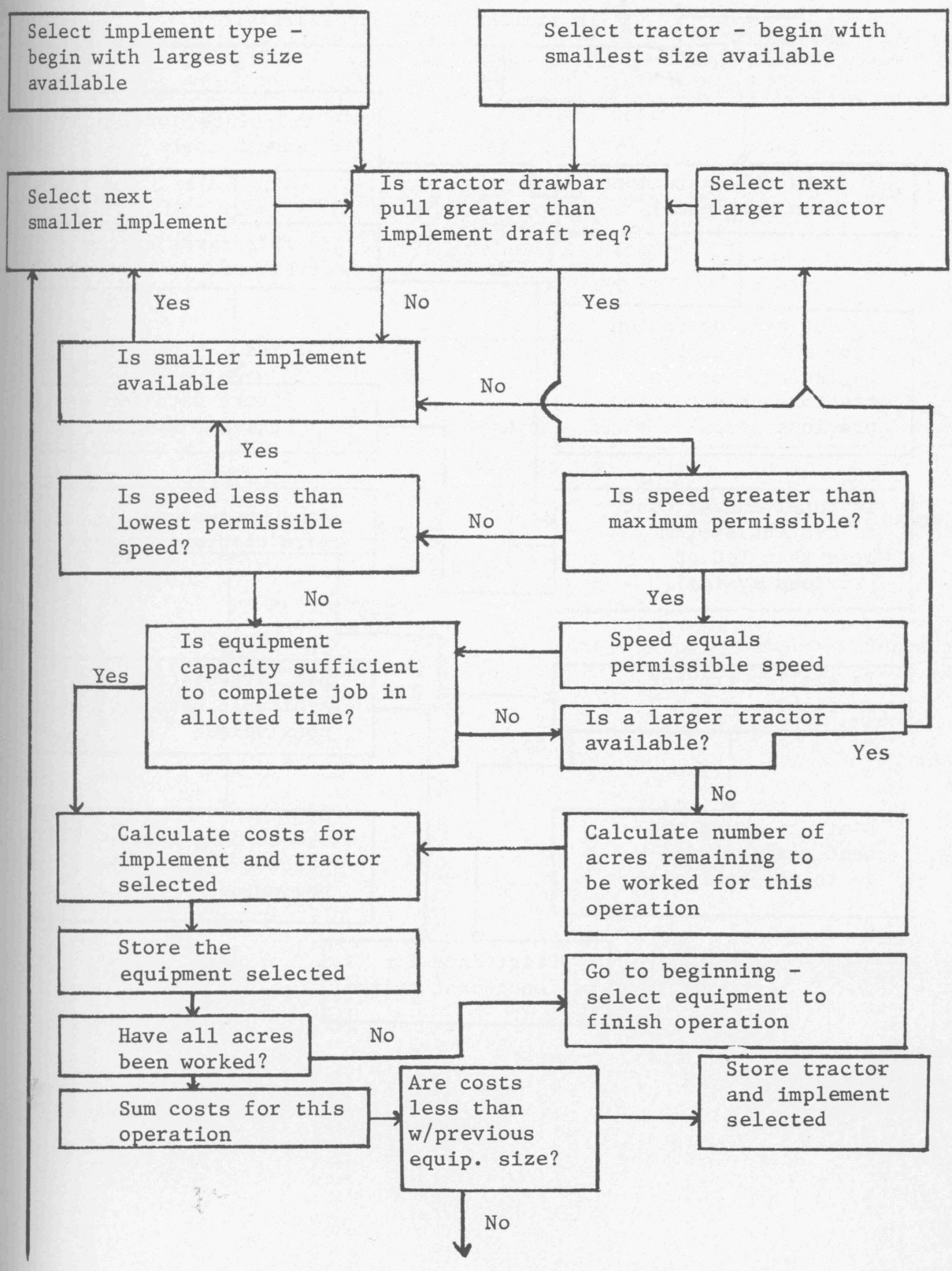
The results of the study indicate that substantial savings are not realized from size of equipment. Farms that include approximately 500 acres appear to be a breakeven point with respect to equipment selection. That is, the savings for this size of farm appear to be less from equipment systems than from smaller or larger farms.

An important factor in selection of farm equipment appears to be in the area of capital restriction. Farmers who are relatively more restricted by short term capital may invest long term capital in larger sizes of equipment. Likewise, use of smaller sizes of equipment generally results in higher investment of short term capital than of long term capital for farms of smaller sizes.

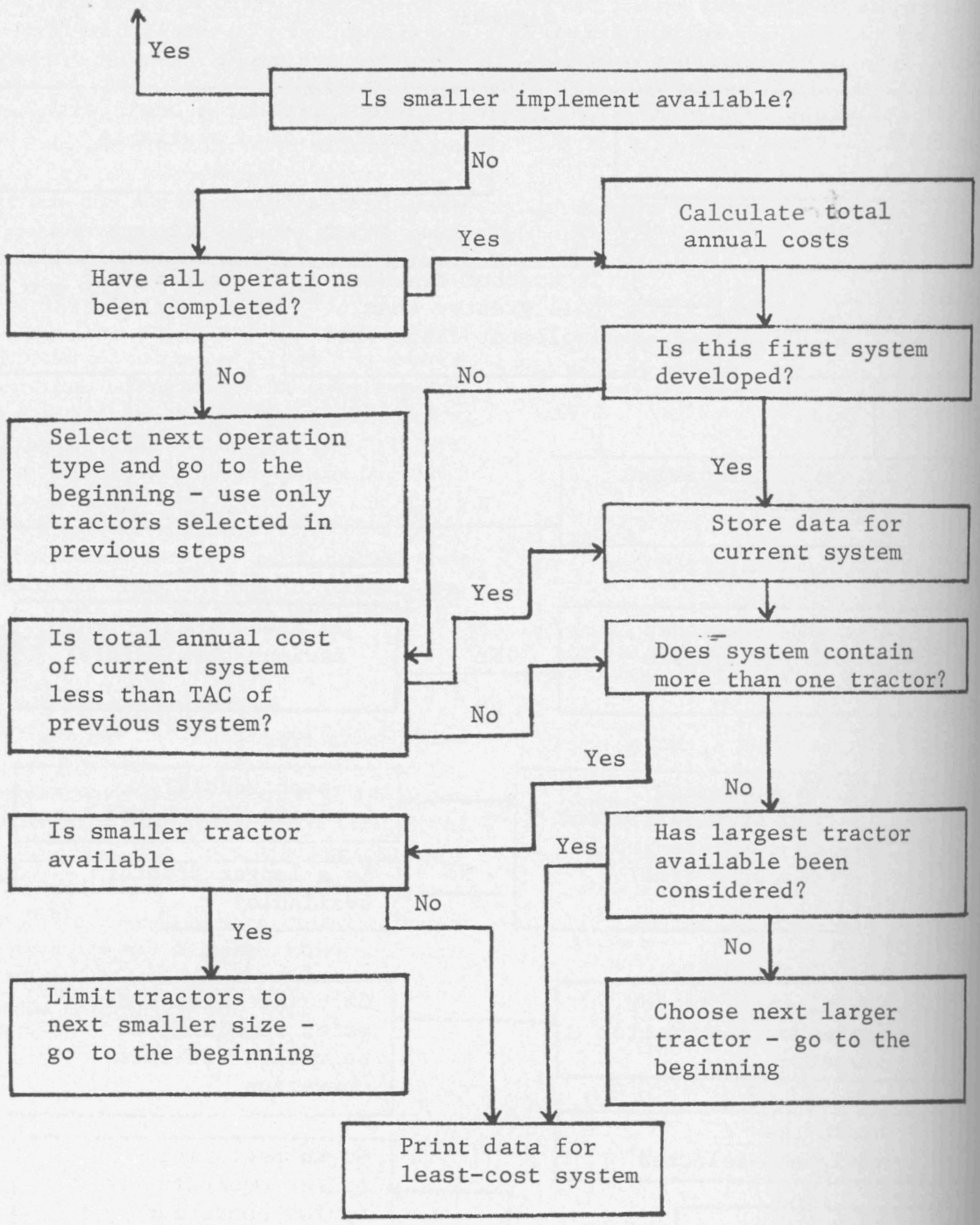
[7]Annual costs for the least-cost equipment system were determined for the purpose of obtaining a fourth point on the long-run average cost curve.

References

1. Davis, Bob, and J. Patrick Madden. "Theory and Procedure for Studying Economies of Size on Irrigated Cotton Farms of the Texas High Plains." Texas Agricultural Experiment Station MP-780, August 1965.
2. "Farm Machinery Cost and Use." *Agricultural Engineers Yearbook, 1967.* St. Joseph, Michigan: American Society of Agricultural Engineers, May 1967.
3. Holloway, Milton Lee. "Economic Impact of Selected Resources on Distributive Shares of Income for Grain Sorghum in the Texas High Plains." Unpublished MS Thesis, Texas Technological College, June 1968.
4. Hunt, Donnell R. *Farm Power and Machinery Management.* Ames, Iowa: Iowa State University Press, 1964.
5. Informal Discussions with Area Farmers — Summer and Fall 1968.
6. LePori, W. A., and Stapleton, H. N. "Analyzing Field Machinery Systems by Computer." *Agricultural Engineering,* January 1967, pp. 24-25.
7. Madden, J. Patrick, and Bob Davis. "Economics of Size on Irrigated Cotton Farms of the Texas High Plains." Texas Agricultural Experiment Station B-1037, June 1965.
8. Morris, W. H. M. "Farm Machinery Replacement." *IBM 4th Agricultural Symposium.* San Jose, California IBM Corporation, 1966, pp. 303-320.
9. "Nebraska Tractor Tests." (I. F. Larsen, engineer in charge). The University of Nebraska Agricultural Experiment Station, Lincoln, Nebraska.
10. "Texas Cotton — Estimated Acreage, Yield and Production by Counties — 1967 Crop." Texas Crop and Livestock Reporting Service, March 1968.
11. "Texas Sorghum — Estimated Acreage, Yield and Production by Counties — 1967 Crop." Texas Crop and Livestock Reporting Service, June 1968.
12. Department of Commerce, Bureau of the Census. *1964 Census of Agriculture, Vol. I, Part 37: Texas,* Washington, D. C.: United States Government Printing Office, 1966.



Appendix Figure 1. The model for selection of a least-cost set of farm machinery.



Appendix Figure 1. (Continued).

APPENDIX TABLE 1. ESTIMATED ANNUAL MACHINE USE, 160-ACRE FARM, TEXAS HIGH PLAINS, 1969[1]

	Land use											
Crop	Grain sorghum		Cotton		Wheat		Other crops		Layout			
Acres	44.2		36.7		17		10.2		37			
Operation	Times over	Total acres	Times over	Total acres	Times over	Total acres	Times over	Total acres	Times over	Total acres	Total acres covered per year	Total time available (hr)
Shred	1.00	44.20	1.00	36.70			1.00	10.20			91.1	50
Break	0.25	11.15	0.25	9.12	0.5	8.5	0.25	2.16			31.3	150
Tandem	2.00	88.40	2.00	73.40	3.0	51.0	2.00	20.40	3.0	111.0	344.2	450
Chisel	1.00	44.20	1.00	36.70	2.0	34.0	1.00	10.20	1.0	37.0	162.1	250
Float	2.00	88.40	2.00	73.40			2.00	20.40			182.2	200
List	1.00	44.20	1.00	36.70	1.0	17.0	1.00	10.20			108.1	[2]
Ditch											3.0	30
Rotary Hoe	1.00	44.20	1.50	55.10			1.50	15.30			114.4	50
Lister plant	1.25	55.30	1.25	45.90			1.25	12.80			113.9	250
Knife	1.00	44.20	0.50	18.40			0.50	5.10			67.7	60
Sandfight	1.50	66.30	1.50	55.10	1.5	25.5	1.50	15.30	1.5	55.5	217.7	15
Cultivate	2.00	88.40	3.00	110.10			3.00	30.60			229.1	150
Drill					1.0	17.0					17.0	75

[1]Adapted from Davis and Madden (1).
[2]Included in requirements for lister planter.

APPENDIX TABLE 2. PRICE AND OPERATING CHARACTERISTICS OF DIESEL TRACTORS BY HORSEPOWER RATING, TEXAS HIGH PLAINS, 1968

PTO[1] horsepower	Price (dollars)[2]	Fuel use (gal/hr)[1]	Drawbar pull (lb)[1]	Speed (mph)[1]
32.0	2,750	1.400	799	11.79
			1,455	6.93
			2,360	4.31
			2,350	4.31
			3,134	3.08
			4,371	1.82
37.0	3,800	1.440	988	10.85
			1,375	8.23
			1,556	7.12
			2,144	5.38
			2,311	4.81
			3,091	3.59
			4,105	2.50
38.0	4,000	1.850	893	11.85
			1,494	7.90
			2,271	5.41
			3,053	4.00
			4,246	2.67
52.4	5,300	1.970	967	14.19
			1,446	10.02
			2,005	7.57
			2,277	6.57
			3,141	4.92
			3,351	4.39
			4,532	3.21
			5,496	2.31
53.0	5,270	2.354	1,332	11.91
			2,532	6.74
			3,648	4.68
			3,789	4.45
			4,597	3.74
			5,461	3.02
			6,521	2.36
53.5	5,200	3.022	1,130	13.56
			1,696	9.85
			2,139	7.74
			2,694	6.25
			3,047	5.61
			3,056	4.49
			3,882	4.32
			4,770	3.50
			5,504	3.04
			6,799	2.38
54.0	5,400	2.185	1,197	13.63
			1,826	9.52
			2,963	6.12
			4,074	4.43

TABLE 2. (CONTINUED)

PTO[1] horsepower	Price (dollars)[2]	Fuel use (gal/hr)[1]	Drawbar pull (lb)[1]	Speed (mph)[1]
			4,164	4.21
			5,712	2.99
			6,464	2.64
			6,851	1.89
54.0	5,900	2.330	1,826	9.41
			2,326	7.46
			3,196	5.47
			3,979	4.40
			5,120	3.34
			6,415	2.43
61.0	6,100	2.710	1,923	10.63
			3,002	6.86
			4,318	4.76
			4,440	4.53
			5,315	3.82
			6,275	3.08
			7,486	2.47
63.7	5,900	2.392	1,302	14.61
			1,907	10.29
			2,637	7.82
			3,005	6.73
			4,078	5.06
			4,341	4.50
			5,897	3.24
			6,092	2.34
64.0	6,250	2.957	1,354	14.08
			1,787	11.12
			3,353	6.31
			4,217	4.95
			5,107	4.17
			6,326	3.23
			7,276	2.49
65.0	6,720	3.320	2,194	10.56
			2,823	8.37
			3,858	6.15
			4,758	4.95
			6,085	3.73
			7,558	2.75
69.0	6,400	3.223	1,501	13.34
			2,606	8.15
			3,472	6.24
			4,059	5.38
			5,334	4.06
			7,936	2.52
71.0	6,229	3.001	2,521	9.05
			3,088	7.70
			3,825	6.24
			5,277	4.61
			6,082	3.87

TABLE 2. (CONTINUED)

PTO[1] horsepower	Price (dollars)[2]	Fuel use (gal/hr)[1]	Drawbar pull (lb)[1]	Speed (mph)[1]
			7,533	3.11
			8,281	2.86
			9,646	2.21
80.0	6,300	3.470	1,561	14.33
			2,381	10.43
			3,108	8.18
			4,374	5.91
			4,978	5.13
			6,139	4.09
			6,913	3.67
			8,629	2.87
			8,822	2.79
			9,697	2.05
85.9	6,000	3.925	2,663	10.29
			3,452	8.09
			4,843	5.66
			6,273	4.54
			9,299	2.95
			10,054	2.33
92.9	7,120	4.130	1,825	14.49
			2,732	10.50
			3,488	8.18
			4,928	5.91
			5,542	5.14
			6,999	4.09
			7,954	3.66
			9,660	2.85
			9,771	2.79
			10,675	2.11
93.6	7,200	3.949	2,107	13.81
			3,175	9.64
			4,915	6.20
			6,144	4.92
			7,029	4.23
			8,676	3.29
			9,199	2.76
93.9	7,400	3.912	2,149	12.50
			2,250	11.48
			3,081	8.99
			3,885	7.11
			5,055	5.57
			5,204	5.27
			7,051	4.06
			7,452	3.71
			9,672	2.79
			10,184	2.31
94.9	7,200	3.954	2,878	10.72
			3,867	8.23
			5,183	6.21
			6,544	4.92
			8,518	3.72
			11,349	2.63
97.8	7,200	4.506	2,398	12.84
			3,958	8.33
			4,921	6.76
			4,978	5.60
			6,724	4.99
			7,245	4.54
			9,922	3.30
			10,329	3.12
			11,808	2.15
100.5	7,800	4.442	2,154	14.50
			2,982	11.17
			4,077	8.18
			5,391	6.27
			5,589	6.03
			6,250	5.27
			7,213	4.61
			8,074	4.00
			8,315	3.83
			9,417	2.90
101.8	7,000	4.694	2,865	11.49
			3,771	9.07
			5,446	6.35
			6,697	5.19
			9,871	3.46
			12,056	2.60

TABLE 2. (CONTINUED)

PTO[1] horsepower	Price (dollars)[2]	Fuel use (gal/hr)[1]	Drawbar pull (lb)[1]	Speed (mph)[1]
105.2	8,500	4.587	2,188	14.76
			3,246	9.96
			4,096	8.26
			5,000	6.83
			6,034	5.81
			6,393	5.29
			7,259	4.79
			7,952	4.36
			8,886	3.89
			9,651	3.58
			10,837	3.17
			12,884	2.04
105.0	8,000	4.330	2,153	14.03
			3,545	9.22
			5,233	6.45
			6,220	5.51
			8,361	4.00
			11,502	2.62
111.0	8,705	5.067	2,511	13.54
			4,176	8.76
			5,204	7.13
			6,351	5.92
			7,187	5.27
			7,816	4.80
			10,563	3.51
			11,267	3.33
			14,443	2.22
116.1	9,200	5.353	2,609	14.49
			3,469	11.53
			4,765	8.20
			6,270	6.29
			6,502	6.10
			7,357	5.33
			8,424	4.66
			9,431	4.06
			9,975	3.80
			11,104	2.97
120.5	9,400	5.069	2,794	13.79
			2,963	12.64
			3,998	9.95
			5,029	7.92
			6,603	6.21
			6,740	5.89
			8,970	4.58
			9,417	4.21
			12,131	3.24
			14,182	2.45
127.8	10,000	5.438	3,140	13.35
			4,739	9.19
			7,263	6.07
			9,771	4.47
			12,116	3.37
			15,261	2.34
131.5	11,200	6.066	2,715	14.26
			4,072	9.66
			5,208	7.97
			6,366	6.57
			7,387	5.80
			7,994	5.08
			8,981	4.79
			10,053	4.19
			10,809	3.87
			11,965	3.43
			13,284	3.16
			10,509	1.97
133.0	12,200	5.610	3,723	10.91
			5,083	8.36
			6,927	6.30
			8,678	5.00
			11,187	3.80
			15,195	2.74
			16,197	1.79

[1]Nebraska Tractor Tests (9).

[2]Price information obtained from equipment dealers in the Texas High Plains, 1968.

APPENDIX TABLE 3. IMPLEMENT PRICE RANGE BY SIZE, TEXAS HIGH PLAINS, 1968

Implement	Width (ft)[1]	Price range (dollars)[1]
Rear-mounted cultivator	13.3 (4 row)	600- 950
	20.0 (6 row)	900-1,375
	26.7 (8 row)	1,200-2,050
Lister-planter	13.3 (4 row)	680-1,400
	20.0 (6 row)	1,180-1,900
	26.7 (8 row)	1,785-2,600
Rotary hoe	13.3 (4 row)	480- 560
	20.0 (6 row)	795- 975
	26.7 (8 row)	1,131
Knife sled	13.3 (4 row)	375- 485
	20.0 (6 row)	525- 745
	26.7 (8 row)	1,115
Shredder	6.7 (2 row)	575- 750
	13.3 (4 row)	1,200-1,550
Sandfighter	30 (9 row)	135- 170
	40 (12 row)	214- 245
	60 (18 row)	325- 360
Chisel plow	8	400- 635
	9	325
	10	525
	11	415- 800
	12	650
	13	540
	15	875
	21	1,100
Tandem disc	10	690- 695
	11	800- 900
	12	795
	13	925-1,250
	15	1,600
	17	1,535-1,800
	20	1,610-1,950
	21	1,700-1,750
Grain drill	7	700
	9	824
	13	690
	16	1,000
	18	910- 975
Breaking plow	2.7 (3 bottom)	600- 785
	4 (3 bottom)	800-1,095
	5.3 (4 bottom)	1,200-1,450
	9.4 (7 bottom)	2,000
V-ditcher	8.2	175- 225
Float	9 (32 ft long)	1,050
	12 (32 ft long)	1,250-1,325
	12 (33 ft long)	1,300
	12 (45 ft long)	1,600

[1]Information obtained from equipment dealers in the Texas High Plains, 1968.

APPENDIX TABLE 4. IMPLEMENT OPERATING CHARACTERISTICS, TEXAS HIGH PLAINS, 1969

Implement	Typical ranges in draft requirements (16 per ft of width)	Typical range of operating efficiency (%)	Efficiency used (%)	Tractive and transmission coefficient	Repair, maintenance and lubrication (% /hr)	Minimum permissible speed (mph)	Maximum permissible speed (mph)
Breaking plow (16 inch bottoms, 12 inches deep)	720-1,296	74-88	74	.9	.08	3.5	5.0
Tandem disc	190- 250	77-90	77	.75	.065	3.5	6.0
Lister-planter	120- 240	60-80	77	.75	.065	2.5	6.0
Chisel plow	175- 315	75-90	75	.75	.07	1.5	5.5
Shredder	119[1]		75[1]	.9	.24	2.0	8.0
Cultivator	80- 190		70	.65	.06	2.5	5.0
Rotary hoe	40- 100	80-90	80	.75	.019	3.0	8.0
Knife sled	64[1]		75[1]	.65	.06	1.5	3.5
Float	227[1]		75[1]	.55	.06	1.5	5.0
Sandfighter	9[1]		150[1]	.75	.08	5.0	15.0
Grain drill	50- 130	65-85	65	.75	.08	2.5	4.0
V-ditcher	420[1]		25[1]	.65	.04	2.5	4.5

[1]These values were estimated for this study. Other data were obtained from published sources (1, 4, 5 and 6).

APPENDIX TABLE 5. OPTIMUM FOUR-ROW EQUIPMENT SYSTEMS FOR ALTERNATIVE WAGE RATES FOR A 160-ACRE FARM, LOW DRAFT REQUIREMENTS, TEXAS HIGH PLAINS, 1969

		Wage rates (dollars per hr)							
		1.25[1]		2.25		2.75		3.25	
Item	Units	Size	Hours of use	Size	Hours of use	Size	Hours of use	Size	Hours of use
Tractor	hp	54.0	294.3	53.5	286.9	53.5	282.3	53.5	275.8
Float	ft	9	50.3	9	49.6	9	49.6	9	49.6
Breaking plow	16 inch	2	25.8	2	25.8	2	25.8	3	19.4
Tandem disc	ft	10	61.5	12	54.8	12	54.8	12	54.8
Lister planter	row	4	29.8	4	29.8	4	29.8	4	29.8
Chisel	ft	11	29.5	11	29.5	13	24.9	13	24.9
Shredder	row	2	18.7	2	18.7	2	18.7	2	18.7
Cultivator	row	4	40.6	4	40.6	4	40.6	4	40.6
Rotary hoe	row	4	11.1	4	11.1	4	11.1	4	11.1
Knife sled	row	4	16.0	4	16.0	4	16.0	4	16.0
Sandfighter	row	9	2.9	9	2.9	9	2.9	9	2.9
Grain drill	ft	13	4.1	13	4.1	13	4.1	13	4.1
Ditcher	unit	1	4.0	1	4.0	1	4.0	1	4.0

[1]The equipment system and hours of use for a wage rate of $1.75 per hour were identical to the equipment system and hours of use for wage rate of $1.25 per hour.

APPENDIX TABLE 6. OPTIMUM FOUR-ROW EQUIPMENT SYSTEMS FOR ALTERNATIVE WAGE RATES FOR A 160-ACRE FARM, HIGH DRAFT REQUIREMENTS, TEXAS HIGH PLAINS, 1969

		Wage rates (dollars per hr)				
		1.25[1]		2.75		3.25
Item	Units	Size	Hours of use	Size	Hours of use	Size	Hours of use
Tractor	hp	63.7	307.0	85.9	276.2	85.9	272.0
Float	ft	9	44.5	9	44.5	9	44.5
Breaking plow	16 inch	2	25.8	3	19.2	3	19.2
Tandem disc	ft	12	60.7	12	54.3	13	50.1
Lister planter	row	4	39.7	4	31.6	4	31.6
Chisel	ft	9	39.2	11	29.5	11	29.5
Shredder	row	2	18.7	2	18.7	2	18.7
Cultivator	row	4	40.6	4	40.6	4	40.6
Rotary hoe	row	4	11.1	4	11.1	4	11.1
Knife sled	row	4	16.0	4	16.0	4	16.0
Sandfighter	row	4	2.9	9	2.9	9	2.9
Grain drill	ft	13	4.1	13	4.1	13	4.1
Ditcher	unit	1	3.7	1	3.7	1	3.7

[1]The equipment systems and hours of use for wage rates of $1.75 and $2.25 per hour were identical to the equipment system and hours of use for wage rates of $1.25 per hour.

APPENDIX TABLE 7. OPTIMUM SIX-ROW EQUIPMENT SYSTEMS FOR ALTERNATIVE WAGE RATES FOR A 160-ACRE FARM, LOW DRAFT REQUIREMENTS, TEXAS HIGH PLAINS, 1969

		Wage rate (dollars per hr)							
		1.25		1.75[1]		2.75		3.25	
Item	Units	Size	Hours of use	Size	Hours of use	Size	Hours of use	Size	Hours of use
Tractor	hp	53.5	267.6	53.5	260.9	53.5	256.3	53.5	249.9
Float	ft	9	49.6	9	49.6	9	49.6	9	49.6
Breaking plow	16 inch	2	25.8	2	25.8	2	25.8	3	19.4
Tandem disc	ft	10	61.5	12	54.8	12	54.8	12	54.8
Lister planter	row	6	26.5	6	26.5	6	26.5	6	26.5
Chisel	ft	11	29.5	11	29.5	13	24.9	13	24.9
Shredder	row	2	18.7	2	18.7	2	18.7	2	18.7
Cultivator	row	6	27.0	6	27.0	6	27.0	6	27.0
Rotary hoe	row	6	7.4	6	7.4	6	7.4	6	7.4
Knife sled	row	6	10.6	6	10.6	6	10.6	6	10.6
Sandfighter	row	9	2.9	9	2.9	9	2.9	9	2.9
Grain drill	ft	13	4.1	13	4.1	13	4.1	13	4.1
Ditcher	unit	1	4.0	1	4.0	1	4.0	1	4.0

[1]The equipment system and hours of use for a wage rate of $2.25 per hour were identical to the equipment system and hours of use for wage rate of $1.75 per hour.

APPENDIX TABLE 8. OPTIMUM SIX-ROW EQUIPMENT SYSTEMS FOR ALTERNATIVE WAGE RATES FOR A 160-ACRE FARM, HIGH DRAFT REQUIREMENTS, TEXAS HIGH PLAINS, 1969

		Wage rate (dollars per hr)							
		1.25		1.75[1]		2.75		3.25	
Item	Units	Size	Hours of use	Size	Hours of use	Size	Hours of use	Size	Hours of use
Tractor	hp	63.7	305.7	85.9	271.5	85.9	264.9	85.9	260.7
Float	ft	9	44.5	9	44.5	9	44.5	9	44.5
Breaking plow	16 inch	2	25.8	2	25.8	3	19.2	3	19.2
Tandem disc	ft	12	60.7	12	54.3	12	54.3	13	50.1
Lister planter	row	6	45.0	6	40.3	6	40.3	6	40.3
Chisel	ft	9	39.2	11	29.5	11	29.5	11	29.5
Shredder	row	2	18.7	2	18.7	2	18.7	2	18.7
Cultivator	row	6	41.7	6	29.7	6	29.7	6	29.7
Rotary hoe	row	6	8.8	6	7.4	6	7.4	6	7.4
Knife sled	row	6	10.6	6	10.6	6	10.6	6	10.6
Sandfighter	row	9	2.9	9	3.9	9	3.9	9	3.9
Grain drill	ft	13	4.1	13	4.1	13	4.1	13	4.1
Ditcher	unit	1	3.7	1	2.7	1	2.7	1	2.7

[1]The equipment system and hours of use for a wage rate of $2.25 per hour were identical to the equipment system and hours of use for wage rate of $1.75 per hour.

APPENDIX TABLE 9. OPTIMUM EIGHT-ROW EQUIPMENT SYSTEMS FOR ALTERNATIVE WAGE RATES FOR A 160-ACRE FARM, LOW DRAFT REQUIREMENTS, TEXAS HIGH PLAINS, 1969

		Wage rate (dollars per hr)							
		1.25		1.75[1]		2.75		3.25	
Item	Units	Size	Hours of use	Size	Hours of use	Size	Hours of use	Size	Hours of use
Tractor	hp	53.5	289.3	53.5	282.6	53.5	278.0	53.5	253.5
Float	ft	9	49.6	9	49.6	9	49.6	9	49.6
Breaking plow	16 inch	2	25.8	2	25.8	2	25.8	3	19.4
Tandem disc	ft	10	61.5	12	54.8	12	54.8	12	54.8
Lister planter	row	8	25.5	8	25.5	8	25.5	8	25.5
Chisel	ft	11	29.5	11	29.5	13	24.9	13	24.9
Shredder	row	2	18.7	2	18.7	2	18.7	2	18.7
Cultivator	row	4	40.6	4	40.6	4	40.6	8	22.5
Rotary hoe	row	4	11.1	4	11.1	4	11.1	4	11.1
Knife sled	row	4	16.0	4	16.0	4	16.0	4	16.0
Sandfighter	row	9	2.9	9	2.9	9	2.9	9	2.9
Grain drill	ft	13	4.1	13	4.1	13	4.1	13	4.1
Ditcher	unit	1	4.0	1	4.0	1	4.0	1	4.0

[1]The equipment system and hours of use for a wage rate of $2.25 per hour were identical to the equipment system and hours of use for wage rate of $1.75 per hour.

APPENDIX TABLE 10. OPTIMUM EIGHT-ROW EQUIPMENT SYSTEMS FOR ALTERNATIVE WAGE RATES FOR A 160-ACRE FARM, HIGH DRAFT REQUIREMENTS, TEXAS HIGH PLAINS, 1969

		Wage rate (dollars per hr)					
		1.25[1]		2.75		3.25	
Item	Units	Size	Hours of use	Size	Hours of use	Size	Hours of use
Tractor	hp	85.9	281.4	85.9	274.8	85.9	270.6
Float	ft	9	44.5	9	44.5	9	44.5
Breaking plow	16 inch	2	25.8	3	19.2	3	19.2
Tandem disc	ft	12	54.3	12	54.3	13	50.1
Lister planter	row	8	30.2	8	30.2	8	30.2
Chisel	ft	11	29.5	11	29.5	11	29.5
Shredder	row	2	18.7	2	18.7	2	18.7
Cultivator	row	4	40.6	4	40.6	4	40.6
Rotary hoe	row	4	11.1	4	11.1	4	11.1
Knife sled	row	4	16.0	4	16.0	4	16.0
Sandfighter	row	9	3.9	9	3.9	9	3.9
Grain drill	ft	13	4.1	13	4.1	13	4.1
Ditcher	unit	1	2.7	1	2.7	1	2.7

[1]The equipment system and hours of use for wage rates of $1.75 and $2.25 per hour were identical to the equipment system and hours of use for wage rate of $1.25 per hour.

APPENDIX TABLE 11. LEAST COST EQUIPMENT SYSTEMS FOR ALTERNATIVE WAGE RATES FOR A 160-ACRE FARM, LOW DRAFT REQUIREMENTS, TEXAS HIGH PLAINS, 1969

		Wage rate (dollars per hr)							
		1.25		1.75[1]		2.75		3.25	
Item	Units	Size	Hours of use	Size	Hours of use	Size	Hours of use	Size	Hours of use
Tractor	hp	54.0	294.3	53.5	273.3	53.5	263.3	53.5	256.9
Float	ft	9	50.3	9	49.6	9	49.6	9	49.6
Breaking plow	16 inch	2	25.8	2	25.8	2	25.8	3	19.4
Tandem disc	ft	10	61.5	12	54.8	12	54.8	12	54.8
Lister planter	row	4	29.8	4	29.8	4	29.8	4	29.8
Chisel	ft	11	29.5	11	29.5	13	24.9	13	24.9
Shredder	row	2	18.7	2	18.7	2	18.7	2	18.7
Cultivator	row	4	40.6	6	27.0	6	27.0	6	27.0
Rotary hoe	row	4	11.1	4	11.1	4	11.1	4	11.1
Knife sled	row	4	16.0	4	16.0	6	10.6	6	10.6
Sandfighter	row	9	2.9	9	2.9	9	2.9	9	2.9
Grain drill	ft	13	4.1	13	4.1	13	4.1	13	4.1
Ditcher	unit	1	4.0	1	4.0	1	4.0	1	4.0

[1]The equipment system and hours of use for a wage rate of $2.25 per hour were identical to the equipment system and hours of use for a wage rate of $1.75 per hour.

APPENDIX TABLE 12. LEAST COST EQUIPMENT SYSTEMS FOR ALTERNATIVE WAGE RATES FOR A 160-ACRE FARM, HIGH DRAFT REQUIREMENTS, TEXAS HIGH PLAINS, 1969

		Wage rate (dollars per hr)					
		1.25[1]		2.75		3.25	
Item	Units	Size	Hours of use	Size	Hours of use	Size	Hours of use
Tractor	hp	63.7	307.0	85.9	259.9	85.9	255.7
Float	ft	9	44.5	9	44.5	9	44.5
Breaking plow	16 inch	2	25.8	3	19.2	3	19.2
Tandem disc	ft	12	60.7	12	54.3	13	50.1
Lister planter	row	4	39.7	4	31.6	4	31.6
Chisel	ft	9	39.2	11	29.5	11	29.5
Shredder	row	2	18.7	2	18.7	2	18.7
Cultivator	row	4	40.6	6	29.7	6	29.7
Rotary hoe	row	4	11.1	4	11.1	4	11.1
Knife sled	row	4	16.0	6	10.6	6	10.6
Sandfighter	row	9	2.9	9	3.9	9	3.9
Grain drill	ft	13	4.1	13	4.1	13	4.1
Ditcher	unit	1	3.7	1	2.7	1	2.7

[1]The equipment systems and hours of use for wage rates of $1.75 and $2.25 per hour were identical to the equipment system and hours of use for wage rate of $1.25 per hour.

APPENDIX TABLE 13. OPTIMUM FOUR-ROW EQUIPMENT SYSTEMS FOR ALTERNATIVE WAGE RATES FOR A 500-ACRE FARM, LOW DRAFT REQUIREMENTS, TEXAS HIGH PLAINS, 1969

		Wage rate (dollars per hr)							
		1.25		1.75[1]		2.75		3.25	
Item	Units	Size	Hours of use	Size	Hours of use	Size	Hours of use	Size	Hours of use
Tractor	hp	54.0	954.4	53.5	913.6	80.0	716.8	80.0	695.8
Float	ft	9	168.1	9	165.9	12	111.7	12	111.7
Breaking plow	16 inch	3	65.7	3	64.9	4	44.0	4	44.0
Tandem disc	ft	10	205.4	12	183.1	17	122.7	17	122.7
Lister planter	row	4	99.6	4	99.6	4	99.6	4	99.6
Chisel	ft	11	98.5	13	83.3	21	55.3	21	55.3
Shredder	row	2	62.5	2	62.5	4	31.5	4	31.5
Cultivator	row	4	132.2	4	132.2	4	132.2	4	132.2
Rotary hoe	row	4	37.1	4	37.1	4	37.1	8	18.5
Knife sled	row	4	53.5	4	53.5	4	53.5	4	53.5
Sandfighter	row	9	9.8	9	9.8	9	9.5	12	7.1
Grain drill	ft	13	13.8	13	13.8	13	13.8	13	13.8
Ditcher	unit	1	8.2	1	7.9	1	5.9	1	5.9

[1]The equipment system and hours of use for a wage rate of $2.25 per hour were identical to the equipment system and hours of use for a wage rate of $1.75 per hour.

APPENDIX TABLE 14. OPTIMUM FOUR-ROW EQUIPMENT SYSTEMS FOR ALTERNATIVE WAGE RATES FOR A 500-ACRE FARM, HIGH DRAFT REQUIREMENTS, TEXAS HIGH PLAINS, 1969

		Wage rate (dollars per hr)							
		1.25		1.75		2.25[1]		3.25	
Item	Units	Size	Hours of use	Size	Hours of use	Size	Hours of use	Size	Hours of use
Tractor	hp	63.7	1017.9	80.0	864.5	80.0	833.5	80.0	831.1
Float	ft	9	148.9	12	111.7	12	111.7	12	111.7
Breaking plow	16 inch	2	86.3	3	71.2	3	71.2	3	71.2
Tandem disc	ft	12	203.0	13	160.4	13	160.4	13	160.4
Lister planter	row	4	132.8	4	101.1	4	101.1	4	101.1
Chisel	ft	9	130.8	11	105.6	11	105.6	11	105.6
Shredder	row	2	62.5	2	62.5	4	31.5	4	31.5
Cultivator	row	4	132.2	4	132.2	4	132.2	4	132.2
Rotary hoe	row	4	37.1	4	37.1	4	37.1	4	37.1
Knife sled	row	4	53.5	4	53.5	4	53.5	4	53.5
Sandfighter	row	9	9.5	9	9.5	9	9.5	12	7.1
Grain drill	ft	13	13.8	13	13.8	13	13.8	13	13.8
Ditcher	unit	1	7.5	1	5.9	1	5.9	1	5.9

[1]The equipment system and hours of use for a wage rate of $2.75 per hour were identical to the equipment system and hours of use for wage rate of $2.25 per hour.

APPENDIX TABLE 15. OPTIMUM SIX-ROW EQUIPMENT SYSTEMS FOR ALTERNATIVE WAGE RATES FOR A 500-ACRE FARM, LOW DRAFT REQUIREMENTS, TEXAS HIGH PLAINS, 1969

		Wage rate (dollars per hr)									
		1.25		1.75		2.25		2.75		3.25	
Item	Units	Size	Hours of use	Size	Hours of use	Size	Hours of use	Size	Hours of use	Size	Hours of use
Tractor	hp	54.0	869.8	53.5	827.9	80.0	624.2	80.0	609.9	80.0	607.5
Float	ft	9.0	168.1	9	165.9	12	111.7	12	111.7	12	111.7
Breaking plow	16 inch	3	65.7	3	64.9	3	58.3	4	44.0	4	44.0
Tandem disc	ft	10	205.4	12	183.1	17	122.7	17	122.7	17	122.7
Lister planter	row	6	89.7	20	88.5	6	67.3	6	67.3	6	67.3
Chisel	ft	11	98.5	13	83.3	21	55.3	21	55.3	21	55.3
Shredder	row	2	62.5	2	62.5	4	31.5	4	31.5	4	31.5
Cultivator	row	6	87.9	6	87.9	6	87.9	6	87.9	6	87.9
Rotary hoe	row	6	24.7	6	24.7	6	24.7	6	24.7	6	24.7
Knife sled	row	6	35.6	6	35.6	6	35.6	6	35.6	6	35.6
Sandfighter	row	9	9.8	9	9.8	9	9.5	9	9.5	12	7.1
Grain drill	ft	13	13.8	13	13.8	13	13.8	13	13.8	13	13.8
Ditcher	unit	1	8.1	1	7.9	1	5.9	1	5.9	1	5.9

APPENDIX TABLE 16. OPTIMUM SIX-ROW EQUIPMENT SYSTEMS FOR ALTERNATIVE WAGE RATES FOR A 500-ACRE FARM, HIGH DRAFT REQUIREMENTS, TEXAS HIGH PLAINS, 1969

		Wage rate (dollars per hr)							
		1.25		1.75		2.25[1]		3.25	
Item	Units	Size	Hours of use	Size	Hours of use	Size	Hours of use	Size	Hours of use
Tractor	hp	80.0	818.6	101.8	664.1	101.8	661.2	101.8	649.4
Float	ft	12	111.7	12	111.7	12	111.7	12	111.7
Breaking plow	16 inch	3	71.2	3	58.3	3	58.3	3	58.3
Tandem disc	ft	13	160.4	20	118.7	20	118.7	20	118.7
Lister planter	row	6	108.3	6	76.6	6	76.6	6	76.6
Chisel	ft	11	105.6	13	88.3	13	88.3	15	76.5
Shredder	row	2	62.5	4	31.5	4	31.5	4	31.5
Cultivator	row	6	107.5	6	87.9	6	87.9	6	87.9
Rotary hoe	row	6	24.7	6	24.7	6	24.7	6	24.7
Knife sled	row	6	35.6	6	35.6	6	35.6	6	35.6
Sandfighter	row	9	11.9	9	11.6	12	8.7	12	8.7
Grain drill	ft	13	13.8	13	13.8	13	13.8	13	13.8
Ditcher	unit	1	5.4	1	5.4	1	5.4	1	5.4

[1]The equipment system and hours of use for a wage rate of $2.75 per hour were identical to the equipment system and hours of use for a wage rate of $2.25 per hour.

APPENDIX TABLE 17. OPTIMUM EIGHT-ROW EQUIPMENT SYSTEMS FOR ALTERNATIVE WAGE RATES FOR A 500-ACRE FARM, LOW DRAFT REQUIREMENTS, TEXAS HIGH PLAINS, 1969

		Wage rate (dollars per hr)									
		1.25		1.75		2.25		2.75		3.25	
Item	Units	Size	Hours of use	Size	Hours of use	Size	Hours of use	Size	Hours of use	Size	Hours of use
Tractor	hp	63.7	800.1	80.0	619.6	80.0	588.6	80.0	574.3	80.0	553.3
Float	ft	9	148.9	12	111.7	12	111.7	12	111.7	12	111.7
Breaking plow	16 inch	3	58.3	3	58.3	3	58.3	4	44.0	4	44.0
Tandem disc	ft	10	205.4	17	122.7	17	122.7	17	122.7	17	122.7
Lister planter	row	8	66.2	8	50.4	8	50.4	8	50.4	8	50.4
Chisel	ft	11	98.5	21	55.3	21	55.3	21	55.3	21	55.3
Shredder	row	2	62.5	2	62.5	4	31.5	4	31.5	4	31.5
Cultivator	row	8	65.8	8	65.8	8	65.8	8	65.8	8	65.8
Rotary hoe	row	4	37.1	4	37.1	4	37.1	4	37.1	8	18.5
Knife sled	row	8	26.6	8	26.6	8	26.6	8	26.6	8	26.6
Sandfighter	row	9	9.5	9	9.5	9	9.5	9	9.5	12	7.1
Grain drill	ft	13	13.8	13	13.8	13	13.8	13	13.8	13	13.8
Ditcher	unit	1	7.5	1	5.9	1	5.9	1	5.9	1	5.9

APPENDIX TABLE 18. OPTIMUM EIGHT-ROW EQUIPMENT SYSTEMS FOR ALTERNATIVE WAGE RATES FOR A 500-ACRE FARM, HIGH DRAFT REQUIREMENTS, TEXAS HIGH PLAINS, 1969

		Wage rate (dollars per hr)							
		1.25[1]		2.25		2.75		3.25	
Item	Units	Size	Hours of use	Size	Hours of use	Size	Hours of use	Size	Hours of use
Tractor	hp	85.9	870.6	80.0	809.2	101.8	681.3	101.8	650.9
Float	ft	9	148.9	12	111.7	12	111.7	12	111.7
Breaking plow	16 inch	3	64.2	3	71.2	3	58.3	3	58.3
Tandem disc	ft	13	167.5	13	160.4	20	118.7	20	118.7
Lister planter	row	8	100.9	8	103.7	8	86.1	8	86.1
Chisel	ft	11	98.5	11	105.6	13	88.3	15	76.5
Shredder	row	2	62.5	4	31.5	4	31.5	4	31.5
Cultivator	row	4	132.2	4	132.2	8	95.1	8	95.1
Rotary hoe	row	4	37.1	4	37.1	4	37.1	8	18.5
Knife sled	row	8	26.6	8	26.6	8	26.6	8	26.6
Sandfighter	row	9	13.0	9	9.5	12	8.7	12	8.7
Grain drill	ft	13	13.8	13	13.8	13	13.8	13	13.8
Ditcher	unit	1	5.4	1	5.9	1	5.4	1	5.4

[1]The equipment system and hours of use for a wage rate of $1.75 per hour were identical to the equipment system and hours of use for wage rate of $1.25 per hour.

APPENDIX TABLE 19. LEAST-COST EQUIPMENT SYSTEMS FOR ALTERNATIVE WAGE RATES FOR A 500 ACRE FARM, LOW DRAFT REQUIREMENTS, TEXAS HIGH PLAINS, 1969

		Wage rate (dollars per hr)									
		1.25		1.75		2.25		2.75		3.25	
Item	Units	Size	Hours of use	Size	Hours of use	Size	Hours of use	Size	Hours of use	Size	Hours of use
Tractor	hp	54.0	883.1	53.5	830.0	80.0	593.1	80.0	578.8	80.0	576.4
Float	ft	9	168.1	9	165.9	12	111.7	12	111.7	12	111.7
Breaking plow	16 inch	3	65.7	3	64.9	3	58.3	4	44.0	4	44.0
Tandem disc	ft	10	205.4	12	183.1	17	122.7	17	122.7	17	122.7
Lister planter	row	4	99.6	4	99.6	6	67.3	6	67.3	6	67.3
Chisel	ft	11	98.5	13	83.3	21	55.3	21	55.3	21	55.3
Shredder	row	2	62.5	2	62.5	4	31.5	4	31.5	4	31.5
Cultivator	row	6	87.9	6	87.9	8	65.8	8	65.8	8	65.8
Rotary hoe	row	4	37.1	6	24.7	6	24.7	6	24.7	6	24.7
Knife sled	row	8	26.6	8	26.6	8	26.6	8	26.6	8	26.6
Sandfighter	row	9	9.8	9	9.8	9	9.5	9	9.5	12	7.1
Grain drill	ft	13	13.8	13	13.8	13	13.8	13	13.8	13	13.8
Ditcher	unit	1	8.1	1	7.9	1	5.9	1	5.9	1	5.9

APPENDIX TABLE 20. LEAST-COST EQUIPMENT SYSTEMS FOR ALTERNATIVE WAGE RATES FOR A 500-ACRE FARM, HIGH DRAFT REQUIREMENTS, TEXAS HIGH PLAINS, 1969

		Wage rate (dollars per hr)									
		1.25		1.75		2.25		2.75		3.25	
Item	Units	Size	Hours of use	Size	Hours of use	Size	Hours of use	Size	Hours of use	Size	Hours of use
Tractor	hp	85.9	839.9	85.9	827.5	85.9	793.2	101.8	652.2	101.8	640.4
Float	ft	9	148.9	9	148.9	9	148.9	12	111.7	12	111.7
Breaking plow	16 inch	3	64.2	3	64.2	3	64.2	3	58.3	3	58.3
Tandem disc	ft	13	167.5	13	167.5	13	167.5	20	118.7	20	118.7
Lister planter	row	4	105.6	4	105.6	4	105.6	6	76.6	6	76.6
Chisel	ft	11	98.5	11	98.5	11	98.5	13	88.3	15	76.5
Shredder	row	2	62.5	2	62.5	4	31.5	4	31.5	4	31.5
Cultivator	row	6	96.8	6	96.8	6	96.8	6	87.9	6	87.9
Rotary hoe	row	4	37.1	6	24.7	6	24.7	6	24.7	6	24.7
Knife sled	row	8	26.6	8	26.6	8	26.6	8	26.6	8	26.6
Sandfighter	row	9	13.0	9	13.0	12	9.7	12	8.7	12	8.7
Grain drill	ft	13	13.8	13	13.8	13	13.8	13	13.8	13	13.8
Ditcher	unit	1	5.4	1	5.4	1	5.4	1	5.4	1	5.4

APPENDIX TABLE 21. OPTIMUM FOUR-ROW EQUIPMENT SYSTEMS FOR ALTERNATIVE WAGE RATES FOR A 960-ACRE FARM, LOW DRAFT REQUIREMENTS, TEXAS HIGH PLAINS, 1969

		Wage rate (dollars per hr)					
		1.25[1]		2.25		2.75[2]	
Item	Units	Size	Hours of use	Size	Hours of use	Size	Hours of use
Tractor	hp	80.0	1,174.0	80.0	1,169.4	80.0	1,161.9
Tractor	hp	37.0	315.6	37	259.5	37.0	259.5
Float	ft	12	200.0	12	200.0	12	200.0
Float	ft	9	138.6	9	100.9	9	100.9
Breaking plow	16 inch	4	85.6	4	85.6	4	85.6
Tandem disc	ft	17	239.0	17	239.0	17	239.0
Lister planter	row	4	179.3	4	179.3	4	179.3
Chisel	ft	21	107.8	21	107.8	21	107.8
Shredder	row	4	61.3	4	61.3	4	61.3
Cultivator	row	4	150.0	4	150.0	4	150.0
Cultivator	row	4	132.8	4	114.4	4	114.4
Rotary hoe	row	8	40.8	8	40.8	8	40.8
Knife sled	row	4	60.0	4	60.0	4	60.0
Knife sled	row	4	44.2	4	44.2	4	44.2
Sandfighter	row	12	13.9	18	9.3	18	9.3
Grain drill	ft	13	27.0	13	27.0	18	19.5
Ditcher	unit	1	9.3	1	9.3	1	9.3

[1]The equipment system and hours of use for wage rate $1.75 per hour were identical to the equipment system and hours of use for wage rate $1.25 per hour.

[2]The equipment system and hours of use for wage rate $3.25 per hour were identical to the equipment system and hours of use for wage rate $2.75 per hour.

APPENDIX TABLE 22. OPTIMUM FOUR-ROW EQUIPMENT SYSTEMS FOR ALTERNATIVE WAGE RATES FOR A 960-ACRE FARM, HIGH DRAFT REQUIREMENTS, TEXAS HIGH PLAINS, 1969

Units	Item	Wage rate (dollars per hr)							
		1.25		1.75		2.25		2.75[1]	
		Size	Hours of use	Size	Hours of use	Size	Hours of use	Size	Hours of use
Tractor	hp	80.0	1,410.5	85.9	1,402.6	101.8	1,224.7	101.8	1,224.7
Tractor	hp	54.0	337.6	63.7	307.7	54.0	236.7	85.9	200.0
Float	ft	9	200.0	9	200.0	12	200.0	12	200.0
Float	ft	9	132.2	9	117.1	12	63.3	12	41.7
Breaking plow	16 inch	3	138.6	3	124.9	3	113.4	3	113.4
Tandem disc	ft	13	312.6	13	326.4	20	231.4	20	231.4
Lister planter	row	4	182.0	4	190.0	4	179.3	4	179.3
Chisel	ft	11	205.8	11	191.9	15	149.2	15	149.2
Shredder	row	4	61.3	4	61.3	4	61.3	4	61.3
Cultivator	row	4	150.0	4	150.0	4	150.0	4	150.0
Cultivator	row	4	129.2	4	114.4	4	129.2	4	114.4
Rotary hoe	row	4	50.0	4	50.0	8	40.8	8	40.8
Rotary hoe	row	4	32.0	4	32.0				
Knife sled	row	4	60.0	4	60.0	4	60.0	4	60.0
Knife sled	row	4	44.2	4	44.2	4	44.2	4	44.2
Sandfighter	row	12	13.9	18	12.6	18	11.3	18	11.3
Grain drill	ft	13	27.0	13	27.0	18	19.5	18	19.5
Ditcher	unit	1	9.3	1	8.5	1	8.5	1	8.5

[1]The equipment system and hours of use for wage rate $3.25 per hour were identical to the equipment system and hours of use for wage rate $2.75 per hour.

APPENDIX TABLE 23. OPTIMUM SIX-ROW EQUIPMENT SYSTEMS FOR ALTERNATIVE WAGE RATES FOR A 960-ACRE FARM, LOW DRAFT REQUIREMENTS, TEXAS HIGH PLAINS, 1969

Item	Units	Wage rate (dollars per hr)					
		1.25[1]		2.25		2.75[2]	
		Size	Hours of use	Size	Hours of use	Size	Hours of use
Tractor	hp	80.0	1,124.9	80.0	1,120.3	80.0	1,112.1
Tractor	hp	32.0	195.1	32.0	195.1	38.0	140.7
Float	ft	12	200.0	12	200.0	12	200.0
Float	ft	9	138.6	9	138.6	9	94.5
Breaking plow	16 inch	4	85.6	4	85.6	4	85.6
Tandem disc	ft	17	239.0	17	239.0	17	239.0
Lister planter	row	6	121.0	6	121.0	6	121.0
Chisel	ft	21	107.8	21	107.8	21	107.8
Shredder	row	4	61.3	4	61.3	4	61.3
Cultivator	row	4	150.0	4	150.0	4	150.0
Cultivator	row	4	42.0	4	42.0	4	32.9
Rotary hoe	row	4	50.0	4	50.0	4	50.0
Rotary hoe	row	4	5.2	4	5.2	4	4.8
Knife sled	row	4	60.0	4	60.0	4	60.0
Knife sled	row	4	9.3	4	9.3	4	9.3
Sandfighter	row	12	13.9	18	9.3	18	9.3
Grain drill	ft	13	27.0	13	27.0	18	19.5
Ditcher	unit	1	9.3	1	9.3	1	9.3

[1]The equipment system and hours of use for wage rate $1.75 per hour were identical to the equipment system and hours of use for wage rate of $1.25 per hour.
[2]The equipment system and hours of use for wage rate $3.25 per hour were identical to the equipment system and hours of use for wage rate of $2.75 per hour.

APPENDIX TABLE 24. OPTIMUM SIX-ROW EQUIPMENT SYSTEMS FOR ALTERNATIVE WAGE RATES FOR A 960-ACRE FARM, HIGH DRAFT REQUIREMENTS, TEXAS HIGH PLAINS, 1969

Item	Units	Wage rate (dollars per hr)					
		1.25		1.75		2.25[1]	
		Size	Hours of use	Size	Hours of use	Size	Hours of use
Tractor	hp	101.8	1,222.8	101.8	1,199.9	101.8	1,192.4
Tractor	hp	54.0	196.4	85.9	84.0	85.9	84.0
Float	ft	9	200.0	12	200.0	12	200.0
Float	ft	9	132.2	12	41.7	12	41.7
Breaking plow	16 inch	3	113.4	3	113.4	3	113.4
Tandem disc	ft	20	231.4	20	231.4	20	231.4
Lister planter	row	6	137.8	6	137.8	6	137.8
Chisel	ft	13	172.1	15	149.2	15	149.2
Shredder	row	4	61.3	4	61.3	4	61.3
Cultivator	row	6	150.0	6	150.0	6	150.0
Cultivator	row	6	49.0	6	28.5	6	28.5
Rotary hoe	row	6	50.0	6	50.0	6	50.0
Rotary hoe	row	6	5.9	6	4.5	6	4.5
Knife sled	row	6	60.0	6	60.0	6	60.0
Knife sled	row	6	9.3	6	9.3	6	9.3
Sandfighter	row	18	11.3	18	11.3	18	11.3
Grain drill	ft	13	27.0	13	27.0	18	19.5
Ditcher	unit	1	8.5	1	8.5	1	8.5

[1]The equipment systems and hours of use for wage rates $2.75 and $3.25 per hour were identical to the equipment system and hours of use for wage rate $2.25 per hour.

APPENDIX TABLE 25. OPTIMUM EIGHT-ROW EQUIPMENT SYSTEMS FOR ALTERNATIVE WAGE RATES FOR A 960-ACRE FARM, LOW DRAFT REQUIREMENTS, TEXAS HIGH PLAINS, 1969

Item	Units	Wage rate (dollars per hr)					
		1.25[1]		2.25		2.75[2]	
		Size	Hours of use	Size	Hours of use	Size	Hours of use
Tractor	hp	80.0	1,059.0	80.0	1,054.4	80.0	1,046.9
Tractor	hp	32.0	138.6	32.0	138.6	37.0	100.9
Float	ft	12	200.0	12	200.0	12	200.0
Float	ft	9	138.6	9	138.6	9	100.9
Breaking plow	16 inch	4	85.6	4	85.6	4	85.6
Tandem disc	ft	17	239.0	17	239.0	17	239.0
Lister planter	row	8	90.7	8	90.7	8	90.7
Chisel	ft	21	107.8	21	107.8	21	107.8
Shredder	row	4	61.3	4	61.3	4	61.3
Cultivator	row	8	131.7	8	131.7	8	131.7
Rotary hoe	row	8	40.8	8	40.8	8	40.8
Knife sled	row	8	51.9	8	51.9	8	51.9
Sandfighter	row	12	13.9	18	9.3	18	9.3
Grain drill	ft	13	27.0	13	27.0	18	19.5
Ditcher	unit	1	9.3	1	9.3	1	9.3

[1]The equipment system and hours of use for wage rate of $1.75 per hour were identical to the equipment system and hours of use for wage rate $1.25 per hour.

[2]The equipment system and hours of use for wage rate of $3.25 per hour were identical to the equipment system and hours of use for wage rate $2.75 per hour.

APPENDIX TABLE 26. OPTIMUM EIGHT-ROW EQUIPMENT SYSTEMS FOR ALTERNATIVE WAGE RATES FOR A 960-ACRE FARM, HIGH DRAFT REQUIREMENTS, TEXAS HIGH PLAINS, 1969

Item	Units	Wage rate (dollars per hr) 1.25 Size	1.25 Hours of use	1.75[1] Size	1.75[1] Hours of use	2.75[2] Size	2.75[2] Hours of use
Tractor	hp	120.5	1,097.7	120.5	1,070.2	120.5	1,070.2
Tractor	hp	32.0	138.6	32.0	138.6	37.0	100.9
Float	ft	12	200.0	12	200.0	12	200.0
Float	ft	9	138.6	9	138.6	9	100.9
Breaking plow	16 inch	3	113.4	4	93.4	4	93.4
Tandem disc	ft	20	203.9	20	203.9	20	203.9
Lister planter	row	8	117.0	8	117.0	8	117.0
Chisel	ft	21	120.7	21	120.7	21	120.7
Shredder	row	4	61.3	4	61.3	4	61.3
Cultivator	row	8	143.8	8	143.8	8	143.8
Rotary hoe	row	8	40.8	8	40.8	8	40.8
Knife sled	row	8	51.9	8	51.9	8	51.9
Sandfighter	row	18	9.4	18	9.4	18	9.4
Grain drill	ft	13	27.0	18	19.5	18	19.5
Ditcher	unit	1	8.5	1	8.5	1	8.5

[1]The equipment system and hours of use for wage rate $2.25 per hour were identical to the equipment system and hours of use for wage rate $1.75 per hour.

[2]The equipment system and hours of use for wage rate $3.25 per hour were identical to the equipment system and hours of use for wage rate $2.75 per hour.

APPENDIX TABLE 27. LEAST-COST EQUIPMENT SYSTEMS FOR ALTERNATIVE WAGE RATES FOR A 960-ACRE FARM, LOW DRAFT REQUIREMENTS, TEXAS HIGH PLAINS, 1969

Item	Units	Wage rate (dollars per hr) 1.25 Size	1.25 Hours of use	1.75 Size	1.75 Hours of use	2.25 Size	2.25 Hours of use	2.75[1] Size	2.75[1] Hours of use
Tractor	hp	80.0	1,089.3	80.0	1,059.0	80.0	1,054.4	80.0	1,046.6
Tractor	hp	32.0	138.6	32.0	138.6	32.0	138.6	37.0	100.9
Float	ft	12	200.0	12	200.0	12	200.0	12	200.0
Float	ft	9	138.6	9	138.6	9	138.6	9	100.9
Breaking plow	16 inch	4	85.6	4	85.6	4	85.6	4	85.6
Tandem disc	ft	17	239.0	17	239.0	17	239.0	17	239.0
Lister planter	row	6	121.0	8	90.7	8	90.7	8	90.7
Chisel	ft	21	107.8	21	107.8	21	107.8	21	107.8
Shredder	row	4	61.3	4	61.3	4	61.3	4	61.3
Cultivator	row	8	131.7	8	131.7	8	131.7	8	131.7
Rotary hoe	row	8	40.8	8	40.8	8	40.8	8	40.8
Knife sled	row	8	51.9	8	51.9	8	51.9	8	51.9
Sandfighter	row	12	13.9	12	13.9	18	9.3	18	9.3
Grain drill	ft	13	27.0	13	27.0	13	27.0	18	19.5
Ditcher	unit	1	9.3	1	9.3	1	9.3	1	9.3

[1]The equipment system and hours of use for wage rate $3.25 per hour were identical to the equipment system and hours of use for wage rate $2.75 per hour.

APPENDIX TABLE 28. LEAST-COST EQUIPMENT SYSTEMS FOR ALTERNATIVE WAGE RATES FOR A 960-ACRE FARM, HIGH DRAFT REQUIREMENTS, TEXAS HIGH PLAINS, 1969

Item	Units	Wage rate (dollars per hr) 1.25 Size	1.25 Hours of use	1.75 Size	1.75 Hours of use	2.25 Size	2.25 Hours of use	2.75[1] Size	2.75[1] Hours of use
Tractor	hp	101.8	1,205.5	101.8	1,182.6	101.8	1,175.1	120.5	1,070.2
Tractor	hp	37.0	178.7	37.0	178.7	37.0	178.7	37.0	100.9
Float	ft	12	200.0	12	200.0	12	200.0	12	200.0
Float	ft	9	100.9	9	100.9	9	100.9	9	100.9
Breaking plow	16 inch	3	1,134.0	3	113.4	3	113.4	4	93.4
Tandem disc	ft	20	231.4	20	231.4	20	231.4	20	203.9
Lister planter	row	6	137.8	6	137.8	6	137.8	6	117.0
Chisel	ft	13	172.1	15	149.2	15	149.2	21	120.7
Shredder	row	4	61.3	4	61.3	4	61.3	4	61.3
Cultivator	row	6	150.0	6	150.0	6	150.0	8	143.8
Cultivator	row	4	77.8	4	77.8	4	77.8		
Rotary hoe	row	8	40.8	8	40.8	8	40.8	8	40.8
Knife sled	row	8	51.9	8	51.9	8	51.9	8	51.9
Sandfighter	row	18	11.3	18	11.3	18	11.3	18	9.4
Grain drill	ft	13	27.0	18	27.0	18	19.5	18	19.5
Ditcher	unit	1	8.5	1	8.5	1	8.5	1	8.5

[1]The equipment system and hours of use for wage rate $3.25 per hour were identical to the equipment system and hours of use for wage rate $2.75 per hour.