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TEXAS AGRICULTURAL EXPERIMENT STATION

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COLLEGE STATION, BRAZOS COUNTY, TEXAS

BULLETIN NO. 362 JULY, 1927

DIVISION OF FARM AND RANCH ECONOMICS

LARGE-SCALE COTTON PRODUCTION IN TEXAS

AGRICULTURAL AND MECHANICAL COLLEGE OF TEXAS

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SYNOPSIS

The recent introduction of tractor power and improved farm machinery in cotton-growing, the new methods in cotton harvesting, and the recent improvements in machinery for extracting the burs and cleaning the lint in the ginning process, mark the beginning of a new era in cotton production.

This Bulletin reports the results of a survey made in the Corpus Christi and the San Angelo areas of Texas. In a general way it shows the effects of large-scale methods on the utilization of land, labor, and power. Specifically, it seeks: (1) to describe the common practices and show the accomplishments in the principal operations involved in large-scale cotton production, (2) to compare the use of animal and tractor power, (3) to point out the influence of these methods on the cost of cotton production, (4) to state the conditions under which such methods are practical, and (5) to indicate those areas in the State to which such methods are most applicable.

The survey shows that one man with a tractor can handle the field operations of at least twice as many acres of cotton as he can with the usual team of four horses. For example, it was found in the Corpus Christi area that one man planted, on an average, 14.3 acres with a two-row planter drawn by four horses and 35.7 acres with a four-row planter drawn by a tractor; in cultivating, one man covered, on an average, 15.4 acres with a two-row horse-drawn outfit and 43.5 acres with a four-row tractor-drawn outfit.

It is generally recognized that the lack of suitable mechanical devices for harvesting cotton has delayed the application of more extensive methods in its production. This Bulletin devotes a brief discussion to mechanical harvesting of cotton, particularly to the method popularly known as "sledding."

Courtesy of International Harvester Company.
Figure 3.—The usual horse-drawn outfit which plants about 14 acres per day.

Courtesy International Harvester Company.
Figure 4.—Four-row outfit which plants from 35 to 40 acres per day.

BULLETIN NO. 362 JULY, 1927

LARGE-SCALE COTTON PRODUCTION IN TEXAS*

L. P. GABBARD
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The recent developments in cotton production in certain areas of the State are nothing less than revolutionary. While they are spectacular, nevertheless, they are fundamental and far-reaching in their economic significance, and even though new, they have already attracted both national and world-wide attention.

These new developments have been made both in the growing and in the harvesting of cotton, and thus far in the State have been limited almost altogether to the coastal plains region about Corpus Christi and to the low plains and high plains regions of Western and Northwestern Texas. For example, in the Corpus Christi area the introduction of tractor power, together with four-row outfits for planting and cultivating, enables one man to handle 200 acres or more of cotton. Similar developments are being introduced in the San Angelo and other areas of the west and northwestern cotton belt of the State. Simultaneously, and particularly during the past season, a large-scale method of harvesting known as "sledding" has been developed by which one man and a team of two horses can harvest 4 to 5 acres of cotton a day. Along with this new method of harvesting, improvements in gin machinery for extracting burs and cleaning the cotton have been developed and are being perfected.

These large-scale, low-cost methods are destined to affect very decidedly the economic welfare of the cotton industry and particularly in those areas where such methods are applicable. Throughout its history, cotton has been characterized and handicapped by an unusually high labor requirement. These new developments in a greater application of power and machinery should do much to remedy the situation. In short, they mean a more efficient utilization of both labor and land. They mean a greater volume of production per man and consequently a better chance of a larger net income. Thus the purchasing power, or

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*In cooperation with the Bureau of Agricultural Economics and the Bureau of Public Roads, United States Department of Agriculture. A. P. Brodell, Bureau of Agricultural Economics and W. M. Hurst, Bureau of Public Roads assisted in the field work. Robert F. Spilman, employed by the Bureau of Agricultural Economics and P. T. Montfort, employed by the Bureau of Public Roads assisted in tabulating and summarizing the data.

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economic status, of the individual farmer will have been materially improved. A more efficient use of land, or a greater net profit per acre, will have its direct effect on increasing the purchasing power of the area, and an indirect effect of facilitating the development of vast untilled areas, thus adding to the entire wealth of the community and the State. Evidently this shift in cotton production from the areas of high costs to the areas of low costs will work a hardship on the farmers of the former. There are certain alternatives open to them such as improving their methods, changing to other enterprises, reducing their standard of living, or going out of business.

A number of factors have contributed to the recent interest in the development of these low-cost, large-scale methods in cotton production. The relative scarcity of farm labor, the increase in wages demanded by such labor as is available, the difficulty of securing and holding labor at the time and in the amount needed, the increase in land values, and the present low prices of cotton, are factors which make more economical methods in cotton production imperative. At the same time, the recent expansion of cotton growing in the level, sub-humid regions of western Texas and Oklahoma, and the marked improvements in farm implements and power machinery, have done much to encourage and facilitate the application of extensive methods, not only in the growing of cotton, but also in the harvesting of it.

Object of the Study

These new developments in both farm power and machinery raise the question of their influence on the methods and costs of producing cotton. The primary object of this study, therefore, is to collect and analyze data from a number of farms where large-scale operations in cotton are employed. In this analysis the influence of such factors as types of farm organization, types of power, types of machinery, and the effect of different types of power and machinery on labor requirements for the production of cotton on a large scale will be determined. This involves a comparison of the relative efficiency of tractor and animal power, and of the different sizes and types of farm implements, as well as the study of the effect of different combinations of power and machinery upon the utilization of labor.

Source of Information

Two areas were selected for study: namely, Corpus Christi and San Angelo. These areas were selected because, in both of them, a number of farmers have recently changed partially or entirely from horse to tractor power. Data were secured by personal interview from approximately 50 farm operators in each of these areas. The schedules used were designed to secure information as to the organization of the farm, types of power and machinery used, and the labor and power requirements for each of the several operations in the growing of cotton and

feed crops. Data were secured from three groups of farmers: namely, those using mechanical power alone, those using mechanical and animal power, and those using animal power alone. In all cases, an attempt was made to obtain schedules from operators who were considered as fairly successful with whatever type of power used.

Description of the Areas Studied

The Corpus Christi area, the first to be studied, is located on the Gulf Coast in the southern part of the State.* The area extends for a radius of about 50 miles about Corpus Christi, and in general has the appearance of a perfectly level plain. The surface slopes in a general way from the western part toward the coast, and as a whole the area is well drained. The climate is semi-tropical. The average annual rainfall for the past 54 years has been 27.18 inches and is fairly well distributed throughout the year. The temperature is remarkably uniform. The average annual temperature for the past 55 years has been 70.70° F., while the difference for this period between the monthly average for January, the coldest month, and July, the hottest month, has been 26.70° F. The soils range from dark, calcareous clays to sandy loams, with the heavy types predominating. For the most part these soils are fertile and are well suited to the production of cotton, truck, and feed crops.

The average size of the 52 farms studied was 376 acres. Of this, 95 per cent was in crops in 1926, and 84 per cent was planted to cotton. The remainder of the cultivated land was planted very largely to feed crops such as corn, grain sorghum, and cane for hay.

Forty-eight farms were studied in the San Angelo area. Almost all of these were east of San Angelo in the vicinities of Miles and Ballinger, Texas. The region, of which this area is taken as fairly typical, extends east as far as the east side of Coleman County, north to the State line, and west to the High Plains. According to W. T. Carter, Chief, Division of Soil Surveys, Texas Agricultural Experiment Station, the prevailing soil series are Abilene, Miles, Roscoe, and Vernon. They are clays, clay loams, and fine sandy loams, with clay loams predominating. The rainfall of the region ranges from about 20 inches in the extreme western part to 27 inches in the eastern part. The mean annual temperature is 60° to 65° F. In the vicinity of Ballinger the growing season is around 230 to 240 days. The topography of the area is rolling to undulating. There are some large areas of very smooth land, while on the other hand there are some large bodies of rather rough and broken lands. A large percentage of the area is well suited to cotton farming and is smooth enough for the use of mechanical power and improved farm machinery.

The average size of the 48 farms studied in the San Angelo area

*Soil Survey of the Corpus Christi area, Texas, U. S. D. A. Bureau of Soils, by A. W. Magnum and H. L. Westover, 1908.

was found to be 453 acres. The average number of acres per farm planted to cotton was 153 acres, or 34 per cent, while 46.7 per cent of the farm was in crops. The principal crops, in addition to cotton, were grain sorphum, oats, etc.

In addition to these two areas there is the High Plains section, estimated to be at least 8,000,000 acres in extent. Its level topography, fine sandy loam soils, and general freedom from weed pests are conditions very favorable to extensive methods of cotton production. There are also limited areas throughout the cotton belt of the State where more extensive methods in cotton production might well be introduced.

Principal Operations and Common Practices in Cotton-Growing

The principal field operations in cotton-growing common to both areas are bedding, harrowing, planting, chopping, hoeing, and cultivating. The disposal of the cotton stalks by one method or another is the usual practice. This operation was of much greater importance in the Corpus Christi area than in the San Angelo section. In fact, the disposal of cotton stalks is, perhaps, one of the most difficult operations, certainly the least standardized, of all confronting the cotton grower in the Corpus Christi area. There are at least two reasons for this. First, the cotton plants in this region grow unusually large; and second, the stalks remain green and tough after the crop has been harvested because of semi-tropical weather conditions. Under these conditions the use of the ordinary stalk cutter has proved unsatisfactory. Four fairly distinct methods seem to prevail. A brief description of each will help to indicate the wide variation in practice for this operation.

1. One rather common practice, particularly among farmers using animal power alone, is that of ripping out or cutting off the stalks by means of a middle buster from which the moldboard has been removed. Following this, the stalks are usually raked together in windrows with an ordinary hay rake, and after being allowed to dry for several days are burned. This method leaves the land clean, but deprives it of the possible fertilizer value of the stalks, and makes a heavy demand on labor.

2. In some cases where the stalks are not excessively rank and tough a tandem disc harrow is first run over them. This is followed immediately by the bedding operation; a one- or a two-row middle buster is used. Although this method did not give as satisfactory results as others perhaps, it required less labor.

3. Another method is to tear and cut the stalks to pieces by means of a disc harrow drawn by a tractor, the rear wheels of which are equipped with long, specially constructed, well-sharpened, angle-iron cleats. Unless the stalks are excessively large and tough this arrangement does quite satisfactory work. It has the advantage of leaving the stalks in such a condition that they can be plowed under or fairly well

covered so as not to interfere with the planting and cultivation of the succeeding crop. The principal objections in this method of stalk disposal seem to be the expense and the time required to equip the tractor with these cleats and keep them sharpened, and the danger to the operator. On types of tractors having the wheels close together and unprotected by fenders, there is danger of the operator's being caught and injured by these sharp cleats.

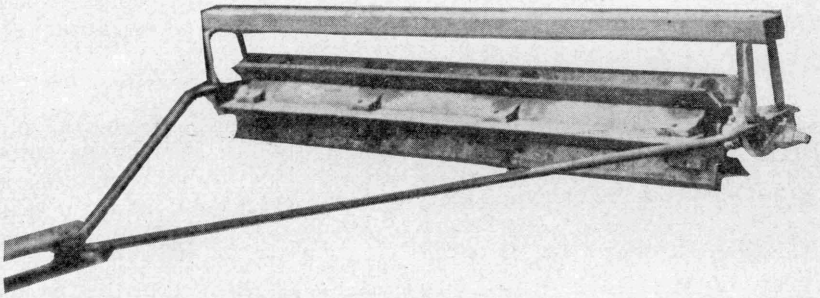
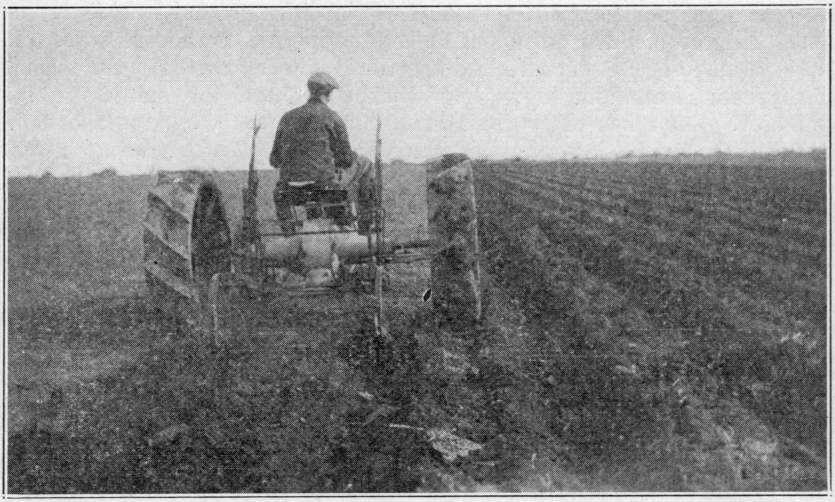


Figure 1.—Specially constructed stalk cutter used in the Corpus Christi area.

4. A number of farmers were found who were using a heavy, specially constructed stalk cutter, similar to that illustrated by Figure 1, which was pulled either by a tractor or team and which cut two to four rows at a time. This device consisted essentially of an extremely heavy cast iron drum to which were attached a number of long sharp knives. It was pulled behind the tractor like a long roller and, owing to its weight of about 500 pounds to the row, broke down and cut up the stalks in a very satisfactory manner. Some farmers have constructed cutters of a similar type, using wood instead of cast iron for the drum.

The disposal of the cotton stalks in the San Angelo area is a much simpler problem because the plants do not make the rank growth and also because they become dry and brittle before time for preparing the land for the next crop. In fact, with a few exceptions, the condition of the stalks is such that the land can be plowed or bedded immediately without previously resorting to some special means of stalk disposal. In exceptional cases, the common stalk cutter is the only implement used.

The next step in the preparation of cotton land is bedding. If done by horses, a one-row, four-hourse middle buster is used. The usual tractor-drawn machine beds two rows at a time as shown in Figure 2. Following the bedding operation, it is quite a common practice to flatten or smooth down the beds by means of a section or spike-tooth harrow drawn either by horses or a tractor.



Courtesy Ford Motor Company.

Figure 2.—Bedding with a two-row outfit. Fifteen acres in a 10-hour day is quite common

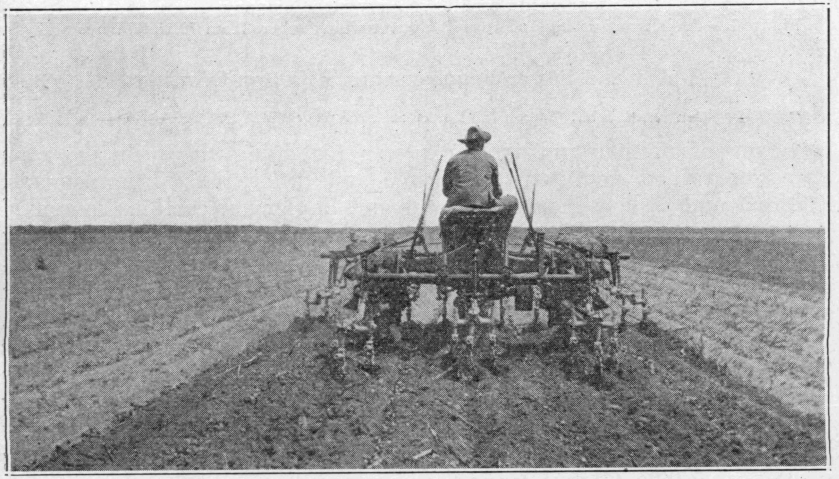
Planting in both areas is done largely by means of the usual two-row, riding type of cotton planter. Four horses are required for the horse-drawn outfit as illustrated in Figure 3. In the Corpus Christi area a special four-row, tractor-drawn cotton planter, Figure 4 (see page 4), is being used with satisfactory results. In fact, a number of tractor operators in this area hitch two two-row, horse planters behind the tractor.

The practice of harrowing or scratching following planting is quite common. In many cases it is the first cultivation to young cotton. The operation is more necessary when there is a considerable amount of rainfall following planting in order to keep down young weed growth. Perhaps three-fourths of the farmers in the Corpus Christi area harrow or scratch as a first cultivation regardless of moisture conditions.

Cultivation for the purpose of destroying weeds and conserving soil moisture, begins soon after the harrowing or scratching operation and is done by two-row riding cultivators pulled by four horses or by two-, four-, or six-row outfits drawn by tractors. The four-row machine seems to be the most economical for tractor power. This is illustrated in Figure 6. The majority of the farmers cultivate their cotton crop, on an average, five times.

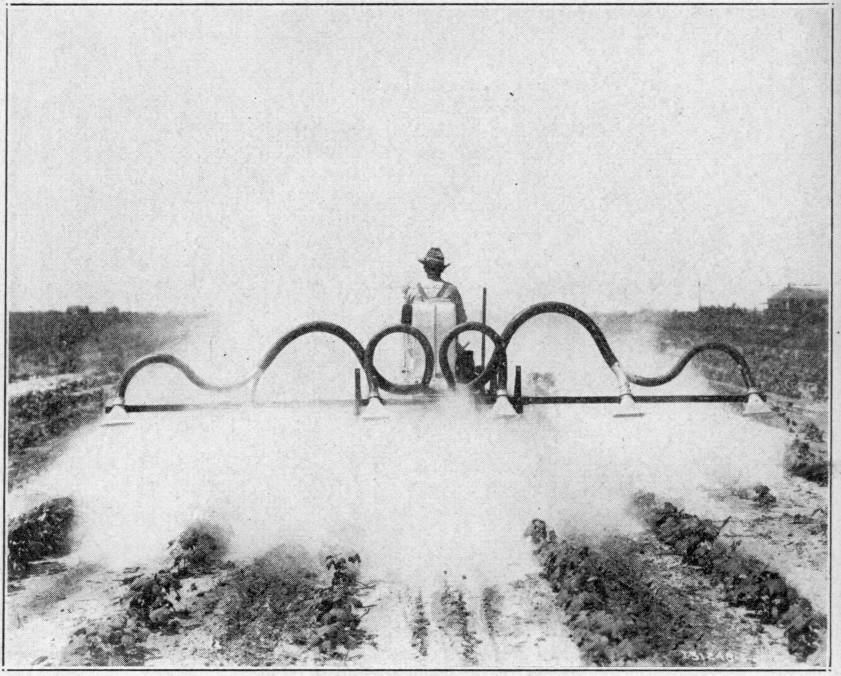
The usual insect pests such as leaf worm and boll weevil are controlled largely by means of poisons applied in dust or spray form with horse- or tractor-drawn machines. The number of applications and the amount of work and time involved vary from year to year in the different sections, according to the degree of infestation and other factors. More poisoning is done in the Corpus Christi area than in

Courtesy International Harvester Company.
Figure 5.—The usual horse-drawn outfit for cultivating cotton and other crops, 15 to 16 acres per day is the usual amount covered.



Courtesy International Harvester Company.
Figure 6.—Four-row outfit which cultivates from 40 to 45 acres per day

the San Angelo area. Figure 7 illustrates a common type of dusting machine as used in the former area.



Courtesy International Harvester Company.
Figure 7.—A six-row dusting and spraying outfit which covers from 70 to 80 acres a day.

Labor and Power Requirements in Cotton-Growing

One of the primary objects of this study is to measure the relative efficiency of animal and tractor power for doing the principal crop operations when used with the same and different-sized implements. Tables 1 and 2 show the usual power and implement combinations used in the important field operations in these particular cotton-growing areas, and the daily accomplishments of such combinations as indicated by the survey. It will be observed from both of these tables that all of the horse-drawn implements used require a four-horse team. The tractor handles implements of the same or larger size. In the San Angelo area it is the common practice to use two-row implements with both animal and tractor power, with the exception of bedding with horses. Doubtless larger tractor-drawn implements will replace the two-row outfits in this area, especially in planting and cultivating machinery. The Corpus Christi area showed a much wider range in the size of implements. For example, in the case of cultivating all

Table 1.—Accomplishments of animal and tractor power in growing cotton.

Corpus Christi Area, 1926.

Operation	Horse	Tractor	Size of Implement	Crew			Hours Per Acre			Horse Equivalent of Tractor	Acres Covered Ten-Hour Day
				M.	H.	T.	Man	Horse	Tractor		
Bedding	H.		1-row	1	4		1.80	7.20			5.5
Bedding		T.	2-row	1		1	.63		.63	11.40	15.9
Harrowing	H.		2-section	1	4		.46	1.84			21.7
Harrowing		T.	4-section	1		1	.23		.23	8.00	43.5
Planting	H.		2-row	1	4		.70	2.80			14.3
Planting		T.	2-row	1*		1	.59		.43	6.50	23.3
Planting		T.	4-row	2*		1	.68		.28	10.00	35.7
Cultivating	H.		2-row	1	4		.65	2.60			15.4
Cultivating		T.	2-row	1*		1	.45		.42	6.20	23.8
Cultivating		T.	4-row	2**		1	.50		.23	11.30	43.5
Cultivating		T.	6-row	3*		1	.58		.19	13.70	52.6

*Additional labor used on some farms.

**Number of men in crew varies from one to three, with an average of approximately two men to the crew. There is a strong tendency for the four-row one-man tractor outfit to become standard.

Table 2.—Accomplishments of animal and tractor power in growing cotton.

San Angelo Area, 1926.

Operation	Power		Size of Implement	Crew			Hours Per Acre			Horse Equivalent	Acres Covered in Ten-Hour Day
	Horse	Tractor		M.	H.	T.	Man	Horse	Tractor		
Bedding	H.		1-row	1	4		1.56	6.24			6.4
Bedding		T.	2-row	1		1	.59		.59	10.58	16.9
Planting	H.		2-row	1	4		.69	2.76			14.5
Planting		T.	2-row	1		1	.53		.53	5.21	18.9
Cultivating	H.		2-row	1	4		.61	2.44			16.4
Cultivating		T.	2-row	1		1	.39		.39	6.26	25.6

horse operations are performed with two-row implements, while with the tractor, two-, four-, and six-row implements are used.

The most interesting and significant fact shown in these tables is the horse equivalent of the tractor for the several operations with the different-sized implements. The number of horses displaced by the tractor, or the number which would be required to do the same amount of work as one tractor in an equal period of time ranged from 5.21 in planting with a two-row planter to 13.70 in cultivating with a six-row outfit.

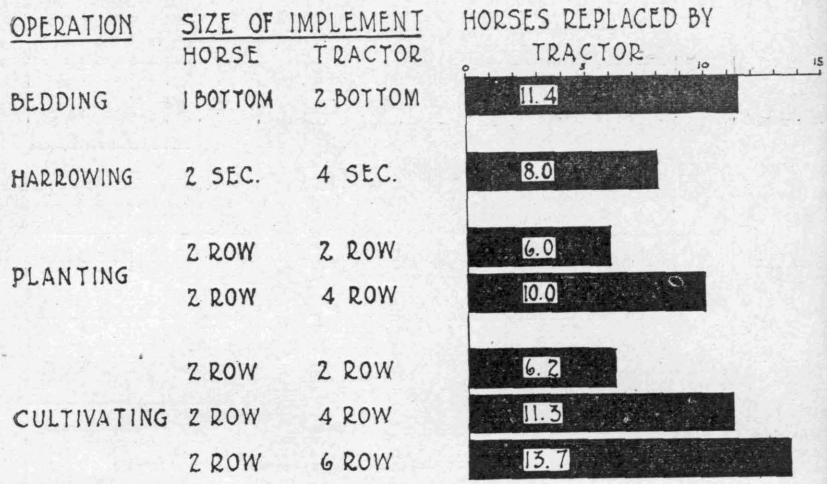


Figure 8.—The horse equivalent of the tractor for the important machine operations in cotton growing for Corpus Christi area.

The horse equivalent of the tractor for cultivating with two-, four-, and six-row cultivators as shown in Table 1 is 6.2, 11.3, and 13.7, respectively, when compared with the usual two-row horse-drawn cultivator. The accomplishment of a six-row cultivator would probably be greater if a more adequate sample were available. Only three farmers who used six-row cultivators were interviewed. A six-row outfit is gotten by trailing two two-row riding cultivators in the rear of the regular two-row tractor cultivator. Three men are required for this outfit, whereas only one man is needed on the standard four-row cultivator. The six-row outfit has the disadvantages of being unwieldy in turning and of being too much of a load on the tractor where the soil conditions are not very favorable.

Figure 8 is a further emphasis of the "horse equivalent" as given in Table 1. The size of the horse-drawn implement is given for the operations, followed by the size of the tractor-drawn implement and these followed by the "horse equivalent," or the number of horses necessary to do a like amount of work in the same period of time as that of the tractor. The important fact to note is that the tractor is com-

paratively most efficient in those operations, such as bedding, planting, and cultivating, which require the greatest amount of power.

Another interesting comparison is on the basis of the acres covered in a ten-hour day by animal and tractor power when implements of both similar and different sizes are used. It will be observed from Table 1 that a crew of one man and four horses bedded, on an average, 5.5 acres per day, while a crew of one man and a tractor bedded 15.9 acres per day. It will be seen from Table 2 that for the same operation and like crews 6.4 and 16.9 acres, respectively, were covered per day. Comparisons for cultivating show 15.4 acres for a two-row horse outfit and 23.8 acres for a two-row tractor outfit at Corpus Christi, and 16.4 acres for a two-row horse outfit and 25.6 acres for a two-row tractor outfit at San Angelo. Four- and six-row tractor-drawn outfits in the Corpus Christi area cultivated, on an average, 43.5 and 52.6 acres, respectively. Furthermore, it is observed in comparing the acres covered per day in Tables 1 and 2 that for like crews with similar-sized implements the accomplishments are slightly greater in the San Angelo area. This difference is caused, no doubt, very largely by a soil difference in the two areas.

The greater acreage covered by the tractor pulling an implement of the same size as that drawn by horses is for the most part due to (a) its greater speed; (b) the relatively small amount of time lost in turning at the ends; and (c) no stops for rest.

Another significant fact shown in these tables is the better utilization of labor when combined with tractor power. For example, in the Corpus Christi area the man hours per acre were 1.80 when one was bedding with a team and .63 when one was bedding with a tractor. The man hours per acre for planting with a two-row, horse-drawn planter was .70, while with a four-row tractor-drawn planter the man hours per acre were .28. In both illustrations the labor requirement with animal power is almost three times the labor requirement with tractor power.

Utilization and Cost of Animal and Tractor Power

Having discussed the physical requirements in labor and power for the several field operations, and the accomplishments in acres per day for each, let us next consider the utilization and cost of both animal and tractor power. One of the most important items of cost in the production of cotton is that of power, and the cost of power per unit is influenced very materially by the extent to which it is utilized.

The power for growing cotton in Texas is furnished by horses and tractors. At present a relatively small part of this power is furnished by tractors. But as previously indicated in this Bulletin, the use of tractors is gaining headway rapidly in the level blackland area about Corpus Christi and in the level, sub-humid cotton belt of the rolling and high plains of western and northwestern Texas. In fact, a number of cotton farms in these regions have been completely tractorized

within the last few years. These changes in both farm power and machinery raise the question of their influence on the methods and costs of producing cotton.

The Corpus Christi and San Angelo areas furnish a good opportunity to compare the use of tractor and horse power, as well as a combination of the two, in the organization and operation of the cotton farm.

Table 3.—Utilization and cost of horse and tractor power per farm.

Corpus Christi Area, 1926.

Kind of Power	Number Farms	Average Acres in Crops	Average Acres in Cotton	Hours Per Acre on Cotton up to Picking			Average Tractor Hours Per Year	Average Cost Per Hour (Cents)	Average Horse Hours Per Year	Average Cost Per Hour (Cents)
				Man	Horse	Tractor				
Tractor	9	256	247	10.3	.....	3.7	804	77	.....	.....
Horse	12	467	387	14.2	22.8	.....	....	.....	739	18
Horse and tractor	12	319	291	15.8	8.1	2.4	799	76	436	25

Table 3 shows the utilization and cost of horse and tractor power on three groups of farms in the Corpus Christi area: namely, those which used tractor power alone, those which used animal power alone, and those which used a combination of the two. It will be observed from this table that there is practically no difference in the number of tractor hours per farm when mechanical power alone is used, and when it is used in combination with horses. The number of hours per farm and per tractor where mechanical power alone was used for 9 farms averaged 804 hours for the year with an average cost of 77 cents per hour. For the farms having both animal and mechanical power the number of hours per tractor was 799 with an average cost of 76 cents per hour. Such slight differences are not significant and might easily be accidental. There is a wide difference between these two groups of farms, however, in the utilization of man labor per acre. For example, the man labor per acre for cotton up to picking on tractor-operated farms was 10.3 hours, while on horse-operated farms it was 14.2 hours. The greatest difference in the utilization of power is that of animal power on the two groups of farms: horse and horse-and-tractor farms. A group of 12 horse-operated farms had an average of 739 hours per horse for the farm, while on a group of 12 horse-and-tractor-operated farms the horses worked an average of only 436 hours each. In the case of horses alone the cost per hour was 18 cents, while in the combination group the cost per hour was 25 cents.

This does not mean that horses cannot be used efficiently on the farm with the tractor. In fact, there are certain operations on these farms, namely, hauling to gin, raking and piling stalks, rolling after planting, and odd jobs of hauling about the farm for which horses seem better fitted than the tractor.

Doubtless the best explanation for the low utilization of horses on the tractor-horse-operated farms lies in the fact that the introduction

of tractor power for doing the different crop operations is of recent date. Consequently, farmers have not had time to dispose of their surplus mules, especially since the market for them is dull. Then, too, some farmers may be somewhat reluctant to sell off their surplus mules until they have had ample time to decide just how many mules they need to supplement the work of their tractor. The fact that the majority of farmers who had both horses and tractors expressed a preference for the tractor perhaps accounts to some extent for the poor utilization of horses on the combination farms.

Table 4.—Utilization and cost of horse and tractor power per farm. San Angelo Area. 1926.

Kind of Power	Number Farms	Average Acres in Crops	Average Acres in Cotton	Hours Per Acre on Cotton up to Picking			Average Tractor Hours Per Year	Average Cost Per Hour (Cents)	Average Horse Hours Per Year	Average Cost Per Hour (Cents)
				Man	Horse	Tractor				
Tractor	9	209	151	9.8	.....	4.1	684.0	68	.....	.....
Horse	21	146	97	14.8	24.5	.....	.....	.....	498.0	14
Horse and tractor	11	315	231	8.8	9.1	2.2	570.5	76	406.2	15

Table 4 shows similar data for the San Angelo area as shown in Table 3 for the Corpus Christi area. The outstanding difference is in the relatively low utilization of tractor power on the horse-tractor farms as compared to the greater utilization of tractor power on the farms using the tractor alone. The variation in animal power for the two groups of farms was small compared with that of the Corpus Christi area. The cost per hour was found to be relatively low, owing to a certain extent to the abundance of cheap feed and ample pasture.

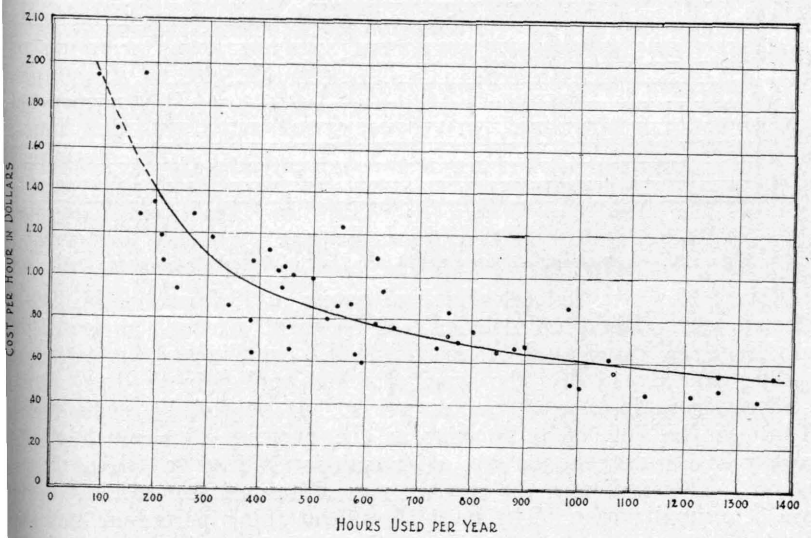


Figure 9.—Cost of tractor power for 51 tractors in the Corpus Christi and San Angelo areas, 1926.

In Tables 3 and 4 data on only those tractors which had been used during the year in connection with the principal field operations were included. A more general consideration of the utilization and cost per hour for all tractors studied in both areas is shown in Figure 9. A curve fitted to the data as shown in this illustration gives a coefficient of curvilinear correlation of $+.89 \pm .02$, which is high and significant. Briefly explained, it shows that the cost per hour for tractor power decreases as the number of hours the tractor is used increases. This decrease in cost is very marked until a utilization of about 600 hours is reached; thereafter it is more gradual but enough to be significant. The steep decline is undoubtedly due to the influence of a rather high fixed overhead charge on a small number of hours used per year. It is very evident that the best way to reduce the cost of operation per hour on the tractor is to use it.

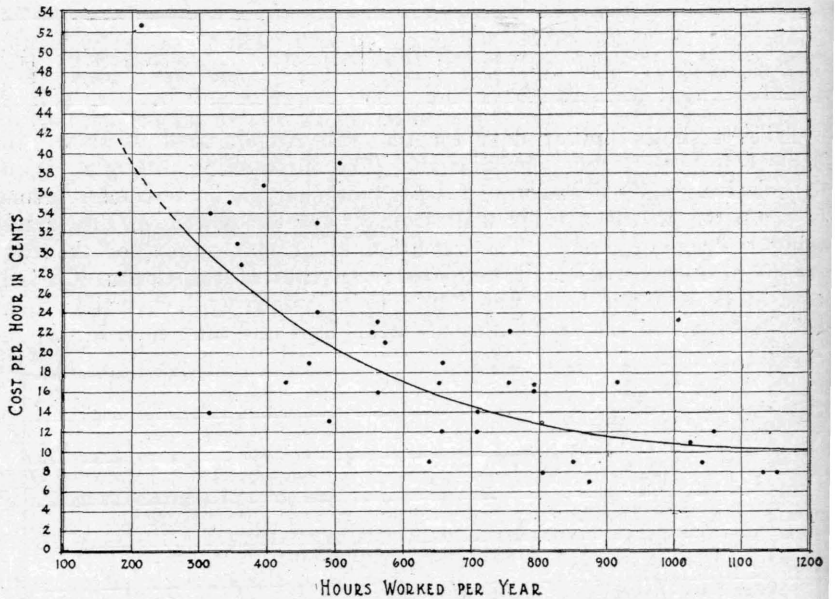


Figure 10.—Cost of animal power on 38 farms in the Corpus Christi area, 1926.

Figure 10 shows the cost of animal power on 38 farms in the Corpus Christi area. Here, as in the case of Figure 9, a curve has been fitted to the data given and a coefficient of curvilinear correlation of $+.80 \pm .04$ calculated. The same principal applies in the case of animal power as in that of tractor power, but not to the same degree. There is the lack of uniformity or the presence of a much greater scatter in the data on the cost of animal power than on that of tractor power. This indicates the greater possibilities of economizing in the use of animal power. The most significant thing portrayed, however, is the decrease in cost per hour with the increase in the number of

hours per horse. An idle horse on the farm or a hired hand asleep in the hay mow are about equally productive and profitable.

In calculating the above cost rates per hour for both animal and tractor power, depreciation and interest on the investment have been included. A life of five years has been assigned to the tractor. It was assumed that the productive work period of the horse would end at an average age of 16. Interest has been charged on the investment at the rate of 6 per cent. Gas, oil, grease, and repairs have been included in the total charge against the tractor. Feed, veterinary bills, and chores have been included in the total charge against animal power.

A 200-Acre Horse-Operated Farm Compared with a 200-Acre Tractor-Operated Farm

By way of emphasizing the outstanding facts which have been presented and with the hope of making their application more concrete, "set-ups" for a 200-acre cotton farm, one operated by animal power and the other operated by tractor power, are given for the Corpus Christi area.

The cropping system, field operations, times over, acres per day, etc., are based upon the detailed information secured from 52 farmers in the area.

It will be assumed in both cases that all of the land is in cultivation. In the case of the horse "set-up" 180 acres will be planted to cotton and 20 acres to feed crops. Eight horses will be considered as sufficient to take care of the power requirements. This is a maximum utilization of animal power when checked against actual practices for the area. Ordinarily 9 to 12 horses are kept where 200 acres are in crops. There is always the probability of a horse becoming disabled, and in case the farmer does not have an extra horse he may lose the work of an entire team and thus have his work delayed. In the case of the tractor farm one tractor is considered sufficient power to handle all operations. Four-row planters and cultivators will be used. While four-row implements for planting and cultivating are not the most common, at the present time there seems to be a strong tendency for them to become standard. This is particularly true in the Corpus Christi region.

Table 5 gives in detail the "set-up" for the horse-operated farm. Stalk cutting, bedding, and cultivating are the operations requiring a relatively large amount of power. For the operations considered, the total number of days required for one man is 169.4, and for one horse 647.8. This would mean about 86 days for each of two crews of one man and four horses.

Table 6 gives in detail the "set-up" for the tractor-operated farm. The outstanding feature of this table is the small number of days required for both man and tractor. The number of days for man is 71.8 and for tractor 66.2.

Table 5.—A detail set-up for a 200-acre cotton farm, Corpus Christi area.

Animal power is to be used for the operations given.

Operation	Size of Implement	Acres	Times Over	Acres Over	Crew*		Acres Per Day	Days Required (10 Hours)	
					Man	Horse		Man	Horse
Stalk cutting	1-row	180	1	180	1	4	6	30.0	120.0
Raking	Sulky rake	180	1	180	1	2	25	7.2	14.4
Bedding	1-bottom	200	1	200	1	4	6	33.3	133.2
Harrowing	2-section	200	1	200	1	4	22	9.0	36.0
Planting	2-row	200	1	200	1	4	15	13.3	53.2
Harrowing	2-section	200	1	200	1	4	22	9.0	36.0
Cultivating	2-row	180	5	900	1	4	16	56.2	224.8
Cultivating	2-row	20	3	60	1	4	16	3.7	14.8
Poisoning	6-row	180	3	540	1	2	70	7.7	15.4
Total				2660				169.4	647.8

*It is assumed that two crews of one man and four horses each will be used regularly, with the exception of such operations as raking and poisoning.

Table 6.—A detail set-up for a 200-acre cotton farm, Corpus Christi area.

Tractor power is to be used for the operations given.

Operation	Size of Implement	Acres	Times Over	Acres Over	Crew		Horse Equivalent for Tractor	Acres Per Day	Days Required (10 Hours)	
					Man	Tractor			Man	Tractor
Stalk cutting	7-ft tandem	190	1	190	1	1	13.3	20	9.5	9.5
Bedding	2-bottom	200	1	200	1	1	10.6	16	12.5	12.5
Harrowing	4-section	200	1	200	1	1	8.2	45	4.4	4.4
Planting	4-row	200	1	200	2	1	9.6	36	11.1	5.5
Harrowing	4-section	200	1	200	1	1	8.2	45	4.4	4.4
Cultivating	4-row	190	5	950	1	1	11.3	45	21.1	21.1
Cultivating	4-row	10	3	30	1	1	11.3	45	.7	.7
Poisoning	6-row	190	3	570	1	1	2.0	70	8.1	8.1
Total				2540			9.3		71.8	66.2

A comparison of the calculated cost of operating for each "set-up" should help to make the contrast more clear. An arbitrary figure of $2.00 per day will be used for man labor and calculated rates of 18 cents per hour for horse work, and 77 cents an hour for tractor work will be applied. These rates give a total cost of $1,504.84 for labor and power on the horse-operated "set-up" and a total cost of $653.34 on the tractor "set-up" for labor and power required. This indicates a saving of $851.50 on the tractor "set-up" over the horse "set-up." These figures are for the machine operations only in growing the crop. It is assumed that chopping, hoeing, picking, hauling to gin, etc., would be about the same for both "set-ups."

Mechanical Harvesting of Cotton

Hand picking, until recently, has been the universal method of harvesting cotton. The extensive methods in growing cotton which have been discussed previously in this Bulletin have greatly intensified the

need for a quicker and more economical method of harvesting. Cotton growers in the low plains and the high plains are already beginning to respond to this need. For six or eight years a considerable amount of the cotton in these regions has been snapped. This is a hand method but enables the picker to harvest about double the amount of cotton that he could pick in the same length of time. After the first killing frost, the cotton bolls are removed with very slight pressure, a condition which renders hand picking very difficult. This means snapping and sledding are about the only alternatives the grower has for harvesting his crop.

During the past season a mechanical method known as "sledding" has become quite common throughout the high plains and over the greater part of the low plains. This is a mechanical method of snapping, and is an effort on the part of the grower to further reduce his costs of harvesting. The relatively high labor rate for picking and snapping, coupled with low and declining cotton prices, might be assigned as the immediate causes for the development of this new method. The large acreage per man and the limited time available for harvesting the crop have likewise been factors in its development.

No standardized equipment has been perfected for sledding or stripping cotton. The machines used thus far have been constructed by the cotton growers themselves or by local blacksmiths. Cost figures* secured on 26 sleds in the Lubbock area showed a range from $9.75 to $27.00, with an average cost per sled of $18.61.

As might be expected, these sleds vary greatly in design, but might be grouped roughly under two types: namely, the *finger* and the *slot* type. In both cases the sled is a wooden box on runners or wheels—generally runners. The slot type of sled was more commonly used at first, but as the season advanced and growers became more experienced the finger type became more commonly used. No attempt will be made to describe these two types in detail, but pictures illustrating them are given in Figures 11 and 12.

The usual crew used in sledding cotton is one man and two horses. Records taken at random from 26 growers in the Lubbock area showed that such a crew harvested, on an average, 4.4 acres per day from which an average of 1.8 bales was obtained. Allowing $3.00 a day for labor and $2.00 for the team gives an average cost of $1.13 per acre, or $2.78 per bale. The amount harvested will vary from year to year, depending upon the yield per acre, and the cost of harvesting will vary as labor rates and yields vary.

Cotton growers are by no means agreed as to the possibilities of this new method of harvesting. Some are of the opinion that sledding should be practiced more extensively since it reduces the cost of har-

*The Bureau of Agricultural Economics, in cooperation with the Texas Agricultural Experiment Station and the Oklahoma Experiment Station, has recently made a study of picking, snapping, and sledding cotton and the results are to be published soon.

vesting and in most cases enables the grower to harvest his own crop. Others think that sledding should be practiced as a last resort only. Be this as it may, the chances are very good that so long as labor for picking is relatively scarce and dear and cotton prices are low, the cotton grower will continue to be vitally interested in reducing his costs of harvesting to a minimum. Improvements in ginning machinery, together with improvements and standardization in the sleds, should do much to establish this new method. A better understanding on the part of cotton merchants and spinners of the value of snapped and sledded cotton should help to remove the heavy penalty which is being placed at present on cotton harvested by these methods.

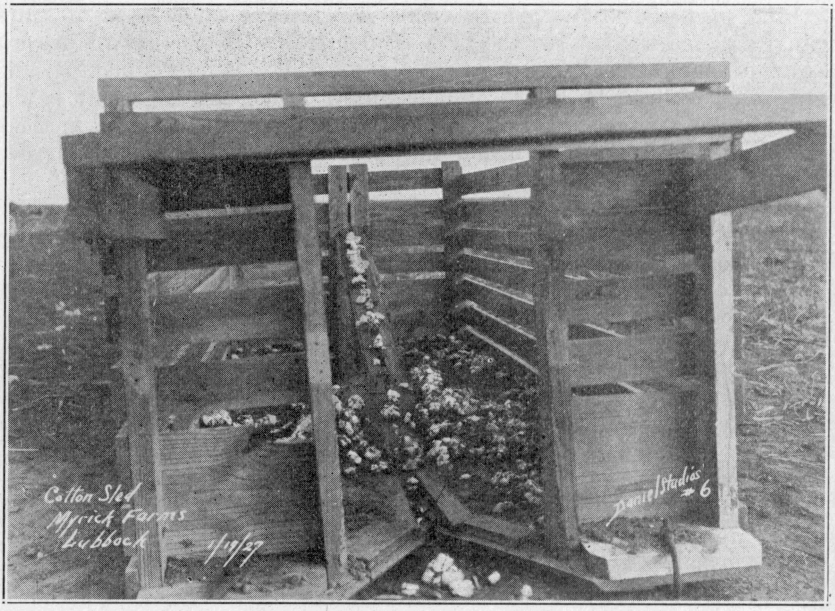


Figure 11.—Slot type of sled used in harvesting cotton in Lubbock area, 1926 crop.

Spinning tests which have been and are being made on cotton harvested by different methods should do much to clarify the matter. For example, spinning tests* made in 1925 of Texas and Oklahoma picked and snapped cotton showed that the spinning qualities of the cotton were not noticeably affected by the method of harvesting nor was the percentage of visible waste materially greater in snapped than in picked cotton of equal grade. The commercial grade of the snapped

*"Spinning Tests of Picked and Snapped Cotton (Texas and Oklahoma—1925 Crop)," by Horace H. Willis, Associate Marketing Economist, Bureau of Agricultural Economics.

samples, however, was about two grades below the picked samples. This raises the question as to whether the arbitrary commercial grades, as used at present, give a proper basis for price differences.

During the season of 1926 a limited number of machine pickers were tried out experimentally with encouraging results. As yet none have been perfected. The perfection of such a machine and the sale of it

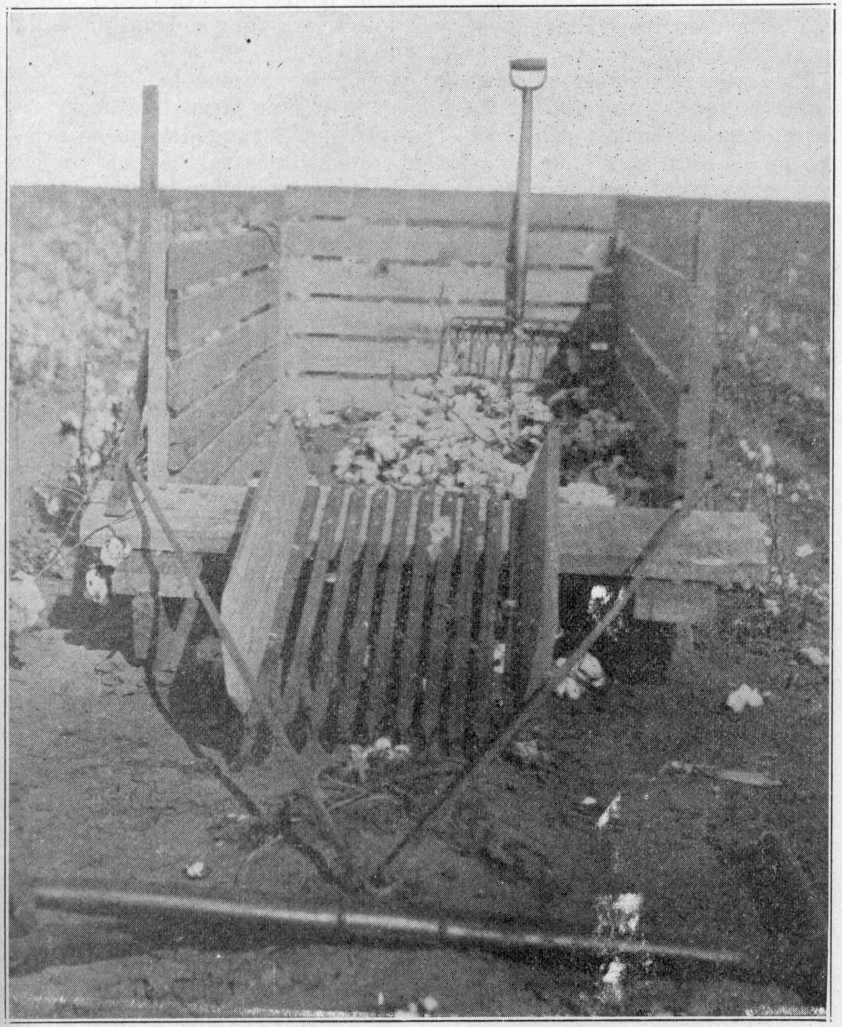


Figure 12.—Finger type of sled used in harvesting cotton, Lubbock area, 1926 crop.

at a price that would permit of its general distribution would revolutionize cotton-growing.

SUMMARY

The average annual number of hours of work per tractor ranged from 570 on horse-and-tractor farms to 804 on farms using tractor power alone. The average cost of tractor power on farms where tractors were used for the principal field operations ranged from 68 to 77 cents per hour.

The average number of hours of work done by one horse per year per farm varies from 406 on the horse-and-tractor farms to 739 on the horse-operated farms. The cost of animal power ranged from an average of 14 cents per hour on horse-operated farms in the San Angelo area to 25 cents per hour on farms using a combination of tractor and animal power in the Corpus Christi area.

The labor requirements per acre in both areas for cotton up to picking averaged 10.0 hours on tractor-operated farms and 14.5 hours on horse-operated farms.

The number of horses displaced by the tractor, or the number which would be required to do the same amount of work as one tractor in an equal period of time, varies from 5.2 in planting with a two-row *planter in the San Angelo area to 13.7 in cultivating with a six-row* outfit in the Corpus Christi area. For example, in the Corpus Christi area the tractor pulling a two-bottom bedder is equal to 11.4 horses, compared with a four-horse team pulling a one-bottom bedder. In planting, a four-row tractor outfit is equal to 10 horses, compared with a two-row horse outfit. In cultivating, a four-row tractor outfit is equal to 11.3 horses, compared with a two-row horse outfit.

Even when pulling an implement of the same size, the tractor will do more work in a day than a four-horse team because it travels faster, loses less time in turning, and requires no rest. Another important fact in this connection is that the tractor shows the greatest efficiency in those operations, such as bedding, planting, and cultivating, which requires the greatest amount of power.

A 200-acre farm "set-up" operated with horses compared with a similar "set-up" operated with tractor power in which only the mechanical operations in growing the crop are included, requires 172.7 days' labor and 661 days' horse work for the former and 71.8 days labor and 66.2 days' tractor work for the latter. When the cost of the labor and power required for the two "set-ups" is figured, a difference of $871.66 is shown in favor of tractor power.

The usual crew for "sledding" cotton is one man and two horses. Twenty-six farmers in the Lubbock area harvested, on an average, 4.4 acres per day from which 1.8 bales of cotton were obtained at a cost of $2.78 a bale. This allows $3.00 a day for labor and $2.00 a day for the team.