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UNIVERSITY OF MINNESOTA
Department of Agriculture

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TRACTOR COSTS AND RATES OF PERFORMANCE

A preliminary report of data secured in 1935 covering
the cost of operation and the rate of performance
of farm tractors in Minnesota
and summaries for 1933 and 1934

By

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TRACTOR COSTS AND RATES OF PERFORMANCE

Source of Data

The operators of 30 tractors submitted records of the cost of operating their tractors and of the amount and kind of work done by them during the year 1935 to the Minnesota Agricultural Experiment Station. These records were obtained from 24 farms. On six of these farms, two tractors were used. Only 22 of the 30 records cover the use of a tractor for a full calendar year as some of the records were started or discontinued during the year. The distribution of the tractors by makes and models was as follows: Case, Model C, 1; Case Model CC, 1; Case, Model L, 2; Farmall 20, 4; Farmall 30, 1; McCormick-Deering, Model 10-20, 3; McCormick-Deering, Model 15-30, 3; John Deere, Model F-12, 1; John Deere, Model A, 7; John Deere, Model B, 1; John Deere, Model D, 3; and John Deere, Model GP, 3. The years in which these tractors were purchased ranged from 1928 to 1935. Seven were purchased prior to 1930 and 13 in 1934 and 1935. The average years of use per tractor prior to 1935 were two and one-half. The average estimate of the operators as to the total life of these tractors was ten years. Fifteen tractors were equipped with rubber tires. The average estimated life of these was six and one-half years. These records were supervised and tabulated jointly by the Divisions of Agricultural Engineering and Agricultural Economics.

Cost of Tractor Operation

The cost per hour of operating these tractors is shown in Tables 1 and 2. Only tractors for which records for the full calendar year were available are included in this table. The separation into two-plow and three-plow tractors is more or less arbitrary. It is based in part on the rating of the tractor and in part on the plows used. Two-bottom plows were used with all of the tractors listed in Table 1 and three-bottom plows with all but one listed in Table 2. In the latter case, a four-bottom plow was used and the tractor would usually be classed as a three-four plow size altho with other tractors of the same rating only three bottoms were used. Fuel and lubricants were charged at the purchase price. Man labor spent in servicing and repairing was charged at 25 cents per hour. Annual depreciation was determined by dividing the purchase price of the tractor by the farmer's estimate of the number of years it would last. Interest is charged at the rate of eight per cent on the average value of the tractor in 1935. Costs are shown for each individual tractor for 1935 and also average costs for both size groups in 1935 and also for the tractors for which records were kept in 1933 and 1934.

There is a wide variation among different tractors in each of the items of cost. To a considerable extent, this reflects differences among the operators in their ability to handle their tractors economically and to provide adequate work for them. To a lesser extent it reflects chance differences such as variations in fuel prices in different localities and the irregularity with which repairs and overhauling are necessary. Fuel is the most variable item of operating costs. The amount of fuel per hour varied from 1.0 to 1.8 gallons per hour for the two-plow tractors and from 1.8 to 3.1 gallons for the three-plow tractors. There was also a variation in the kind of fuel used and in the price of each of the three fuels. Gasoline was used exclusively as fuel for seven tractors, distillate was used except in starting for twelve, kerosene for two, and gasoline and distillate in the ratio of one to two for another. The average price per gallon of these three fuels was gasoline 12.9 cents, kerosene 9.3 cents, and distillate 7.7 cents. The average fuel cost per hour for the three-plow tractors using gasoline was one-third higher than those using distillate. The difference was almost altogether a price difference as there was little difference in the number of gallons used per hour. Of the total fuel used 57 per cent was distillate, 34 per cent gasoline, and 9 per cent kerosene.

The fixed charges per hour varied relatively more among different tractors than did the operating costs. This variation is largely due to differences in the number of hours of work annually for which the tractors were used. In general, the larger the number of hours of work annually the lower the fixed charges per hour. There is also some variation in the operators' estimates of the length of life of different tractors. Since this was used as a basis for the depreciation charge, these variations in the operators' judgment are reflected in the fixed charges.

An analysis of these figures shows no advantage or disadvantage for rubber tires. The fixed charges are somewhat higher for the tractors equipped with rubber tires but this was offset by the larger number of hours that these tractors were used. The average purchase price of all rubber tires reported in this study was \$211. The average annual interest and depreciation charge as estimated by the operators was \$40.91. On the basis of the average number of hours of work per tractor, this would represent an average additional cost of 6.7 cents per hour for the use of the rubber tires. No significant difference was noted in the amount of work done per hour between tractors equipped with rubber tires and those equipped with steel wheels.

Amount and Kind of Work Done Annually

The annual hours of use of the tractors included in Tables 1 and 2 are shown in Table 3. The three-plow tractors are used for belt work much more than are the two-plow tractors. Silo filling, threshing, corn shredding, and feed grinding were the common belt operations. More power could be used advantageously for these operations than could be supplied by the smaller tractors. On the other hand, it was impossible to utilize the capacity of the large tractors to good advantage at many drawbar operations. Ninety-two per cent of the tractor-drawbar work is done on the home farm but only one-half of the belt work. The larger tractors are used much more extensively for custom work than are the smaller ones.

Rate of Tractor Performance

The rate at which various operations were performed with these tractors is shown in Tables 4, 5, 6 and 7. The rate of performing drawbar operations varied with the size of implement used, the kind and condition of the soil, the size and shape of field, the distance travelled to work, and the yield of crops. Undoubtedly, the rate for tillage operations varied somewhat with the amount of overlapping in case of such items as disking, harrowing, and field cultivating. In case of feed grinding, the output was expressed in bushels but the kind of grain was not specified. In these cases, the weight per bushel was estimated at 40 pounds. It is quite apparent that the proportion of the capacity of the tractor utilized for belt operations varies widely. These tables include all tractors for which records are available for any portion of the year. They do not include minor operations for which no output is recorded or which are performed by only one tractor or under conditions that vary widely from farm to farm. Average rates of performance in 1933 and 1934 are shown in comparison with the 1935 average rate.

Use of Data

These summaries should be useful to the individual tractor operator for purposes of comparison with his own figures. They should point out cost items in which economies might well be adopted. They should also indicate to some degree, at least, the effectiveness with which he is securing a satisfactory rate of performance. Furthermore, they may suggest the possibilities of using the tractor for operations for which it is not now used and the advantage of using implements large enough to utilize the capacity of the tractor to best advantage. In some cases, full utilization of the capacity of the tractor may be secured by using a combination of two implements at the same time. Two operations may be performed at the same time at very little additional expense since none of the items of tractor cost except fuel would be materially affected by the heavier load and the rate of travel would probably be about the same.

Table 1

Cost per Hour of Operating Two-Flow Tractors in 1935 with Averages for 1933 and 1934

Tractor Number:	1151*	3122	2112	2082	1112	4122	2132	1182	1082	1192	2192	Average		
												1935	1934	1933
Operating Cost:														
Fuel	\$.109	\$.148	\$.110	\$.125	\$.137	\$.119	\$.133	\$.169	\$.154	\$.154	\$.125	\$.137	\$.154	\$.141
Lubricants	.025	.051	.013	.011	.036	.022	.031	.031	.019	.068	.024	.031	.050	.037
Labor	.008	.027	.009	.009	.014	.016	.014	.012	.017	.008	.014	.014	.018	.019
Cash repairs	-	-	.003	.010	.159	.015	.009	.008	.054	-	-	.026	.028	.025
Total	.142	.226	.135	.155	.346	.172	.187	.220	.244	.230	.163	.208	.250	.222
Fixed Charges:														
Depreciation	.259	.385	.181	.174	.104	.128	.170	.129	.102	.112	.100	.159	.214	.233
Interest at 8% on avg. value	.140	.075	.130	.125	.060	.020	.032	.092	.074	.075	.060	.074	.086	.110
Total	.399	.460	.311	.299	.164	.148	.202	.221	.176	.187	.160	.233	.300	.343
Total cost per hour	.541	.686	.446	.454	.510	.320	.389	.441	.420	.417	.323	.441	.550	.565
Hours of work per year	445	145 $\frac{1}{4}$	469 $\frac{1}{2}$	620	654	710 $\frac{1}{2}$	717 $\frac{1}{2}$	844	976	993	1146	728	516	587
Labor and Materials per 100 Hrs:														
Servicing, hrs.	3.3	8.3	3.6	3.5	3.4	4.9	4.0	4.8	4.3	3.1	5.2	4.5	5.5	5.1
Repairing, hrs.	-	2.6	-	-	2.1	1.6	1.5	-	2.5	-	.3	1.1	1.1	3.1
Fuel: Gasoline, gal.	91.0	15.1	104.5	5.6	9.6	21.7	17.5	8.0	17.1	40.5	10.8	25.0	40.0	54.0
Kerosene, gal.	-	-	-	-	-	5.3	129.9	-	-	-	-	13.5	35.0	22.0
Distillate, gal.	-	166.3	-	142.0	156.5	118.5	-	195.1	166.1	131.7	139.8	121.6	95.0	92.0
Total	91.0	181.4	104.5	147.6	166.1	145.5	147.4	203.1	183.2	172.2	150.6	160.1	170.0	168.0
Oil, gal.	4.9	8.4	2.5	1.9	4.4	3.5	6.2	5.0	2.8	-	4.2	3.9	7.1	5.8
Grease, lb.	-	-	-	1.6	7.6	2.8	4.3	4.8	1.5	2.0	.9	3.2**	16.1**	12.9**

*One-plow tractor, not included in averages.

**Average of farms reporting.

Table 2

Cost per Hour of Operating Three-Plow Tractors in 1935 with Averages for 1933 and 1934

Tractor Number:	1033	1153	4193	2113	1073	2123	3013	2013	3193	2133	2183	Averages		
												1935	1934	1933
Operating Cost:														
Fuel	\$.361	\$.183	\$.237	\$.265	\$.334	\$.235	\$.203	\$.298	\$.213	\$.187	\$.188	\$.246	\$.256	\$.160
Lubricants	.069	.064	.029	.024	.018	.043	.024	.026	.038	.041	.076	.041	.057	.036
Labor	.058	.008	.006	.008	.002	.019	.009	.011	.008	.017	.025	.016	.022	.015
Cash repairs	.211	-	-	-	.009	-	.107	.022	.005	.032	.048	.039	.045	.033
Total	.699	.255	.272	.297	.363	.297	.343	.357	.264	.277	.337	.342	.380	.244
Fixed Charges:														
Depreciation	.364	.482	.308	.326	.260	.191	.216	.193	.099	.220	.130	.254	.308	.227
Interest at 8% on avg. value	.291	.269	.209	.147	.083	.130	.103	.092	.024	.062	.044	.132	.147	.100
Total	.655	.751	.517	.473	.343	.321	.319	.285	.123	.282	.174	.386	.455	.327
Total cost per hour	1.354	1.006	.789	.770	.706	.618	.662	.642	.387	.559	.511	.728	.835	.571
Hours of work per year	231½	259½	451	460	461¼	463¼	490	519	670¼	681	957½	564	406	664
Labor and Materials per 100 Hrs.:														
Servicing, hrs.	11.6	3.4	2.4	3.3	.9	7.7	3.1	4.5	2.3	6.0	4.8	4.5	5.4	4.5
Repairing, hrs.	11.4	-	-	-	-	-	.5	-	.9	1.3	5.2	1.8	3.2	1.5
Fuel: Gasoline, gal.	306.3	19.6	21.1	251.7	256.9	25.1	179.9	265.3	134.0	20.3	6.3	135.1	83.0	17.0
Kerosene, gal.	-	-	-	-	-	.5	-	-	-	187.8	-	17.1	65.0	-
Distillate, gal.	-	264.7	252.1	-	-	248.5	-	-	56.0	-	231.4	95.7	123.0	201.0
Total	306.3	284.3	273.2	251.7	256.9	274.1	179.9	265.3	190.0	208.1	237.7	247.9	271.0	218.0
Oil, gal.	11.7	12.7	4.7	4.7	13.0	7.2	2.6	3.6	5.7	7.7	14.0	8.0	9.7	7.5
Grease, lbs.	-	-	-	-	-	1.6	8.7	5.1	3.8	12.1	-	6.3*	19.3*	20.1*

*Average of farms reporting.

Table 3

Amount of Belt and Drawbar Work per Tractor and Proportion
of Home and Custom Work

Tractor number	Hours of Work			Percentage of Custom Work		
	Drawbar	Belt	Total	Drawbar	Belt	Total
<u>Two-Plow Tractors</u>						
3122	125	20 $\frac{1}{4}$	145 $\frac{1}{4}$	0	0	0
1151	445	-	445	2	-	2
2112	496 $\frac{1}{2}$	-	496 $\frac{1}{2}$	14	-	14
2082	434	186	620	5	70	24
1112	475 $\frac{1}{2}$	178 $\frac{1}{2}$	654	0	0	0
4122	687 $\frac{3}{4}$	22 $\frac{3}{4}$	710 $\frac{1}{2}$	7	-	7
2132	672 $\frac{3}{4}$	45	717 $\frac{3}{4}$	5	-	5
1182	805	39	844	21	-	20
1082	735	241	976	9	60	22
1192	735	258	993	-	38	10
2192	1070 $\frac{1}{2}$	75 $\frac{1}{2}$	1146	10	-	10
Avg. hours	607	97	704			
Percentage	86	14	-	8	35	12
<u>Three-Plow Tractors</u>						
1033	122 $\frac{1}{2}$	109	231 $\frac{1}{2}$	-	75	32
1153	115	144 $\frac{1}{2}$	259 $\frac{1}{2}$	-	45	29
4193	289 $\frac{1}{4}$	161 $\frac{1}{4}$	451	18	56	32
2113	224	236	460	-	71	36
1073	162 $\frac{3}{4}$	298 $\frac{1}{2}$	461 $\frac{1}{4}$	19	64	48
2123	371 $\frac{3}{4}$	91 $\frac{1}{2}$	463 $\frac{1}{4}$	11	-	9
3013	482	8	490	2	-	1
2013	52	467	519	12	59	54
3193	280	390 $\frac{1}{4}$	670 $\frac{1}{4}$	31	71	55
2133	619 $\frac{3}{4}$	61 $\frac{1}{4}$	681	0	0	0
2183	622	335 $\frac{1}{2}$	957 $\frac{1}{2}$	6	45	20
Avg. hours	304	209	513			
Percentage	59	41	-	8	56	28
<u>All Tractors</u>						
Avg. hours	456	153	609			
Percentage	75	25	-	8	50	18

Table 4

Size of Implement and Acres Covered per Hour for Drawbar Operations with Two-Flow Tractors
in 1935 with Averages for 1933 and 1934

Operation: Tractor No.	Plowing		Disking		Springtooth harrowing		Field Cultivating		Harrowing		Seeding Grain	
	Size	Acres	Size	Acres	Size	Acres	Size	Acres	Size	Acres	Size	Acres
3122	2-14"	.73	-	-	-	-	-	-	26'	6.08	-	-
1151	2-14"	.68	8'	2.31	10'	2.06	-	-	18'	5.65	-	-
2112	-	-	10'	2.67	-	-	-	-	26'	7.23	10'	2.97
2082	2-14"	.94	10'	2.96	8'	2.00	-	-	20'	6.81	10'	2.55
1112	3-14"	1.29*	7'	2.00	14'	4.95	-	-	20'	9.32	-	-
4122	2-14"	.60	8'	3.01	-	-	7'6"	1.81	20'	7.18	-	-
2132	2-14"	.75	-	-	-	-	9'	2.72	22'	8.74	14'	3.75
1182	2-16"	.99	14'	4.80	10'	4.87	-	-	16'	9.03	-	-
1082	2-14"	.63	15'	3.97	-	-	-	-	-	-	10'	2.52
1192	2-14"	.98	8'	3.40	-	-	10'	3.75	-	-	-	-
2192	2-14"	.68	8'	2.09	8'	2.30	-	-	24'	8.81	-	-
2032	2-16"	1.06	8'	2.41	9'	3.29	-	-	20'	11.84	10'	4.30
4193	-	-	-	-	-	-	-	-	-	-	9'	1.00
4082	2-16"	.98	-	-	7'	2.96	-	-	20'	8.65	11'	3.92
3082	2-16"	.94	15'	3.71	7'	3.00	-	-	-	-	-	-
1012	2-14"	.69	8'	3.70	-	-	-	-	26'	6.27	16'	1.71
1232	2-14"	.91	15'	3.11	-	-	7'	3.68	20'	6.01	-	-
1062	2-14"	.90	14'	4.84	9'	5.56	-	-	20'	8.57	-	-
Avg. 1935		.83		3.21		3.44		2.99		7.87		2.84
Avg. 1934		.83		3.21		2.97		2.58		7.45		3.33
Avg. 1933		.85		3.30		-		2.60		8.02		3.32

*Not included in average.

(Table 4 continued)

Operation:	Cutting Grain		Planting Corn		Cultivating Corn		Cutting Corn		Picking Corn		Mowing Hay	
Tractor No.	Size	Acres	Size	Acres	Size	Acres	Size	Acres	Size	Acres	Size	Acres
3122	-	-	-	-	-	-	-	-	-	-	-	-
1151	8'	2.03	-	-	2-row	1.82	2-row	1.34	-	-	-	-
2112	8'	2.18	4-row	2.76	2-row	1.91	2-row	1.82	-	-	7'	1.71
2082	10'	2.17	-	-	2-row	2.02	-	-	-	-	-	-
1112	8'	2.13	-	-	-	-	-	-	1-row	.74	-	-
4122	7'	1.58	-	-	2-row	2.10	-	-	1-row	.75	-	-
2132	-	-	4-row	2.62	2-row	1.79	-	-	1-row	.87	7'	2.72
1182	7'	1.62	-	-	-	-	-	-	-	-	-	-
	10'	2.67	-	-	2-row	2.78	-	-	-	-	-	-
1082	8'	1.53	3-row	2.09	3-row	2.69	1-row	.67	1-row	.87	-	-
1192	8'	2.34	-	-	2-row	2.22	-	-	1-row	.70	-	-
2192	7'	1.29	-	-	2-row	2.08	1-row	.73	2-row	1.16	-	-
2032	-	-	-	-	-	-	-	-	-	-	-	-
4193	10'	2.19	-	-	2-row	2.65	1-row	.75	-	-	-	-
4082	-	-	-	-	2-row	2.17	-	-	-	-	7'	3.10
3082	8'	1.96	-	-	-	-	-	-	-	-	-	-
1012	7'	1.27	3-row	2.18	3-row	2.64	1-row	1.06	1-row	.56	7'	1.79
1232	-	-	4-row	3.35	-	-	-	-	2-row	1.67	-	-
1062	-	-	-	-	2-row	2.83	-	1.50	-	-	-	-
Avg. 1935		1.92		2.60		2.60		1.12		.92		2.33
Avg. 1934		1.97		2.41		2.19		1.33		1.03		2.58
Avg. 1933		1.45		2.73		2.29		.82		.80		-

Table 5

Size of Implement and Acres Covered per Hour for Drawbar Operations with Three-Plow Tractors
in 1935 with Averages for 1933 and 1934

Operation:	Plowing	Disking	Springtooth	Field	Harrowing	Seeding	Cutting	Cultivating	Cutting	Picking
	Size Acres	Size Acres	Harrowing	Cultivating	Size Acres	Grain	Grain	Corn	Corn	Corn
Tractor No.			Size Acres	Size Acres		Size Acres	Size Acres	Size Acres	Size Acres	Size Acres
1033	3-14"	1.25	-	-	11' 3.79	-	-	-	-	-
1153	3-16"	1.22	8'	2.06	-	-	-	-	-	-
4193	3-14"	1.21	10'	4.51	-	-	10'	2.52	-	-
2113	3-14"	1.10	10'	3.15	-	-	-	-	-	1-row 1.00
1073	4-14"	1.64*	-	-	9' 3.07	-	-	-	-	-
2123	3-14"	1.05	15'	3.37	-	-	8' 6"	3.45	20' 6.67	-
3013	3-14"	1.07	-	-	-	-	26'	6.45	-	-
2013	3-14"	1.10	-	-	-	-	-	-	8' 2.09	2-row 2.01
	2-16"	1.00*	-	-	-	-	-	-	-	-
3193	3-14"	.98	10'	3.05	9' 2.78	9' 3.39	20' 5.07	-	8' 2.08	-
	-	-	-	-	-	12' 3.26	-	-	-	-
2133	3-16"	1.32	10'	3.53	-	-	9' 2.99	22' 9.64	14' 3.64	-
2183	3-16"	1.26	17'	4.78	11' 6"	3.00	-	-	10' 2.66	-
	-	-	9'	3.25	-	-	-	-	-	1-row .98
1203	3-14"	.57	-	-	-	-	8' 2.84	22' 7.01	-	-
	-	-	-	-	-	-	-	-	7' 1.18	-
Avg. 1935	1.10	3.46	3.16	3.04	6.98	3.64	2.19	1.92	.79	1.14
Avg. 1934	1.22	3.33	3.71	3.25	8.62	4.00	2.12	1.69	-	1.14
Avg. 1933	1.36	3.16	-	3.11	-	3.52	1.70	2.17	-	.99

*Not included in average.

Table 6

Size of Implement and Rate of Performance per Hour for Belt Operations with Two-Plow Tractors in 1935 with Averages for 1933 and 1934								
Operation:	Grinding Feed		Shelling Corn		Filling Silo		Threshing	
Tractor No.	Mill	Pounds per hour	Type	Bushels per hour	Size	Tons per hour	Size	Bushels per hour
3122	-	-	-	-	16"	6.8	-	-
1151	-	-	-	-	-	-	-	-
2122	-	-	-	-	-	-	-	-
2082	-	-	-	-	-	-	22"	58.5
1112	8" burr	2656	-	-	-	-	22"	96.2
4122	-	-	-	-	12"	14.3	-	-
2132	Hammer	1284	No.2 cyl.	92.7	-	-	-	-
1182	10" burr	988	-	-	-	-	-	-
1082	10" burr	2070	-	-	-	-	26"	66.6
1192	Hammer	3185	-	-	-	11.3	22"	165.5
2192	-	-	-	-	15"	4.6	-	-
2032	-	1338	-	-	-	-	-	-
4192	-	-	2-hole	49.5	16"	7.5	-	-
4082	8" burr	1949	-	-	-	-	22"	33.1
3082	8" burr	2200	-	-	-	-	22"	68.8
1012	10" Letz	1224	-	-	-	-	-	-
1232	Hammer	845	No.2 cyl.	58.0	16"	7.7	-	-
1062	10" burr	1911	No.2 cyl.	75.1	16"	4.6	22"	88.8
Avg. 1935		1786		68.8		8.1		82.5
Avg. 1934		1544		50.4		8.1		76.6
Avg. 1933		2254		93.0		8.7		128.0

Table 7

Size of Implement and Rate of Performance per Hour for Belt Operations with Three-Plow Tractors in 1935 with Averages for 1933 and 1934										
Operation:	Grinding Feed		Shelling Corn		Filling Silo		Threshing		Shredding Corn	
Tractor No.	Mill	Pounds per hour	Type	Bu. per hour	Size	Tons per hour	Size	Bu. per hour	Type	Bu. per hour
1033	8" burr	1600	-	-	19"	9.9	36"	101.0	-	-
1153	Hammer	2657	-	-	16"	19.7	28"	151.8	-	-
4193	10" burr	1622	-	-	-	-	24-46	79.7	-	-
2113	-	-	-	-	IHC-B.	13.0	28"	123.8	-	-
1073	10" burr	1618	-	-	15"	9.2	24"	75.2	6-roll	28.0
2123	8" burr	2372	Cylinder	103.3	-	-	28-46	85.5	-	-
3013	10" burr	2489	-	-	-	-	-	-	-	-
2013	10" burr	2089	-	-	McD-A	7.5	32-54	111.6	4-roll	29.1
3193	-	-	-	-	16"	6.3	21-36	76.5	4-roll	26.2
2133	Hammer	1663	No.2 cyl.	64.2	-	-	28-50	115.8	-	-
2183	8" burr	3205	-	-	16"	8.0	-	-	-	-
-	-	-	-	-	11"	8.0	-	-	-	-
Avg. 1935		2146		83.8		10.2		102.3		27.8
Avg. 1934		1666		104.9		10.2		73.3		-
Avg. 1933		1889		160.0		12.4		138.0		-