THE INFLUENCE OF NEW SUGAR BEET PRODUCTION METHODS ON TIME AND COST REQUIREMENTS IN MICHIGAN, 1946

Thesis for the Degree of M. S.

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CLARENCE EDMUND JOHNSON

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This is to certify that the

thesis entitled

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presented by

Clarence E. Johnson

has been accepted towards fulfillment of the requirements for

M. S. degree in Farm Management

Elton B. Hill
Major professor

Date May 28, 1947

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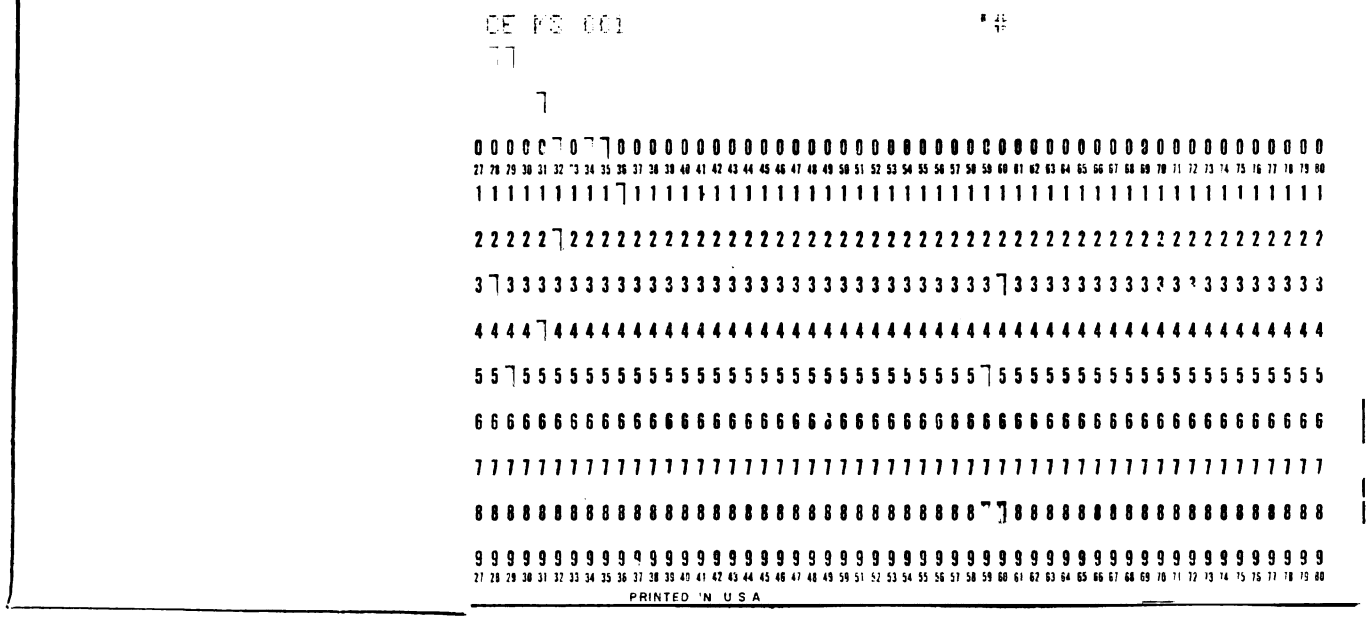
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THE INFLUENCE OF NEW SUGAR BEET PRODUCTION METHODS ON TIME AND COST REQUIREMENTS IN MICHIGAN, 1946

By

CLARENCE EDMUND JOHNSON

A THESIS

Submitted to the School of Graduate Studies of Michigan State College of Agriculture and Applied Science in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

Department of Farm Management

June 1947

THESIS

VITA

Clarence Edmund Johnson

PERSONAL

Age: 29 years
Birthplace: Polk County, Wisconsin
Nationaltiy: American
Marital status: married
Religion: Protestant
Height: 5 ft. 8 in.
Weight: 155
Health: excellent

EDUCATION

North Branch High School, North Branch, Minnesota: graduated 1936.
College of Agriculture, University of Minnesota; Bachelor of Science
Major: Animal Husbandry.

AFFILIATION

FarmHouse Fraternity.

PRACTICAL TRAINING AND EXPERIENCE

Reared on a general livestock farm in Chisago County, Minnesota.

Three years with the United States Marine Corps Reserve; twenty-two months in the Pacific Theater of Operations as a troop officer with the Fourth Marine Division. Rank: First Lieutenant.

One year at Michigan State College on a graduate fellowship from Beet Sugar Development Foundation, Fort Collins, Colorado.

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THE INFLUENCE OF NEW SUGAR BEET PRODUCTION METHODS ON TIME AND COST REQUIREMENTS IN MICHIGAN, 1946

Clarence Edmund Johnson

INTRODUCTION

The Problem: During years when the cost of labor has been high and when the supply of hand labor has been inadequate, some farmers have reduced their sugar beet acreage. This has stimulated the development of new labor saving methods in sugar beet production, particularly in the use of segmented seed and mechanical harvesters. Sugar beet growers are concerned (1) with the effect of these new developments on the costs and returns of sugar beet production, and (2) to what extent such developments may reduce or entirely replace contract labor operations.

The Need for the Study: Unless farmers are able to reduce the hand labor requirements and increase the efficiency of sugar beet production, the crop may not be able to compete successfully with other crops for the good land on Michigan farms. Thus this study is needed to discover the effect of the new developments in the sugar beet industry on the following:

(1) Production costs and returns,

(2) Replacement of contract labor,

(3) Timing of blocking and thinning and of harvesting,

(4) Other production techniques.

Purpose and Objectives of the Study: This study was made for the purpose of helping Michigan farmers produce sugar beets more efficiently by determining the effect of new production developments on costs in sugar

beet production. Specific objectives were as follows:

(1) To compare the differences in time and costs in blocking and thinning sugar beets when regular and segmented seed are used,

(2) To compare the differences in time and costs in hand harvesting and mechanical harvesting,

(3) To determine the most advantageous time to perform each operation,

(4) To compare the difference in costs of marketing following different methods of harvesting,

(5) To evaluate non-cost advantages of improved methods of production.

TRENDS IN SUGAR BEET PRODUCTION IN MICHIGAN

During the last thirty years the acreage of sugar beets produced in Michigan has ranged between 56,000 and 160,000 acres (Table 1). Three times during this period the acreage has reached approximately 150,000 acres, and twice it has declined almost to 50,000 acres. The periods of extreme reduction in acreage have been a serious threat to the survival of the industry. During these periods several factories were forced to close and have had their beets processed at other factories. Even with 109,000 acres of beets produced in 1946, four of the 14 sugar beet factories in Michigan had their beets processed elsewhere. Millions of dollars are invested in these idle factories and the companies cannot withstand many successive years of low production.

In addition to affecting the operation of the factories, the wide variations in the acreage of sugar beets have also affected incomes of farmers from this source. Cash receipts from the beets in Michigan have varied from 2.5 million dollars to 15 million dollars during this period. (Appendix, table 1).

Several factors have brought about the fluctuations in the sugar beet acreage. Among the most important are (a) the price of beets in relation to beans, (b) the price of beets in relation to all farm products, (c) yield of beets per acre, (d) farm wage rates, (e) available labor supply, and (f) weather conditions during planting and harvesting seasons.

The crop that competes with beets to the greatest extent in the Saginaw valley is beans. More favorable prices for beans have usually been reflected in lower beet acreages during the following year. Similarly, the prices of other crops and livestock have influenced farmers in making

adjustments in their farm enterprises causing them to place greater emphasis on crops and livestock that appear to be the most profitable.

Average beet yields have fluctuated from 5 to 11 tons per acre during the past 30 years. Weather conditions are largely responsible for these differences. When yields of beets have been high, acreage of beets the following year usually has been increased.

Since hand labor has been one of the major items of expense in raising beets, the level of wage rates in relation to prospective prices for beets has had an influence on the acreage planted. When farmers have had difficulty with inefficient or inadequate labor, the tendency has been to plant other crops the next year in preference to beets.

Unfavorable weather conditions during the spring in some years has made it impossible to plant the entire acreage of beets contracted and early frosts or heavy fall rains have even made it impossible to harvest all of the beets. Past experience has also shown that severe fall weather encourages migratory laborers to leave early, often before harvesting is completed. All of these factors have their influence not only on the individual farmer but on the prosperity of the entire sugar beet industry.

Indexes of some of the more important factors show how the acreage of sugar beets was affected during the period from 1915 to 1946 (Table 1 and figure 1). The acreage of sugar beets produced in a given year was affected by conditions that existed the previous year as well as by the outlook. Therefore, there is a lag of one year in acreage in relation to other factors as plotted on the graph. The graph shows the effects of the yield per acre, and the effects of the ratio of sugar beet prices to bean prices and to the average prices of farm products on sugar beet acreage

the following year.

In 1917 the acreage of beets harvested was at a low point of 82,000 acres. There was a reduction of 18,000 acres from the previous year and a reduction of 40,000 acres from 1915. This was caused partly by the low average yield of 5.1 tons in 1916 and an unfavorable relationship between beet prices and other farm products and between beets and wages. Although prices for farm crops rose rapidly during 1915, 1916, and 1917, the index of the price of beans rose to more than twice that of beets.

In 1920 and 1921 sugar beet production rose to about 150,000 acres, a steady increase since 1917. Part of this increase in acreage was due to the patriotic efforts of farmers to increase sugar supplies badly needed during and following the first World War. In addition, the price of beets reached a peak of $12.52 per ton in 1919. The index of beet prices was about on par with other crops in 1919 and somewhat above the index of wages. The average yield of beets had been increasing since 1917 and reached a high point of 8.8 tons per acre in 1920. All of these conditions stimulated high production of beets during the few years following World War I.

Beet acreage again dropped to 84,000 acres in 1922 during the post-war slump in farm prices and at a time when yields had begun to decline. The ratio between the index of beet prices and the index of prices of all farm products had dropped from 104 in 1919 to 79 in 1921 which was partly responsible for the low acreage of beets in 1922. More favorable prices in 1923 again brought beet production up to 150,000 acres in 1924. From 1925 beet acreage declined steadily to 58,000 acres in 1929. This period was typified by relatively unfavorable prices of beets compared

to other crops, high wages, and also by steadily declining average yields. Although beet prices were generally about 25 percent above the 1910-14 base period, other farm products were 50 to 60 percent and wages were 70 to 80 percent above the base period. Average yields had declined to 5.8 tons per acre in 1929.

During the depression period, sugar beet acreage again began to rise until it reached an all-time high of 160,000 acres in 1933. Yields also had been at a high level of 10 tons per acre during 1931 and 1932. Prices of all farm products and labor rates had declined steadily after the break in 1929, however, the price of beets was still near the 1910-14 level and in a very favorable position in relation to other crops. One reason that sugar beet prices did not drop as far as did other farm products is that the protective tariff curtailed imports of foreign sugar.

From the record acreage of 1933, sugar beet acreage was reduced steadily to 81,000 acres in 1937, a decrease of about 50 percent in four years. During this period average yields fluctuated considerably, and, except for the reduced yield in 1933 and 1935, seemed to have little influence on acreage. Severe drouth was partly responsible for decreased yields in 1935. Although prices in general began to rise, the relationship of the price of beets to other crops became less favorable.

Another year of high production was 1939 when 137,000 acres were harvested, an increase of 56,000 acres from 1937. Prices for all farm products had declined to an index of 97 and beans had declined to 87 while the price of sugar beets was at an index of 128. From 1939 there was a downward trend to 56,000 acres in 1943 which was the lowest acreage harvested since the beginning of the century. Although the average yield

of beets increased to a high point of 11.1 tons per acre in 1941 and the price of beets remained high compared to other farm prices, the high wages and the difficulty in obtaining an adequate supply of hand labor encouraged farmers to produce other crops requiring less labor. The high yield of 11.1 tons per acre in 1941, however, was partly responsible for the increase in acreage from 108,000 acres in 1941 to 128,000 in 1942 but the acreage dropped to 56,000 the following year. Factors responsible for the labor shortage during this period were the movement of agricultural workers into industrial work, the drafting of men into military service and the lack of transportation facilities to import migratory labor from the southern states.

Since 1943 there has been a gradual increase in sugar beets harvested to 109,000 acres in 1946, almost double that of 1943. During this period the labor supply become more adequate. Some prisoners of war were used in sugar beet areas during the late war years. In addition, the sugar companies' labor recruiting services have become more adequate in the southern states where there is an excess of labor of the type used in blocking, thinning and in harvesting sugar beets. Also during this period the price of beets reached the highest point in history, and recent developments in segmented seed and mechanization have made it possible to reduce at least a part of the need for hand labor formerly required to produce sugar beets.

In order to maintain its status or even increase its size in the state, the sugar beet industry depends on the cooperation of the individual farmer. In order to obtain and retain that cooperation, the sugar beet industry must keep pace in the technology of producing sugar beets with

that of other agricultural enterprises.

Table 1-SUGAR BEET ACREAGE AND SELECTED PRICE INDEXES IN MICHIGAN, 1915-46

Year	Sugar beet acreage*		Index of Beet Prices*	Ratio of Sugar beet prices to: #		
	Planted	Harvested		Dry Beans**	All farm products**	Farm Wages***
	(Thousand acres)					
1910-14			100	100	100	100
1915	Not Available	122	104	73	99	100
16		100	107	47	80	91
17		82	141	38	74	100
18		115	176	59	88	111
19		124	219	101	101	120
1920		150	176	104	81	78
21		148	107	97	79	73
22		84	126	72	96	88
23		109	164	88	115	96
24		150	155	105	113	90
1925		115	123	79	80	73
26		118	122	95	75	69
27		99	125	68	81	70
28		71	126	51	77	71
29	66	58	149	72	90	82
1930	89	83	149	110	103	99
31	62	60	112	200	119	103
32	128	123	98	213	153	126
33	173	160	102	146	140	148
34	150	127	131	154	147	164
1935	136	124	133	190	128	145
36	113	104	114	61	95	107
37	92	81	137	173	104	103
38	141	134	138	242	135	114
39	143	137	128	147	132	106
1940	142	131	140	130	132	113
41	115	108	158	112	122	101
42	159	129	169	113	104	87
43	69	56	224	122	111	90
44	80	68	253	136	127	88
1945	106	90	243	127	115	77
46	120	109	284	75	119	84

* Personal correspondence with P. A. Reeve, Farmers and Manufacturers Beet Sugar Association, Saginaw, Mich. (Price indexes include government payments.)

** Michigan Farm Economics Chartbook - 1947

*** Crop and Livestock Report for Michigan, 1946

\# The ratios of sugar beet price indexes to other price indexes were obtained by dividing the index of sugar beet prices by the other index numbers for the same year.

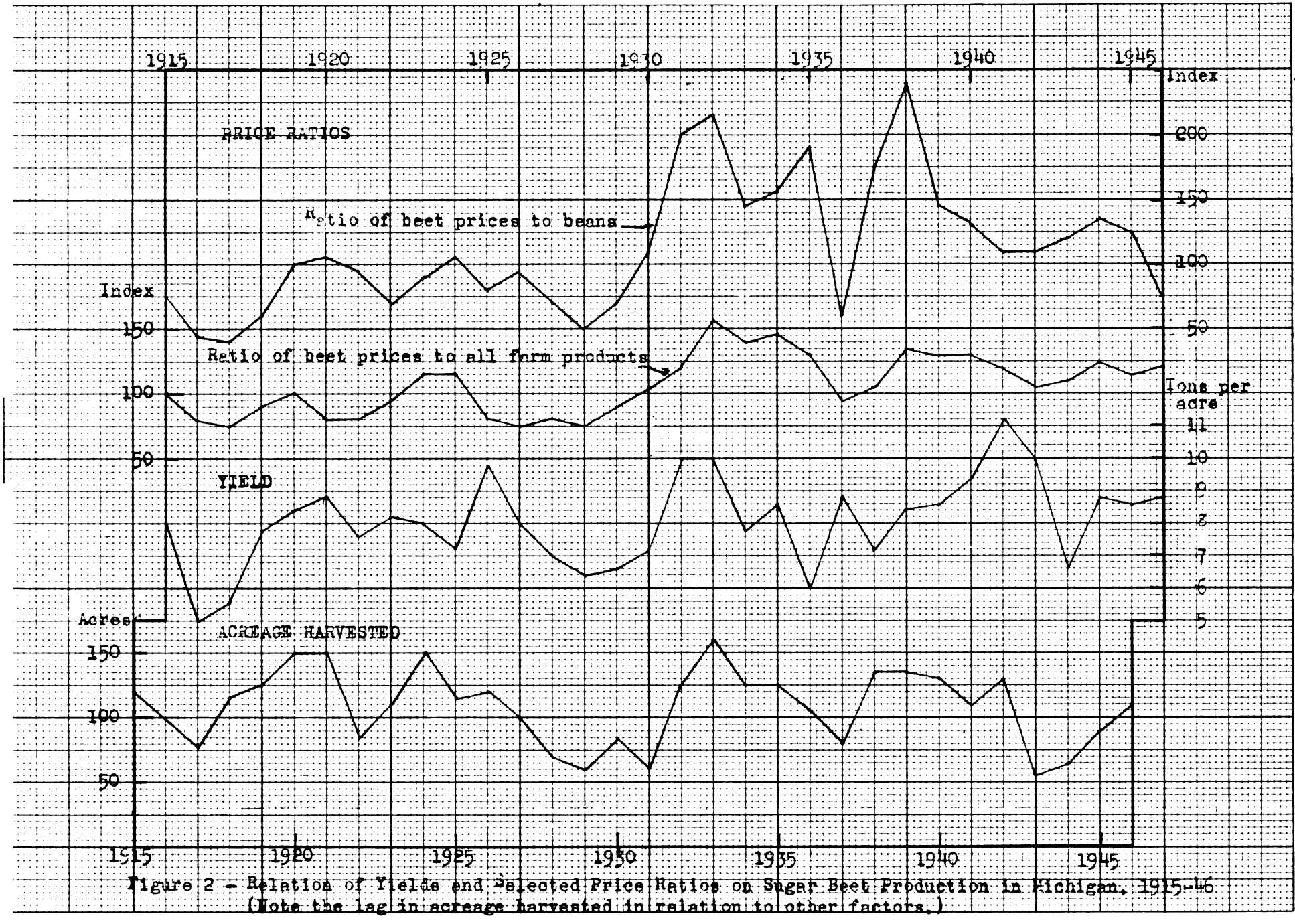

Figure 2 - Relation of Yields and Selected Price Ratios on Sugar Beet Production in Michigan, 1915-46
(Note the lag in acreage harvested in relation to other factors.)

SUMMARY OF RECENT TECHNOLOGICAL DEVELOPMENTS

One of the objectives of research workers in the sugar beet industry is to introduce new methods to increase efficiency and reduce the cost of producing sugar beets, thus making it possible for farmers to receive larger net returns for their beets.

High labor costs and an insufficient labor supply have been factors in stimulating the development of labor saving methods. Mechanization of the industry will relieve the labor problem, at least in part for spring work, and it is possible to eliminate entirely the need for contract labor in harvesting. Mechanization will also make it possible and more practical for each farmer to increase his acreage of beets. Weather conditions cannot be controlled but mechanization will speed up operations to the extent that work can be done quickly while weather is most favorable.

Some of the more important developments in labor saving methods in producing sugar beets that have taken place or are in experimental stages are the use of segmented and pelleted seed, mechanical harvesters, improved beet drills, mechanical blockers, mechanical loaders and chemical weed controls.

Segmented or sheared seed is a processed seed containing a high percentage of single germs. It is produced by a shearing and grading process by which the regular or multiple germ seed cluster is broken into segments. The new type of seed was introduced in 1942 after extensive experimental tests. In 1945 about 30 percent and in 1946 about 70 percent of the beets in Michigan were planted with segmented seed. The advantage in using segmented seed is in obtaining more uniform placement with a high

percentage of single plants, thus reducing the labor requirements in hand blocking and thinning or in making the stands more adaptable for mechanical blocking. Results from experiments under controlled conditions have shown that the labor requirements for blocking and thinning stands planted with segmented seed are 30 to 40 percent less than that required for regular or whole seed.*

Pelleted seed is processed further by encasing the single germ seed in a water soluble pellet about the size of a small pea. This type of seed, as yet in an experimental stage, is being developed in an attempt to obtain more uniformity in seed placement that is possible with a segmented seed.

Mechanical blockers are not as yet of much importance in Michigan. The common method of blocking and thinning has been with hand labor using either short or long hoes and spacing blocks at 12 to 14 inches. These blocks are then thinned to a single plant. Mechanical blockers are being developed, however, and it can be expected that they will become increasingly important as techniques of planting and weed control are perfected.

Several types of mechanical blockers are in the experimental stage. These are (1) row type, (2) cross blockers, (3) chemical blockers, and (4) flame blockers. Row type blockers are either one or two row machines, very similar to cotton choppers used in the South, having an adjustable revolving knife which cuts out uniform blocks in each row. Cross blockers are similar to standard cultivators with shovels or sweeps and are operated across the rows to cut out blocks of desirable widths. The most

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* Bell, R. W., LABOR SAVINGS RESULTING FROM USE OF SEGMENTED SEED. Proceedings American Society of Sugar Beet Technologists, Eastern United States and Canada. Detroit, Mich., 1947.

recently developed cross-blockers have hydraulic adjustments for varying the widths of blocks. Chemical and flame blockers have shields which protect the beets within the block while the beets and weeds between the blocks are destroyed by chemical sprays or a flame. The row type and cross-blockers appear to be the most practical. Flame and chemical blockers are as yet too expensive for the average farmer to operate.

Chemical weed control methods are being developed, some for use before planting, and others as direct sprays. None of these have reached a standard of performance or are of a low enough cost of operation to be of practical use by farmers.

Mechanical sugar beet harvesters have been used for many years in the more friable soils of the western states where soil moisture can be regulated by irrigation. The harvesters used in the West have not been practical for use in Michigan soils which are generally harder, less uniform in texture, frequently quite stony, and subject to extremes in moisture conditions. During the last few years, mechanical harvesters have been developed to operate quite successfully in the variable soil conditions in Michigan.

Mechanical sugar beet harvesters were introduced on a commercial scale in this area in 1943. Although there were five different makes of harvesters in use in this area in 1946, one make of machine was by far the most popular. There are two general types of harvesters, (1) those that top the beets in the ground, and (2) those that top the beets after lifting. The machine that is in most common use in Michigan is of the latter type. The principle function of these machines is lifting and topping. In addition, most of them have elevators that load the beets

directly to a wagon or truck, or they can be adjusted to windrow the beets. Other machines have tanks or hoppers that hold the beets until the end of the row is reached. There the beets are elevated to trucks or dumped to be loaded at a later time. About 135 machines were used in Michigan in 1946 and harvested about 9170 acres.*

Sugar beet loaders are of two types, (1) fork-in or hand-mechanical loaders and (2) pick-up or mechanical loaders. The first type consists principally of an elevator with a hopper into which the beets are forked. The elevator loads the beets into a truck or wagon and is usually powered by a power take-off from the tractor that pulls the machine. A pick-up loader is similar except that it has a revolving pick-up mechanism that picks the beets from the ground and places them on the elevator. The power is supplied either by a motor mounted on the loader or by a power take-off attachment from the tractor. Only one man is required to operate most of these machines. Some pick-up loaders are capable of loading piled beets as well as windrowed beets.

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* Reeve, P. A., RESULTS SECURED WITH SUGAR BEET HARVESTERS IN THE EASTERN AREA IN 1946. Proceedings American Society of Sugar Beet Technologists, Eastern United States and Canada. Detroit, Mich., 1947.

METHODS USED IN COLLECTING DATA

It was originally intended to select seven sugar beet growers to keep time and cost records from each of eleven factory districts in central, eastern, and south-eastern Michigan. Final selection varied from five to twelve growers in each district. Growers were selected mostly through the recommendations of district field managers. The sugar beet factories in Michigan and the distribution of growers who kept records for this study are shown in Figure 2.

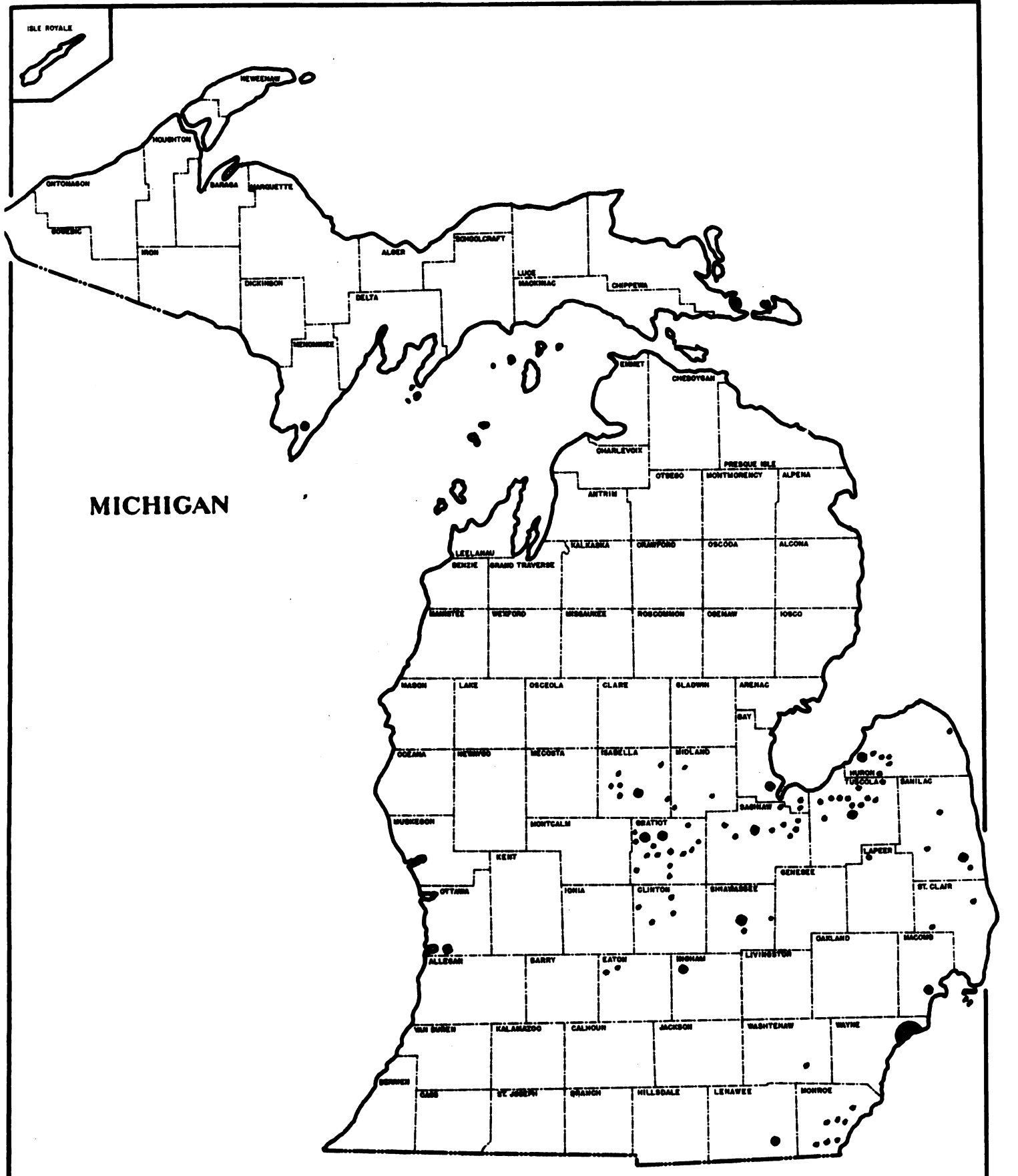
An attempt was made to get a fair representation of growers using different methods of production. Comparisons desired were (1) the type of seed used, (2) kind of labor used for hand work, (3) methods of harvesting, and (4) methods of loading. No consideration was given to acreage in selecting growers, nor was any particular attempt made to obtain a representative sample of the whole beet industry in the state. Forms were provided the farmers on which to keep records. (Appendix, pages 3-9).

Seventy-one growers completed records out of 85 who started the project. These 71 growers kept time and cost records on 88 fields from the beginning of the season until harvesting was completed. Most growers had only one field of sugar beets. Where there was more than one field and where cultural practices were similar, one record was kept. Where cultural practices varied, separate records were kept. As a means of obtaining the greatest possible accuracy, farmers' records were checked with all available information from factory records.

Time records on some spring work were partly estimates since the project was not started until after the season had begun. In several

instances, farmers found it impossible to keep daily records of hours, and estimates were made in these cases.

Each grower was visited three times, at planting time, during the middle of the summer and after harvesting was completed. On the first and second visits, the records were brought as nearly as possible up to date and on the final visit the records were completed.



MICHIGAN

Beet sugar factories ●

Farmer cooperators •

Figure 2 - Sugar Beet Factories in Michigan and Locations of Farmers Who

EXPLANATION OF ITEMS

Farm Labor: All labor except contract labor and any farm labor used for blocking, thinning, hoeing or pulling and topping were included in farm labor. For the most part it included farm labor used for machine operation. Rates for farm labor were the farmers' own estimates. Variations in estimates were from 50 cents to $1.25 per hour and averaged 81 cents. For greater accuracy in making comparison of costs on various operations, the labor charges were adjusted to the average rate.

Hand Labor: Hand labor included contract labor and farm labor used in blocking, thinning, hoeing and in hand harvesting. Rates for contract labor were established by the United States Department of Agriculture. The rate for blocking, thinning and hoeing was $18.00 per acre where segmented seed was planted and $20.00 per acre where whole seed was used. Rates for harvesting were based on yield per acre and varied from $1.41 per ton for a 16 ton yield to $2.10 per ton for a 4 ton yield. The minimum payment was $8.00 an acre. All charges for contract labor were obtained from factory statements of growers' deductions or from growers' own records where contract labor was hired on an hourly basis and paid by the farmers in cash.

Tractor Work: Rates for tractor work were determined on the basis of plow capacity. These rates were based on previous studies made on tractor costs and adjusted to present price levels. The rate for one plow tractors was set at 60 cents per hour, two plow tractors at 75 cents and three plow tractors at 90 cents per hour. A few track-type tractors were used and charged at the rate of $1.25 per hour. The average rate for all tractor work was 73 cents per hour.

Horse Work: Rates for horse work were based on the hourly cost of one horse and were taken from farmers' estimates. Estimates varied from 25 to 40 cents per hour and averaged 34 cents. Most of the horse work was used for "fitting", planting, cultivating and lifting. Only one farmer used horses for plowing. The total cost of horse work was less than one percent of the total cost of producing beets and only about ten percent of the total power costs.

Equipment Use: The costs of all machinery used in the production of sugar beets except tractor and truck use were included in equipment use. In arriving at a charge for equipment use, the total annual cost of operation of each machine was determined. A charge was made proportional to the amount each machine was used on the sugar beet crop for the season. The total annual cost of each machine was determined by adding depreciation based on the normal expected life of the machine, interest at five percent of the investment, taxes, insurance and housing at two percent of the investment, and the average annual cost of repairs.

Farm Truck Use: Farm truck costs were determined from farmers' records of mileage traveled and on their estimates of truck operation costs per mile. Estimates on operation costs varied from 7 to 15 cents per mile with most estimated around 10 cents.

Trucking Hired and Freight: The cost of trucking hired included both the cost of loading and trucking since no separate rates were made for the two operations. These rates varied from $1.05 to $3.00 per ton and averaged $1.94. Freight was the charge for rail transportation from weighing stations to the factories where distances were too great to make trucking practical. Freight rates averaged $1.16 per ton.

Land Use and Taxes: The cost of land use was determined by taking five percent of the estimated normal agricultural value of the land and adding average real estate taxes per acre. Land values varied from $100 to $200 and averaged $161. Interest on land averaged $8.08 and taxes averaged 83 cents per acre making a total land use charge of $8.91. Taxes ranged from 45 cents to $1.25 per acre.

Manure: The costs of barnyard manure, straw plowed under and green manure crops were combined. Barnyard manure spread on the field was charged at the rate of $2.00 per ton. Forty percent of this value was charged where manure had been applied within a year prior to planting beets, 30 percent if applied within the second year, 20 percent if applied within the third year, and 10 percent if applied within the fourth year before the 1946 crop. Crops plowed under that were considered of importance were rye seedings and grain straw. Some alfalfa and sweet clover sod was plowed under for beets but the stands varied considerably. The value of these crops was determined by the cost of seed and sowing, or on the farmers' estimates.

Fertilizer and Minor Elements: Fertilizer costs used were those reported by farmers or, if actual costs were not available, charges were made at standard rates for the particular analysis of fertilizer used. Prices of fertilizer of the same analysis varied only slightly in the parts of the state included in this study. The cost of minor elements was added to the cost of the fertilizer. Minor elements included borax, manganese sulphate and copper sulphate. The entire cost of commercial fertilizer was charged against the beet crop since only in very dry years would any appreciable fertilizer remain for succeeding crops. The average

cost of commercial fertilizer was $35.62 per ton. The most common fertilizer analyses used were 2-16-8 and 2-12-6. A few farmers used 3-12-12, 0-12-12, 3-9-18, and 0-20-0.

Salt was used by three farmers at a cost of about $8.50 per ton and applied at the rate of about 500 pounds per acre.

Seed: All sugar beet seed was supplied by the sugar companies. The cost of segmented seed was 50 cents per pound in all factory districts except one where it was 60 cents. The price charged for whole seed was 20 cents per pound in all but the one district where it was 27 cents. One factory district furnished seed at the regular price or a drill and seed of either kind for $3.00 per acre.

Overhead: In order to include the part of general farm expenses that could not be charged directly to the beet crop, an overhead charge was made. This was calculated at five percent of all other expenses exclusive of marketing costs. Trucking hired and freight constituted the greater portion of marketing costs and since those items had no direct influence on general farm operating costs, all marketing costs were omitted in determing overhead.

Miscellaneous costs: Miscellaneous costs included house rent for contract labor, interest on advances made to the growers by the sugar companies and dues paid to the beet sugar associations.

House rent for labor was charged generally at 50 cents per acre where contract labor was used, and where the dwelling was not furnished by the farmer. In a few cases, where contract labor was not used for harvesting, the charge for house rent was only 25 cents an acre. On farms where the farmers provided the dwellings for laborers, depreciation was

considered.

Most growers requested that the companies advance payment for contract labor. These payments were deducted from the growers' returns when the beets were delivered. Interest was charged on payments for spring labor at the rate of about 1.9 percent for the period the payments were advanced.

Association dues were deducted from each grower's returns in all but one district where no association dues were charged for 1946. The rate varied from two to three cents per ton. These dues were paid to local beet sugar associations and partly to the Farmers and Manufacturers Beet Sugar Association for further research and administrative work in the beet sugar industry.

TOTAL BEET COSTS AND RETURNS

The 88 records in this study on sugar beets included a total of 1543 acres planted and 1494 acres harvested (Table 3). About 50 acres or about 3.2 percent of that planted was abandoned because of poor stands, drowning out, or lack of contract labor for blocking and thinning. The average acreage harvested per grower was 21 acres. Acreage of individual growers varied from 3.0 to 125 acres.

The total production of sugar beets on these farms was 14,727 net tons or an average of 9.9 tons per acre. This average is more than one ton per acre greater than the state average production for 1946. Yields on individual farms varied from 3.7 to 15.2 tons per acre.

The average cost of all operations in producing sugar beets from the 88 records used in this study was $92.92 per acre and costs varied from $54 to $149. (Table 3). Ton costs averaged $9.44 and varied from $3.75 to $23.75.

Hand labor was by far the largest single item of expense in producing beets. The average cost of this item on all farms included in this study was $29.36 per acre or 31.6 percent of all costs. This figure, however, does not represent hand labor in harvesting on all farms since one-fourth of the men used mechanical harvesters and those costs were included in farm labor, power and equipment use. On farms where hand labor was used for blocking, thinning, hoeing and harvesting, the average cost was $35.41 per acre. This cost was somewhat higher than it would have been on a straight contract basis because labor costs were higher on farms where farmers did their own work, and a few farmers who used contract labor spent extra time hoeing their own beets.

Table 3 - TOTAL SUGAR BEET PRODUCTION, COSTS AND RETURNS ON 71 FARMS IN MICHIGAN, 1946

Number of farmers who kept records	71
Number of records	88
Total acres planted	1543
Total acres harvested	1494
Average acres harvested per record	17
Total net tons produced	14,727
Average yield per acre (tons)	9.9
Average value of land per acre	$161
Average cost of fertilizer per ton	$36
Average pounds of fertilizer applied per acre	374
Pounds of seed used per acre: Segmented	3.3
Whole	9.7

COSTS *	Cost per acre	Cost per ton	Percent of total
Hand labor	$ 29.36	$ 2.98	31.6
Farm labor	13.32	1.34	14.3
Tractor work	7.26	.75	7.8
Horse work	.81	.08	0.9
Equipment use	5.58	.57	6.0
Farm truck use	1.95	.20	2.1
Trucking hired and freight	10.74	1.09	11.5
Land use and taxes	8.91	.90	9.6
Manure	1.96	.20	2.1
Fertilizer	6.75	.69	7.3
Seed	1.76	.18	1.9
Overhead	3.61	.37	3.9
Miscellaneous	.91	.09	1.0
TOTAL COSTS	$92.92	$9.44	100.0
RETURNS			
Gross Return on Beets	$160.85	$16.25	
Credit for Beet Tops	6.75	.68	
Total Credits	$167.60	$16.93	
Less total costs	92.92	9.44	
NET RETURN ON BEETS	$ 74.68	$ 7.49	

* Explanations of cost items are given on page 17.

Farm labor, consisting mostly of machine operation, was the next highest cost which averaged $13.32 per acre or 14.3 percent of the total costs. The average rate per hour for farm labor was 81 cents.

Custom work hired and freight was the third highest cost. Items included were some lifting and mechanical harvesting in addition to trucking hired and freight. These costs averaged $10.74 per acre or 11.5 percent of the total costs. One farmer had his beets lifted and two farmers had their beets machine harvested by custom work. Loading and trucking was hired for marketing beets from 49 fields. Eight farmers shipped their beets by freight from weigh stations to the factories.

Land use and taxes was the next highest item of cost which averaged $8.91 per acre or 9.6 percent of the total. Tractor work amounted to $7.26 or 7.8 percent of the total. Fertilizer costs averaged $6.75 per acre or 7.3 percent. Equipment use was next at $5.58 or 6.0 percent. All other costs including horse work, farm truck use, manure, seed, overhead and miscellaneous amounted to $11.00 per acre or the remaining 12 percent of the total costs.

Expenses in producing sugar beets were also separated into production costs, harvesting costs and marketing costs (Table 4). These costs are averages for the total acreage included in this study even though most farms did not have charges for all items.

Production costs, or costs up to harvesting, included labor, power and equipment expenses through cultivating, charges for land use, fertilizer, manure, seed, overhead and miscellaneous items. Production costs averaged $57.73 per acre and $5.87 per ton. Hand labor was the largest item in production costs and averaged $19.49 per acre. Other

items in order of their importance were land use and taxes at $8.91 per acre, fertilizer at $6.75 per acre, farm labor at $6.53 and tractor work at $5.05 per acre. The average of all other items of production costs was $11.00 per acre. Production costs were about 62 percent of the total costs of producing, harvesting and marketing beets.

Table 4 - SUGAR BEET PRODUCTION, HARVESTING AND MARKETING COSTS ON 71 FARMS IN MICHIGAN, 1946

Item	Cost per acre	Cost per ton	Percent of total
Production Costs:			
Hand labor	$19.49	$ 1.98	21.0
Farm labor	6.53	.66	7.0
Tractor work	5.05	.52	5.4
Horse work	.60	.06	.6
Equipment use	2.16	.22	2.3
Land use and taxes	8.91	.90	9.6
Manure	1.96	.20	2.1
Fertilizer	6.75	.69	7.3
Seed	1.76	.18	1.9
Overhead	3.61	.37	3.9
Miscellaneous	.91	.09	1.0
Total	$57.73	$ 5.87	62.1%
Harvesting Costs:			
Hand labor	$ 9.87	$ 1.00	10.6
Farm labor	3.68	.37	4.0
Tractor work	1.84	.19	2.0
Horse work	.21	.02	0.2
Equipment use	2.95	.30	3.2
Total	$18.55	$ 1.88	20.0%
Marketing Costs:			
Farm labor	$ 3.11	$ 0.31	3.4
Tractor work	.37	.04	0.4
Farm truck use	1.95	.20	2.1
Equipment use	.60	.06	0.6
Trucking hired	9.08	.92	9.8
Freight	1.53	.16	1.6
Total	$16.64	$1.69	17.9%
Total of all items	$92.92	$ 9.44	100.0%

Harvesting costs included labor, power and equipment expenses in lifting, pulling and topping, mechanical harvesting and pitting. The average cost per acre for harvesting on 71 farms was $18.55 which was about 20 percent of all costs. The largest item of expense in harvesting was hand labor which averaged $9.87 per acre. About one-fourth of the growers used mechanical harvesters and had no charges for hand labor for pulling and topping. Farm labor costs averaged $3.68 per acre in harvesting. This cost was relatively high because labor used in mechanical harvesting was included in that item. Equipment use was also high at $2.95 per acre because of the high cost of mechanical harvester use.

Marketing costs averaged $16.64 per acre and were about 18 percent of the total costs. The highest item of expense in marketing was trucking hired which averaged $9.08 per acre for the 71 farms. Farm labor, truck use and freight were other major items of expense in marketing. Only 8 farmers shipped beets by freight and, because this item was quite high on those farms, the average cost on all farms was $1.53 per acre and 16 cents per ton.

Costs were also separated by operations and averages were based on the total acreage included in this study (Table 5). Since all operations were not performed on each farm, the average costs do not indicate the actual acre costs of doing each operation but merely the average costs on all farms.

The highest cost operation was blocking and thinning which averaged $19.49 per acre. All fields of beets included in this study were blocked and thinned with hand labor. The rates for this work as established by the United States Department of Agriculture for 1946 was $18.00 per acre

for beets planted with segmented seed and $20.00 per acre for beets planted with whole seed. Variations in the costs of this work were not very large except on farms where the work was done by farm labor.

Table 5 - SUGAR BEET COSTS BY OPERATIONS ON 71 FARMS IN MICHIGAN, 1946

Operation	Cost per acre						Cost per ton
	Hand labor	Farm labor	Power	Equip-ment	Work hired	Total	
Production Operations:							
Plowing	-	$ 1.04	$0.97	$0.31	-	$ 2.32	$0.24
Fitting	-	1.83	1.71	.51	-	4.05	.41
Broadcasting fertilizer	-	.19	.14	.13	-	.46	.05
Planting	- -	.66	.48	.56	-	1.70	.17
Blocking and thinning	$19.49	-	-	-	-	19.49	1.98
Cultivating	-	2.81	2.35	.65	-	5.81	.49
Total	$19.49	$ 6.53	$5.65	$2.16		$33.83	$3.44
Harvesting Operations:							
Lifting	-	$ 1.23	$1.00	$0.34	$ 0.03	$ 2.60	$0.26
Hand Harvesting	9.87	-	-	-	-	9.87	1.00
Mech. "	-	2.11	.86	2.07	.10	5.14	.52
Pitting	-	.33	.19	.42	-	.94	.10
Total	$ 9.87	$ 3.67	$2.05	$2.83	$ 0.13	$18.55	$1.88
Marketing Operations:	-	$ 3.11	$ .37	$2.55	$10.61	$16.64	$1.69
Total Operation Costs:	$29.36	$13.32	$8.07	$7.53	$10.74	$69.02	$7.01
Other Production Costs:							
Manure and cover crops						$ 1.96	$0.20
Fertilizer						6.75	.69
Seed						1.76	.18
Land use						8.91	.90
Overhead						3.61	.37
Miscellaneous						.91	.09
Total						$23.90	$2.43
Total Costs						$92.92	$9.44

Hand harvesting was the next highest operation which averaged $9.87

on all farms. About three-fourths of the farmers harvested by this method. The average cost of all harvesting including hand labor and mechanical methods was $18.55 per acre.

Other operation costs in order of their importance were cultivating, mechanical harvesting, fitting, lifting, plowing, planting, pitting and broadcasting fertilizer. The average cost of these operations on all farms was $23.02 per acre or about 25 percent of all costs.

Hand labor required on these farms for blocking, thinning, hoeing and harvesting averaged 49 hours per acre (Table 6). Hand labor was used to block and thin all beets. The average hours required for all blocking, thinning and hoeing was 32.1 hours per acre. Not all beets were harvested by hand. On farms where hand labor was used, it took 27.6 hours to pull and top an acre of beets yielding an average of 9.9 tons. Where contract labor was used both for spring work and for harvesting the average total time required was 59.7 hours.

The average hours of farm labor spent in plowing, fitting, planting, cultivating, harvesting, etc., was only 16.4 hours. Operations that took the most time were marketing, cultivating, mechanical harvesting and fitting ground for planting. These farms used an average of 2.4 hours of horse work per acre for beets or 1.2 hours for a team. Tractors were used an average of 9.9 hours per acre for beets of which about 70 percent was used in production work through cultivating. Although most farm labor was used for machine operation, there were more man hours than tractor hours because several machines, especially harvesters, required at least two men.

Notable changes have taken place during the last ten years in labor requirements. As a comparison to labor and power requirements as determined

by this study, during the period from 1933 to 1936 it took 72 hours of hand labor, 15.1 hours of farm labor for machine operation, 26.5 hours of horse work and 214 hours of tractor work per acre of beets.* Hand labor requirements have been reduced to about 70 percent of the amount required in 1933 to 1936. Factors that have brought about this reduction were the use of segmented seed, improved weed control, improved cultural methods, the replacement of hand labor by mechanical harvesters and the use of mechanical loaders. Farm labor requirements have remained about the same as ten years ago but a part of this farm labor is now used in mechanical harvesting which is replacing hand harvesting. Improved machines and techniques have made it possible to do the same work much faster than was possible ten years ago.

Table 6 - AVERAGE HOURS OF LABOR AND POWER PER ACRE IN SUGAR BEET PRODUCTION IN MICHIGAN, 1946 **

Operation	Hand labor	Farm labor	Tractor work	Horse work
	Hours	Hours	Hours	Hours
Plowing	-	1.3	1.2	0.1
Fitting	-	2.3	2.1	0.2
Broadcasting fertilizer	-	0.2	0.2	0.1
Planting	-	0.8	0.6	0.2
Cultivating	-	3.5	2.8	1.2
Blocking and thinning	32.1	-	-	-
Total Production	32.1	8.1	6.9	1.8
Lifting	-	1.5	1.1	0.6
Pulling and topping	17.1	-	-	-
Machine harvesting	-	2.6	1.1	-
Pitting	-	0.4	0.3	-
Total harvesting	17.1	4.5	2.5	0.6
Total marketing	-	3.8	.5	-
Total production, harvesting, and marketing	49.2	16.4	9.9	2.4

** Several operations represent records only from a part of the farms but average hours are based on the total acreage included in this study.

* Wright, K. T., SUGAR BEET COSTS AND RETURNS IN MICHIGAN. Mich. Agr. Exp. Sta. Spec. Bul. 305.

There has been a reversal of the hours of tractor and horse work used for sugar beets from that of ten years ago. The average hours of horse work from 1933 to 1936 was 26.5 hours per acre and the hours of tractor work was 2.4. In this study the average hours of horse work on beets was 2.4 and the average hours of tractor work was 9.9 per acre. The cost of horse work was only 10 percent of the power costs and only about one percent of all costs.

Returns: The average price received for beets in Michigan in 1946 was $16.25 per ton including government payments.* Prices varied slightly from one factory district to another because of differences in sucrose content of the beets. The average gross returns per acre was $160.85 based on an average yield of 9.9 tons.

Credit was also given for beet tops. The average of all estimates on the value of beet tops was $6.75 per acre. Estimates were made only by farmers who fed the beet tops, however, the average value was used for all farms whether tops were fed or left on the fields for fertilizer.

Total credits for the beet crop averaged $167.60 per acre and $16.93 per ton. Total credits less total expenses of $92.92 per acre or $9.44 per ton left an average net return on beets of $74.68 per acre or $7.49 per ton. Net returns per acre varied from a gain of $185.79 to a loss of $37.51.

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* Reeve, P. A., Farmers and Manufacturers Beet Sugar Association, Saginaw, Michigan. Personal correspondence with the author, May 6, '47.

EFFECTS OF PRODUCTION PRACTICES ON COSTS

Production costs, including all operations up to harvesting, charges for land use, manure, fertilizer, seed, overhead and miscellaneous items, averaged $57.73 per acre and $5.87 per ton (Tables 4 and 5). These were discussed briefly in the previous section. The practices that caused variation in yields, costs or time required to perform production operations are discussed in more detail in this section.

Plowing and "Fitting": Out of 88 fields, 13 fields were not plowed for beets. Most of the fields that were not plowed had beans in the rotation preceding beets. Of the 75 fields that were plowed, only one was plowed with horses (Table 7). An average of 1.5 man hours per acre were required to plow with tractors as compared to 2.4 hours per acre with horses. Although one record is insufficient for reliable comparison, it does indicate that the use of horses increases costs because of the longer time required to perform the work. This is particularly true where labor rates are high.

Table 7 - PLOWING METHODS AND COSTS ON SUGAR BEETS IN MICHIGAN, 1946

Method	Number records	Acres per record	Yield per acre tons	Labor Hrs/A.	Cost per acre Labor	Power	Machine	Total
Fall:								
Tractor	20	11.6	10.3	1.9	$1.50	$1.42	$0.41	$3.33
Horse	1	24.9	6.4	2.4	1.95	1.20	.61	3.76
Spring:								
Tractor	42	16.6	9.5	1.2	.97	.92	.34	2.23
Both Spring and Fall:								
Tractor	12	28.2	10.2	1.8	1.42	1.32	.35	3.09
Average	75	17.2	9.7	1.5	$1.20	$1.12	$0.36	$2.68

The average yield of beets from fall plowed land was 0.4 tons per

acre greater than the yield from spring plowed land assuming other conditions to be the same. Factors that might have been partly responsible for this difference were firmer seed beds and more soil moisture retained after fall plowing.

An average of 2.3 hours were spent per acre in "fitting" ground for beets (Table 8). "Fitting" included all harrowing, dragging, disking, rolling, and cultipacking. The average cost of this work was $4.05 an acre. Costs of "fitting" by different methods varied from $3.68 per acre to $4.86. The cost of "fitting" land not plowed was 57 cents per acre more than on land that was plowed, however, the combined plowing and "fitting" cost was $2.11 less per acre on land that was not plowed.

Table 8 - "FITTING" COSTS FOR SUGAR BEETS IN MICHIGAN, 1946

Method	Number records	Acres per record	Yield per acre tons	Labor Hrs/A.	Cost per acre Labor	Power	Machine	Total
After fall plowing	21	12.3	9.9	2.1	$1.74	$1.55	$0.54	$3.83
After spring plowing	42	16.6	9.5	2.1	1.66	1.52	.50	3.68
No plowing	13	15.5	10.6	2.4	1.96	1.85	.49	4.30
Mixed methods	12	28.2	10.2	2.7	2.17	2.15	.54	4.86
Average	88	17.0	9.9	2.3	$1.83	$1.71	$0.51	$4.05

Higher costs could be expected in "fitting" following fall plowing than following spring plowing because more harrowing was necessary to prepare the seed bed. Higher costs where "fitting" followed mixed methods of plowing may be a reflection of the general inefficiency of those farmers in more time spent on small fields or in working the same fields by different methods.

The yield of beets was also 0.9 tons higher on land that was not plowed. The same factors, firmer seedbeds and more soil moisture retained,

may have been conditions that influenced yields on land not plowed even to a greater extent than on land that was fall plowed. The spring and summer of 1946 were very dry and any measures used to conserve moisture during that season undoubtedly were reflected in higher yields. Since most of the fields that were not plowed were in beans the preceding year, there probably was a carry-over of fertilizer nutrients that had a considerable influence on beet yields.

Fertilizer and Manure: Where commercial fertilizer was broadcast in addition to row application, the average amount used was 487 pounds per acre (Table 9). Where applied only in the row, the application was only 314 pounds per acre. The yield of beets where fertilizer was broadcast in addition to row application was 1.0 tons per acre more than where fertilizer was applied only at the time of planting.* Differences in soil types may also have been a factor in increasing yields where heavier applications of fertilizer were used, however, adequate information was not available to determine the effect of soils on yield. Where fertilizer was broadcast, the cost of fertilizer per acre was $2.73 more than where applied only in the row. The cost of application was $1.28 per acre making a total cost of $4.01 more per acre where fertilizer was broadcast. No separate cost of applying fertilizer was considered when put on at the time of planting since it was a combined operation and the additional expense would be negligible.

Total fertilizer applications varied from 118 pounds to 718 pounds and averaged 374 pounds per acre. The records were sorted into three groups based on total fertilizer used disregarding method of application

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* Dr. R. L. Cook, Soils Department, Michigan State College, stated that this was not an unreasonable increase to expect from the added amount of fertilizer.

Table 9 - FERTILIZER APPLICATION METHODS AND ACRE COSTS ON SUGAR BEETS IN MICHIGAN, 1946

Method of application	Number records	Acres per record	Yield per acre	Fertilizer		Application cost	Total Cost
				Lbs./A.	Cost/A.		
			tons				
Broadcast and in row	34	15.2	10.5	487	$8.44	$1.28	$9.72
In row only	54	18.1	9.5	314	5.71	-	5.71
Difference	-	-	1.0	173	$2.73	$1.28	$4.01

(Table 10). Nineteen records in the low group averaged 208 pounds of fertilizer per acre, 39 records in the medium group averaged 364 pounds per acre, and 30 records in the high group averaged 550 pounds per acre. There was a difference of 342 pounds of fertilizer between the low and high groups, a difference in costs of $7.13 including the cost of broadcasting, and a difference of 1.3 tons per acre in yield. Higher yields may have been due partly to larger amounts of fertilizer used but other good management practices may be equally responsible. None of the farmers in the low group broadcast fertilizer, 23 percent in the middle group, and 83 percent of the high group broadcast fertilizer in addition to applying it in the row.

Table 10 - FERTILIZER USE BY QUANTITY AND COSTS ON SUGAR BEETS IN MICHIGAN, 1946

Quantity of fertilizer	Number records	Acres per record	Yield per acre	Av. fert. per acre	Fields broadcast	Cost per acre *
pounds			tons	pounds		
0 - 249	19	17.8	9.0	208	0	$ 3.70
250 - 449	39	20.3	10.0	364	9	6.77
450 - over	30	12.1	10.3	550	25	10.83
Average	88	17.0	9.9	374	34	$ 7.21

* Costs include both fertilizer and the application costs where fertilizer was broadcast.

During the past four years, barnyard manure was applied on 41 or nearly one-half of the fields on which records were kept for this study.

The usual application was about 8 to 10 tons per acre. Manure was valued at $2.00 per ton spread on the fields. Forty percent of the value was charged against the beet crop where manure was applied during the first year prior to planting beets, 30 percent where applied during the second year, 20 percent for the third year and 10 percent where applied during the fourth year prior to planting beets. The average charge for manure applied on these fields, was $4.19 per acre.

Applications of commercial fertilizer on fields where manure had been applied during the past four years averaged 334 pounds per acre. Applications on fields where no manure had been applied averaged 394 pounds or 60 pounds more per acre. This would indicate that farmers generally apply less commercial fertilizer on land that has been manured recently.

Blocking and Thinning: The average time required by contract labor to block and thin beets was 31.5 hours per acre where segmented seed was planted as compared to 34.9 hours per acre where whole seed was used (Table 11). This was 3.4 hours per acre less on fields planted with segmented seed, a saving of about 10 percent in labor requirements. Where contract labor was used, the cost of blocking and thinning was $1.25 per acre less where segmented seed was planted than where whole seed was used. The rates for blocking and thinning established by the United States Department of Agriculture were $2.00 lower per acre for plantings of segmented seed than for whole seed, however, some farm labor was used for hoeing after contract labor, and several farmers were charged the maximum rate even though they used segmented seed.

There were considerable variations in time, costs and yields where

farmers block and thinned their own beets, however, only 8 records were available where the work was done by this method. The advantage of using segmented seed was more pronounced in those records than in the ones where contract labor was used. Other cropping practices than the difference in type of seed used may have been at least partly responsible for the higher yields, lower time requirements, and lower costs where segmented seed was used.

Table 11 - EFFECT OF SEED TYPE ON BLOCKING AND THINNING SUGAR BEETS IN MICHIGAN, 1946

Seed type and labor	Number records	Acres per record	Yield per acre	Hours per acre	Cost per acre
			tons		
Segmented Seed:					
Contract labor	56	19.1	9.9	31.5	$18.92
Farm labor	6	9.5	12.6	25.9	20.96
Whole Seed:					
Contract labor	24	14.7	9.6	34.9	20.16
Farm labor	2	8.6	7.2	45.1	36.54
Average	88	17.0	9.9	32.1	$19.49

Only 8 out of 71 farmers who kept records, or 11 percent, blocked and thinned their own beets (Table 12). This group had only 5 percent of the total acreage. All others used contract labor. No farmers in this study used mechanical methods of blocking. The average acreage of beets on farms where blocking and thinning was done by farm labor was only 9.3 acres as compared to 17.8 acres on farms where contract labor was used. There was a difference in yield of about 1.6 tons more per acre where farmers did their own hand labor.

Although the average time required to block and thin beets by farm labor was almost two hours less per acre than that required where contract labor was used, the cost per acre was $5.36 more. This is due

to the difference in labor rates of 21 cents more per hour for farm labor.*

Table 12 - BLOCKING AND THINNING METHODS AND COSTS ON SUGAR BEETS IN MICHIGAN, 1946

Method	Number records	Acres per record	Yield per acre	Hours per acre	Rate per hour	Cost per acre
			tons			
Contract labor	80	17.8	9.7	32.2	$0.60	$19.22
Farm labor	8	9.3	11.3	30.3	.81	24.58
Difference	-	-	1.6	-1.9	$0.21	$ 5.36

Normally the most desirable time to block and thin sugar beets is within the first two weeks after the row can be seen plainly. Weather conditions during some years may have an influence in determining the best time, especially when stands have not emerged uniformly because of variable moisture conditions.

Usually in about two weeks after the plants have emerged; they are about at the "four leaf" stage. Experiments have indicated a decrease in yield when blocking and thinning was delayed beyond the second week after emergence.** After the beets have passed the "four leaf" stage there is more danger of weakening the remaining plants in the thinning process. With the use of segmented seed, it is possible to obtain more uniform

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* Actual payments for contract labor and time spent by contract labor in doing the work as reported by the farmers themselves were used in calculating the hourly rate for contract labor. An accurate record was not available for the hours of contract labor on all farms but the hours were adjusted on the basis of records that were complete. Most farmers experienced difficulty in keeping records on time spent by contract labor because all of the workers did not usually start or finish at regular times each day nor did the same number of laborers always work on the same fields on successive days. Very frequently men, women, and children all worked together in the same fields. This condition made it difficult to keep records on the basis of hours of adult labor.

** Lill, J. G., SUGAR BEET CULTURE IN THE HUMID AREAS OF THE UNITED STATES. U. S. Dept. of Agr. Farmer's Bul. 1637.

placement than is possible with whole seed. This may be a factor in reducing the damage in thinning and it may also be possible to delay thinning without danger to the stand if the work can be done without distrubing the remaining plants.

Seed and Planting: Segmented seed was used on 1124 acres or on about 75 percent of the acreage of beets covered in this study. The average rate of planting segmented seed was 3.3 pounds per acre. Whole seed was used on 369 acres at the average rate of 9.7 pounds per acre.

There was a difference in yield of 0.53 tons per acre in favor of segmented seed. Although the difference is not large and yields may have been affected by other conditions in 1946, it may indicate that more uniform and more vigorous stands of beets were obtained with segmented seed than with whole seed. Experiments under controlled conditions have indicated that beets planted with segmented seed out-yielded beets planted with whole seed by an average of 6.6 percent. The reason given for the increased yield was that seedlings from plats planted with segmented seed were damaged to a lesser extent in the thinning process than were seedlings from whole seed.*

The average cost of all seed was $1.76 per acre. The cost of segmented seed averaged $1.68 and the cost of whole seed averaged $2.00 per acre. This was a saving of 32 cents per acre in using segmented seed.

The net difference in using segmented seed compared to whole seed on the farms included in this study were (1) a saving of 32 cents per acre

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* Bell, R. W., Robertson, L. S. and Cook, R. L., THE EFFECT OF SHEARING SUGAR-BEET SEED ON STAND OF BEETS, ON LABOR REQUIREMENTS AT THE TIME OF BLOCKING AND THINNING AND ON YIELD OF BEETS. Mich. Agr. Exp. Sta. Quart. Bul., Vol. 28, No. 2. Nov. '45.

in seed costs, (2) a saving of 3.4 hours of labor per acre in blocking and thinning where contract labor was used, (3) a saving of $1.25 per acre in the cost of contract labor for blocking and thinning, and (4) an increase in yields of about a half a ton per acre.

There was very little difference in labor needs and costs between the use of horses and tractors in planting (Table 13). Because of the greater accuracy of planting attained at slow speeds, tractors were seldom driven faster than three miles per hour. For this reason, there was not a very large saving in time by planting with a tractor. However, the total difference in costs between the two methods was 29 cents less per acre where tractors were used. The average time required to plant beets was 0.8 hours per acre and the average cost for labor, power and machine use was $1.71 an acre.

Table 13 - PLANTING METHODS AND COSTS ON SUGAR BEETS IN MICHIGAN, 1946

Methods	Number records	Acres per record	Yield per acre	Labor Hrs/A.	Cost per acre			
					Labor	Power	Machine	Total
			tons					
Tractor	77	17.2	9.7	0.8	$0.66	$0.46	$0.55	$1.67
Horse	11	15.3	10.9	0.9	.72	.63	.61	1.96
Average	88	17.0	9.9	0.8	$0.66	$0.48	$0.56	$1.70

Cultivating: The average cost of cultivating was $5.81 per acre (Table 14). Labor costs averaged $2.81, power $2.35, and machine costs averaged 65 cents per acre. The cost where beets were cultivated with horses was $3.03 more per acre than where tractors were used.

Beets were cultivated an average of 4.5 times where tractors were used compared to 4.7 times where horses were used. Seventy-five fields were cultivated entirely with tractors, 11 fields were cultivated entirely with horses and both horses and tractors were used on two fields. The

acreage on which horses were used for cultivating was only about 10 percent of the total acreage included in this study but horse work amounted to 25 percent of the total power costs in cultivating. An average of 2.2 man hours more per acre was required where horses were used for cultivating than where tractors were used.

Table 14 - CULTIVATING METHODS AND COSTS ON SUGAR BEETS IN MICHIGAN, 1946

Power	Times cult.	Number records	Acres per record	Yield per acre tons	Labor Hrs/A.	Cost per acre Labor	Power	Machine	Total
Tractor	3	10	17.3	12.0	1.8	$1.44	$1.12	$0.57	$3.13
	4	26	19.3	9.6	3.0	2.40	2.00	.46	4.86
	5	30	17.8	10.2	3.5	2.82	2.44	.86	6.12
	6	9	13.1	8.2	4.6	3.75	3.31	.94	8.00
Av.	4.5	75	17.7	10.0	3.2	$2.56	$2.17	$0.68	$5.41
Horse	4	6	14.5	7.3	5.4	$4.34	$3.45	$0.38	$8.17
	5	2	16.6	10.5	3.4	2.78	2.30	.51	5.59
	6	3	8.8	10.6	7.9	6.43	5.82	.65	12.90
Av.	4.7	11	13.3	8.6	5.4	$4.36	$3.62	$0.46	$8.44
Mixed Methods	6.0	2	9.3	9.9	10.0	$8.12	$4.91	$0.39	$13.42
Average all cult.	4.6	88	17.0	9.9	3.5	$2.81	$2.35	$0.65	$ 5.81

Costs were progressively higher as the number of cultivations increased where tractors were used. There was a difference of $4.87 between three and six cultivations. The costs increased at an average of $1.62 per additional cultivation.

EFFECTS OF HARVESTING PRACTICES ON COSTS

Harvesting costs included all costs of lifting, pulling and topping, mechanical harvesting, and pitting or piling. The average cost of harvesting per acre on all farms was $18.55 (Table 4 and 5).

Lifting: Of the total acreage included in this study, 922 acres or about 62 percent of the beets were lifted with the use of horses or tractors and were pulled and topped by hand. Mechanical harvesters were used on the rest of the beets.

The average cost of lifting was $4.27 per acre (Table 15). The average time required per acre to lift beets was 2.5 hours. The cost of lifting with tractors was $2.11 less than the cost of lifting with horses. One farmer hired a man, tractor and machine to lift his beets at the rate of $2.00 per acre. Lifting with horses required about 1.2 hours more per acre or about a third more time than lifting with tractors. This again shows an advantage in the lower costs and shorter time required for tractor operations compared to horse work.

Table 15 - LIFTING METHODS AND COSTS ON SUGAR BEETS IN MICHIGAN, 1946

Method	Number records	Acres per record	Yield per acre	Labor Hrs/A.	Cost per acre			
					Labor	Power	Machine	Total
			tons					
Tractor	61	12.7	10.2	2.4	$1.91	$1.51	$0.56	$3.98
Horses	8	15.1	8.6	3.6	2.92	2.62	.55	6.09
Hired	1	24.8	9.7	-	-	-	-	2.00
Average	70	13.2	10.0	2.5	$2.05	$1.66	$0.56	$4.27

Pulling and Topping: Of the total acres included in this study, 884 acres or 54 percent of the beets were harvested by contract labor. Only 38 acres or about 3 percent of the beets were pulled and topped by hand labor. The cost of contract labor in harvesting averaged $15.53 per acre

(Table 16).* Only six records were available where farmers pulled and topped their own beets and the acreage of beets on these farms was usually quite small, averaging only 6.4 acres. The cost of pulling and topping per acre on these farms was $26.49. The hours required by farm labor to pull and top beets was only 8 hours more per acre than the time required for contract labor but the cost was about $11.00 more per acre. The reason for this difference was that the hourly rate for farm labor was about 24 cents higher than the rate for contract labor. The cost of contract labor in harvesting averaged 57 cents per hour and the cost of farm labor averaged 81 cents.

Table 16 - PULLING AND TOPPING COSTS IN HARVESTING SUGAR BEETS IN MICHIGAN, 1946

Method	Number records	Acres per record	Yield per acre	Hours per ton	Hours per acre	Cost per ton	Cost per acre
			tons				
Contract labor	63	14.0	10.0	2.7	27.4	$1.55	$15.53
Farm labor	6	6.4	9.6	3.4	32.7	2.76	26.49
Average	69	13.4	10.0	2.8	27.6	$1.60	$15.98

Mechanical harvesting: Mechanical harvesters were used by 18 farmers out of the 71 who cooperated on this project. This included records on 26 fields, a total of 571 acres or about 38 percent of the acreage included in this study. Sixteen of the farmers owned their harvesters and did their own work. Two farmers had their beets harvested by custom work. Although there were harvesters of several makes in use throughout this area, all of those on which records were kept were Scott-Urschel machines.

Costs of mechanical harvesting where machines were owned varied

* Contract labor rates as determined by the United States Department of Agriculture were $15.60 per acre for beets yielding 10.0 tons per acre.

from $6.95 to $18.37 per acre. The average cost was $13.48 per acre or $1.39 per ton (Tables 17 and 18). Custom harvesting was charged at the same rate as contract labor based on yield per acre with an additional charge of 25 to 50 cents per ton for lifting. The average charge on the two farms where beets were custom harvested was $11.58 per acre. This cost was lower than the costs on other farms because of the difference in yield which was 4.2 tons per acre lower than on farms where harvesters were owned.

Table 17 - ACRE COSTS OF MECHANICAL HARVESTING SUGAR BEETS IN MICHIGAN, 1946

Method	Number records	Acres per record	Yield per acre	Labor Hrs/A.	Cost per acre			
					Labor	Power	Machine	Total
			tons					
Own machine	24	23.3	9.7	6.8	$5.65	$2.31	$5.52	$13.48
Hired	2	6.3	5.5	-	-	-	-	11.58
Average	26	22.0	9.6	-	-	-	-	$13.44

Table 18 -TON COSTS OF MECHANICAL HARVESTING SUGAR BEETS IN MICHIGAN, 1946

Method	Number records	Acres per record	Yield per acre	Labor Hrs/T.	Cost per ton			
					Labor	Power	Machine	Total
			tons					
Own machine	24	23.3	9.7	0.7	$0.58	$0.24	$0.57	$ 1.39
Hired	2	6.3	5.5	-	-	-	-	2.11
Average	26	22.0	9.6	-	-	-	-	$ 1.40

The total costs of mechanical harvesting where harvesters were owner-operated included 42 percent for labor, 41 percent for machine use and 17 percent for power.

Hours of man labor used in machine harvesting averaged 7.0 hours per acre and varied from 3 to 10. Labor costs averaged $5.65 and varied from $2.40 to $8.10 per acre. Farmers having the lowest labor costs used only two men to operate the tractor and machine, whereas the high cost farmers used three and even four men. The extra men were used as general

mechanics, for topping untopped beets in the load or for picking up stray beets that were missed by the machines. Some farmers hired extra labor to pick up beets left in the fields. They found that, with the high labor costs, the beets left on the field after machine harvesting were hardly worth the extra cost of picking them up.

Mechanical harvesting required from 1.3 to 3.3 hours of harvester operation per acre. On a daily basis, it was possible to harvest from 3 to 7 acres. The speed at which the machines were operated, width of rows, soil types, soil conditions, and the skill of the operator all had an effect on the number of acres that could be harvested in a day.

The cost of harvester use varied from $3.63 to $8.56 per acre and averaged $5.52. Factors causing this variation were number of acres harvested, depreciation based on the estimated life of the machine, and repairs. The acres harvested by the 18 owner-operated harvesters during the season varied from 40 to 128 acres. Depreciation was calculated from the farmers' estimates of the expected life of the machines which varied from 3 to 10 years. Since almost all the machines were new in 1946, the value of each machine was considered the same as the original cost. The purchase price was about $1600 unless extra parts were added. The average estimated life was 6 years and depreciation on that basis was $265 per year. Interest was figured at 5 percent of the purchase price. Insurance, taxes and housing was charged at 2 percent of the purchase price. The cost of repairs and new parts was about $90 per machine for the season.

Repair costs varied considerably and were higher on machines that harvested large acreages. No estimate was made on the cost of repairs necessary to condition the machines for the next year's operation. Since

most of the machines were new in 1946, repair costs are likely to be higher each year as the machines become older. For practical purposes, repair costs can be considered about $1.00 per acre. This estimate is comparable to that determined in other studies on mechanical harvester use in this area in 1946.*

The average power cost for operating mechanical harvesters was $2.31 per acre and varied from $1.00 to $3.00. Since harvesters are quite heavy machines, larger tractors were generally used for mechanical harvesting than for most other operations.

Assuming that depreciation, interest, insurance, taxes and housing are constant regardless of the amount of use, and that repairs, labor costs and power costs are proportional to the acreage, it is possible to determine the cost per acre for mechanical harvesting for any given acreage (Table 19). The average costs as determined in this study were used in this table but acreages are theoretical. The effect of harvester use on cost per acre is also shown in graphic form (Figure 3). It was found that costs were the same for mechanical harvesting as for hand harvesting when machines harvested a total of about 33 acres yielding 9.9 tons of beets per acre. Thus, on the basis of these results, a farmer would have to harvest at least 33 acres of beets with a machine each season in order that his costs will be no greater than the cost of hand harvesting.

There was an average saving by mechanical harvesting of $6.77 per acre or 77 cents per ton. This was determined by considering the average

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* Reeve, P. A. RESULTS SECURED WITH SUGAR BEET HARVESTERS IN THE EASTERN AREA IN 1946. Proceedings American Society of Sugar Beet Technologists, Eastern United States and Canada. Detroit, Mich., 1947.

Hentchel, Herbert, COST OF OPERATION OF SUGAR BEET COMBINES IN 1946. Mich. State Col. Farm Mgt. Dept. unpublished report.

cost of lifting at $4.27 per acre (Table 15) and the average of hand harvesting at $15.98 (Table 16) or a total of $20.25 per acre. The most efficient growers saved up to $13.30 an acre by harvesting with mechanical harvesters and the least efficient saved $1.88 per acre. Savings by mechanical harvesting varied from almost nothing to about two-thirds of the cost of hand harvesting and averaged about one-third. There are also other factors that should be considered.

Table 19 - EFFECT OF AMOUNT OF BEET HARVESTER USE ON COSTS PER ACRE *

Acres per machine	20	40	60	80	100	120	140
Fixed costs:							
Deprec. @ 16.7%	265.00	265.00	265.00	265.00	265.00	265.00	265.00
Interest @ 5%	80.00	80.00	80.00	80.00	80.00	80.00	80.00
Ins., taxes, housing @ 2%	32.00	32.00	32.00	32.00	32.00	32.00	32.00
Variable costs:							
Repairs @ $1.00 per acre	20.00	40.00	60.00	80.00	100.00	120.00	140.00
Labor @ $5.65 per acre	113.99	226.00	339.00	452.00	565.00	678.00	791.00
Power @ $2.31 per acre	46.20	92.40	138.60	184.80	231.00	277.20	323.40
Total Costs	556.20	735.40	914.60	1093.80	1273.00	1452.20	1631.40
Cost per acre	27.81	18.38	15.24	13.67	12.73	12.10	11.65
Machine lifting, & hand topping	20.25	20.25	20.25	20.25	20.25	20.25	20.25
Difference	-7.56	1.87	5.01	6.58	7.52	8.15	8.60

* Acreages are theoretical. Cost items are averages as determined in this study.

The largest item of expense in mechanical harvesting was labor costs. Most of these machines were used for the first time in 1946 by inexperienced operators which undoubtedly resulted in less efficient use than might have been possible. It has been demonstrated that only two men are necessary to

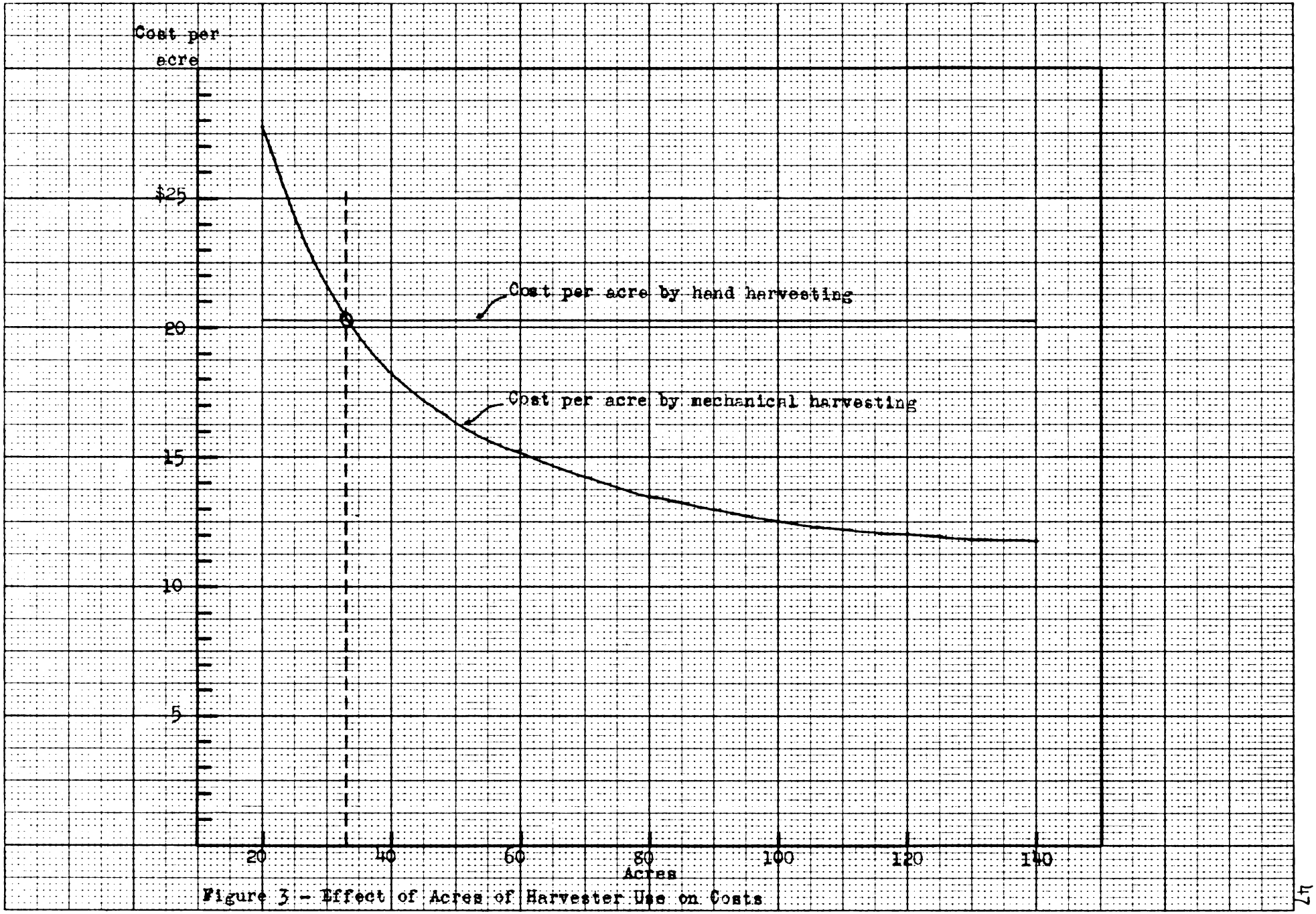

Figure 3 - Effect of Acres of Harvester Use on Costs

Acreages are theoretical. Cost items are averages as determined in this study.

operate these harvesters under most conditions.

Since beet harvesters were not used extensively in this area before 1946, it is difficult to determine how many years they can be expected to last and what charges should be made for depreciation. Estimates on the expected life of the harvesters varied between three and ten years and averaged about six years. It is possible that many of them may last for a much longer time than the present estimates, particularly where they are used for relatively small acreages each season. On the other hand, repair expenses may have been figured too low for most machines in 1946 since no accurate data could be obtained on repairs needed to put the machines in condition for the next year's harvest.

Another saving in the use of harvesters is in the cost of loading. These costs involve the use of a loader, labor and power to operate the loader, or a considerable amount of labor when beets are forked into trucks from piles or windrows. On the other hand, hauling costs would be somewhat higher when beets are loaded directly from the harvester because of the additional traveling in the field required by a truck when loading only one row at a time.

Most farmers visited were very favorably impressed with the operation of harvesters. A few, however, expressed some disadvantages. The initial cost of a harvester is quite high and a farmer with a small acreage of beets can hardly afford to own one unless he plans on doing custom harvesting. Soil conditions affected the operation of the machine considerably. Dry silt or clay soils tended to form clods which made operation difficult. Wet soils adhered to working parts of the machines. Stony or gravelly soils caused excessive wear. A few farmers expressed opinions

that the machines were too complicated in construction especially for hired help to keep in proper repair and adjustment. Many farmers were concerned about excessive packing of the soil resulting from travel in fields by heavy machines and by heavily loaded trucks.

In addition to lower costs, there are other advantages which favor harvesting beets mechanically. (1) Harvesting can be delayed later in the fall for maximum growth of the beets. Opinions expressed among farmers were that harvesting too early reduced yields up to three tons per acre. With contract labor it is usually necessary to harvest when labor is available. (2) There is usually an opportunity to wait for ideal weather and soil conditions rather than harvest when the soil is either too wet or too dry. (3) Beets can be delivered to the factory promptly to eliminate shrinkage. Tests have shown that fresh beets are favored at the factory because of better storage qualities.* (4) With mechanical harvesters, the constant uncertainty in obtaining contract labor is eliminated.

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* Wait, R., DELIVERY AND STORAGE OF FRESH BEETS. Proceedings American Society of Sugar Beet Technologists, Eastern United States and Canada. Detroit, Mich., 1947.

EFFECTS OF MARKETING PRACTICES ON COSTS

Marketing costs included labor, power, equipment use, trucking and freight costs in delivering the beets from the field to the factory. The average cost of marketing on all farms was $16.64 per acre. The average cost per ton was $1.69 (Tables 4 and 5).

Loading: Three methods of loading were used where beets were piled or windrowed. These were (1) hand loading where beets were forked into a wagon or truck, (2) hand-mechanical where fork-in loaders were used, and (3) mechanical where pickup loaders were used. The average cost of loading by all methods was $4.74 per acre or 45 cents per ton (Tables 20 and 21).

Table 20 - ACRE COSTS OF LOADING SUGAR BEETS IN MICHIGAN, 1946 *

Method	Number records	Acres per record	Yield per acre	Labor Hrs/A.	Cost per acre			
			tons		Labor	Power	Machine	Total
Hand	4	5.3	8.5	4.0	$3.22	$0.00	$0.00	$3.22
Hand-mech.	6	21.0	11.0	4.4	3.59	1.69	1.18	6.46
Mechanical	13	25.1	10.4	1.5	1.21	.77	2.21	4.19
Average	23	20.6	10.5	2.4	$1.93	$0.98	$1.83	$4.74

Table 21 - TON COSTS OF LOADING SUGAR BEETS IN MICHIGAN, 1946 *

Method	Number records	Acres per record	Yield per acre	Labor Hrs/T.	Cost per ton			
			tons		Labor	Power	Machine	Total
Hand	4	5.3	8.5	.5	$0.38	$0.00	$0.00	$0.38
Hand-mech.	6	21.0	11.0	.4	.32	.15	.11	.58
Mechanical	13	25.1	10.4	.1	.12	.07	.21	.40
Average	23	20.6	10.5	.2	$0.19	$0.09	$0.17	$0.45

* These tables include records only where farmers loaded and hauled their own beets. No records other than total costs were available where loading and trucking was hired except for a small amount of farm labor used to assist in loading.

Analysis of these records did not indicate the expected reduction in costs from hand to mechanical methods of loading. Instead, the costs of

mechanical methods of loading were found to be higher.

The average cost of hand loading was $3.22 per acre compared to $4.19 for loading with pickup loaders and $6.46 per acre with fork-in loaders. One factor which contributed to lower acre costs of hand loading was that yields on those fields were about 2.5 tons per acre lower than on fields where beets were loaded by fork-in or pickup loaders.

On a tonnage basis, the time required to load by hand was only one-tenth of an hour more than the time required to load with fork-in loaders. This was a difference in costs of 6 cents per ton. In addition to labor costs, there were costs for power and machine use in loading with fork-in loaders which were negligible in hand loading. The net difference in costs between these two methods was 20 cents per ton less for hand loading.

Hours of labor required for loading with a pickup loader were slightly less than one-third of that required for hand loading. The labor cost was 26 cents per ton lower. Power and machine costs, however, were 28 cents per ton by this method making a net of 2 cents more in the cost of loading with pickup loaders than by hand loading. Pickup loaders were relatively expensive machines considering the amount they were used. The machine cost of using this method of loading was more than the combined labor and power cost.

Even though the costs of both hand-mechanical and mechanical methods were higher than hand loading, there was an advantage in getting the job done faster and in eliminating a large amount of heavy work.

Trucking: Forty-eight percent of the farmers who kept records trucked their own beets, 38 percent hired both loading and trucking and 14 percent did at least a part of the loading and trucking themselves and

hired the rest. One farmer, who was only a mile from the factory, used tractors and wagons to haul his beets.

Since separate records were not available for loading where loading and trucking was hired, the combined costs were used to compare costs of marketing where farm labor was used and where the work was hired. The cost of marketing by farm labor was $7.00 less per acre than where hired (Table 22). The average cost where farmers hauled their own beets was $10.64 per acre. Of this amount $5.50 was for labor and $5.15 was for equipment use. The average time required to load and haul beets was 6.8 hours per acre. The average cost of trucking hired was $17.65 per acre.

Table 22 - ACRE COSTS OF MARKETING SUGAR BEETS IN MICHIGAN, 1946*

Marketing Method	Number records	Acres per record	Yield per acre tons	Labor Hrs/A.	Cost per acre: Labor	Equipment	Hired	Total
Farm labor:								
Loading	26	15.9	10.1	7.1	$5.74	$6.18	$0.00	$11.92
Direct from harvester	17	20.8	10.0	6.5	5.23	3.94	.00	9.17
Average	43	17.8	10.0	6.8	$5.50	$5.15	$0.00	$10.65
Hired:								
Loading	31	13.8	9.2	-	-	-	$18.19	$18.19
Direct from harvester	7	14.0	8.6	-	-	-	15.26	15.26
Average	38	13.9	9.1	-	-	-	$17.65	$17.65

* Freight charges not included

There was a saving of 88 cents per ton where farmers marketed their own beets (Table 23). The total cost per ton was $1.06 where farmers did their own work as compared to $1.94 where loading and trucking was hired. The average cost of loading and trucking on all farms was $1.53 per ton. The average distances of the farms from the factories was very nearly the

same for both methods.

Table 23 - TON COSTS OF MARKETING SUGAR BEETS IN MICHIGAN, 1946 *

Marketing Method	Number records	Acres per record	Yield per acre tons	Labor Hrs/T	Cost per ton Labor	Equipment	Hired	Total
Farm labor:								
Loading	26	15.9	10.1	.7	$0.57	$0.61	$0.00	$1.18
Direct from harvester	17	20.8	10.0	.7	.52	.40	.00	.92
Average	43	17.8	10.0	.7	$0.55	$0.51	$0.00	$1.06
Hired:								
Loading	31	13.8	9.2	-	-	-	$1.97	$1.97
Direct from harvester	7	14.0	8.6	-	-	-	1.78	1.78
Average	38	13.9	9.1	-	-	-	$1.94	$1.94

* Freight charges not included.

The total cost of marketing was lowest on farms where beets were loaded directly from mechanical harvesters. On farms where farmers marketed their own beets, there was a saving of $2.75 per acre or 26 cents per ton where beets were loaded directly from mechanical harvesters instead of being loaded from piles and windrows.

Where trucking was hired, the saving in marketing direct from harvesters was $2.93 per acre or 19 cents per ton. The average cost of all marketing where beets were loaded direct from harvesters was $10.50 per acre or $1.09 per ton. The cost of marketing by all other methods, including hand and mechanical loading, averaged $17.11 or $1.72 per ton. Thus, there was an average saving of $6.61 per acre or 63 cents per ton by marketing beets directly from harvesters compared to loading and marketing beets from piles or windrows.

Freight: Eight farmers hauled their beets to weigh stations and

shipped them by freight from there to the factories. These farmers lived an average distance of 52 miles from the factories and found it impractical to truck their beets the whole distance. The average cost of freight was $1.16 per ton.

SUMMARY

Sugar beet growers are facing the problem of deciding whether or not it is practical for them to make use of new developments in sugar beet production with their present systems of farming. This study was begun with the purpose of determining the effect of new methods on time and costs in producing sugar beets.

Seventy-one farmers in the sugar beet areas of Michigan kept records on time and costs. The average cost of production was found to be $92.92 per acre. Acre costs varied from $54 to $149. Ton costs averaged $9.44 and varied from $3.75 to $23.75. The average yield on these farms was 9.9 tons per acre which was 1.1 tons per acre higher than the average yield for all beets grown in Michigan in 1946.

Hand labor for blocking, thinning and harvesting was the largest single item of expense. This amounted to $35.47 per acre or about 36 percent of all costs on farms where mechanical harvesters were not used. Farm labor, mostly for machine operation, was the next highest item of expense at $13.32 or 13.5 percent of total costs. These two items of labor together averaged $48.79 or about 49 percent of all costs.

The average gross returns for beets on farms included in this study was $167.60 per acre. This included a credit of $160.85 per acre for beets and a credit of $6.75 per acre for beet tops. The average price received for beets was $16.25 per ton in 1946 including government payments.

The average net returns on these farms was about $74.68 per acre or $7.49 per ton. Net returns varied from a gain of $185.79 per acre to a loss of $37.51.

New developments in labor saving methods on which data were obtained

in this study were the use of segmented seed, mechanical harvesters and mechanical loaders. Experimental work is being carried on in this state on pelleted seed, improved beet drills, mechanical blockers, and chemical weed control methods.

Segmented seed was used by about 70 percent of the beet growers in Michigan in 1946. The advantages in using segmented seed were (1) less labor required and lower costs for blocking and thinning, (2) lower seed costs, and (3) higher yields.

Stands of beets planted with segmented seed were more uniform and had a higher percentage of single plants. This made it possible to block and thin beets with long handled hoes and reduced the labor requirements in hand thinning to a minimum. Results from this study showed that fields planted with segmented seed required about 10 percent less hand labor in blocking and thinning than where whole seed was used. Results from controlled experiments indicate that labor needs in blocking and thinning may be reduced up to 30 percent by the use of segmented seed.

The rate for blocking and thinning fields planted with segmented seed as established by the United States Department of Agriculture for 1946 was $2.00 less per acre than where whole seed was planted. The saving in labor costs where segmented seed was used as determined by this study was only $1.25 per acre since many farmers paid the maximum rate regardless of the kind of seed used.

The net results of using segmented seed compared to whole seed were (1) 3.4 hours less contract labor per acre required for blocking and thinning, (2) a saving of $1.25 per acre lower labor costs, (3) a saving of 32 cents per acre in seed costs, and (4) higher yields of about one-half ton

per acre.

Mechanical harvesters were used in Michigan on a fairly large scale for the first time in 1946. There were about 135 machines of five different makes in use, an increase of more than a hundred machines from the previous year. Most of these machines were made by the Scott-Viner Company.

It was possible to harvest from 3 to 7 acres per 10 hour day with a harvester. The average was about 4 acres a day, or 2.6 hours per acre. Although the machine could have been operated with only two men under most conditions, several farmers used three men. About 7 hours of farm labor were spent per acre in operating the harvester.

Costs of harvesting with mechanical harvesters varied from $6.75 to $18.37 and averaged $13.48 an acre. This included $5.65 for labor, $5.52 for machine use and $2.31 for power.

The total cost of lifting and hand harvesting, the old method, was $20.25 an acre. There was an average saving of $6.77 per acre by using mechanical harvesters or one-third of the cost of lifting and hand harvesting. This saving amounted to 77 cents per ton.

Following are some of the other advantages of using mechanical harvesters in addition to lower costs:

(1) Harvesting can be delayed later for maximum growth of beets rather than harvesting when migratory labor is available.

(2) Beets can be delivered promptly to eliminate shrinkage and retain good storage qualities.

(3) The uncertainty in obtaining adequate contract labor is eliminated.

(4) There is an additional saving in loading costs when beets are loaded directly into trucks from harvesters as can be done with most machines.

It was determined in this study that the theoretical acreage that could be harvested by machine at the same cost as hand harvesting was about 35 acres. However, in order to make a beet harvester a practical investment, a farmer should plan to harvest about 75 to 100 acres in order to make significant savings. This can be done either by increasing his own acreage or by doing custom harvesting.

Mechanical loaders are being used extensively on farms where beets are put into piles or windrows after harvesting. The labor cost per ton of loading with fork-in loaders was found to be only about 20 percent lower than the cost of hand loading. However, with the additional power and machine expense the total cost of using fork-in loaders was about 50 percent higher than hand loading.

The total cost of loading with pick-up loaders was very nearly the same as hand loading, however, labor costs were only about one-third as much by this method as by hand loading. Power and machine costs made up the remaining two-thirds of the costs where pickup loaders were used. Even though the costs of mechanical methods of loading may be as high or higher than hand loading, there is an advantage in getting the work done faster and in eliminating the heavy work of forking beets into a wagon or truck.

APPENDIX

Table 1 - CASH RECEIPTS FROM SUGAR BEETS, BEANS AND ALL FARM PRODUCTS IN MICHIGAN, 1915-46 *

Year	Beets	Beans	All Farm Products	Percent of Beets to Beans	Percent of Beets to all Farm Products
	(1000 dollars)			(percent)	
1915	5912	10792	Not	55	-
16	3377	11804	available	29	-
17	4302	17121		25	-
18	9157	17405		53	-
19	15092	14920		101	-
1920	13305	13014		102	-
21	7042	9117		77	-
22	4973	11658		43	-
23	7674	15082		51	-
24	8302	17231	266,063	48	3.12
1925	7265	18827	280,965	39	2.59
26	5872	15231	286,370	37	2.05
27	5135	16211	271,329	32	1.89
28	3696	20233	276,129	18	1.34
29	2602	22694	268,755	11	.97
1930	3702	15193	229,645	24	1.61
31	3792	7733	167,787	49	2.26
32	6138	4953	128,799	124	4.77
33	6982	8342	146,393	84	4.77
34	5743	9606	168,955	60	3.40
1935	5053	9077	189,830	56	2.66
36	5940	12583	230,343	47	2.58
37	3851	12100	248,651	32	1.55
38	6076	8242	208,000	74	2.92
39	5567	10187	216,801	55	2.57
1940	5678	11117	230,432	51	2.46
41	6592	18174	298,350	36	2.21
42	9208	27366	390.905	34	2.36
43	3022	29689	467,476	10	.65
44	5207	19836	488,730	26	1.07
1945	10625**	14263**	501,427**	74	2.12
46	15559**		592,739*		2.62

* Source of data from 1915 to 1924 from INCOME PARITY FORAGRICULTURE, Part I, Sections 11 and 18, 1910-43. U. S. Dept. of Agr., Bur. of Ag. Econ. Washington D. C. Data from 1925 to 1944 from CASH RECEIPTS FROM FARMING BY STATES AND COMMODITIES, U. S. Dept. of Agr., Bur. of Agr. Econ., Washington, D. C.

** Preliminary

Table 2 - SUGAR BEET ACREAGE AND SELECTED PRICES AND PRICE INDEXES FOR MICHIGAN, 1915-46.

Year	Acres** Planted	Acres** Harvested	Prices Sugar beets*	Prices Dry beans***	Indexes of Prices Sugar beets	Indexes of Prices Dry beans	Indexes of Prices All farm products	Wages#
			tons	cwt.	(1910-14 = 100)			
1910-14			5.72	3.23				
1915	Not	122	5.91	4.62	104	143	105	104
16	available	100	6.14	7.33	107	227	133	117
17		82	8.04	11.98	141	371	191	141
18		115	10.08	9.61	172	298	201	159
19		124	12.52	6.98	219	216	217	183
1920		150	10.08	5.47	176	169	218	225
21		148	6.10	3.56	107	110	135	147
22		84	7.22	5.61	126	174	131	143
23		109	9.38	6.03	164	186	143	171
24		150	8.85	4.77	155	148	137	172
1925		115	7.06	5.03	123	156	153	169
26		118	7.00	4.12	122	128	163	178
27		99	7.16	5.90	125	183	155	179
28		71	7.22	8.00	126	248	163	178
29	66	58	8.50	6.70	149	207	165	181
1930	89	83	8.50	4.35	149	135	144	150
31	62	60	6.38	1.80	112	56	94	109
32	128	123	5.60	1.50	98	46	64	78
33	173	160	5.85	2.25	102	70	73	69
34	150	127	7.50	2.75	131	85	89	80
1935	136	124	7.63	2.25	133	70	104	92
36	113	104	6.52	6.00	114	186	120	107
37	92	81	7.85	2.55	137	79	132	133
38	141	134	7.88	1.85	138	57	102	121
39	143	137	7.35	2.80	128	87	97	121
1940	142	131	7.99	3.50	140	108	106	124
41	115	108	9.05	4.55	158	141	129	157
42	159	128	9.60	4.80	169	149	161	193
43	69	56	12.79	5.90	224	183	202	248
44	80	68	14.45	6.00	253	186	199	287
1945	106	90	13.88**	6.20	243	192	211	314
46	120	109	16.25**	12.20	284	378	238	339

* Sugar beet prices include government payments.

** Personal correspondence with P. A. Reeve, Farmers and Manufacturers Beet Sugar Association, Saginaw, Mich.

*** Michigan Farm Economics Chartbook - 1947

\# Crop and Livestock Report for Michigan, 1946

Farm Management Department
Michigan State College
East Lansing, Michigan

INDIVIDUAL GROWER'S RECORD

FOR SUGAR BEET TILE AND COST STUDY

Grower's Name _____ Factory District _____

Address _____

Acres of beets planted _____ Acres of beets harvested _____

Financial Summary

Charges

Item	Amount
Seed furnished: Lbs. _____, seg.( ), whole( )	
Cost per lb. _____, Total	$ _____
Fertilizer furnished: Analysis _____, lbs _____	
Cost per ton _____, Total	$ _____
Salt: _____ lbs.	$ _____
Drill rent: Make of drill _____	
Cost per acre _____, Total	$ _____
Contract labor: Blocking, thinning and hoeing:	
Rate per acre _____, Total	$ _____
Topping:	
Rate per acre _____, Total	$ _____
Other charges:	
_____	$ _____
_____	$ _____
Total charges	$ _____

Credits

Item	Amount
Seed returned: _____ lbs.	$ _____
Beets delivered:	
Gross tons _____	
Tare _____	
Net tons _____	
Credit on beets delivered	$ _____
Other credits:	
_____	$ _____
_____	$ _____
Total credits	$ _____
Less charges	$ _____
Net return on beets	$ _____

Field No. _____

Name _____ Address _____

County _____ Township _____ Factory District _____

DESCRIPTIVE NOTES

Acres planted in beets _____

Kind of soil _____

Drainage (good, fair, poor) _____

Crop in field last year _____

Manure applied _____ Year _____, tons _____

Year _____, tons _____

Fertilizer: Total pounds used _____

Pounds per acre _____

Analysis _____

Minor elements (boron, copper sulphate, salt) _____

Method of application _____

Cost per ton _____ $ _____

Plowing (fall, spring, or not at all) _____

Kind and size of crop plowed under _____

Estimated value of crop plowed under _____ $ _____

Planting: Date _____

Kind of seed used (whole, segmented, pelletted) _____

Pounds of seed used _____ rate per acre _____, total _____

Total cost of seed _____ $ _____

Width of rows _____

Length of rows _____

Number of rows in field _____

Kind of planter used _____

Crop rotation followed _____

_____

Field No. 5

Name _____ Address _____

County _____ Township _____ Factory district _____

LABOR AND POWER RECORD

Date	Operation	Hours contract labor	Man hours	Horse hours*	Tractor hours	Truck miles
	Plowing					
	Harrowing					
	Disking					
	Cultipacking or rolling					
	Fertilizing (commercial)					
	Planting					
	Cultivating 1.					
	2.					
	3.					
	4.					
	5.					
	Hoeing 1.					
	2.					
	3.					
	4.					
	Total					

Contract labor on above operation _____

Contract labor used on _____ acres. Cost per acre $_____ Total cost $_____

Note: Enter fractional hours to the nearest quarter hour.
* Hours of work for one horse.

Field No. _____

Name _____ Address _____

County _____ Township _____ Factory district _____

DESCRIPTIVE NOTES - BLOCKING AND THINNING

Weed condition of field (clean moderate, weedy) - - - - - - - - _____

Plants per 100 inches before thinning - - - - - - - - - - - - - - _____

Plants per 100 feet after thinning - - - - - - - - - - - - - - - - _____

Spacing desired in rows - _____

Method of blocking and thinning used: (draw line through those not used)

1. Hand blocking and thinning, (a) short hoe, (b) long hoe.
2. Mechanical blocking with hand thinning, (a) short hoe, (b) long hoe.
   Kind of machine used - _____
3. Mechanical blocking and thinning - Machine used - - - - - _____

Was contract labor used for blocking and thinning or thinning only? _____

Contract labor used on _____ acres. Cost per acre $ _____ Total cost $_____

LABOR AND POWER USED IN BLOCKING AND THINNING

Date (keep each day's work separate)	Man Hours		Tractor Hours	Rows covered in day *			Condition of soil (wet, dry or ideal)
	Farm Labor	Contract Labor		Blocked only	Thinned only	Blocked, thinned	
Total							

*If blocking and thinning are done in one operation, enter labor in column headed "Blocked & thinned; if done separately enter in column headed "Blocked only" and "Thinned only".

Field No. _____

Name _____ Address _____

County _____ Township _____ Factory District _____

DESCRIPTIVE NOTES - HARVESTING SUGAR BEETS

Stand count per 100 feet before harvesting. . . . . _____

Acres harvested . . . . . _____

Acres abandoned . . . . . _____

Method of harvesting used:

1. Lifting - (horses, tractor) . . . . . _____
2. Pulling and topping - (farm labor, or contract labor) . . . _____
3. Windrowing or bunching . . . . . _____
4. Combining . . . . . _____
5. Loading - (direct from combine, from piles, from windrow, pickup loader, forked into loader, forked into wagon or truck) . . . . . _____

Marketing - (hauled direct to factory, reloaded from wagon to truck, pitted and reloaded, hauled by freight) . . . _____

Beets hauled _____ miles to factory at _____

Beets shipped by freight from _____ to factory at _____

Gross tons of beets produced. . . . . _____

Tare. . . . . _____

Net tons sold . . . . . _____

Use of beet tops . . . . . _____

Value of beet tops . . . . . _____

GROWER'S ESTIMATE ON HOURLY LABOR AND POWER COSTS

Operators labor. . . . . $_____	Horse work per horse . . . . $_____
Other family labor . . . . $_____	Tractor work . . . . . $_____
Hired labor other than contract . . . . . $_____	Truck use per mile (farm truck) . . . . . $_____

Field No. _____

Name _____ Address _____

County _____ Township _____ Factory District _____

LABOR AND POWER RECORD ON HARVESTING SUGAR BEETS

Date	Operation	Hours Contract Labor	Man (1) Hours	Horse(2) Hours	Tractor Hours	Truck(3) Miles	Soil Condition
	Lifting						
	Pulling and topping						
	Bunching or Windrowing						
	Pitting						
	Loading						
	Combining						
	Hauling						
	Miscellaneous						

Contract labor used on _____ acres, Rate per acre $_____

Total $_____

(1) Do not include contract labor
(2) Hours of work for one horse
(3) Miles for farm truck only

Field No. 9

Name _____ Address _____

County _____ Township _____ Factory District _____

MACHINERY USED ON SUGAR BEETS

Machine	Make, size and Model	Acres Use: Total	Acres Use: Beets	Value	Dep.	Int. 5%	Taxes Ins. 2%	Re-- airs	Mach. hired	Cost Total	Cost Beets
Manure Spreader											
Plow											
Disk											
Spike tooth harrow											
Spring tooth harrow											
Roller or cultipacker											
Beet drill											
Cultivator											
Lifter											
Combine											
Loader											
Wagon											
Tractor											
Truck											
Machinery housing											
Total											

MISCELLANEOUS COSTS

Is beet land rented or owned	
Value of land per acre	
Land rent	$
Taxes	
Trucking and freight (hired)	
Other charges (house rent for labor, association dues, interest on advances, etc.)	
Overhead (5% of all other costs)	

BIBLIOGRAPHY

BIBLIOGRAPHY

Bell, R. W.
1947. LABOR SAVINGS RESULTING FROM USE OF SEGMENTED SEED. Proceedings American Society of Sugar Beet Technologists, Eastern United States and Canada. Detroit, Mich., 1947.

Bell, R. W., Robertson, L. S. and Cook, R. L.
1945. EFFECT OF SHEARING SUGAR BEET SEED ON STAND OF BEETS, ON LABOR REQUIREMENTS AT THE TIME OF BLOCKING AND THINNING, AND ON YIELD OF ROOTS. Mich. Agr. Exp. Quart. Bul. 28:157-64. Nov. '45.

Black, J. D. and Corson, C. T.
1947. SUGAR: PRODUCE OR IMPORT? University of California Press, Berkeley, Calif.

Coons, G. H.
1936. IMPROVING THE SUGAR BEET. U. S. Agr. Yearbook, pp. 625-56.

Culbertson, J. O.
1944. AGRONOMIC CONSIDERATION OF MECHANIZED SUGAR BEET PRODUCTION. Journ. Am. Soc. Agron. 36:558-565. July '44.

Culbertson, J. O.
1943. SEGMENTED SUGAR-BEET SEED. Minn. Agr. Ext. Bul. 240.

Culbertson, J. O.
1940. SUGAR BEET CULTURE IN MINNESOTA. Minn. Agr. Exp. Sta. Bul. 349.

Harmer, P. M.
1943. MUCK SOIL MANAGEMENT FOR SUGAR BEET PRODUCTION. Mich. Agr. Exp. Sta. Circ. Bul. 187.

Hentchel, H.
1947. COST OF OPERATION OF SUGAR BEET COMBINES IN 1946. Mich. State Col. Farm Mgt. Dept. unpublished report.

Higgins, F. H.
1939. MECHANIZATION MAKES STRIDES TOWARD SOLVING BEET FARMING PROBLEMS. Facts About Sugar. 34:23-7. Dec. '39.

Hill, E. B.
1939. TYPES OF FARMING IN MICHIGAN. Mich. Agr. Exp. Sta. Spec. Bul. 206.

Hill, E. B.
1922. SUGAR BEET CULTURE. Thesis (M. Agr.), Mich. State Col.

Lill, J. G.
1939. SUGAR BEET CULTURE IN THE HUMID AREAS OF THE UNITED STATES. U. S. Dept. of Agr. Farmer's Bul. 1637.

Macy, L. K. and others
1937. CHANGES IN TECHNOLOGY AND LABOR REQUIREMENTS IN CROP PRODUCTION - SUGAR BEETS. Works Progress Administration, National Research Project.

McKibben, E. G., Bell, R. W. and Smith, L. E.
1945. SUGAR BEET HARVESTER TRIALS IN MICHIGAN IN 1943 AND 1944. Mich. Agr. Exp. Sta. Quart. Bul. 28:1. Aug. '45.

Mervine, E. M.
1943. LABOR SAVING BY SUGAR BEET MECHANIZATION. Agr. Eng. 24:79-80. Mar. '43.

Mervine, E. M. and Barmington, R. D.
1943. MECHANICAL THINNING OF SUGAR BEETS. Colo. Agr. Exp. Sta. Bul. 476.

Mervine, E. M., and Burdick, R. T.
1945. SUGAR BEET GROWERS LOOK TO MECHANICAL HARVESTERS TO SOLVE LABOR PROBLEMS. Colo. Agr. Exp. Farm. Bul. 7:2-4. Nov. '45.

Reeve, P. A.
1947. Farmers and Manufacturers Beet Sugar Association, Saginaw, Mich. Personal correspondence with the author. May 6, '47.

Reeve, P. A.
1947. RESULTS SECURED WITH SUGAR BEET HARVESTERS IN THE EASTERN AREA IN 1946. Proceedings American Society of Sugar Beet Technologists, Eastern United States and Canada. Detroit, Mich., 1947.

Reeve, P. A. and Buschlen, M. J.
1944. IMPROVED TECHNIQUES OF SEGMENTING AND PLANTING SUGAR-BEET SEED. Mich. Agr. Exp. Quart. Bul. 26:215-26. Feb. '44.

Sauve, E. C.
1943. SUGAR BEET LOADER. Mich. State Col. Agr. Eng. Bul. 317-1.

Smith, P. B.
1946. HARVESTING SUGAR BEETS MECHANICALLY. Sugar 41:33-5. Apr. '46.

Wait, R.
1947. DELIVERY AND STORAGE OF FRESH BEETS. Proceedings American Society of Sugar Beet Technologists, Eastern United States and Canada. Detroit, Mich., 1947.

West, W. T.
1945. SUGAR BEET HARVESTERS. Agr. 52:259-62. Sept. '45.

Willcox, O. W.
1946. MECHANIZATION OF HARVESTING. Sugar 41:30-5. Jan. '45.

Wright, K. T.
1940. SUGAR BEET COSTS AND RETURNS IN MICHIGAN. Mich. Agr. Exp. Sta. Spec. Bul. 305.

Wright, K. T.
1946. SUGAR BEET PRODUCTION AND INCOME IN MICHIGAN. Mich. State Col., Farm Mgt. Dept. unpublished report. Jul. 18, '46.

Wright, K. T. and Aylesworth, P. F.
1934. SUGAR BEET COSTS ON 52 MICHIGAN FARMS. Mich. State Col. Farm Mgt. Dept. mimeographed report FM-128.

Wright, K. T. and Hank, A. M.
1933. SUGAR BEET COSTS ON 45 MICHIGAN FARMS. Mich. State Col. mimeographed report FM-104.

Wright, K. T. and Leonard, A. L.
1936. 1935 SUGAR BEET COSTS ON 95 MICHIGAN FARMS. Mich. State. Col. Farm Mgt. Dept. mimeographed report FM-153.

Wright, K. T. and Taylor, H. B.
1937. 1936 SUGAR BEET COSTS ON 87 MICHIGAN FARMS. Mich. State Col. Farm Mgt. Dept. mimeographed report FM-180.

---1946. CROP REPORT FOR MICHIGAN. U. S. Dept. of Agr., Bureau of Agr. Econ., Mich. Dept. of Agr., Lansing.

---1946. CASH RECEIPTS FROM FARMING BY STATES AND COMMODITIES, 1924-44. U. S. Dept. of Agr., Bureau of Agr. Econ., Washington, D. C.

---1944. INCOME PARITY FROM AGRICULTURE, Part I, Sections 11 and 18, 1910-43. U. S. Dept. of Agr., Bur. Agr. Econ., Washington, D. C.

---1946. MICHIGAN FARM ECONOMICS CHARTBOOK - 1947. Depts. of Econ. and Farm Mgt., Mich. State Col. Agr. Exp. Sta. and Ext. Sec. Dec. '46.

---1946. SHEARED SEED TESTS SHOW LABOR SAVING. Sugar Beet Journ. Mar. '46.

---1938. WAGES, EMPLOYMENT CONDITIONS, AND WELFARE OF SUGAR-BEET LABORERS. U. S. Dept. of Labor, Bureau of Labor Statistics, Ser. No. R. 703. Washington, D. C.