

# The University of Minnesota

AGRICULTURAL EXPERIMENT STATION

BULLETIN 154

## THE COST OF PRODUCING SUGAR BEETS

BY

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DIVISION OF AGRONOMY AND FARM MANAGEMENT



UNIVERSITY FARM, ST.-PAUL

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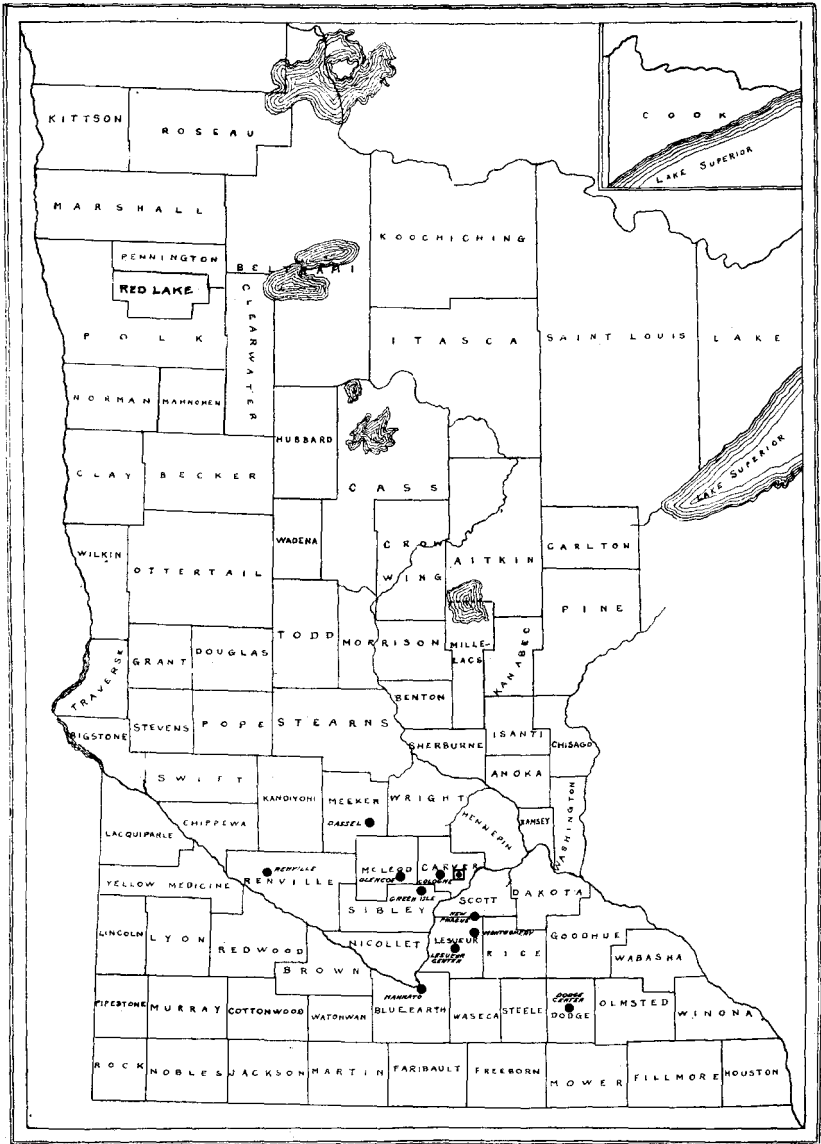


Fig. 1. Localities Visited for Sugar Beet Data

## SUMMARY

1. The Minnesota Sugar Company, located at Chaska, Carver County, has been active in promoting the growth of the sugar beet industry in the state. Over \$12,000 is spent annually to maintain agents in producing centers who supervise the production of the crop. The company supplies the outside labor, contracts with growers for their crops at a definite price, and finances the operations when necessary.

2. Man labor constitutes 49.5 per cent of the total cost of producing beets. If the grower performs the labor without contract help, an average of 155.4 hours per acre is required to grow the beets. At 15 cents per hour the man labor cost was \$23.31. The average cost per acre for both contract and non-contract labor was \$23.61. The professional beet-worker performs the hand operations in 20 per cent less time than the farmer. The average rate per acre for this kind of labor was \$17.19, or \$1.59 per ton, with the yield averaging 10.8 tons. At this rate the professional worker received 20.6 cents per hour for his labor. Thirty-four per cent of the grower's labor is spent in marketing beets where contract or outside labor is employed. Where no outside labor is used this is reduced to 11.5 per cent.

3. Horse labor constitutes 21 per cent of the cost of producing beets. The crop required 110.6 horse-hours per acre, costing \$11.06, at 10 cents an hour. Averaging all farms with varying operations gives a cost of \$9.97 per acre for horse labor. One-third of the horse-time is spent in hauling beets to the loading station.

4. The average rate of seeding was 17 pounds per acre with a seed cost of 15 cents per pound. The cost per acre was \$2.57.

5. Machinery cost varied with the use or non-use of the manure spreader, but averaged \$1.21 per acre.

6. Taxes were higher on the farms studied than on average farms, because of their proximity to town. They averaged 77 cents per acre.

7. Commercial fertilizer was applied in five of the eleven localities studied with no results in yields that are conclusive or even indicative of its value. The average cost per acre was \$1.78 for about 120 pounds. From 6 to 16 loads of manure were usually applied for the beet crop and the labor of application was the only charge made. This amounted to \$3.66 per acre.

8. Land rental constitutes 15 per cent of the total cost. The average of cash rent paid and interest at 6 per cent on owned land amounted to \$7.74 per acre.

9. The total cost per acre was \$47.65. On the average normal yield basis of 9.82 tons per acre the cost was \$4.85 per ton. The receipts were \$5 in each case, leaving a profit of 15 cents per ton, or \$1.45 per acre. In addition to the profit, the producer received \$7.74 per acre as land rent, and \$23.31 as pay for his own labor and that of his family, a total income, over other expenses, of \$32.50 per acre. Where contract labor was employed, the producer had \$15.31 per acre for rent, for his own labor, and for profit.

10. The yields varied from 5 to 22 tons per acre, with a normal average for three years of 9.82 tons. These were the actual scale weights from the sugar company's books.

11. The tops are a valuable by-product of the beet crop. The value depends on the kind and quality of stock fed and the manner of storing and feeding. An average of the estimates of the growers was \$4.40 per acre.

12. A great factor in the popularity of sugar beets is the increase in grain yields the following year. Conservative estimates place the increase of wheat at 6 bushels per acre, or over 30 per cent, and the increase of barley and oats from 4 to 6 bushels.<sup>1</sup>

<sup>1</sup> Valuable assistance has been given in the gathering and compilation of the data for this bulletin by George Pond, R. E. Hodgson, and J. M. Curran, senior students in the College of Agriculture.

# THE COST OF PRODUCING SUGAR BEETS

BY F. W. PECK

The growing of sugar beets as a commercial crop is comparatively new in Minnesota. As early as 1893 a small sugar factory was in operation at St. Louis Park, Hennepin County. In 1906 a sugar factory was built at Chaska, at a cost of \$1,000,000, with a seasonal capacity of 7,500 tons of sugar. This company began the manufacture of sugar with 2,630 tons. The production increased to 7,227 tons in 1914. The increase in beet-growing has been due largely to the activity of the factory management in maintaining field agents to aid in the production of the crop. The soil in many localities is well adapted to sugar-beet growing and prospects are bright for a reasonable growth of the industry, providing sugar prices are such as to warrant the output of the finished product. As with any other crop about which the growers know little, a large amount of pioneer work has been necessary. This work has been principally educational in purpose and result, and has been done by the sugar company in order properly to develop the industry. That the campaign was successful is proved by the increase in the area of beets grown. The 13th Census gives the area planted to sugar beets in 1909 as 2,238 acres. The estimated area in 1914 was about 7,000 acres.

There have been failures in growing sugar beets just as in growing other crops, and, as might be expected, this crop has its enemies as well as its friends. In this survey of the sugar beet industry there was found a consensus of opinion that the crop is a good one to grow, providing certain very definite factors are considered. These include the proper kind of soil, fairly close proximity to a loading station, and the performance of the required labor at the proper time, as outlined and advised by the sugar company's agent.

The seed is furnished by the company at a reasonable price, thus providing for a steady supply of as good seed as can be obtained. The planting and tilling machinery was formerly owned by the company and rented to the growers at the nominal rate of 25 cents per acre for each machine. Recently these machines have been sold to the growers at a very low price, while others have been purchased from dealers, thus making for a more permanent and responsible body of producers. Probably the greatest service performed by the agents of the sugar company is in procuring laborers for the care of the beet crop. The labor item is the largest and most important factor

in the production of beets. The need of a comparatively large amount of hand labor introduces a kind of labor in which the American farmer is inexperienced and for which his type of farming and size of farm are not adapted. Hence the necessity for the importation of foreign labor experienced in the hand-labor operations. This labor is procured by the agents of the company and put on the farms on which the work is to be done. If the grower is unable to finance the growing of the crop the company advances the cash and deducts the amount

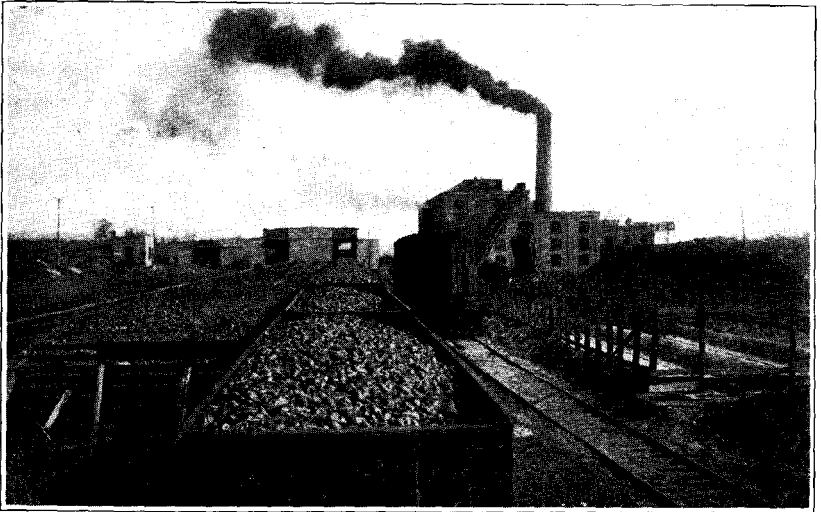


Fig. 2. Unloading Sugar Beets at the Factory



Fig. 3. Floating the Beets in the Sluice Trench



from the proceeds when payment is made for the crop. In addition, the agents act as advisors in preparing the soil, planting, caring for, and harvesting the crop.

THE COST-OF-PRODUCTION SURVEY

Definite and accurate knowledge of the cost of producing sugar beets and of the gross and net returns per acre is important in order to understand the place of this crop in economic production. Numerous inquiries are received asking for advice as to possibilities in sugar-beets, the cost, methods of production, and labor requirements. To obtain such information a survey was made in 1915 of the beet-producing districts in Minnesota. A representative of the Division of

No. 1

**The University of Minnesota** SPECIAL CROP REPORT

DEPT. OF AGRICULTURE  
DIVISION OF AGRONOMY AND FARM MANAGEMENT  
COST ACCOUNTING SECTION

Date.....191...

Crop.....

Operator..... P. O. Address.....

Township..... County..... State.....

Total acres in farm..... Tillable area, acres.....

YEARS	ACRES	YIELD		DISPOSITION OF CROP				PRICE PER TON
		Total	Per Acre	Sold	Fed	Seed	Misc.	
191.....	.....	.....	.....	.....	.....	.....	.....	.....
191.....	.....	.....	.....	.....	.....	.....	.....	.....
191.....	.....	.....	.....	.....	.....	.....	.....	.....
191.....	.....	.....	.....	.....	.....	.....	.....	.....
191.....	.....	.....	.....	.....	.....	.....	.....	.....

Normal acreage..... Normal yield per acre..... Normal price per ton.....

OTHER CROPS (Normal)

CROP	ACRES	YIELD	DISPOSITION	PRICE
Acreage.....	.....	.....	.....	.....
Yield per acre.....	.....	.....	.....	.....
Disposition Sold or fed.....	.....	.....	.....	.....

INVESTMENT (Date.....191...)

Land and improvements (per acre \$.....)	\$.....
Work horses.....	\$.....
Cows.....	\$.....
Beef cattle.....	\$.....
Young stock.....	\$.....
Hogs.....	\$.....
Machinery and tools (estimated).....	\$.....
.....	\$.....
Total, \$.....	\$.....



DIRECT EXPENSE OTHER THAN LABOR (NORMAL)

No. 3

ITEM	AMOUNT USED			USUAL PRICE PER UNIT	TOTAL COST	COST PER ACRE
	Unit	Amount	Per Acre			
Seed.....						
Manure.....						
Fertilizer.....						
Machines hired.....						
Storage charges.....						
Commission.....						
Freight.....						
Repairs.....						
Land rent.....						

Overhead expense

Taxes (rate per acre.....or total paid for farm \$......) \$.....

Insurance..... \$.....

Price per hour of horse labor, if hired \$.....

Estimated annual cost of keeping a work horse.....

Source of seed.....

Width of row..... Distance apart in row.....

Depth plowed..... No. years same crop on land.....

Rotation followed.....

Crop on which manure is applied.....

Description of surface soil..... Subsoil.....

Topography of land.....

Distance from shipping point.....

Distance from factory.....

Shipping rate to factory per ton.....

Varieties grown.....

Record taken by..... Checked by.....

NOTES: (Write additional notes on back of sheet.)

Agronomy and Farm Management visited each beet-grower who had grown the crop before and obtained the data directly from him. Most of the growers' names were obtained from the agent of the sugar company in each locality, who coöperated in every way possible in the investigation. A copy of the blanks used shows the nature of the information obtained.

A study of the blanks will show that the data were gathered on the normal acreage, yield, and labor requirements, so that the results represent average costs and returns under average conditions. This removes the effect of special specific and local conditions. Such in-

DIRECT EXPENSE OTHER THAN LABOR (NORMAL)

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ITEM	AMOUNT USED			USUAL PRICE PER UNIT	TOTAL COST	COST PER ACRE
	Unit	Amount	Per Acre			
Seed.....						
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Fertilizer.....						
Machines hired.....						
Storage charges.....						
Commission.....						
Freight.....						
Repairs.....						
Land rent.....						

Overhead expense

Taxes (rate per acre.....or total paid for farm \$.....) \$.....

Insurance..... \$.....

Price per hour of horse labor, if hired \$.....

Estimated annual cost of keeping a work horse.....

Source of seed.....

Width of row..... Distance apart in row.....

Depth plowed..... No. years same crop on land.....

Rotation followed.....

Crop on which manure is applied.....

Description of surface soil..... Subsoil.....

Topography of land.....

Distance from shipping point.....

Distance from factory.....

Shipping rate to factory per ton.....

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TABLE I  
COMPARISON OF SUGAR BEET ACREAGES

LOCALITY	1914 AVERAGE ACREAGES		SURVEY MORE THAN FACTORY	SURVEY LESS THAN FACTORY	AVERAGE NORMAL ACREAGES		SURVEY MORE THAN FACTORY	SURVEY LESS THAN FACTORY
	Survey	Factory			Survey	Factory		
Chaska.....	Acres 5.6	Acres 5.7	Acres ...	Acres 0.08	5.6	5.6	...	...
Cologne.....	4.7	3.0	1.7	...	4.5	3.2	1.3	...
Dassel.....	19.2	19.7	...	0.5	15.7	15.4	0.3	...
Dodge Center.....	5.6	5.6	0.05	...	6.4	6.7	...	0.3
Glencoe.....	9.7	9.7	...	...	8.4	9.2	...	0.8
Green Isle.....	26.6	26.6	...	...	26.6	26.6	...	...
Lesueur Center.....	6.8	7.7	...	0.9	6.8	7.7	...	0.9
Mankato.....	6.7	7.3	...	0.6	7.3	7.8	...	0.5
Montgomery.....	3.8	3.8	...	...	4.0	3.5	0.5	...
New Prague.....	9.2	11.7	...	2.5	8.5	9.2	...	0.7
Renville.....	17.8	16.0	1.8	...	21.0	20.0	...	1.0
Averages (weighted)....	8.3	8.5	...	0.2	8.2	8.3	...	0.1

TABLE II  
COMPARISON OF SUGAR BEET YIELDS PER ACRE

LOCALITY	1914 AVERAGE YIELDS		SURVEY MORE THAN FACTORY	SURVEY LESS THAN FACTORY	AVERAGE NORMAL YIELDS		SURVEY MORE THAN FACTORY	SURVEY LESS THAN FACTORY
	Survey	Factory			Survey	Factory		
Chaska.....	Tons 10.35	Tons 10.31	Tons 0.04	Tons .....	Tons 10.97	Tons 9.60	Tons 1.37	Tons .....
Cologne.....	13.59	10.75	2.84	.....	14.10	12.87	1.23	.....
Dassel.....	10.51	9.23	1.28	.....	11.09	9.86	1.23	.....
Dodge Center.....	11.80	10.40	1.4	.....	10.86	8.80	2.06	.....
Glencoe.....	10.23	10.27	.....	0.04	9.22	10.52	.....	1.30
Green Isle.....	7.25	6.70	0.55	.....	7.25	6.70	0.55	.....
Lesueur Center.....	9.16	8.22	0.94	.....	9.16	9.99	.....	0.83
Mankato.....	10.23	8.56	1.67	.....	10.48	9.22	1.26	.....
Montgomery.....	13.17	12.64	0.53	.....	13.25	13.14	0.11	.....
New Prague.....	13.50	12.13	1.37	.....	13.05	11.63	1.42	.....
Renville.....	10.52	9.94	0.58	.....	10.26	9.40	0.86	.....
Averages (weighted)....	10.71	9.96	0.75	.....	10.69	9.82	0.87	.....

fluences cannot be summarized and the true effect accurately stated, hence the advantage of basing results on normal factors. To check the accuracy of the survey method of obtaining the 1914 and normal acreages and yields for each farm, the figures given by the growers were compared with those of the sugar company, which were based on actual measurement of acreages and scale weight of beets marketed.

From Table I it is seen that the difference between survey and factory acreages, on the average, is very small, especially in the normal acreage on which these data are based. This information is valuable as supporting the survey method of obtaining certain kinds of farm data. The comparison of yields per acre as shown in Table II is also favorable to the survey method in that the results of the normal yield are within 8 per cent of the actual scale weights. It is only fair to say, however, that the growers always receive from the sugar company the weight of beets harvested and the acreage grown, so their answers to these questions would be based on memory of accurate knowledge rather than on estimates. It is not known how the survey figures would compare with actual facts on crops for which such data were merely an estimate made by the farmer. As close approximation the figures justify the use of the survey method on special crops.

Eleven localities were visited and the number of growers and the acreage of each locality with the totals and averages were as follows:

TABLE III  
ACREAGE AND NUMBER OF GROWERS IN LOCALITIES COVERED  
BY THE SURVEY

Locality	County	Growers	*Acres	Average Acres per Grower	Largest Acreage	Smallest Acreage
Chaska.....	Carver....	48	271.0	5.6	40.0	1.0
Cologne.....	Carver....	5	16.2	3.2	6.8	2.0
Dassel.....	Meeker....	11	169.5	15.4	80.0	3.0
Dodge Center...	Dodge....	17	114.2	6.7	32.0	1.0
Glencoe.....	McLeod...	17	157.4	9.2	19.0	2.0
Green Isle.....	Sibley....	3	80.0	26.6	55.0	4.3
Lesueur Center..	Le Sueur..	6	46.4	7.7	12.0	3.5
Mankato.....	Blue Earth	16	125.0	7.8	18.0	1.5
Montgomery...	Le Sueur..	17	59.5	3.5	10.0	1.5
New Prague.....	Le Sueur..	12	111.0	9.2	20.0	2.0
Renville.....	Renville...	9	179.9	20.0	37.0	13.0
Totals.....	.....	161	1330.0	8.3	.....	.....

\*Sugar Factory figures as normal acreage.

## METHOD OF TABULATING AND REPORTING DATA

It is believed that the above acreage is sufficient on which to base the figures on the cost of production, inasmuch as the normal basis was employed. After carefully checking the computations for each grower a report of the result was sent to each, asking that corrections be made of any items which, to his knowledge, were not correct. This not only gave a second check on the figures but it gave each grower the information he wanted for his own particular crop. Several corrections were made from the replies to these reports and a specific service rendered to those who coöperated in furnishing the data. A copy of such a report is herewith shown.

(Name)

Dear Sir:

The following figures summarize the data given by you for your 1914 *Beet* crop. We believe that each grower of this crop is interested in the particular figures that represent the cost of production and cash returns. The publication giving the detailed figures for all the localities studied will be sent to you when the results are published.

<i>Costs per Acre</i>		<i>Value of Product per Acre</i>	
Seed, 15 lbs. at 15 cents.....	\$2.25	Yield per acre 12 tons.	
Fertilizer.....		12 tons at \$5.00.....	\$60.00
Man labor, 160.7 hours at 15 cents	24.10	Value of tops per acre.....	4.50
Horse labor, 129.4 hours at 10 cents	12.94	Total value of crop.....	64.50
Machinery charge.....	1.35	Total cost of crop.....	47.64
Tax charge at 40 cents.....	.40	Profit per acre.....	16.86
Total direct cost.....	41.04	Total value per ton.....	5.38
Land rental charge per acre.....	6.60	Total cost per ton.....	3.97
Total cost per acre.....	47.64	Profit per ton.....	1.41
Direct cost per ton.....	3.42		
Rental cost per ton.....	.55		
Total cost per ton.....	3.97		

(Signed).....*Chief.*

## ITEMS OF COST

The items of cost that enter into the production of sugar beets are man and horse labor, seed, machinery, taxes, fertilizer, and land rental. All but the last item make up the direct cost. Land rental is usually an indirect cost, but is a proper charge.

## LABOR

Man labor constitutes the largest single item of cost of the sugar beet crop. The nature of the hand labor required is such as to compel the employment of outside town labor properly to care for the crop. This is especially true on those farms where more than five acres of beets are grown. The outside labor is obtained through the aid of the sugar beet agents, and is usually housed on the grower's land, in a small shack, woodshed, machine shed, or granary. Permanent houses are being built by some growers to care for these people and in several instances the laborers live there the entire year and work in the neighborhood, thereby making the labor supply for beets more certain, stable and satisfactory. This labor is paid for on the



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acre basis and is employed in very definite field operations, namely, bunching and thinning, hoeing, pulling, and topping in the field. Payments are made on the installment plan, one being made when bunching and thinning are done, another after the hoeing, and the third when the topping is completed. The price per acre depends on the width of row and the yield per acre. The following labor contract presents the varying prices for different yields and width of rows with the other requirements observed in such labor.

**MINNESOTA SUGAR COMPANY**  
Growers' Application for Beet Workers\*

I, ....., of ....., County of ....., State of Minnesota, hereby make application to the Minnesota Sugar Company to secure for me sufficient beet workers to care for, in a workmanlike manner.....acres of sugar beets, planted in rows.....inches apart, to be grown by me for said Sugar Company on Section....., Township....., County....., State of Minnesota, during the season beginning with the spring of 191....., the cost of such labor to be:

	20- to 22- inch rows	24-inch rows	28-inch rows
8½ tons or under per acre.....	\$19.00	\$17.00	\$15.00
9½ tons and over 8½ tons, per acre.....	19.50	17.50	15.50
10½ tons and over 9½ tons, per acre.....	20.00	18.00	16.00
11½ tons and over 10½ tons, per acre.....	20.50	18.50	16.50
12½ tons and over 11½ tons, per acre.....	21.00	19.00	17.00
13½ tons and over 12½ tons, per acre.....	21.50	19.50	17.50
14½ tons and over 13½ tons, per acre.....	22.00	20.00	18.00
15½ tons and over 14½ tons, per acre.....	22.50	20.50	18.50
16½ tons and over 15½ tons, per acre.....	23.00	21.00	19.00
Over 16½ tons.....	23.50	21.50	19.50

The terms of payment are as follows:

	20- to 22- inch rows	24-inch rows	28-inch rows
As soon as beets are blocked and thinned.....	\$7.00	\$6.00	\$5.00
As soon as first hoeing is completed.....	2.00	2.00	2.00
As soon as harvesting is begun which is for hoeing other than the first hoeing.....	3.00	3.00	2.00
As soon as harvesting is finished.....	7.00	6.00	6.00

THE BALANCE TO BE PAID AS SOON AS BEETS ARE DELIVERED AT STATION AND TONNAGE DETERMINED. TONNAGE TO BE DETERMINED ON CLEANED BEETS.

I further agree to transfer the beet workers from railroad station at ....., to and from the land to be worked for me, and to furnish such laborers with a suitable dwelling place, water, hoes, and knives while they are employed under this agreement.

I further agree that for all money advances made by the Minnesota Sugar Company, upon my order, to care for the growing crop under the terms of this application, I will give to the Minnesota Sugar Company my promissory note, bearing seven (7) per cent annual interest, payable November 15th, 191.....

It is understood that the Minnesota Sugar Company will undertake to secure the best laborers obtainable, but I will not hold the said Minnesota Sugar Company responsible for the efficiency of such laborers.

Dated.....191.....

Signed.....

WITNESS:

*Grower*

Professional beet-workers are able to perform the hand labor for an acre of beets in 20 per cent less time than is needed by the average grower. In other words, for the hand operations he is one-

\*Courtesy Minnesota Sugar Co.

fifth more efficient on a basis of the actual time required. While the grower's time has been estimated at 15 cents per hour on the basis of ordinary hired help, the professional beet-worker earns more than this amount at the price paid per acre. The average cost per acre of contract labor was \$17.19. This was paid for an average yield of 10.83 tons per acre. This price makes the rate per hour for the beet-worker 20.6 cents, as indicated in the following table:

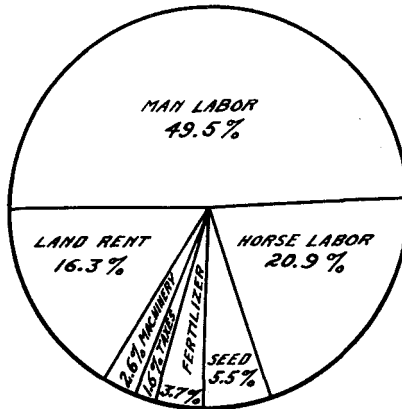
TABLE IV  
HOURS OF LABOR PER ACRE OF HAND OPERATIONS\*

Operations	Contract Labor (Professional)	Grower's Labor
	Hours	Hours
Bunching and thinning .....	31.57	44.18
Hoeing .....	25.51	20.97
Pulling and topping .....	26.34	37.82
Total .....	83.42	102.97

\*Acres considered, contract labor, 680; grower's labor, 462.

Difference in time, 19.55 hours  
 Cost per acre, contract labor..... \$17.19  
 Rate per hour, contract labor..... 20.6 cents  
 Average yield per acre..... 10.83 tons  
 Contract labor cost per ton..... \$1.59

At 20.6 cents per hour for the grower's own labor the cost per acre would be increased from \$17.19 to \$21.21, while at 15 cents per



**MAN LABOR CONSTITUTES ALMOST  
 ONE-HALF THE COST OF PRODUCING  
 SUGAR BEETS,**

Fig. 4. Labor Requirements in Sugar-Beet Production

hour the cost is \$15.45; but regardless of the rate or the cost the grower cannot perform these hand operations, under average conditions, in competition with the foreign-born beet-worker.

The expression in hours of the labor cost per acre of any crop has advantages over that in dollars and cents. The cost in dollars varies with the price of seed, labor, fertility, taxes, land rental, and other factors. The cost in hours of labor is relatively constant and unchanging. Especially is this true if the time considered is based on the normal, as in this study. Knowing the number of hours required per acre, the cost in dollars may easily be computed by using the proper rate per hour, which may change and may vary in different places and at different times. It is not sufficient to know the total hours of labor required, for the greatest value lies in knowing the time of year and the time-requirement of each operation. This permits of a close analysis of the labor required and the available supply, and allows the planning of the acreage and the crops in advance, which is nothing more than good farm management.

A study of Table V discloses the outstanding feature of the beet crop, namely, the large number of hours of man and horse labor required in its production. This fact has no doubt caused many farmers to shun sugar-beet growing and has had a great influence in retarding the increase in beet-acreage in Minnesota.

TABLE V  
LABOR REQUIREMENTS FOR PRODUCING SUGAR BEETS\*

OPERATION	WHEN PERFORMED	TOTAL ACRES	HOURS PER ACRE	
			Man	Horse
Manuring.....	Summer and Fall...	833.9	9.9	21.7
Plowing.....	Fall.....	1,426.0	4.4	13.1
Disking.....	April and May.....	1,134.0	2.3	8.2
Harrowing.....	April and May.....	1,451.4	1.1	2.9
Planking.....	April and May.....	559.5	.9	2.1
Seeding.....	April 25 to June 1..	1,458.4	1.3	2.6
Cultivating.....	May 25 to Aug. 10..	1,447.4	11.1	17.2
Bunching and thinning...	June.....	462.1	44.2	.....
Hoeing.....	July.....	.....	21.0	.....
Pulling and topping.....	October.....	.....	37.8	.....
Lifting.....	October.....	1,458.4	3.5	6.7
Hauling.....	Oct. 15 to Nov. 15..	1,458.4	17.9	36.2
Total.....	.....	.....	155.4	110.7

\*Not contract labor.

†On an average, the land was disked 2.4 times; harrowed, 2.3 times; cultivated, 5.2 times; and hoed 1.4 times.

The figures in Table V represent the hours of ordinary farm labor on the beet crop. According to Table IV, the professional beet-worker

performed the bunching and thinning, the hoeing, pulling, and topping in 19.5 less hours than the farmer, thereby reducing the total man-hours per acre to 136. When professional beet-workers are employed, the farmer performs all operations except those mentioned. The labor of the farmer amounts to but 52.5 hours, indicating that 66 per cent of the labor is concerned with the three important hand operations. Where the size of the farm permits, it seems best to grow a sufficient acreage of beets to employ outside labor for the hand operations, and to fit the cropping system to the time requirements so as to use man and horse labor on other crops when not demanded by the beet crop.

From Table V it is seen that the hand labor is required in June, July, and October. Thus the crop may compete with corn in June and October, and with hay and small grain in July. Hauling the beets to market constitutes one-third of the labor requirement of the farmer when outside labor is employed. This labor is demanded from October 15 to November 15, and may or may not compete with corn harvesting, depending on the manner of handling the corn crop. With the exception of marketing, the farmer's labor on beets is similar to that demanded by corn. Statistics indicate that about 31 hours of man labor and 52 hours of horse labor are required to produce an acre of corn. Most of the operations required are very similar to those for the beet crop. This means that increasing the beet acreage is similar to increasing the corn acreage, with the exception of the hauling to market in October or November. This is true only when professional beet-workers are obtained to perform the heavy hand labor demanded at a time when farm crops also demand considerable labor. The agents of the sugar company estimate 7.5 acres of beets to each beet-worker. This usually means that a family can care for from 15 to 20 acres. Except on very small farms, this acreage seems to be about the minimum that should be grown. If the acreage is increased the number of professional beet-workers must be increased, while the demand for the farmer's time is very similar to that called for by an increase of the corn acreage except that more time is required for marketing. To make the income worth while, and to use farm and contract labor to the best advantage, it does not seem advisable to recommend less than 15 acres, or more than 25, unless the grower is experienced in raising large acreages of beets. To grow from 3 to 7 acres without contract labor seriously interferes with other crops, and means a heavy hand-labor demand with inexperienced labor, while the acreage is too small to use contract labor to the best advantage. This is readily conceded when the hours demanded for the hand operations on 5 acres are considered. This is 220 hours in June, 105 in July, and 190 in October, besides 90 hours of man labor and 180



Fig. 5. Topping and Piling Beets



Fig. 6. A Pile of Beets with Tops Removed

of horse labor for hauling in October. This means that if 300 hours is the monthly expectancy of an ordinary farm laborer, and 50 per cent of this is available for crop labor, the required time on 5 acres in June would be  $1\frac{1}{2}$  times that of one man; in July, three-fourths of one man's time; and in October almost twice one man's time. Provided other crops were not grown that demanded labor at the same time, the crop could be handled by the farmer and his family, and the returns from the crop would justify the hiring of extra help in October, if needed. For very small farms it may be practical to grow 5 acres or less of beets, especially if near a town where market conditions do not warrant the production of garden crops.

In view of the special hand labor required and the competition with other farm crops, it is believed advisable to plant a sufficient

acreage of beets to warrant the employment of special labor and to arrange for it through the sugar company.

In putting the labor item on a cash basis it was necessary to use a man-labor rate per hour and a horse-labor rate per hour for unpaid farm labor. From statistical studies made in Minnesota the approximate rates have been found to be 15 cents per hour for man labor and 10 cents per hour for horse labor. These rates were used in the following computations of costs:

TABLE VI  
LABOR COST PER ACRE FOR PRODUCING SUGAR BEETS\*  
Farmer's Labor

Operation	Man Labor	Horse Labor	Total
Manuring.....	\$1.49	\$2.17	\$3.66
Plowing.....	.66	1.31	1.97
Disking†.....	.34	.82	1.16
Harrowing.....	.16	.29	.45
Planking.....	.13	.21	.34
Planting.....	.20	.26	.46
Cultivating.....	1.67	1.72	3.39
Bunching and thinning.....	6.63	.....	6.63
Hoeing.....	3.14	.....	3.14
Pulling and topping.....	5.68	.....	5.68
Lifting.....	.53	.67	1.20
Hauling.....	2.68	3.62	6.30
Total.....	\$23.31	\$11.07	\$34.38

Contract Labor‡

Total for all but hand operations.....	\$18.93
Cash paid for hand operations (see Table IV).....	17.19
Total cost.....	\$36.12

\*Man labor, 15 cents per hour, and horse labor, 10 cents.

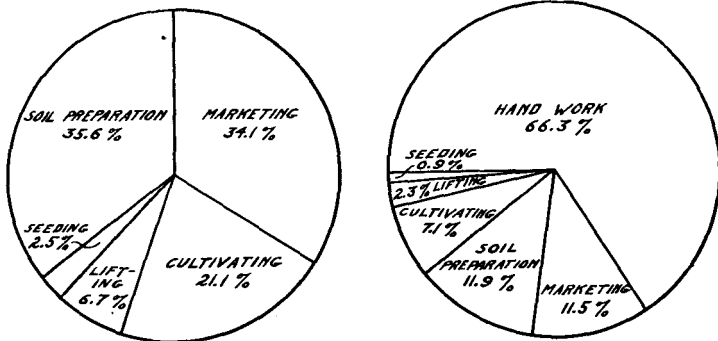
†The land was disked 2.4 times; harrowed 2.3 times; cultivated 5.2 times; and hoed 1.4 times.

‡"Contract labor" method of production cost \$1.74 more per acre than farmer's labor, but time allowed for other crops more than compensates for this.

MARKETING

As already stated the beets are contracted for by the sugar company at a stated price per ton, f o. b. the cars at the local shipping point. Hauling from the field to the cars is the largest single labor item of the grower. The time required for this operation constitutes 34.1 per cent of the grower's total labor, if contract labor is employed, and 32.7 per cent of the total horse labor. Furthermore, this labor is demanded in October or November, at a season when there is other farm work, such as corn harvesting, fall plowing, and even threshing. To market the beets as economically as possible is therefore very essential. The distance hauled is a factor of great importance in determining whether or not the crop can be profitably grown. It is esti-

mated that four miles is the maximum distance from a shipping point that beets should be grown, and most of the sugar agents say three miles should be the limit. Poor roads, scarcity of help, and pressing farm work further emphasize this factor of cost in sugar beet production. Practically all of the growers from whom reports were obtained are within this radius. The majority are within two miles of the loading station.



WHERE CONTRACT LABOR IS EMPLOYED THE FARMER AND HIS FAMILY EXPEND FEWER HOURS ON THE CROP, HENCE MARKETING CONSTITUTES A LARGER PROPORTION OF THEIR LABOR.

WHERE NO CONTRACT LABOR IS EMPLOYED, THE FARMER AND HIS FAMILY PERFORM ALL THE HANDWORK, HENCE THE MARKETING OPERATION CONSTITUTES A SMALLER PROPORTION OF THE TOTAL LABOR.

**MAN LABOR ON SUGAR BEETS SHOWING THE GROWER'S MARKETING LABOR IN RELATION TO OTHER OPERATIONS.**

Fig. 7. Man Labor on Sugar Beets

**SEED**

Sugar beet seed is sold to the growers by the Minnesota Sugar Company. This is the sole source of supply and only the best standard varieties are provided. The seed is all imported from Europe and demands careful selection and care in storing and handling. Usually a two years' supply is maintained to guard against poor seed years with a consequent increase in cost of seed. The sugar company has greatly aided the industry by furnishing the best seed obtainable at a nominal cost to the grower. It is estimated that instead of charging the producer the actual cost of the seed, the company receives not much more than half the cost when storage, labor, and experiments are considered at their actual cost. The flat price of seed in 1915 was 15 cents per pound to the grower with the rate of seeding averaging 17 pounds per acre. The price was formerly but 10 cents per pound. At 15 cents per pound the cost of seed per acre averaged \$2.57 for all farms. Considered on the ton basis, the seed charge amounts to 26 cents per



ton, using the sugar factory weights of 9.82 tons per acre as the normal yield.

Table VII presents the seed cost and rate of seeding per acre at each locality.

TABLE VII  
SEED COST PER ACRE AND PER TON

Locality	Normal Acreage	Pounds per Acre	Cost per per Acre	Cost per Ton of Yield
Chaska.....	285	20.0	\$2.99	\$0.31
Cologne.....	18	16.7	2.50	.19
Dassel.....	220	18.4	2.76	.28
Dodge Center.....	112	15.4	2.31	.26
Glencoe.....	143	16.0	2.40	.23
Green Isle.....	149	15.4	2.31	.34
Lesueur Center.....	40	15.8	2.37	.24
Mankato.....	108	16.5	2.47	.27
Montgomery.....	78	16.0	2.42	.18
New Prague.....	117	15.8	2.36	.20
Renville.....	188	16.5	2.48	.26
Averages (weighted).....		17.0	2.57	.26

#### MACHINERY

Special types of machinery are required for the proper production of sugar beets. Soil can be prepared by the use of standard farm implements, but seeding, cultivating, and lifting demand machines designed for these particular operations. At the outset the sugar company provided these special tools at a nominal charge per acre. Inexperienced growers could not be expected to purchase costly implements with which to experiment with a new crop. The machines have gradually been perfected and very efficient beet drills, cultivators, and lifters are now on the market. During the last three years many growers have purchased such machines, and last year the sugar company sold most of their implements to growers at very low prices so that in 1915 very few machines were rented. Ownership of such machinery makes for more permanent production of the crop, and for more interested and successful growers. The company has always charged 25 cents per acre for each machine. In the tables presented, the machinery charge has been computed from data given in Bulletin 145, The Cost of Producing Minnesota Farm Products, 1908-1912. The cost rate per acre for the various machines used in beet-production with the exception of the seeder and lifter is given as follows: plow, 9 cents; harrow, 2 cents; disk, 4 cents; wagon, 15 cents; manure spreader, 22 cents; and 25 cents per acre for each machine was allowed as a fair rate for the seeder and lifter. Therefore the variation in machinery

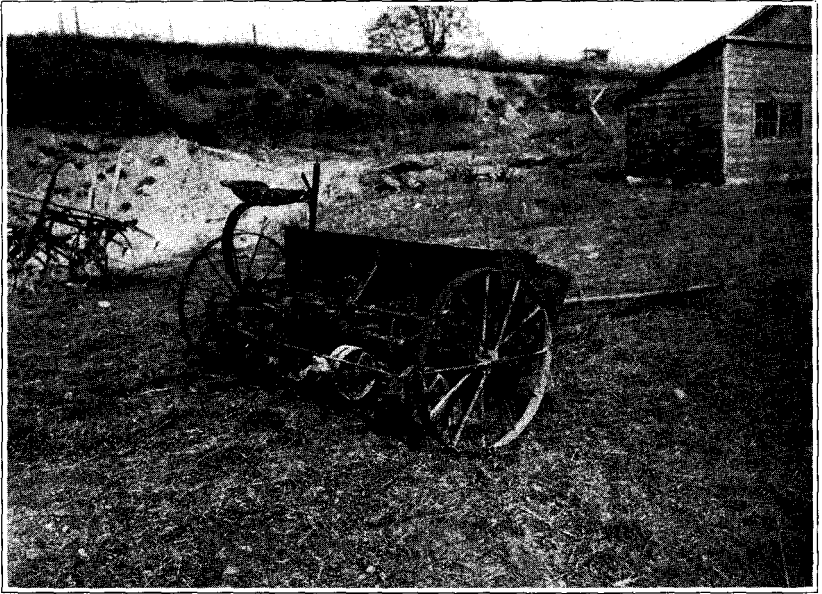


Fig. 8. Beet-Seeding Drill

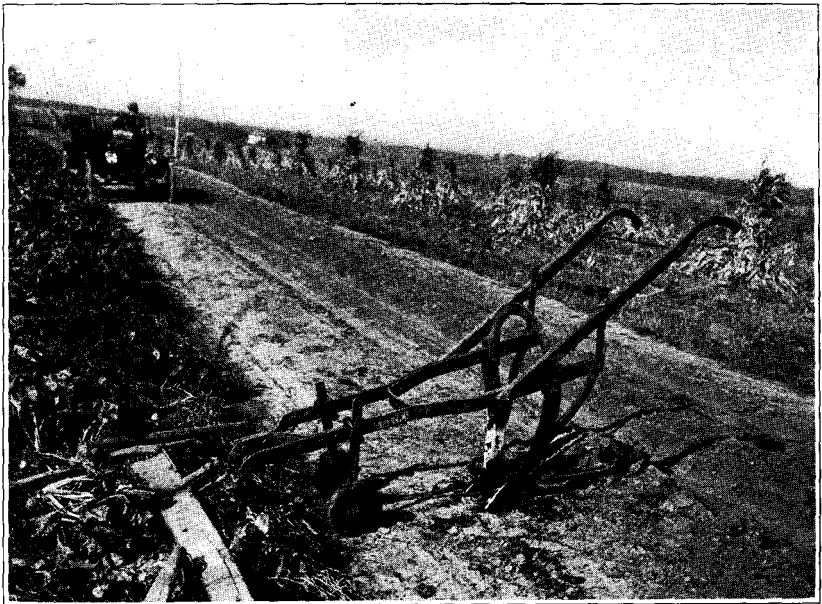


Fig. 9. Beet Lifter

TABLE VIII  
MACHINERY COST PER ACRE AND PER TON

Locality	Cost per Acre	Cost per Ton
Chaska.....	\$1.18	\$0.12
Cologne.....	1.28	.10
Dassel.....	1.23	.12
Dodge Center.....	1.35	.15
Glencoe.....	1.35	.13
Green Isle.....	1.02	.15
Lesueur Center.....	1.17	.12
Mankato.....	1.14	.12
Montgomery.....	1.28	.10
New Prague.....	1.25	.11
Renville.....	1.20	.13
Average.....	1.21	.12

charge was caused principally by the use or non-use of the manure spreader. With the spreader and all other machines the cost per acre was \$1.35, while without the spreader it was \$1.02.

## TAXES

The figures collected on this important and much discussed factor of cost included only the real estate tax. Care was taken when this subject was introduced to explain that the purpose was not to ascertain the tax rate in order to supply information on which to base an increase in taxes, but solely because this cost was a legitimate one against the beet crop and one that should be considered. The rate per acre is relatively high in certain sections, as many beet-growers are situated within or near the town limits, and therefore the land is subject to higher taxes than the more distant farms. From Table IX it is seen that at Chaska, Renville, and Dodge Center the rate per acre is relatively high. This is because of the small farms near town at

TABLE IX  
TAX COST PER ACRE AND PER TON

Locality	Per Acre	Per Ton
	Cents	Cents
Chaska.....	91	9
Cologne.....	65	5
Dassel.....	69	7
Dodge Center.....	87	10
Glencoe.....	70	7
Lesueur Center.....	78	8
Mankato.....	48	5
Montgomery.....	79	6
New Prague.....	59	5
Renville.....	89	9
Average.....	77	8

TABLE X  
COST OF FERTILIZER PER ACRE AND PER TON

Locality	Amount per Acre	Cost per Acre	Cost per Ton	Yield per Acre	Inc. + or Dec. - from Av.
	Lbs.			Tons	Tons
Dassel.....	120	\$1.88	\$0.19	10	+0.2
Dodge Center.....	130	1.95	.22	9	-0.8
Green Isle.....	100	1.45	.21	7	-2.8
New Prague.....	90	1.30	.11	11.8	+2.8
Renville.....	125	1.90	.20	9.5	-0.3
Average.....	120	1.78	.17	10.5	+0.7

Chaska and Dodge Center, and higher priced land and improvements at Renville.

#### FERTILIZER

Commercial fertilizer was used at five of the eleven localities, in which the data were gathered. From these investigations no definite comparable data on fertilized and non-fertilized districts can be obtained. In order to have comparable results other factors affecting propagation and production must be similar. Such similarities cannot be claimed in these studies. It is of interest, however, to note the yields obtained in these instances where commercial fertilizer was purchased and applied. Most of the fertilizer was purchased from Swift & Company, and cost about \$27 per ton, f. o. b. South St. Paul. The sugar company furnished it at this rate plus the freight, thereby saving the grower the retailer's profit. It was applied with the seed in amounts indicated in Table X.

TABLE XI  
COST OF APPLYING MANURE PER ACRE\*

Locality	Loads per Acre	Spreader or Wagon	HOURS AND COST PER ACRE		
			Man Hours	Horse Hours	Cost
Chaska.....	13.5	Both	15.1	27.2	\$4.98
Dassel.....	10.5	Spreader	10.0	21.5	3.65
Dodge Center.....	10.5	Spreader	8.1	15.4	2.75
Glencoe.....	10.0	Spreader	7.3	20.5	3.14
Lesueur Center....	9.0	Wagon	5.0	10.1	1.77
Mankato.....	6.0	Wagon	5.9	11.8	2.05
Montgomery.....	16.5	Both	16.3	31.6	5.60
New Prague.....	14.0	Both	12.9	27.2	4.66
Renville.....	8.5	Spreader	4.8	18.5	2.57
Average ..;			10.0	21.7	3.66

\*Man labor, 15 cents per hour; horse labor, 10 cents per hour.

Barnyard manure was applied in practically all cases except at Cologne and Green Isle, and usually at a relatively high rate per acre. It is common practice to manure freely for beets. This shows that the growers realize that it is a costly crop and that good yields are essential to profits. In Table XI no value has been given the manure, but the labor cost of application has been charged. The cost is included with the labor cost in Table VI.

## LAND RENTAL

A fair interest charge should be made against the land used in the production of the crop, as one would expect the money represented by the land to bring a fair rate of interest if otherwise invested. The rental charge for crop land is often not considered an item in the cost of production. One reason for this is the prevailing idea that land increases in value enough each year to equal, if not exceed, the rental charge, which is based on the interest on the land value. However, if the producer pays a cash rental the cost is no uncertain item. The increase in land value is not certain, nor can it be obtained without actually selling, and obviously there will come a time, if it has not already arrived, when rises in land values will be negligible if not actually negative. The data presented represent both cash rent actually paid and 6 per cent interest on a fair valuation. Most of the land here considered is situated very near town and is relatively more valuable and sustains a higher rent charge than most farm lands. In order clearly to represent the costs of production the summary table designates the land rental charge as an indirect cost and all other charges as direct costs.

Table XII presents the rental charge per acre at each locality.

TABLE XII  
RENTAL CHARGE PER ACRE AND PER TON

Locality	Rental Cost Per Acre	Rental Cost Per Ton
Chaska.....	\$6.80	\$0.71
Cologne.....	8.63	.67
Dassel.....	9.08	.92
Dodge Center.....	7.16	.81
Glencoe.....	6.00	.57
Green Isle.....	8.00	1.19
Lesueur Center.....	7.93	.79
Mankato.....	5.42	.59
Montgomery.....	10.42	.79
New Prague.....	10.86	.93
Renville.....	7.23	.77
Average.....	7.74	.79

TABLE XIII  
COST PER ACRE OF PRODUCING SUGAR BEETS

Locality	Man Labor	Horse Labor	Seed	Ma- chinery	Taxes	Fer- tilizer	Total Direct Costs	Land Rent	Total Cost	Average Normal Yield	Cost per Ton
Chaska.....	\$24.26	\$10.71	\$2.99	\$1.18	\$0.91	.....	\$40.05	\$6.80	\$46.85	Tons 9.6	\$4.88
Cologne.....	29.43	13.24	2.50	1.28	.65	.....	47.10	8.63	55.73	12.9	4.32
Dassel.....	24.76	10.36	2.76	1.23	.69	\$1.88	41.68	9.08	50.76	9.9	5.13
Dodge Center.....	25.77	9.25	2.31	1.35	.87	1.95	41.50	7.16	48.66	8.8	5.53
Glencoe.....	23.78	10.95	2.40	1.35	.70	.....	39.18	6.00	45.18	10.5	4.30
Green Isle.....	24.10	8.52	2.31	1.02	.....	1.45	37.40	8.00	45.40	6.7	6.77
Lesueur Center.....	20.52	7.90	2.37	1.17	.78	.....	32.74	7.93	40.67	10.0	4.07
Mankato.....	22.70	9.55	2.47	1.14	.48	.....	36.34	5.42	41.76	9.2	4.54
Montgomery.....	22.18	11.91	2.42	1.28	.79	.....	38.58	10.42	49.00	13.1	3.73
New Prague.....	22.74	11.34	2.36	1.25	.59	1.30	39.58	10.86	50.44	11.6	4.34
Renville.....	21.24	7.91	2.48	1.20	.89	1.90	35.62	7.23	42.85	9.4	4.55
Average.....	23.61	9.97	2.57	1.21	.77	1.78	39.91	7.74	47.65	9.8	4.85

In Tables VII to XII inclusive, the cost per acre and per ton is given for each item of cost. The acre cost is the proper basis for computation and interpretation as the ton cost depends entirely on the yield per acre. The cost for the ton is given as it shows the necessity of obtaining larger yields in order to keep down the cost per unit of product sold. The costs per acre are relatively constant. Table XIII summarizes the costs per acre for each locality studied.

The labor cost in Table XIII varies from the figures given in Table VI, because the summary presents the average of all methods of handling the crop, including contract and farmer's labor, while Table VI presents all operations but uses the farmer's hand-labor and not the contract-labor requirements.

## YIELDS

As has been explained, the yield per acre was placed on an actual weight basis by checking the records with the sugar company's books. The yield was obtained from each grower for as many years as possible, and the average was called the average normal yield. For the same years each grower's figures were compared with the company's books with the result shown in Table II. The company's figures were used as the actual normal yield.

Any cash crop depends on yield for an increasing cash income, and usually the producer appreciates the fact that all over a certain amount is clear gain. Especially is this true where the price per unit is guaranteed before the crop is planted. This is the case with the beet crop and one would expect to find special efforts being put forth to procure the very highest yields possible with known practical means. That such is not often the case is attested to by the yields shown and by the testimony of the field agents who gathered the data. Table XIV presents the 1914 yields per acre and the normal yield for each locality studied, according to the scale weights shown by the books of the sugar company.

It should be borne in mind that the average gain of \$1.45 per acre allows for all costs, including \$7.74 land rental charge. The farmer's actual cash gain, if he does not pay cash rent, after being paid for his own and his horses' labor is over \$9 per acre. The actual return to the producer as pay for his own labor and that of his family where no contract labor is employed, and for land rent and profit, is \$32.50 per acre after deducting horse labor, taxes, seed, and machinery costs; where cash is paid for contract labor the returns are reduced to \$15.31 per acre as pay for labor, rent, and profit. Very few crops would show such a normal average for as many farms as are here indicated. Table XIV shows that 9.5 tons of beets are re-

TABLE XIV  
YIELDS PER ACRE

Locality	YIELDS PER ACRE		Yield Necessary to Cover Cost	Normal Receipts per Acre	Total Cost per Acre	Normal Gain per Acre	Loss per Acre
	1914	Normal					
Chaska.....	Tons 10.31	Tons 9.60	Tons 9.37	\$48.00	\$46.85	\$1.15	.....
Cologne.....	10.75	12.87	11.14	64.35	55.73	8.62	.....
Dassel.....	9.28	9.86	10.13	48.30	50.76	.....	\$2.46
Dodge Center.....	10.40	8.80	9.73	44.00	48.66	.....	4.66
Glencoe.....	10.27	10.52	9.03	52.60	45.18	7.42	.....
Green Isle.....	6.70	6.70	9.08	33.50	45.40	.....	11.90
Lesueur center.....	8.22	9.99	8.13	49.95	40.67	9.28	.....
Mankato.....	8.56	9.22	8.35	46.10	41.76	4.34	.....
Montgomery.....	12.64	13.14	9.80	65.70	49.00	16.70	.....
New Prague.....	12.13	11.63	10.09	58.15	50.44	7.71	.....
Renville.....	9.94	9.40	8.57	47.00	42.85	4.15	.....
Average.....	9.96	9.82	9.53	49.10	47.65	1.45	.....



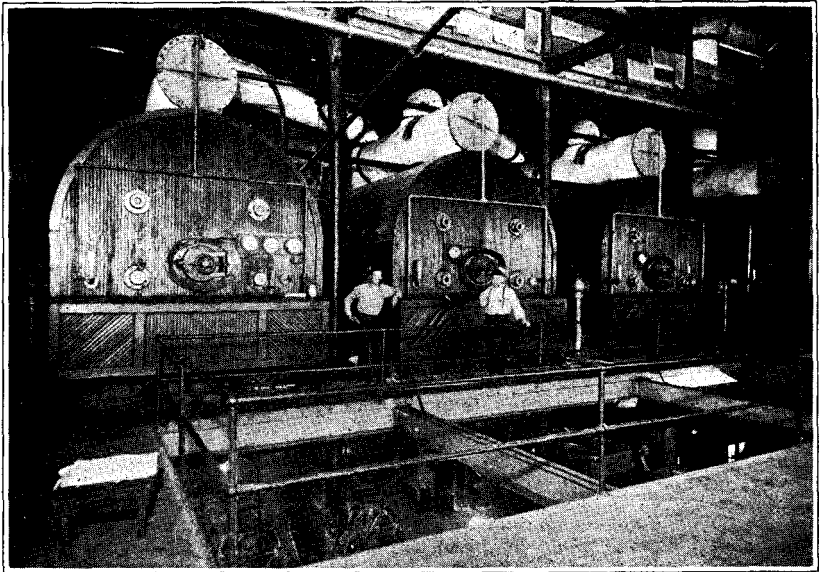


Fig. 10. Interior View of Sugar Factory

quired per acre to pay all costs of the crop, including land rent. Therefore all over that amount is clear gain, after allowing for the increased cost of contract labor and the cost of hauling. Several yields of from 16 to 20 tons per acre were obtained in 1914 and yields of 22 and 24 tons have been reported. Putting a desirable yield at 14 tons is very conservative and this amount is possible of attainment almost without exception. This means a profit of about \$20 per acre. Fifteen acres would add \$300 to the net income. This is almost as much as the average farmer receives annually for all his labor, to say nothing of profits.

#### RELATION OF YIELD TO WIDTH OF ROW

There has been considerable discussion of this problem in sugar beet circles with the prevailing opinion among the field men of the sugar company that as large yields, if not larger, can be obtained by the wider-row method of planting. The latest beet drills are mostly 24-, 26-, and 28-inch rows capacity, while formerly 18-, 20-, and 22-inch were very common. Many growers favor each of the various widths, altho the larger number believe the 26- and 28-inch rows have produced as good yields as the narrow gauges and allow for better cultivation and care of the beets. The following figures are not at all conclusive, but are a contribution to the discussion. Considering the number of acres of record, the 28-inch row appears to be as productive as the

average. The acreages of the 18-, 22-, 27-, and 30-inch rows are too small to have much statistical value. Other factors have such influence in affecting yields that it would require experiments with governed factors to settle the question.

TABLE XV  
RELATION OF YIELD TO WIDTH OF ROW

Width of Row	Farms	Acres	Yield per Acre
Inches			Tons
18.....	3	7.5	10.93
20.....	42	282.0	10.83
22.....	5	21.0	11.98
24.....	36	298.0	10.33
26.....	4	62.0	10.32
27.....	7	39.0	11.60
28.....	59	629.0	10.60
30.....	5	24.0	13.90
Total.....	161	1,362.0	.....
Average.....			10.69

#### METHODS OF INCREASING YIELDS

With standardized seed provided by the sugar company, and agents in principal centers of production to provide labor, oversee details, and arrange for marketing the crop, the greatest opportunity for increasing the yield seems to be in obtaining a better stand of beets. This means that it is strictly a part of the grower's business to properly manure, plow, disk, harrow, and seed the land so as to give the very best possible seed bed. Not only should great care be taken to prepare the land but the beets should be drilled evenly as to depth and amount of seed to the acre, and seeded at about the same time. The care of the land after seeding, eradicating weeds and cultivating at proper times and with proper care, are important phases of beet-production. The men doing the contract labor cannot afford to wait for the farmer to do his part, neither can the farmer afford to wait for the hired workers. The result always shows at shipping-time and often both are disappointed.

The importance of stand is readily understood if one contemplates the huge difference made in the final result by seemingly small increases. With 28-inch rows one added beet to the rod increases the yield over three-quarters of a ton per acre; one added beet every yard means an added yield of 4.5 tons per acre. Surely there is room for one more beet on an average of every yard of land. With a guaranteed price per ton and a sure market for the crop, every effort should be made to obtain profitable yields. It is estimated that one ton more

per acre means an increase in state production of \$60,000 at the present price of \$5 per ton. The increase of 4.5 tons per acre on the present acreage would mean adding \$270,000 to the state's production. This means greater profits to the farmers, more manufacturing at the factory with more labor employed, and greater sugar-production. The maximum limit in beet yields has never been determined and there does not seem to be much danger of too large a yield per acre. There is no doubt a maximum limit beyond which the added effort and cost would exceed the value of the additional product. Before this point is reached the grower should consider placing his labor and efforts on some other enterprise, the increased units of which will return a larger gain than the very close margin of the highly developed beet product. As before stated, however, this is a remote condition for most producers, in the beet crop as well as in most other crops. It is safe to say that 20 tons per acre is possible to practically all growers with present costs very slightly increased.

### BEET TOPS

In addition to the cash value of the beet crop, which has been shown to pay a profit, an added value is obtained from the beet tops. This value depends largely on the feeding of the tops to some class of livestock. Most of the farms studied in this survey used this by-product as a feed for dairy cows and without exception the farmers testify to its worth. The accurate yield of tops per acre was not de-

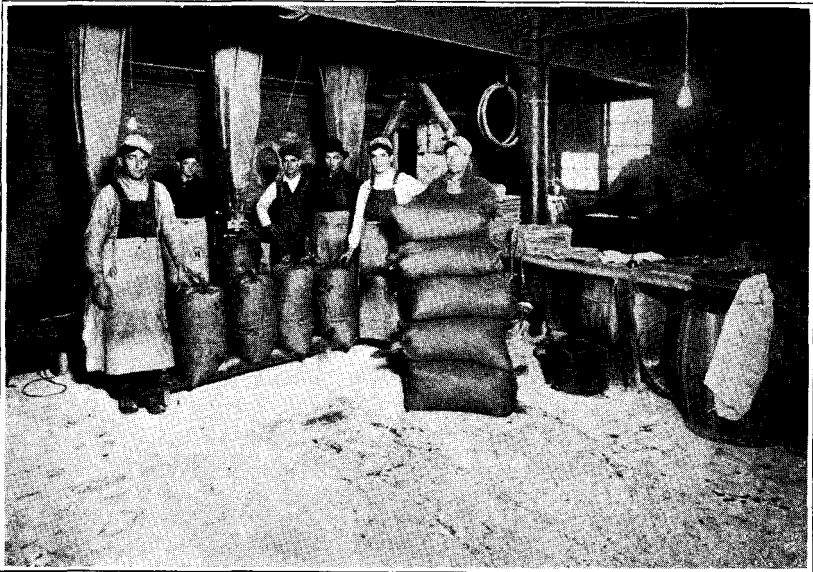


Fig. 11. The Finished Product

terminated, as no actual weights were available. No data on this point are available from experiments and the weight would vary greatly with conditions. The weight depends on the time of hauling from the field, as the green tops contain more water than the dried ones. Estimates by growers range from 1 to 3 tons of cured tops per acre. Various methods of handling the tops are practiced, they are siloed, stacked, hauled from the field as fed, and pastured. It is claimed that the tops may be piled in a large pile and the exterior layer will exclude the air so that a siloed product is obtained.

To place an accurate value per ton or acre on the tops is difficult. In this investigation all possible data on this point were gathered. In several instances records were obtained of sales of tops on the acre basis. These varied from \$2 to \$6 per acre, while estimates of growers on the value per acre ranged from \$2 to \$12. Many growers expressed themselves as being willing to grow the crop for the tops as profit merely "breaking even" on the beets. An average value per acre, obtained from the entire body of producers, was \$4.40. This cannot be accepted as final or accurate. The character of the livestock and the manner of storing and feeding actively affect the value obtained. The testimonies of various growers on this point follow: A grower at Lesueur Center said: "The tops are excellent for milk cows and the flow of milk is very much increased. Very similar to grass in the spring." A grower near Mankato said: "We fed the tops in place of grain with hay and received a surprising increase in milk flow. They are worth at least \$3 per ton." A Dassel grower remarked, "For pasture, the tops are easily worth \$2 an acre, for fertilizer they are worth as much, while for milk cows they are equal to corn silage, if not superior." A feeder of tops at Mankato is enthusiastic over the product. He said, "I bought 10 tons of tops and fed them to five cows all winter. With grain and cured beet tops the cows did well until April. I fed all the tops the cows would eat." Another man said, "The tops are surely great to increase the milk flow, but I notice they cause a peculiar taste to the milk." This man's neighbor testified on the same point: "The tops do not cause any change in the taste of the milk, and I am anxious to buy all the tops I can at \$5 an acre to feed to my cows." By far the majority of those who had fed the tops claimed that they were a very good succulent feed. At about \$4 per acre they are a valuable by-product of the sugar beet crop.

#### EFFECT OF BEETS ON SOIL AND FOLLOWING CROPS

Before a crop can assume a definite place in economic production its effect on the soil must be determined. Obviously a crop profitable in itself that leaves the soil depleted so that following crops are rela-

tively unprofitable has a very heavy handicap in ranking in economic favor. Unless all data, both experimental from a scientific viewpoint and practical from the producer's viewpoint are utterly wrong in interpretation and result, the sugar beet crop must be considered as being particularly valuable to future crops. One of the strongest advantages lies in its favorable effect on the yields of following crops. This is explained in three ways: (1) the land for beets is usually heavily manured previous to beet-seeding; (2) the seed bed is well prepared for the crop, and the land is kept exceedingly clean of weeds; (3) the beets open the soil so that air and moisture can readily act on the plant food, making it available for the following crop. The common practice is to follow beets with small grain, usually wheat or barley. While no definite conclusive data have been obtained from a large area and a large number of growers, all the evidence obtained points to comparatively large increases in yield of small grains following beets. In practically no instances were records obtained of decreased yields of grain compared to previous or average yields. The investigators were struck with the consensus of opinion on this point. A conservative average from growers experienced in beet-growing is an increase of 5 bushels of wheat and from 4 to 5 bushels of barley per acre after beets. This means an increase of from 20 to 30 per cent in wheat without additional cost. Corn is rarely grown after beets as it is also a cultivated crop and the growers have learned that small grain does much better than other crops. From a financial standpoint this may not mean much in total, as beet acreages are relatively small, and 5 bushels of wheat on 15 or 20 acres is not a large increase; yet 100 bushels at 85 cents would mean adding \$85 to the income as clear gain. The fact is that often 8- and 10-bushel increases are obtained, which places the grain crop on a wide margin of profitableness. Testimony of many growers illustrates the advantage of following beets with grain. A beet-grower at Dassel, Meeker County, who planted 80 acres in beets, says, "We obtain one-third increase in wheat after a crop of beets." Another Dassel grower says, "From 6 to 10 bushels increase in wheat per acre is the rule after beets." A New Prague grower claimed "a 50 per cent increase of wheat." A Lesueur Center grower says "wheat or barley yields from 5 to 10 bushels more per acre after beets than after corn." Many similar expressions indicate, in a general way, the effect of the beet crop on the soil and following crops.