COST OF PRODUCING FARM CROPS IN EASTERN CANADA

BY

E. S. HOPKINS, A. GOSSELIN AND J. M. ARMSTRONG

DIVISION OF FIELD HUSBANDRY
DOMINION EXPERIMENTAL FARMS

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DEPARTMENT OF AGRICULTURE
BULLETIN No. 115—NEW SERIES

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COST OF PRODUCING FARM CROPS IN EASTERN CANADA

BY E. S. HOPKINS, A. GOSSELIN AND J. M. ARMSTRONG

THE OBJECT OF COST OF PRODUCTION STUDIES

The main object of cost of production studies is to learn how to reduce the cost of production. Another object is to learn what crops give the most profitable returns. Owing to the fact that the labour requirements for certain crops occur at different periods of the year, it is not always possible to make a direct comparison between these crops but it is possible to compare other crops which compete for labour at the same time, such as wheat, oats and barley, on the one hand, or corn, sunflowers or roots on the other. It may also be possible to calculate the maximum acreage of the various crops which could be produced. Data on cost of production, accurately kept for several years and then properly interpreted, make possible a more intelligent selection of crops and throw some light on a better proportion of each crop to grow.

When figures are kept on the cost of doing various jobs with different equipment, it is possible to decide what equipment does the work most economically. With the recent introduction of much larger machinery for preparing the land, seeding, and harvesting crops and with the marked improvements which have been made in the tractor during the last ten years, it is extremely desirable to have some figures available in regard to the cost of doing certain lines of work with different outfits.

The accuracy of cost of production studies is often questioned. It is claimed that there are many joint costs which must be prorated among different crops and that it is impossible to apportion such costs accurately. For example, when manure or commercial fertilizers are applied to a crop they benefit not only the crop to which they are applied but also the others in the rotation; any rule which may be given to distribute the cost among the various crops can only be an arbitrary rule and cannot cover all cases. In the production of grain crops, straw, as well as grain, is produced but some arbitrary method of dividing the entire cost of the whole crop between the straw and the grain must be assumed. The profit on any crop is largely affected by its value which varies widely from year to year, making it unsafe to decide that, because a certain crop is the most profitable in one year, it will be the same the following year. It is stated, also, that variations in climatic conditions among different seasons make average figures on costs somewhat unreliable because while one season may be ideal for doing certain farm operations, the next may be so adverse as to not only considerably increase the labour involved in producing the crop but also to greatly reduce its yield and quality as well. In attempting to value farm products which are not sold on the market, such as silage and root crops, difficulties arise in determining accurately how this is to be done. Even after figures have been obtained on the cost of producing the various farm crops and the profit derived from each, it would not be advisable to grow only the most profitable crop. It may often be necessary to secure employment for men and teams in the production of some less profitable crop rather than have them stand idle.

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All of these objections have more or less force. Undoubtedly, it is difficult to determine the exact cost of producing certain farm crops and the profit derived from each. However, it is possible to determine the relative profitableness of various competing crops and with this knowledge, the acreage of the more profitable crops may be gradually increased. In regions where one crop constitutes the chief source of revenue from the farm the problem is very much simplified but in most parts of Eastern Canada where there is not only a great diversity of crops but also where live stock enterprises usually constitute the chief source of revenue, the question becomes more complicated. Nevertheless, a thorough study of all the costs and returns is the only intelligent means offering much hope of improving the business and financial aspect of the farming enterprise. Farming remains about the only important business which is conducted without systematic records. When records are kept, it is possible to learn very accurately what average yields may be expected from each crop over a period of years. While no one can predict what the yield will be for the following year, anyone who has kept records for a number of years can estimate fairly accurately what average yield will be obtained over the next five-year period. While costs of production vary widely from year to year, an average can be determined over a period of years which will be useful in comparing different crops. Information will be available, therefore, to enable a more intelligent selection of the most profitable crops. Cost of production studies enable one to calculate the expense of doing various field operations with different types of machinery and with different crews, thereby indicating the most economical system of production.

COST OF PRODUCTION FACTORS

METHODS USED IN ESTIMATING THE COST OF PRODUCING CROPS

In calculating the cost of producing farm crops it is necessary to estimate the value of all the various items which enter into the cost. Some of these items, such as those relating to the cost of manual and horse labour, are very easily figured because in these instances it is possible to record exactly the number of hours worked on the various crops and then multiply this by the cost per hour of this labour. With other items, however, such as the cost for manure, it is necessary to make an assumption regarding what percentage of the total cost should be charged against each particular crop in the rotation. It may be of interest to explain what factors have been used in this bulletin in estimating the cost of producing crops. These factors may be of value to persons attempting to estimate the cost of producing crops on their own farms although some changes might be necessary to meet the needs of individual cases.

ITEMS OF EXPENSE

USE OF LAND

One important item in the cost of producing crops is that of the use of the land on which the crops are grown. If the land is high in price, this item will be large, and in some few localities, such as in the vicinity of cities, may be so high as to make impossible the profitable production of some crops. On high priced land it is customary to find high priced crops while, on low priced land, crops are grown which have a small return per acre.

The simplest method of determining the charge per acre for the use of the land consists in multiplying the value of the land per acre by the current rate of interest as obtained on first mortgages and then adding the upkeep and the amount per acre of the taxes. The value of the land per acre is obtained by

dividing the total value of the farm by the total number of acres in the farm. The total amount of the taxes is also divided by the total number of acres in the farm. Where a farm is rented, the rental charge is obtained by dividing the amount of the rent by the total number of acres in the farm. This method of determining the charge for the use of the land has the advantage of being very simple but it is applicable only to general farms and does not give absolutely accurate results. It is obvious that by taking account only of the total number of acres in the farm, rather than of the number of acres under cultivation, the charge for the use of the land may be too small. Furthermore, by not charging against the live stock a part of the cost of the barn, another error arises, in this case the figure tending to be too high. However, under average conditions, these factors tend to balance each other. If it is desired to secure more accurate figures for the charge for the use of the land the following, somewhat more complicated system, may be adopted.

Where a farm is rented, it is necessary to subtract from the total amount of the rent an estimated figure for the annual return value of the bush land, pasture land, and orchard, and one-half of the charge for the use of the barn. The remainder is divided into the number of acres under cultivation giving the charge per acre for the use of the land under cultivation.

Where a farm is owned, its value should be divided into separate items, such as the value of the cultivated land, permanent pasture, bush land, orchard, house, barn, and other buildings. The sum of these values, it is clear, should not exceed the sale value of the farm as a whole. The total value of the cultivated land is then divided by the number of acres under cultivation thus giving the value of the cultivated land per acre. The charge per acre for the use of the land is then obtained by multiplying this value per acre by the current rate of interest on first mortgages. To this amount is added the proper proportion of the taxes and the upkeep of fences, roads, and drains, and one-half the value of the use of the barn. As the barn both stores crops and houses stock, it is customary to charge one-half of the cost to each.

It is rather difficult to make a valuation for the use of the barn and other buildings and it is frequently necessary to use a figure which is much below the cost of these buildings or the amount it would take to replace them. If there is too high an investment in the buildings for the size of the farm, the excess value cannot be used as it would not increase the value of the farm above that of other farms having a smaller investment in buildings. No charge is made against crops for the use of the house for the reason that it is used as a residence and has nothing to do, directly at any rate, with the income from the farm.

MANURE AND COMMERCIAL FERTILIZERS

A charge of $1.50 a ton has been made in this bulletin for farm manure. This charge includes the cost of hauling and applying the manure to the land, which has been estimated at 50 cents per ton, and the value of the manure itself, which has been calculated at $1 per ton. The assigning to the manure which has been produced on the farm, a value of $1 per ton, may cause a misunderstanding in regard to the profit derived from the crops because, in reality, no expense is actually entailed in its purchase. It is equivalent to crediting to the live stock department of the farm a value of $1 for each ton of manure produced. In some localities manure should be given a value greater than $1 per ton while in others it should be given less. The value of the manure will vary widely depending upon a number of factors such as the fertility of the land to which the manure is applied, the quality of the manure, the season, the crop for which the manure is applied, and the value of the crop. However, for average conditions, $1 per ton is a fair valuation.

The crop to which the manure is applied receives the largest benefit of the manure and naturally must be charged with the largest percentage of the cost. Other crops in the rotation, farther removed from the application of the manure, derive less and less value until the value is all exhausted. It is impossible to fix accurately the percentages of value which are received by each crop but it is necessary to assume some percentage in order to estimate the total charges against each crop. In three and four-year rotations it is customary to apply the manure once during the rotation, a slightly heavier application being given to the four-year rotation. In five- and six-year rotations it is advisable to give two applications of manure but the rate of application is equivalent to the same total quantity per acre per year. The percentage of the value of the manure which is received by each crop in the rotation is arbitrarily set as follows. The first year crop denotes the crop to which the manure has been applied.

Three-Year Rotation

1st year crop—50 per cent of the value of the manure.
2nd year crop—30 per cent of the value of the manure.
3rd year crop—20 per cent of the value of the manure.

Four-Year Rotation

1st year crop—40 per cent of the value of the manure.
2nd year crop—30 per cent of the value of the manure.
3rd year crop—20 per cent of the value of the manure.
4th year crop—10 per cent of the value of the manure.

Five-Year Rotation

1st year crop—40 per cent of the value of the manure.
2nd year crop—25 per cent of the value of the manure.
3rd year crop—20 per cent of the value of the manure.
4th year crop—10 per cent of the value of the manure.
5th year crop— 5 per cent of the value of the manure.

Six-Year Rotation

1st year crop—40 per cent of the value of the manure.
2nd year crop—25 per cent of the value of the manure.
3rd year crop—20 per cent of the value of the manure.
4th year crop—10 per cent of the value of the manure.
5th year crop— 5 per cent of the value of the manure.
6th year crop— 0 per cent of the value of the manure.

Where commercial fertilizers are applied to the land it is even more difficult than with manure to determine the residual influence to the various crops in the rotation. The season exerts a more potent influence with commercial fertilizers than with manure and any apportionment of the cost is liable to be very incorrect in certain seasons. Very little data are available on which to estimate what percentage of the value of the commercial fertilizers should be assigned to each crop in the rotation. At best only an arbitrary percentage may be given.

On the Experimental Farms, it is customary to assume that with a mixed fertilizer 55 per cent of the cost should be charged against the crop to which it has been applied, 30 per cent to the second crop, 10 per cent to the third crop, and 5 per cent to the fourth crop. Where nitrate of soda or ammonium sulphate have been applied alone, 80 per cent of the cost is charged against the first crop and 20 per cent against the second crop. Where superphosphate is

applied alone, 33 per cent is charged against the first crop, 33 per cent against the second, 22 per cent against the third, and 12 per cent against the fourth crop. Where muriate of potash is applied alone 50 per cent is charged against the first crop and 25 per cent against the second and third crops. Where a light dressing of lime, such as one ton per acre, is applied, its cost is distributed equally among each crop in the rotation. If a heavy dressing of lime is applied its cost is divided over a longer period of years.

MANUAL LABOUR

The rate for manual labour should be the prevailing summer wages in the district for hired help, plus the value of the board and lodging. In this bulletin, the rate for manual labour has been charged at 22 cents an hour.

HORSE LABOUR

The rate per hour for horse labour may be computed by figuring the total charge of keeping a horse for a year and dividing this by the total number of hours the horse has worked. In this bulletin, a figure of 10 cents per hour has been used.

The cost of horse labour varies considerably on different farms, depending upon how the horses are kept and the amount of work they do. The cost includes interest, depreciation, feed, harness, stabling, shoeing, veterinary charges and labour. Under average farm conditions this amounts to about $100, while the number of hours worked per year per horse is approximately 1,000 hours. Where horses are worked more than this, the cost of keeping them is greater although the cost per hour, for the hours worked, may be reduced.

TRACTOR LABOUR

The method of determining the charge for tractor labour is discussed on page 32 of this bulletin. In the various detailed statements on the cost of producing the different crops, the costs have been based on the field work being done with horse labour and not with tractors.

MACHINERY

The charge per acre for farm machinery varies widely, depending upon the amount of machinery owned, the care which is given to it, and the number of acres under cultivation. The total annual charge for machinery consists of depreciation, interest, repairs and housing.

Depreciation consits in charging off enough of the initial cost price of any implement to replace it on the market at the end of its period of usefulness. It may happen that the amount charged is not sufficient or it may be too great. However, as there is no means of knowing the probable cost of implements at some future date, the charge for depreciation is usually based on the life of the machine. Thus if the life of any given machine is 10 years, an amount equal to 10 per cent of the cost price is charged off each year as a depreciation or replacement charge.

The method used in this bulletin to calculate the interest charge on farm machinery consists in charging the current rate of interest, as obtained on first mortgages, against the inventory value of the machinery. The result gives an interest charge on the present valuation or on the money that might be realized from the immediate sale of the implements. Another method of computing interest takes into account the "average investment" over the life of the machines. The average investment in a machine is the sum of all inventory

The old method. Benjamin Franklin said:

"He that by the plough must thrive,
Himself must either hold or drive."

With three or four horses and a two-furrow riding gang, one man will plough three acres per day.

values during the life of the machine divided by the number of years in the life period. Interest on this sum at the current rate of interest constitutes the average annual interest charge on machinery.

As the sum arrived at by the use of the "average investment" method is but slightly more than one-half the cost price of the machine, the practice of charging interest on one-half the cost price of any implement has been adopted in some instances. This method has the advantage of being a constant figure for any one machine, is readily found, and is easy to apply.

The charge for repairs is made up from the annual records of expenditure for these items, including cost of parts and repair labour. The total charge for housing is estimated by taking the depreciation, interest and upkeep charges on the buildings used for storing the machines. The result is prorated among the machines in proportion to the space required by each machine.

There are several systems by which the operating cost of machinery may be charged against farm crops. The system used in this bulletin consists in finding the total annual charge for all machinery and dividing this charge by the number of acres under cultivation. While this method is not absolutely accurate, especially in regard to such crops as roots which employ only a small amount of machinery, it gives results that have a fair degree of accuracy and has the advantage of being a very simple method to employ.

Where it is desired to know the machinery cost for each crop, a modification of the above system may be used. This consists in finding the total annual operating cost of all general machinery, that is, machinery used in preparing the soil for all crops or machines used for more than one crop. This cost is apportioned equally to all the cultivated acreage or may be apportioned according to the time used on each crop. The operating cost of special machinery or machines used for only one crop is then charged against the crop for which they are used by dividing the total operating cost by the number of acres of that crop.

An extensive study has been made by the Central Experimental Farm, Ottawa, of the operating cost of farm machinery in which information was received by means of a questionnaire from representative farmers throughout Eastern Canada. The results of this survey may be found on page 27 of this bulletin. It was found that the average annual cost of operating farm machinery was $2.85 per acre of cultivated land.

THRESHING AND ENSILING

Where outfits are rented, the rental charge, as well as the cost of the labour and board of the men, should be included. Where the outfits are owned a proper proportion of the annual cost should be charged. In this bulletin, the cost of threshing grain from the mow or stack has been estimated at 4 cents a bushel for oats, 5 cents for barley, and 7 cents a bushel for wheat. The charge for the ensiling outfit has been estimated at 25 cents per ton of material ensiled. These charges include only the rental cost of the threshing machine and operator and the ensilage cutter and its operator.

SEED

The actual cost or value of the seed used should be charged against the respective crops. In the case of hay crops, the cost of the red clover seed should be charged against the first hay crop, while the cost of the other seed should be distributed equally among each hay and pasture crop in the rotation. In this bulletin seed grain has been valued at 50 per cent above the market price of the grain while grass seed has been charged at actual cost.

This outfit will double disk upwards of 20 acres per day at a cost of 51 cents per acre. The tractor enables a large amount of work to be done per day and thereby permits of more cultural operations being done at the proper time.

RETURN VALUES FOR CROPS

GRAIN CROPS

The prices which should be credited for grain should be a fair farm or market price. It is almost impossible to set an accurate figure for the value of straw. The value varies with a number of factors, such as, whether the straw could be sold on the market, whether it could be used to advantage for stock, whether the supply of both hay or straw is short in the district, as well as the actual quality of the straw. On the Experimental Farms in Eastern Canada, it is customary to give wheat straw a value of $2 per ton and oat and barley straw a value of $4 per ton.

SILAGE CROPS

These crops are also difficult to value. They are fed to livestock and not sold on the market to any appreciable extent. It is necessary, therefore, to estimate their value in comparison with the value of some other marketable crop used for a similar purpose. Since silage is usually substituted for a certain amount of hay in a ration, the method commonly used to determine its return value is to compare silage with hay on the basis of their dry matter content and their respective feeding value. When corn silage has a dry matter content of 25 per cent, it is customary to give it a value on the basis that 300 pounds of silage are equal to 100 pounds of hay. When the silage contains less dry matter it should be given a lower valuation. Accordingly, if it contained only 20 per cent of dry matter it would require 375 pounds of silage to be equal to 100 pounds of hay. It is difficult to describe exactly the stage of maturity of the corn when it contains various percentages of dry matter. However, as an approximate guide, when the corn at Ottawa is in the glazing stage, it contains about 25 per cent dry matter, when in the milk stage it contains 20 per cent, and when in the silking stage it contains about 17 per cent of dry matter.

In this bulletin 333 pounds of corn silage have been regarded as equal in value to 100 pounds of hay; 350 pounds of sunflower silage, 320 pounds of sweet clover silage, 280 pounds of a mixture of oats, peas and vetch silage have also been regarded as equal to 100 pounds of hay. These valuations are based on the average dry matter contents of these crops on the Experimental Farms in Eastern Canada.

ROOTS

Considerable difference of opinion exists regarding what constitutes the correct method of estimating the value of roots when fed to livestock. Their value varies to some extent when used as roughages or concentrates. As roughages, roots are sometimes compared with corn silage, assuming that their content of dry matter is worth 25 per cent more than the dry matter in the corn silage. Corn silage, in turn, is compared with the value of hay on the basis of 300 pounds of silage, having a dry matter content of 25 per cent, being equal in value to 100 pounds of hay. When roots contain 10 per cent dry matter, and assuming that their dry matter is worth 25 per cent more than that of corn, 600 pounds of roots would be equal to 100 pounds of hay. With hay worth $11.75 per ton, as used in this bulletin, roots would be worth $1.96 per ton.

The value depends also upon the quantity of roots fed, the smaller the quantity, the higher the value becomes. Furthermore, when fed in conjunction with silage, roots have a higher value than when fed alone although this may be due to being fed in smaller quantities. However, it is impossible to be able to fix any figure which will apply to all conditions because when fed for

different purposes and in different amounts per day the value changes. It is believed that the figure of $1.96 per ton represents a fair average value when hay is worth $11.75 per ton.

Roots are sometimes compared in value on the basis that their dry matter content is equal to that of the dry matter in concentrates. To compare roots with a mixed grain ration of equal parts of oats and barley, it is necessary to arrive at the amount of dry matter in grain and roots. One ton of roots, having a dry matter content of 10 per cent, would contain 200 pounds of dry matter. Oat and barley grains contain approximately 91 per cent dry matter, thus 109·9 pounds of oats and the same weight of barley grain would contain 200 pounds of dry matter. This amount of oats, valued at 59 cents per bushel would be worth $1.94, while 109·9 pounds of barley valued at 92 cents per bushel would be worth $2.11. Since the dry matter of roots and grain are valued equally pound for pound, according to this method the total value of the 200 pounds of dry matter of the grains or of one ton of roots would be $4.05. Whether to value roots in comparison with a roughage such as corn silage or with a concentrate such as mixed grain depends upon circumstances. If roots are fed in small quantities they have undoubtedly a higher value than when fed in larger quantities.

SUMMARY OF COST OF PRODUCTION FACTORS USED IN THIS BULLETIN

Item	Statement	Amount
		$ cts.
ITEMS OF EXPENSE		
Use of land and buildings	Rent or interest, taxes and upkeep per acre	6 00
Manure, per ton	$1.00 for value and 50 cents for applying per ton	1 50
Machinery, per acre	Total annual charge per acre	2 85
Seed	Seed grain at 50 per cent above market price grass seed at actual cost	.....
Twine	Per pound	0 15
Manual labour	Per hour	0 22
Horse labour	Per hour	0 10
RETURN VALUES		$ cts.
Oats	Per bushel	0 59
Barley	Per bushel	0 92
Wheat	Per bushel	1 50
Oat and barley straw	Per ton	4 00
Wheat straw	Per ton	2 00
Clover and timothy hay	Per ton	11 75
Corn silage	Per ton	3 52
Sunflower silage	Per ton	3 36
Oats, peas and vetch silage	Per ton	4 20
Sweet clover silage	Per ton	3 67
Mangels (compared with hay)	Per ton	1 96
Mangels (compared with grain)	Per ton	4 05
Potatoes	Per bushel	0 60

COST OF PRODUCING CROPS

The cost of producing the various farm crops as reported in this bulletin has been based on the factors discussed in the previous chapter. Crop yields and the number of hours of manual and horse labour required to produce each crop have been averaged for all the Dominion Experimental Farms in Eastern Canada. These records have been taken on the large fields which might represent average farming conditions on the better class of privately owned farms. The labour records have been taken on horse-drawn implements of medium size and not on exceptionally large implements or those drawn by tractors.

One very important means of reducing the cost of producing crops is to raise heavy yields per acre. To produce heavy yields economically necessitates the adoption of all better farming practices, as the neglect of even one factor may materially reduce the crop yields.

COST OF PRODUCING OATS

The average cost of producing oats on seven Dominion Experimental Farms in Eastern Canada, for the five-year period from 1922 to 1926, is presented in the following statement. The average yield for this period has been 55·8 bushels per acre.

COST PER ACRE OF PRODUCING OATS

Item	Statement	Amount
		$ cts.
Use of land and buildings	Rent or interest on value of land plus taxes and upkeep	6 00
Manure	30 per cent of 16 tons at $1.50 per ton	7 20
Seed	2½ bushels	2 20
Machinery	Total annual charge	2 85
Twine	3½ pounds	0 52
Manual labour	22 hours at 22 cents	4 84
Horse labour	32·2 hours at 10 cents	3 22
Threshing	Outfit only (55·8 bushels at 4 cents per bushel)	2 23
	Total cost per acre	29 06
Cost of production	(Considering value of 1·26 tons of straw)	43 cents per bushel.

It will be seen from the above table that the cost of producing oats has averaged $29.06 per acre. It will be remembered, however, that two-thirds of the charge for the manure is due to giving it a value of one dollar a ton but as there would be a supply of this material on most farms there would not be an actual cash outlay for it. In other words, the charge of $7.20 for the manure might, in these circumstances, be reduced to $2.40 which would reduce the total cost of production to $24.26.

It has cost 43 cents a bushel to produce the oats even when a value of $4 per ton has been placed on the straw. If no value were given to the straw, it would have cost 52 cents per bushel to produce the oat grain. When the relative costs of producing the grain and straw are considered, it has cost 45 cents per bushel to produce the oats and $3.06 per ton to produce the oat straw.* It is difficult to determine the exact value of the straw, as it has a value both for feeding and manurial purposes, but it is believed that $4 per ton is not too high.

The costs of marketing oats will vary with the distance from the market and the value of the bags in which the oats are sold. Where oats are hauled 4 miles to market, one man and team hauling 200 bushels of oats per day will market the crop at a cost of 2·1 cents per bushel. To this must be added the cost of bags at 7 cents each. On this basis the total cost of marketing oats would be 2·1 cents for hauling, 3·5 cents for bags or a total of 5·6 cents per bushel. With a yield of 55·8 bushels per acre the total cost of marketing would be $3.12 per acre.

*The relative costs of producing the grain and straw are estimated in the following manner:—

$$\text{Cost of producing grain} = \frac{\text{Value of grain}}{\text{Value of grain and straw}} \times \frac{\text{Cost of production}}{\text{Yield of grain}}$$

$$\text{Cost of producing straw} = \frac{\text{Value of straw}}{\text{Value of grain and straw}} \times \frac{\text{Cost of production}}{\text{Yield of straw}}$$

The profit per acre for oats may be found by subtracting the sum of production and marketing costs from the return value per acre. Over the period from 1922 to 1926 the market price of oats has averaged 59 cents per bushel; with a yield of 55·8 bushels of grain, valued at $32.92, plus 1·26 ton of straw valued at $5.04 per acre, the total value of the grain and straw would be $37.96. From this must be deducted the production and marketing cost of $32.18 leaving an average annual profit of $5.78 per acre throughout the period 1922 to 1926.

To produce an acre of oats has required 22 hours of manual labour and 32·2 hours of horse labour. These totals have been made up by 4 hours of man and 12 hours of horse labour ploughing; 2·4 hours of man and 7·2 hours of horse labour disking; 1·2 hour of man and 2·4 hours of horse labour harrowing; 0·6 hour of man and 1·2 hour of horse labour rolling; 0·8 hour of man labour and 1·6 hours of horse labour seeding; 1·1 hours of man and 3·3 hours of horse labour cutting; stooking has required 2·4 hours of manual labour per acre; hauling 4·8 hours of manual labour and 4·5 hours of horse labour; threshing has required 4·7 hours of manual labour per acre. In addition to the above total of labour for producing the crop, there has been required 2·8 hours of manual and 5·6 hours of horse labour for marketing the crop. If the sum of all the items of expense, except those for manual labour, be subtracted from the total value of the oat crop, a figure will be obtained which may be said to be the return for the manual labour engaged in the production and marketing of the oats. On this basis, the return for the manual labour has been 45 cents per hour.

COST OF PRODUCING BARLEY AND WHEAT

As the cost of producing barley and wheat is practically identical with the cost of producing oats, detailed information regarding this cost may be obtained by referring to the statement on the oat crop. In the five provinces of Eastern Canada there were grown in 1927, only 227,000 acres of spring wheat and 689,000 acres of barley as compared with 4,948,000 acres of oats, showing that the oat crop is the most important cereal in this part of Canada. Wheat straw is not as valuable as oat or barley straw; it has been assumed to have a value of $2 per ton while oat and barley straw have been given a value of $4 per ton.

For the five-year period from 1922 to 1926 it has cost 99 cents per bushel to produce wheat which has given an average yield of 27·2 bushels per acre. The market price of spring wheat has averaged $1.50 per bushel for the period, giving an average profit of $12.34 over and above the cost of production and marketing. Barley has cost 61 cents per bushel with an average yield of 39·4 bushels per acre. The average market price of barley throughout the period has been 92 cents per bushel, giving an average profit of $10 per acre, costs of marketing considered. For the same period oats have returned a profit of $5.78 per acre.

COST OF PRODUCING HAY

The average cost of producing hay on six Dominion Experimental Farms in Eastern Canada, from 1922 to 1926 inclusive, is given in the following statement. This cost is for hay crops that produce only one cutting of hay per year and does not cover crops where two cuttings are secured. The average yield of one cut of hay per season has been 2·46 tons per acre for the above period.

The average yield, on the Central Experimental Farm, Ottawa, of a mixture including alfalfa along with red clover, alsike and timothy over a period of five years, has been 3.72 tons per acre. Heavy yields reduce the cost of production per ton.

COST PER ACRE OF PRODUCING HAY

Item	Statement	Amount
		$ cts.
Use of land and buildings	Rent or interest on value of land plus taxes and upkeep	6 00
Manure	20 per cent of 16 tons at $1.50 per ton	4 80
Seed	Clover and grass mixture	2 39
Machinery	Total annual charge	2 85
Manual labour	13·2 hours at 22 cents	2 90
Horse labour	10·1 hours at 10 cents	1 01
	Total cost per acre	19 95
Cost of production	$8.10 per ton.	

It has cost $19.95 per acre to produce hay where one cut per year has been harvested. With an average yield of 2·46 tons per acre this has cost $8.10 per ton to produce. Where no valuation is placed on manure, and only the cost of applying it is considered, the charge of $4.80 for manure might be reduced to $1.60 per acre, making the total cost of production $16.75 per acre.

The cost of marketing hay will vary with the distance from the market and the cost of baling. Where it is necessary to haul hay 4 miles to market, one man and team will haul about 4 tons per day. At the wages for labour given in this publication, hauling will amount to $1.05 per ton. It is very difficult to give a statement of the cost of baling hay that is applicable to any large number of cases. However, it is assumed that a crew of 4 men and a boy operating a two-horse press will bale 10 tons per day. About 6·3 pounds of hay wire costing $4\frac{1}{4}$ cents per pound, will be required per ton. The charge for the hay press will vary with the cost of the machine and the amount of work it is used on annually. The annual charge for a two-horse press costing $454 will amount to $54.50. Assuming that the press is used on 120 tons of hay annually the cost per ton will be 45 cents for the hay press. Thus the total cost of machinery, labour and materials for baling hay will amount to $1.91 per ton. With a yield of 2·46 tons per acre, baling and hauling to market will cost $7.28 per acre.

For the five-year period considered, hay has sold at an average price of $11.75 per ton. The return value of hay thus amounts to $28.90 per acre, from this figure must be deducted the production and marketing costs of $27.23, leaving an average profit of $1.67 per acre on the hay marketed. In this connection, it should be pointed out that while only one cut of hay has been obtained the subsequent growth would be of some value where it is used for fall pasture.

To produce an acre of hay, giving one cut per year, has required on the average 13·2 hours of manual labour and 10·1 hours of horse labour. Mowing has required 1·2 hours of man and 2·4 hours of horse labour per acre; tedding 1·4 hours of man and 1·4 hours of horse labour; raking 1·2 hours of man and 1·2 hours of horse labour; coiling 3·4 hours of manual labour while hauling and storing in the barn has required 6 hours of manual labour and 5·1 hours of horse labour per acre. The labour required for baling and marketing has amounted to 18·4 hours of man and 17·2 hours of horse labour per acre. These items may be reduced to a tonnage basis by dividing by the yield of 2·46 tons. The cost of labour for cutting, curing and hauling the hay to the barn has been $1.59 per ton. It is obvious that the amount of labour will vary enormously with the efficiency of different crews and out-

fits and that wet years will necessitate very much more labour than seasons when good hay weather prevails. However, on the basis given above, the return for the manual labour has been 27 cents per hour.

On the Central Experimental Farm at Ottawa where alfalfa is included with the regular hay mixture and two cuts of hay are secured per year instead of only one cut as has previously been described, the hay crop has given very good results. During the five-year period from 1922 to 1926 an average yield of 3·72 tons per acre of hay has been secured. It has cost $24.67 per acre to produce this hay requiring 31·0 hours of manual labour and 17·4 hours of horse labour. To this must be added a cost of $3.90 for hauling to market and $7.10 per acre for baling, making a total cost of $35.67 per acre. With hay valued at $11.73 per ton, as given by the Dominion Bureau of Statistics as the average value for the province of Ontario during the five-year period from 1922 to 1926, and with a yield of 3·72 tons, there has been secured a return value of $43.64 per acre, as against a cost of $35.67, leaving a net profit of $7.97 per acre. These figures have reference to hay which is sold on the market but the great bulk of this crop is fed to live stock for which there would be no baling or marketing costs. It will be seen that where a much higher yield is secured through the use of alfalfa and where two cuts per season are available, there is a much larger profit than where only one cut per season has been obtained.

COST OF PRODUCING CORN SILAGE

The average cost of producing corn silage on the Dominion Experimental Farms in Eastern Canada, for the five-year period from 1922 to 1926 is presented in the following statement. While the yields have varied considerably from year to year, the average yield for this period has been 13·53 tons per acre.

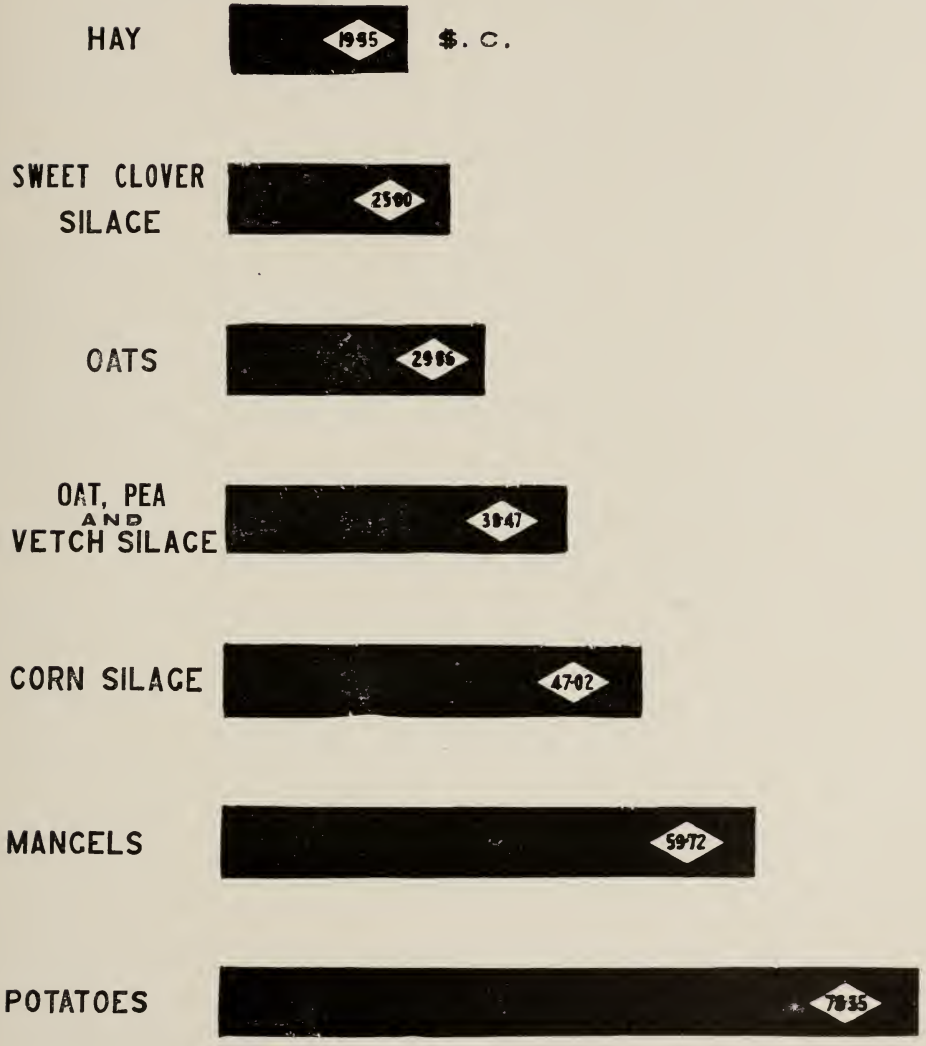
COST PER ACRE OF PRODUCING CORN SILAGE

Item	Statement	Amount
Use of land and buildings	Rent or interest on value of land plus taxes and upkeep	$ 6 00
Manure	40 per cent of 16 tons at $1.50 per ton	9 60
Seed	½ bushel	1 23
Machinery	Total annual charge	2 85
Twine	3¾ pounds	0 56
Manual labour	74·2 hours at 22 cents	16 32
Horse labour	69·5 hours at 10 cents	6 95
Ensiling	Outfit only	3 38
	Total cost per acre	46 89
Cost of production	$3.46 per ton.	

The average cost of producing corn silage has been $46.89 per acre or $3.46 per ton when the yield was 13·53 tons per acre. In cases where the yield varied from this average, the difference in the total cost per acre, is represented by the difference in the cost of loading, hauling and ensiling the crop. This cost includes man and horse labour and the cost of the ensiling machinery and amounts to approximately 81 cents per ton. Thus for every ton of increase or decrease from the yield of 13·53 tons per acre, the figure of $46.89, for the total cost of production, would be raised or lowered by 81 cents per ton. If the corn crop gives a heavy yield per acre, therefore, the cost of production is increased only a small amount per acre while the cost per ton of silage is materially reduced. On the Central Experimental Farm

COST OF PRODUCING CROPS

COST PER ACRE



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at Ottawa the average yield for the period 1922 to 1926 has been 17·14 tons per acre, costing $3.14 per ton. With this yield a profit of $6.51 per acre has been secured.

The climate affects very considerably the growth of the corn crop, the yield in cooler regions being greatly reduced. Where the yield of corn is small, the cost of production per ton is greatly increased. Considering the yield on all the Experimental Farms in Eastern Canada, which has averaged 13·53 tons per acre, the total value of the crop has amounted to $47.62 per acre. As the cost of production was $46.89 per acre there has been left an average profit of 73 cents per acre.

The two chief items in the cost of producing corn silage are for manure and manual labour. It will be recalled, in connection with the manure item, that two-thirds of the charge for the manure is due to the placing of a value on it of $1 per ton. If no valuation were placed on the manure applied, the total cost of production would be $40.49 per acre. On this basis there would be a profit of $7.13 per acre.

Since 1925 the Central Experimental Farm, at Ottawa, has handled a large part of its corn crop with the Ronning Ensilage harvester, a machine which takes the place of the corn binder and ensilage cutter. This machine reduces the cost of harvesting the corn crop, especially in regard to the number of men required. The machine is attached to a tractor and derives its power from the tractor motor. It cuts the standing corn in the field and moves it into a cylinder-type of cutter, where it is cut to the desired length for ensiling. This cut material is then taken to the silo where it is elevated into the silo by a special blower. The crew required to operate the Ronning harvester system consists, in addition to the teamsters, of one man on the tractor who also handles the machine, one man to help unload at the silo, one man to operate the blower engine and help unload, and one man in the silo to handle the distribution pipes. The economy effected by the use of this machine varies with the acreage and yield of the crop but taking all factors into consideration, the saving, in comparison with the usual corn binder and silage cutter method, is from 10 to 20 per cent. The saving in the labour required, however, is from 45 to 60 per cent when the outfit is used on 65 acres annually. The information given in this chapter on the cost of producing corn silage is not based, however, on the use of this Ronning Ensilage harvester. It is based on the usual corn binder and silage cutter method.

The cost of the manual and horse labour with the binder and silage cutter method have constituted more than one-half of the total cost of producing the corn silage. If the sum of all the items of expense, except those for manual labour, be subtracted from the total value of the crop, a figure will be obtained which may be said to be the return for the manual labour engaged in the production of the corn silage. On this basis, the return for the manual labour has been 23 cents per hour.

To produce an acre of corn has required an average of 74·2 hours of manual labour and 69·5 hours of horse labour. These totals have been made up of 6 hours of man labour and 18 hours of horse labour ploughing; 4·1 hours of man labour and 12·3 hours of horse labour disking; 1·1 hours of man labour and 2·2 hours of horse labour harrowing; 0·6 hours of man labour and 1·2 hours of horse labour rolling; 1·3 hours of man labour and 2·6 hours of horse labour seeding; 7·1 hours of man labour and 14·2 hours of horse labour cultivating; 22·9 hours of man labour hoeing; 2 hours of man labour and 6 hours of horse labour cutting; and 29·1 hours of man labour and 13 hours of horse labour ensiling.

COST OF PRODUCING SUNFLOWER SILAGE, A MIXTURE OF OAT, PEA AND VETCH SILAGE, AND SWEET CLOVER SILAGE

As sunflowers are handled in the same manner as corn for silage, the cost of production is very similar. Sunflowers give a little more trouble in loading upon the wagons at the time of ensiling, owing to the sunflower heads tending to make the sheaves somewhat top heavy, but there is no appreciable difference in the time required to handle the crop. In cool regions sunflowers give a larger yield per acre than corn, and even in the more temperate areas sunflowers do relatively better than corn on heavy clay soils which are somewhat cold. Corn, however, makes a slightly better quality of silage. During the five-year period from 1922 to 1926, on five Experimental Farms in Eastern Canada, it has cost $50.27 per acre to produce sunflowers. The yield has averaged 18·82 tons per acre making the cost of production $2.67 per ton. Valuing the crop at $3.36 per ton has given a return value of $63.24 per acre thus showing a profit per acre of $12.97 for sunflowers.

The production of a mixture of oats, peas and vetches for silage differs from the production of corn or sunflowers chiefly in the fact that no cultivation or hoeing of the crop is required. This reduces the amount of manual labour spent on the crop but it is offset in part by the heavier cost of the seed, the price of peas and vetches being fairly high. The crop is cut with a grain binder instead of a corn binder but as it is impossible to take a full swath there is not very much difference in the cost of these operations. During the five-year period from 1922 to 1926 on five Experimental Farms in Eastern Canada, it has cost $38.47 per acre to produce this crop. The yield has averaged 6·79 tons per acre making the cost of production $5.66 per ton. Corn cost only $3.46 per ton to produce. The mixture of oats, peas and vetches contains a higher percentage of dry matter than the corn. However, valuing the mixture at $4.20 per ton, the value of this crop is $28.52 per acre or $9.95 less than its cost of production. It must be remembered, nevertheless, that there are some cool districts throughout Canada where corn has not yet given profitable results and where the mixture of oats, peas and vetches makes a very useful silage crop.

Sweet clover is ensiled in the same manner as the mixture of oats, peas and vetches. It does not require, however, any expense for seeding as it is seeded the previous year along with the nurse crop and the cost of the seed itself is considerably cheaper. As this crop is a legume which grows very well on poor soil, it does not require very much, if any, manure; certainly its requirements in this regard are very much less than corn, sunflowers, or the mixture of oats, peas and vetches. On the other hand, sweet clover will not grow on soil that is even slightly acid or sour and for this reason is not produced in many parts east of Montreal. It grows well in many parts of Ontario but in most parts of Quebec and the Maritime Provinces it cannot be produced unless the soil is heavily limed. The cost of producing sweet clover silage at the Central Experimental Farm, Ottawa, was $25 per acre which is the smallest cost to produce any of the silage crops. With a yield of 7·90 tons per acre and valuing the silage at $3.67 per ton the return per acre has been $28.99, a profit of $3.99 per acre.

COST OF PRODUCING MANGELS

The average cost of producing mangels on the Dominion Experimental Farms in Eastern Canada, for the five-year period from 1922 to 1926 is presented in the following statement. As the method of growing and the yield of turnips are so similar to mangels, the statement might be said to apply to both root crops. Mangels have yielded an average of 18·10 tons per acre for the period considered.

The root crop requires a very large amount of manual labour for hoeing and harvesting. It should be grown only on a small scale or when there is a surplus of home labour.

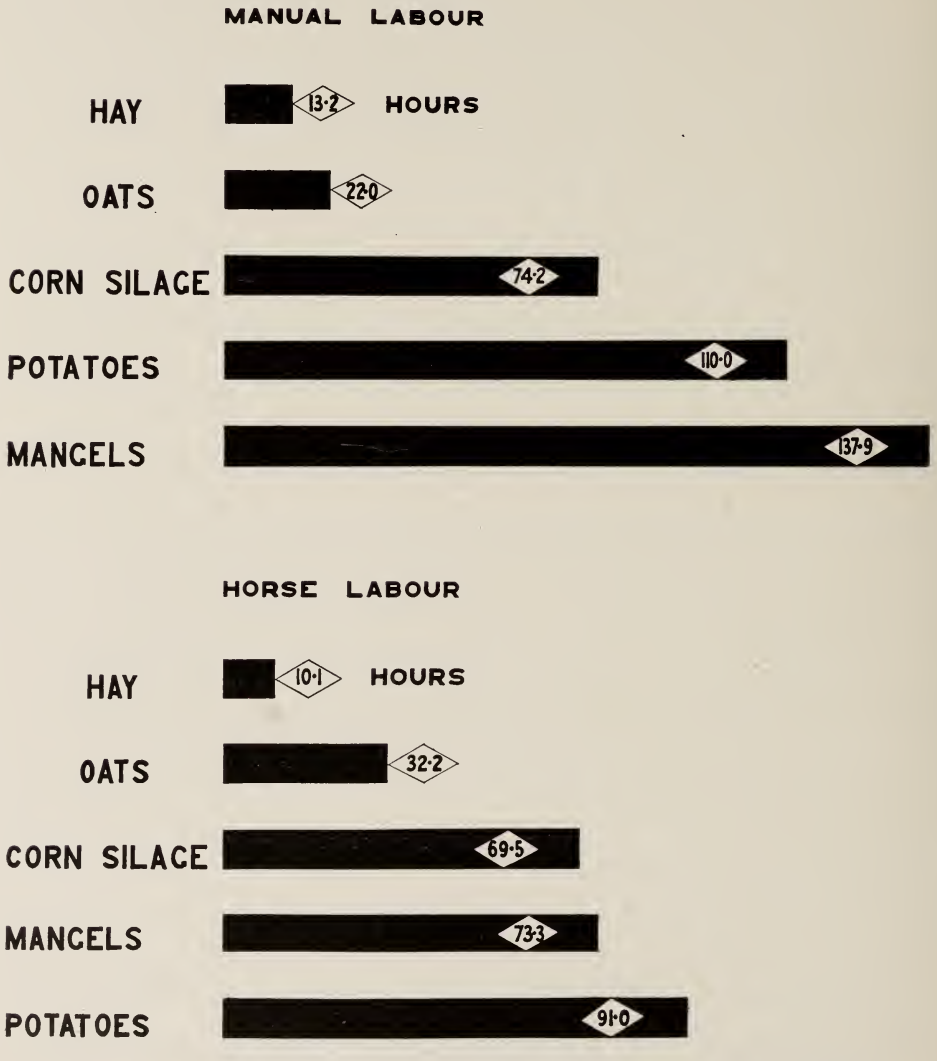
COST PER ACRE OF PRODUCING MANGELS

Item	Statement	Amount
		$ cts.
Use of land and buildings	Rent or interest on value of land plus taxes and upkeep	6 00
Manure	40 per cent of 16 tons at $1.50 per ton	9 60
Seed	9 pounds at 40 cents	3 60
Machinery	Total annual charge	2 85
Manual labour	137·9 hours at 22 cents	30 34
Horse labour	73·3 hours at 10 cents	7 33
	Total cost per acre	59 72
Cost of production	$3.30 per ton.	

The cost of producing mangels has averaged $59.72 per acre. With a yield of 18·10 tons per acre, it has cost, therefore, $3.30 per ton to produce them. When only the labour costs of applying manure are considered, the charge for manure is reduced from $9.60 per acre to $3.20, reducing the total cost of production to $53.32 per acre. Considerable difference of opinion exists as to what value should be given to roots. In this bulletin they are valued on the basis that 600 pounds of roots are equal to 100 pounds of hay which gives them a value of $1.96 per ton. On this basis there has been an average loss in producing roots of $24.24 per acre. If roots are valued on the basis that their dry matter content is equal in value to the dry matter in such concentrates as mixed grain, as explained on page 12 of this bulletin, the roots would have a value of $4.05 per ton which would transform the loss of $24.24 per acre to a profit of $13.58 per acre. This latter method of calculation, however, would be correct only when very small quantities of roots were fed per day.

Over one-half of the cost of growing roots consists in the cost of the manual labour. They require such a large amount of manual labour chiefly because they require to be thinned and hoed by hand and because very little machinery can be used in harvesting them. A total of 137·9 hours of manual labour and 73·3 hours of horse labour has been required to produce an acre of mangels. These totals have been made up by 6 hours of man labour and 18 hours of horse labour ploughing; 5·3 hours of man labour and 15·9 hours of horse labour disking; 1·3 hour of man labour and 2·6 hours of horse labour harrowing; 0·5 hour of man labour and 1·0 hour of horse labour rolling; 3·2 hours of man labour and 6·4 hours of horse labour ridging; 1·8 hour of man labour and 1·8 hour of horse labour seeding; 9·3 hours of man labour and 9·3 hours of horse labour cultivating. Hoeing and thinning has required 52 hours of manual labour, pulling 40·2 hours of manual labour, while hauling and storing has taken 18·3 hours of both manual and horse labour per acre. When a value of $1.96 per ton is placed on the mangels, the return for the manual labour spent on their production pays only 4 cents per hour which is considerably less than that received for working on any of the other farm crops. However, where mangels are fed in very limited quantities and the valuation of $4.05 per ton is used, the return value for the manual labour spent on the crop is 32 cents per hour.

HOURS OF LABOUR REQUIRED TO PRODUCE ONE ACRE OF CROP



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COST OF PRODUCING POTATOES

The average cost of producing potatoes on four Experimental Farms in Eastern Canada is presented in the following statement. The average yield for the period from 1922 to 1926 has been 264 bushels per acre.

COST PER ACRE OF PRODUCING POTATOES

Item	Statement	Amount
		$ cts.
Use of land and buildings	Rent or interest on value of land plus taxes and upkeep	6 00
Manure and fertilizers	50 per cent of 18 tons at $1.50 per ton	13 50
Seed	18 bushels at 90 cents	16 20
Machinery	Total annual charge	2 85
Spray materials		6 50
Manual labour	110·0 hours at 22 cents	24 20
Horse labour	91·0 hours at 10 cents	9 10
	Total cost per acre	78 35
Cost of production	30 cents per bushel.	

It has cost $78.35 per acre to produce potatoes, or 30 cents per bushel. This low cost per bushel has been due to the high yield of 264 bushels per acre. If no valuation were given to the manure applied, and only the cost of applying the manure considered, this item would amount to only $4.50, making the total cost of production $69.35.

In estimating the cost of marketing potatoes, grading and bagging have been calculated at 6 cents per bushel. One man and team hauling 140 bushels per day will add a hauling charge of 3 cents per bushel. Bags are priced at 10 cents each. On the basis outlined, the total cost of grading, bagging and hauling to market has been about 15·6 cents per bushel, or with the yield of 264 bushels, $41.36 per acre. The total of production and marketing costs have amounted to $119.71 per acre. With a market value of 60 cents per bushel the return value of the crop has been $158.40 per acre. Potatoes have thus produced a yearly profit of $38.69 per acre.

The period from 1922 to 1926 has included several years when the price of potatoes has been very high, averaging for the entire period 60 cents per bushel. On this account a very substantial profit has been made from the potato crop but it would be unwise to expect in the future such a high price for this crop. To produce one acre of potatoes has required 110 hours of manual labour and 91 hours of horse labour. These totals have been made up of 12 hours of manual labour cutting seed potatoes; 6 hours of manual labour and 18 hours of horse labour ploughing; 5 hours of manual labour and 15 hours of horse labour disking; 1·2 hour of manual labour and 2·4 hours of horse labour harrowing; 0·5 hour of manual labour and 1·0 hour of horse labour rolling; 6·0 hours of manual labour and 6·0 hours of horse labour planting; 10·0 hours of manual labour and 10 hours of horse labour cultivating. Hoeing has required 16·3 hours of manual labour. Spraying has accounted for 18 hours of manual labour and 17 hours of horse labour, while digging, hauling and storing has required 35 hours of manual labour and 21·6 hours of horse labour. It should also be pointed out that the labour required to grade and market the crop has amounted to 90·0 hours of manual labour and 37·7 hours of horse labour per acre. When the sum of all the items of expense incurred in producing and marketing potatoes, except the item for manual labour, is subtracted from the

total value of the crop, a figure of 41 cents per hour is obtained for each hour of manual labour worked.

FLAX AND HEMP

Many experiments have been conducted throughout Canada by the Fibre Division of the Dominion Experimental Farm system in order to learn the best methods of growing and handling flax and hemp for fibre. Accurate data have also been secured on the cost of production and the return value of these crops.

The cost of producing line fibre flax during a three-year period from 1924 to 1926, has averaged $69.37 per acre. A large amount of hand labour is required for this crop. The principal items are pulling the flax by hand which costs about $15 per acre, and breaking and scutching the crop, which cost approximately $17 per acre. There are also other items which involve considerable hand labour such as spreading, lifting and hauling. It costs less to produce tossed flax fibre than line fibre. For tossed fibre, the crop may be cut with a mower instead of being pulled by hand; after retting is completed, it is raked and handled without any care to keep the material in line. The returns which are secured from flax depend upon the yield of fibre and seed per acre, the type of fibre made, and the market value of the different products. An average yield of line flax fibre would range from 250 to 350 pounds per acre with about 100 pounds of tow; an average yield of tossed flax fibre, when the crop is cut, would range from 300 pounds to 400 pounds per acre. In addition to this, the yield of seed would average from 8 to 10 bushels per acre.

As hemp is cut with a reaper the cost of harvesting is considerably less than with line fibre flax which has to be pulled. However, as its yield per acre is greater, the cost of breaking and scutching are proportionately increased so that the total cost of production is very nearly the same for these two crops. As an average of two years' records, during 1924 and 1925, the cost of producing hemp for fibre has been $73.54 per acre. The yield of long fibre averaged 670 pounds per acre and the yield of tow 298 pounds per acre.

TOBACCO

The Tobacco Division of the Dominion Experimental Farm system has conducted many experiments at the Harrow Station in Ontario and at the Farnham Station in Quebec in order to learn the most suitable types of tobacco and the best methods of growing and handling the crop. In Ontario, the two principal types are the Burley, or air-cured tobacco, and the flue-cured tobacco which is cured in special kilns with artificial heat. In Quebec, the cigar tobacco is grown most extensively and is air-cured.

The average cost of producing flue-cured tobacco at Harrow for the three-year period, 1924, 1926, and 1927, was $187.41. The average yield over this period was 1,207 pounds per acre making the cost 15·5 cents per pound. The average cost of producing Burley tobacco at Harrow over the same period was $173.45 per acre. The average yield was 1,466 pounds per acre making the cost of production 11·8 cents per pound. The average cost at Farnham, for a three-year period from 1920 to 1922 inclusive, of producing cigar tobacco, which yielded 1,989 pounds per acre, was $260 per acre, or 13 cents per pound.

These costs have been based on the various charges which have prevailed in the tobacco-growing districts. They are not the same rates which have been used where detailed statements have been shown of the cost of producing the more extensively grown farm crops. The yields which have been secured on the Experimental Stations are considerably heavier than the average yields obtained throughout the district. The average yield throughout the tobacco growing sections of the province of Ontario, for a three-year period, has been 832 pounds per acre of flue-cured tobacco, and 1,208 pounds of Burley tobacco; in Quebec the average yield of cigar tobacco was 927 pounds per acre.

A COMPARISON OF CROP YIELDS

A comparison of the average yield of field crops obtained from 1922 to 1926 inclusive on the Experimental Farms in Eastern Canada with the yields obtained throughout the country in the five provinces of Eastern Canada.

Crop	Average yield for the eastern experimental farms	Average yield for the five eastern provinces
Oats	55·8 bushels per acre.	32·3 bushels per acre.
Spring wheat	27·2 bushels per acre.	17·7 bushels per acre.
Barley	39·4 bushels per acre.	27·5 bushels per acre.
Hay	2·46 tons per acre.	1·51 tons per acre.
Corn for silage	13·53 tons per acre.	8·50 tons per acre.
Potatoes	264 bushels per acre.	169 bushels per acre.
Mangels	18·10 tons per acre.	10·28 tons per acre.
Sunflowers	18·82 tons per acre.	
Sweet clover for silage	7·90 tons per acre. (Ottawa only)	

It will be seen from the above table that the yields on the Experimental Farms are very much heavier than the average yield throughout the country. These increased yields have been obtained by the use of improved agricultural methods. Detailed statements have been presented in this bulletin showing the cost of producing these crops on the Experimental Farms, but no information is available in regard to the cost of production on the average farm throughout the country.

FARM MACHINERY OPERATING COSTS IN CANADA

In order to secure reliable information regarding the average investment and operating cost of farm machinery, a questionnaire was sent in 1925 to representative farmers in all parts of Canada. The replies which were received have given very useful information relating to the average life of the various implements, the amount of money invested in machinery on farms of various sizes, and the annual cost of the machinery per acre of cultivated land. Approximately 1,300 replies were received from the five provinces of Eastern Canada. It is impossible to say, even with this large number of replies, that the findings will be absolutely representative although they should approach this very closely. It should be remembered, also, that the figures presented are average figures and that extremes occur in each direction from these averages.

The following table shows the average life of the various farm machines:—

AVERAGE LENGTH OF LIFE OF FARM MACHINES

Kind of Machine	Length of life. Years.
Automobile	10·1
Buggy	18·9
Corn-binder	20·6
Corn-cultivator	22·2
Corn-planter	23·0
Cultivator	21·1
Cutter	21·2
Disk-harrow	19·7
Fanning-mill	33·8
Gasolene engine	17·6
Grain-binder	22·6
Grain-drill	25·1
Harness	15·3
Hay-fork	29·3
Hay-loader	21·3
Hay-rake	22·1
Hay-rack	14·8
Manure-spreader	18·2
Motor truck	9·8
Mower	20·1
Other machinery	17·6
Packer or roller	25·1
Plough-gang	19·3
Plough-sulky	20·6
Plough-walking	20·0
Potato-digger	16·8
Potato-planter	18·7
Potato-sprayer	14·5
Silage-cutter	19·3
Sleigh	21·0
Spike-tooth harrow	22·8
Sweep rake	23·2
Tedder	20·7
Threshing machine	24·7
Tractor	12·1
Average life	20·2
Rate of depreciation (per cent)	5·0

The foregoing figures, secured on farms having an average of 76 acres under cultivation, will afford a very useful reference regarding the length of life which may be expected from various farm machines. With care, this lifetime may be prolonged while, on the other hand, excessive usage or careless handling will undoubtedly shorten the life below the figure given.

The annual cost of farm machinery includes depreciation, interest, repairs and housing. The depreciation is based on the average life of the various machines and as the average value given in this survey is for machinery of all ages, it is assumed that the machinery at present on these farms has, on the average, completed half of its useful life. Therefore, the value on which the depreciation is reckoned should be twice that of the inventory value given in this survey. The interest has been figured at 6 per cent of the inventory value of the machinery. The repairs comprise the cost of repair parts while the housing charge includes the annual cost of the building in which the machinery is stored. The total amount of these charges vary with the amount of the machinery which is owned and with the care which is used in operating it. The cost of the machinery per acre of cultivated land depends to a large extent upon the number of acres in the farm under cultivation.

The following table shows the average annual cost of the farm machinery in Eastern Canada. These figures include those farms where general machinery only is owned; they do not include farms where tractors, trucks, and automobiles are owned or where threshing outfits are owned except in some parts of Eastern Canada where it is customary for each farmer to own a small threshing separator. The figures which are given, therefore, are applicable only for farms where there is no special machinery; it is clear that where there are any of these machines, the cost would be increased proportionately above these figures.

ANNUAL COST OF FARM MACHINERY

Item	Eastern Provinces
	$ cts.
Average inventory value of machinery per farm	871 04
Investment in machinery shed	270 34
Number of acres cultivated	76
	$ cts.
Depreciation	87 10
Interest on investment	52 26
Repairs	55 72
Housing	21 62
Total annual cost	216 70
Cost per acre of cultivated land	2 85

The annual cost of general farm machinery per acre of cultivated land is $2.85 per acre in Eastern Canada. These figures showing the annual cost of farm machinery are average figures covering a large number of farms; it should be borne in mind that each individual farm has a separate cost depending upon the amount of machinery owned, the care which is exercised in handling it and upon the number of cultivated acres in the farm.

The great majority of farmers owned some special machinery such as a tractor, truck, automobile or large threshing outfit. Taking the average of all reports received from farmers, some of which had no special machinery while others had one or more special machines, the average annual cost of machinery per acre of cultivated land was $4 in the eastern provinces. These latter figures, however, do not apply to any particular amount of machinery on a farm but to the average amount of machinery on all the farms examined.

Wide variations occur between individual farmers in the amount of machinery which they own. In Eastern Canada, where the average investment in general machinery was valued at $11.46 per acre of cultivated land, one farmer had an investment of $58 per acre. It will be seen, therefore, how wide the variations are in the amount of machinery owned on different farms. It is impossible to determine what is the most efficient amount of machinery to own as this varies with almost every different instance, indeed the kind and amount of machinery owned may very materially reduce the expense of manual labour. Care in operating and repairing machinery may greatly prolong its life but there finally comes a time when the expense for repairs becomes excessive and the delay and losses in doing field work necessitate the purchase of new machinery.

In fact, the item of expense incurred by machinery in the cost of producing crops is a relatively small percentage of the total cost. In Eastern Canada, the cost of producing a crop of oats would be approximately $29, of which $2.85 is charged against general machinery. This is only 9·8 per cent of the total

The Ronning ensilage harvester. This machine takes the place of the corn binder and silage cutter.

cost which is not very high when it is considered that the manual and horse labour constitute 28 per cent of the total cost. The introduction of farm machinery, along with the development of scientific agriculture, has made it possible for the Canadian farmer to compete successfully with many foreign countries where the cost of labour and the cost of living are very much below Canadian standards. It is very economical to use large, labour-saving machinery whenever the size of the farm will warrant its purchase.

The chief factor influencing the cost of farm machinery is the number of acres under cultivation. Within certain limits, the larger the acreage, the lower the cost. Repairs are an important charge against machinery which suggests that care in handling, oiling, and tightening bolts, afford the best means of reducing costs. In humid regions it is very necessary to house the machinery when it is not in actual use.

THE FARM TRACTOR

In order to secure information regarding the opinion of farmers with respect to the value of their tractors, questionnaires were forwarded in 1926 to representative tractor owners throughout Canada. There were received 179 replies from Eastern Canada and British Columbia. It may be of some interest to examine the information which was secured.

In Eastern Canada and British Columbia, 85 per cent of the men who replied stated that their tractor was profitable for work on the land.

ADVANTAGES OF THE TRACTOR

The main advantages of a tractor are its capacity to do a large amount of work in a short time and also its ability to provide any belt power which may be required. These advantages enabled the owners of tractors to keep both their field work and harvest operations up-to-date. Nearly one-half the tractor owners claimed that the chief value of the tractor was to keep the work up-to-date. Eighty-five per cent of the men who replied stated that their tractor was profitable for work on the land. The tractor enables the work to be kept up-to-date because it can do more work in a ten-hour day than is possible with horses. This is especially the case where two-horse teams are most commonly used. The tractor is particularly valuable in getting ploughing and cultivating work done in a short time and in getting spring seeding done promptly. Where a farmer is trying to eradicate weeds from any particular field and must cultivate it frequently and perhaps plough it a couple of times during hot weather, the tractor comes in very useful. It was also claimed that the tractor was very useful in breaking and clearing new land and in working hard dry land, especially during hot weather.

Tractor owners claimed that the tractor enabled them to make some reduction in the amount of hired help required. Sixty-one per cent of the men who contributed information stated that they were able to effect some reduction in their hired help. Approximately 30 per cent were able to dispense with one man or more for the season. Where tractor owners were able to use their tractor a large number of days per year, they were able to effect a greater reduction in hired help.

Tractor owners were able to operate their farms with fewer horses after they had purchased a tractor. Owners of two-plough tractors had a reduction of 1·8 horses per farm, but as they increased the number of acres of cultivated land on their farms after they had purchased their tractor it was really equiva-

lent to a reduction of 2·5 horses per farm. It was observed that where tractor owners used their tractors for a greater number of days than the average, they were able to effect a greater reduction in the number of horses which were kept on the farm.

It should not be overlooked that there are some conditions where the tractor has not given very satisfactory results for field operations. Where the land was too hilly, too stony, too sandy or too wet, the tractor did not apparently give very good results. Such conditions, together with the objection of having too small a farm, inefficient operators, high initial cost and high cost of fuel were given as the chief reasons for the cases where the tractor was not regarded as a profitable investment.

On very small farms, where two or three horses are sufficient to do all the work, it may be more economical to use these horses than to operate a tractor, as some horses would have to be kept for work which could not be done economically with the tractor. Another point to be remembered is that while a tractor would enable such work as fall ploughing to be done much more quickly than with a two-horse team, it might not be possible to use to much advantage the time thus saved.

With regard to the smallest size of farm which would justify the purchase of a tractor, owners in Eastern Canada and British Columbia claimed that approximately 100 acres of cultivated land is about the smallest acreage. This acreage, it will be understood, is the average for general farm conditions. It is quite probable that certain special conditions such as breaking new land, cultivation of orchards, or use for custom work might somewhat alter these figures.

THE COST OF OPERATING A TRACTOR

The cost of operating a tractor includes two main and somewhat distinct items, namely, fixed or overhead cost, and direct operating cost. The direct operating charge includes fuel, oil and the wages of the operator. The fixed charge includes depreciation, interest, repairs and repair labour. In order to determine the daily cost of operating the tractor, the total fixed or overhead charges for the year should be divided by the number of days of work the tractor does annually; to this figure must then be added the direct operating costs of fuel, oil and the wages of the operator. It will be seen that if the machine is used only a few days per year, the fixed or overhead charges per day will be very high because these charges do not change with increasing amounts of work except to a slight extent in so far as the repairs are concerned. However, if the tractor is operated a large number of days per year the daily overhead charge becomes small.

The charges for kerosene, gasolene and lubricating oil have been figured at 1925 prices. Any hired labour required for repairing the tractor has been charged at 60 cents per hour while home labour, both for repairing the tractor and also for operating it, has been charged at 30 cents per hour. The average amount of fuel used per day may be stated as approximately 2·2 Imperial gallons per acre ploughed in Eastern Canada and British Columbia. The average amount of lubricating oil used was approximately 0·4 of a quart per acre of ploughing.

The following table gives a detailed statement of the various items of expense of operating tractors in Eastern Canada and British Columbia. While the two-plough tractor was most commonly used, information is also given covering the operation of three-plough tractors.

Where there is sufficient work for a tractor to do, it will frequently prove a profitable investment. Its chief advantages are that it will do field work rapidly and provide a source of belt power on the farm.

COST OF OPERATING A TRACTOR

—	2-plough tractor	3-plough tractor
Number of tractors in group	130	49
Average life in years	12·8	13·2
Rate of depreciation in per cent	7·8	7·5
Average cost price new	$728 03	$1,181 63
Average present value	445 34	608 80
Yearly depreciation charged on cost price	$56 79	$88 62
Annual interest at 6 per cent charged on present value	26 72	36 53
Average annual repairs	13 67	13 44
Average hired repair labour for groups	2 13	2 15
Average home repair labour for groups	4 20	5 95
Total annual overhead	$103 51	$146 69
Average number of days tractor used per year	55·3	48·5
Daily cost of draw bar work. Average daily overhead= Total overhead ÷ days used	$1 87	3 02
Average daily fuel cost	3 16	3 33
Average daily lubricating oil cost	0 64	0 86
Tractor cost per 10-hour day	$5 67	$ 7 22
Daily cost of operator	3 00	3 00
Total cost of draw-bar work	$8 67	$10 22

It will be seen that the average daily operating cost ranges from $8.67 for a two-plough tractor to $10.22 for the three-plough tractor. Of greater significance than the average cost of operating these tractors is the fact that many were operated at a much lower cost than others of the same size. Such machines were used on a greater amount of annual work, with a resulting lower overhead cost.

The tractors, on which information was secured in this survey, performed a considerable amount of custom work over and above that done on the owner's farm. In Eastern Canada and British Columbia 25 per cent of the work done was custom work. In the event that no custom work were available and the tractors were not, accordingly, used as many days per year, the overhead charges would be somewhat increased.

COST OF FIELD OPERATIONS WITH HORSES COMPARED WITH TRACTORS

In Eastern Canada the common horse outfit is a two-horse team. There are a few three-horse teams, and occasionally a four-horse team will be seen but the usual outfit consists of two horses. The following table shows the acreages covered per ten-hour day and the costs per acre with two-, three-, and four-horse teams and with two- and three-plough tractors. Horse labour has been figured at $1 per ten-hour day and manual labour at $3 per day. It should be remembered that the amounts of work done per day by the various outfits are average figures and are subject to change under varying conditions. They are offered only as guides and may be altered to suit each different condition.

ACREAGES COVERED PER TEN-HOUR DAY

Operation	Horses			Tractor	
	2-horse team	3-horse team	4-horse team	2-plough tractor	3-plough tractor
Ploughing	1·5	2·0	3·0	5·2	6·7
Disking	7·0	9·0	12·0	16·3	18·9
Cultivating	8·0	10·0	15·0	18·1	18·7
Harrowing	13·0	17·0	.....	26·5	26·8

COSTS PER ACRE

Operation	Horses			Tractor	
	2-horse team	3-horse team	4-horse team	2-plough tractor	3-plough tractor
	$ cts.	$ cts.	$ cts.	$ cts.	$ cts.
Ploughing	3 33	3 00	2 33	1 65	1 52
Disking	0 71	0 66	0 58	0 53	0 54
Cultivating	0 62	0 60	0 46	0 48	0 55
Harrowing	0 38	0 35	.....	0 33	0 38

It will be seen that the two-plough tractor not only ploughs more than three times as much per day as the two-horse team but does this at one-half the cost per acre. For disking and cultivating there is a fairly substantial saving, while for harrowing, the horses do the work nearly as cheaply as the tractor. It is probable that the reason why the tractor has not been more economical in harrowing is because the owners of tractors have not had available a sufficient number of sections of harrows to pull after the tractor. It will be observed that the larger-sized team reduced the costs considerably as compared with the two-horse team.

It will be seen in studying the above tables that the acreages covered per day by the two-plough and three-plough tractors are very nearly the same. This seems rather peculiar but as it is actually what has been found from this survey it is reported as found. The explanation may be that some farmers were using tractors of only two-plough capacity for three-plough tractor work or that for some operations the implements were not sufficiently wide for three-plough tractors.

The results of this survey show that, according to the opinion of tractor owners, where a farmer has sufficient work for a tractor to do, it will frequently prove a very profitable investment. The main advantage consists in enabling the work to be kept up-to-date. It should be remembered that there are many jobs which can be done more economically with horses than with a tractor. The place of the tractor is to supplement the work of horses and to provide power for belt work where conditions warrant its purchase.

THE NORMAL DAY'S FARM WORK

THE AVERAGE TEN-HOUR DAY'S WORK OF MEN, CREW AND FARM IMPLEMENTS

In order to secure information as to the average amount of work done per day on various farm operations, the Dominion Experimental Farms sent a questionnaire, in 1928, to representative farmers in Eastern Canada. About 610 of these questionnaires were returned. It is felt that the data secured from these reports will be of value to the individual farmer in enabling him to compare his own standards of labour with the average for Eastern Canada.

In the following tables are shown the average daily accomplishment of men, crews and farm implements. All estimates are based on a working day of ten hours.

PLOUGHING

The table given below shows the daily performance with horse and tractor ploughs working on sod and on stubble. The data are given for one and two furrow ploughs of various widths.

ACRES PLOUGHED PER 10-HOUR DAY

Implement	Width of furrow	Power used	Acres per day	
			Ploughing sod	Ploughing stubble
	inches			
One-furrow plough	7– 8	2 horses	1·33	1·58
One-furrow plough	9–10	2 horses	1·37	1·69
One-furrow plough	11–12	2 horses	1·52	1·88
Two-furrow plough	7– 8	3 horses	2·35	2·81
Two-furrow plough	9–10	3 horses	2·53	2·96
Two-furrow plough	11–12	3 horses	2·74	3·08
Two-furrow plough	9–10	4 horses	3·16	3·58
Two-furrow plough	11–12	4 horses	3·00	3·37
Two-furrow plough	.....	tractor	4·81	5·51
Three-furrow plough	.....	tractor	6·85	7·73

SEED BED PREPARATION

Power used	Acres per 10-hour Day				
	Single disking	Double disk	Cultivating	Harrowing	Rolling
2 horses	7·47	6·18	7·48	11·47	13·79
3 horses	9·54	7·48	9·48	17·93	.....
4 horses	12·09	9·72	12·71	28·66	.....
Two-plough tractor	17·48	15·92	.....	.....	.....
Three-plough tractor	20·37	19·93	.....	.....	.....

SEEDING AND CROP CULTIVATION—ACRES PER DAY

Power used	Seeding oats	Seeding roots	Seeding corn	Cultivating corn	Cultivating roots	Cultivating potatoes
2 horses	9·93	.....	.....	.....	.....	.....
3 horses	11·91	.....	.....	.....	.....	.....
4 horses	14·00	.....	.....	.....	.....	.....
Hand seeding	.....	2·24	.....	.....	.....	.....
Horse seeding	.....	5·73	.....	.....	.....	.....
Size of Implement						
1-row	.....	.....	3·54	4·55	4·60	4·80
2-row	.....	.....	7·63	8·04	6·93	.....
Grain drill	.....	.....	10·29	.....	.....	.....

HOEING AND THINNING—ACRES PER MAN PER DAY

Hoeing corn	Hoeing potatoes	Hoeing roots	Thinning roots
0·91	0·77	0·76	0·46

Cutting seed potatoes ..... 17·70 bushels per man per day

PLANTING AND SPRAYING POTATOES

Planting Potatoes	With plough, 2 men, 1·35 acres per day. With plough, 3 men, 1·51 acres per day. With planter, 1 man, 4·04 acres per day.
Spraying Potatoes	By hand, 1 man, 2·77 acres per day. With sprayer, 1 man 1 horse, 6·30 acres per day. With sprayer, 2 men 1 horse, 6·45 acres per day. With sprayer, 2 men 2 horses, 8·90 acres per day.

HARVESTING OPERATIONS

OATS

BINDING OATS—ACRES PER TEN-HOUR DAY

Implement	Power used	Acres per day
5-foot binder	2 horses	7·25
5-foot binder	3 horses	8·02
6-foot binder	2 horses	7·90
6-foot binder	3 horses	9·65
7-foot binder	3 horses	12·54

Stooking oats, 7·50 acres per man per day.

Hauling oat sheaves to the barn 2 men and 2 horses cleared an average of 6·67 acres per 10-hour day. The average yield of oats was 38·71 bushels per acre.

In threshing oats the amount of grain that can be threshed per hour is controlled to a large extent by the yield of grain and the size of the machine. It appears that in a fair day's threshing about 9·71 bushels are threshed per hour for every man in the crew, thus a crew of 10 men working 10 hours per day would thresh approximately 971 bushels.

HAY

CUTTING HAY—ACRES PER TEN-HOUR DAY

Implement	Width of cut	Acres per day
Mower	4-foot cut	5·00
Mower	5-foot cut	8·40
Mower	6-foot cut	9·95
Mower	7-foot cut	12·33

TEDDING AND RAKING HAY—ACRES PER TEN-HOUR DAY

Operation	Power used	Acres per day
Tedding	1 horse	13·64
Raking	1 horse	12·25
Raking	2 horses	15·81

With a two-horse cultivator, one man will average 7.5 acres per day at a cost of 56 cents per acre.

With a four-horse cultivator, one man will average 12.7 acres per day at a cost of 49 cents per acre. The four-horse machine is three feet wider than the one shown above.

COCKING HAY—ACRES PER MAN PER TEN-HOUR DAY

Operation	Yield of hay	Acres per day
Cocking hay	1 ton	6·38
Cocking hay	1·5 tons	5·81
Cocking hay	2 tons	4·87

HAULING AND STORING HAY—TONS PER TEN-HOUR DAY

Yield 1·75 tons per Acre

Operation	Crew		Tons per day
	Men	Horses	
Hauling and storing hay	2	2	9·51
Hauling and storing hay	3	2	11·08
Hauling and storing hay	4	4	15·05

CORN

CUTTING CORN—ACRES PER TEN-HOUR DAY

Implement	Power used	Acres per day
Sickle	By hand, 1 man	1·07
Binder	2 horses	4·35
Binder	3 horses	5·09

HAULING AND ENSILING CORN—TONS PER TEN-HOUR DAY

Crew used		Yield of corn in tons	Tons per crew per day
Men	Horses		
4	2	9·00	22·05
8	8	10·00	52·50
10	10	10·85	56·68
12	8	11·33	79·05
14	10	10·66	91·50

ROOTS

In harvesting roots reports were received for crews ranging from one man to twenty men. These returns were brought to a common basis of acres cleared per man per day. On the average, each man in the crew cleared 0·316 acres of roots per 10-hour day.

POTATOES

DIGGING POTATOES—ACRES PER TEN-HOUR DAY

Implement	Power used	Acres per day
Walking plough	2 horses	1·25
Digger	2 horses	2·33
Digger	3 horses	3·02
Digger	4 horses	3·23

The yield of potatoes determines to a large extent the daily accomplishment in picking and storing. The table given below shows in bushels the amount of potatoes picked and stored per man per day in the maritime provinces and in Quebec and Ontario.

PICKING AND STORING POTATOES—BUSHELS PER TEN-HOUR DAY

—	Maritime Provinces	Quebec	Ontario
Bushels per man per day	101·70	64·66	54·97
Average yield	282·45	187·11	165·56

With two horses on the manure spreader, one man will spread 18 tons per day. With a team and wagon, one man will average 12 tons per day.

HAULING AND SPREADING MANURE

The table given below shows the daily tonnage of manure that can normally be handled when spread by hand and with a manure spreader. Loads were hauled an average distance of 82 rods. One horse and wagon hauled 0·61 of a ton per load. Two horses on a wagon hauled an average of 1·10 tons, while two horses on the spreader hauled an average load of 1·06 tons. Three horses on the spreader hauled loads averaging 1·25 tons.

HAULING AND SPREADING MANURE—TONS PER TEN-HOUR DAY

Implement used	Crew used		Tons per day
	Men	Horses	
Wagon	1	1	10·25
Wagon	1	2	12·43
Wagon	2	2	15·62
Manure spreader	1	2	18·23
Manure spreader	1	3	21·03
Manure spreader	2	2	23·25
Manure spreader	2	3	28·91

CHANGES IN THE NUMBER AND SIZE OF FARMS

During the last forty years there has been a slight decrease in Eastern Canada in the number of farms. On the other hand, there has been a small increase in the number of acres under cultivation. While the number of farms decreased approximately three per cent, the crop acreage increased sixteen per cent. In Ontario and Quebec the increases in crop acreages have been much more marked than in the Maritime Provinces where the acreages have remained practically stationary. In the five provinces of Eastern Canada the crop acreage has increased from 14,777,000 acres in 1881 to 17,132,000 in 1921, while the number of farms has decreased during this period from 451,191 to 433,460.

While the number of farms and the crop acreage in Eastern Canada during the last forty years have remained practically stationary, on the three prairie provinces marked increases have occurred. Even for the twenty-year period from 1901 to 1921 there has been on the prairie an increase in the number of farms from 55,176 to 255,657 and in the acreage in crop from 3,600,000 acres to 32,187,000 acres. Practically the whole development of the prairie has occurred since 1881.

The following tables show the number of farms and the crop acreage per farm in the five eastern provinces of Canada as given by the Dominion Bureau of Statistics for the three census dates of 1881, 1901 and 1921:—

NUMBER OF FARMS IN EASTERN CANADA

Provinces	1881	1901	1921
Prince Edward Island	13,629	13,748	13,701
Nova Scotia	55,873	54,478	47,432
New Brunswick	36,837	37,006	36,655
Quebec	137,863	140,110	137,619
Ontario	206,989	204,054	198,053
Total	451,191	449,396	433,460

ACRES IN CROP PER FARM

Provinces	1881	1901	1921
Prince Edward Island	34·3	32·6	33·5
Nova Scotia	16·9	13·4	13·6
New Brunswick	23·1	24·2	24·5
Quebec	30·0	33·6	43·3
Ontario	40·4	45·1	46·3
Average (weighted)	32·7	35·6	39·5

In addition to the above acreages in crop there is also a certain acreage in pasture. As an average of Eastern Canada there were at the last census 13·7 acres of improved pasture and 10·4 acres of unimproved pasture land per farm.

It will be seen from the census figures that the number of farms has remained practically stationary in all the five provinces. The number of acres in crop per farm has also remained almost the same in the three Maritime Provinces while in Quebec and Ontario small increases have occurred. One of the more important changes which have taken place during the last forty years has been the transformation from the growing of farm crops which were largely sold on the market to the production of more finished products, such as meat and dairy

products. While the stock population is not primarily the subject of this chapter it may be of interest to know that in 1921 there were 2·91 horses, 5·08 milch cows, 6·28 other cattle, 5·54 sheep, 5·31 swine and 68·38 poultry per farm. Compared to the census figures of 1891 this shows a very slight increase in horses, one-third more sheep, an increase of about two-thirds in the number of milch cows, double the number of other cattle, twice the number of swine and three times the amount of poultry.

The most significant point to be learned, perhaps, from the above tables is the very small acreage in crop per farm. As an average of all of Eastern Canade there were in 1921 only 39·5 acres in crop per farm which varied from 13·6 acres in Nova Scotia to 46·3 acres in Ontario. It is true, of course, that these are average figures and that there are many farmers with considerably larger acreages. Moreover, among the small farms would be included market gardens and farms where the owner did not derive all his income from the farm. However, it is clear that the average acreage in crop per farm is extremely small, especially when one considers the modern equipment and power machinery which is now available to handle crops. It would seem that the size of farms in Eastern Canada has remained very much the same as when the original settler cleared the land, constructed his buildings with the cheap building materials then available, and seeded and harvested his crop by his own manual labour or with very small equipment. In the state of New York there were 42·1 crop acres per farm at the time of the last census, while in the New England States, which are very similar to the Maritime Provinces, there were 27·2 crop acres per farm. In the province of Saskatchewan there were, at the time of the last census, 149·2 acres in crop per farm.

In order to learn if there are now relatively fewer persons working on farms in Eastern Canada than formerly, statistics have been obtained in regard to the number of males on farms over fifteen or sixteen years of age. From this data it is possible to learn the number of crop acres per person at the various census dates. Unfortunately the census on population gives the number of males over fifteen years at some census and over sixteen years at others. However, from 1891 to 1911 there was an increase in the five provinces of Eastern Canada from 22·87 to 28·44 crop acres per male person over fifteen years of age, and from 1901 to 1921 from 26·46 to 28·95 crop acres per male person over sixteen years of age. This shows an increase but it is small. The acres in crop per male person over sixteen in 1921 was 13·87 in Nova Scotia and 32·6 in Ontario. In New York State it was 34·15, while in the province of Saskatchewan it was 106·53 crop acres. In different parts of the country there are varying percentages of different types of crops grown, such as more grain for example, on the prairie, which makes it easier for one man to handle a larger acreage.

In Eastern Canada, hay constitutes the largest percentage of field crops. This percentage varied at the time of the last census from 37 per cent of the total area of field crops in Ontario to 72 per cent in Nova Scotia; grain crops varied in the other direction, being 19 per cent of the total acreage in Nova Scotia and 55 per cent in Ontario. The remaining percentages comprised potatoes, roots, corn and other forage crops. Since 1890 there has been a marked decrease in the acreage of wheat grown in Eastern Canada. Barley has shown a small decrease while the acreage in oats has slightly increased. The major part of the total cereal production of Canada is now found in the three prairie provinces where in 1927 there was produced 94 per cent of the wheat, 78 per cent of the barley, and 61 per cent of the oats grown in Canada. On the other hand, 88 per cent of the hay acreage is located in the five provinces of Eastern Canada.

HOW TO REDUCE THE COST OF PRODUCING CROPS

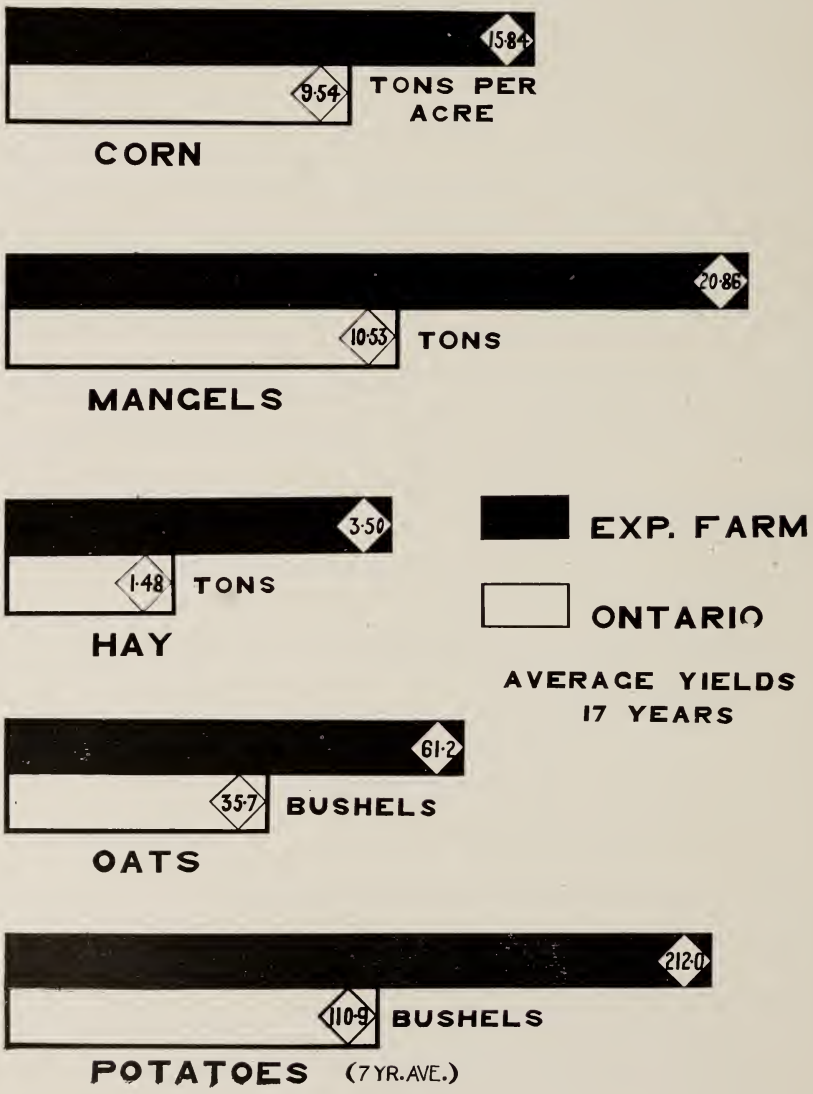
There are three principal methods of reducing the cost of producing crops. These methods include the economical production of heavier yields per acre, the use of larger machinery and more labour-saving equipment, and the operation of a larger area of land under cultivation. Furthermore, information derived from cost of production studies makes possible the substitution of more profitable for less profitable crops.

The production of larger yields per acre is one of the most important methods of reducing the cost of production per bushel or per ton of crop. Many items in the expense in growing a crop are the same whether the crop be small or large while only a few items vary directly with the yield. It is clear that the items of expense for rent or use of land, preparation of the soil, seed, seeding, cutting and machinery do not vary materially no matter what yield is secured. The costs of hauling and storing, and threshing do vary with the yield but they are relatively a small percentage of the total cost. Larger yields will entail greater costs per acre but will give smaller costs per bushel or per ton of crop, unless the cost of the increased yield is greater than its value.

In the production of larger yields, all better farming practices should play a part. The neglect of one practice may cause a poor yield even though all the other practices have been followed. While it is not the function of this bulletin to discuss better farming methods, it may be mentioned that good seed grain, adequate manure or fertilizers, proper drainage, thorough cultivation, suitable rotations, and effective control of weeds, insects and fungous diseases all play important parts in increasing crop yields. The careful study of agricultural bulletins dealing with these subjects will prove very useful in learning how to obtain the very highest yields and most economically produced crops.

The use of larger machinery and more labour-saving equipment is a method of reducing the cost of producing crops which reduces the expenses of manual and horse labour. Hired labour on the farm has gradually increased in price and decreased in quality. On many farms it is often desirable to purchase sufficient equipment to enable one to dispense with as much hired labour as possible. In recent years farm machinery firms have made considerable progress in the manufacture of larger machines which enable more work to be done per day. This economy has not only the advantage of saving expense on manual labour but it enables more work to be done at the proper time. This latter advantage is useful in facilitating earlier seeding in the spring and more effective control of weeds. It will be seen by referring to the chapter on The Normal Day's Farm Work on page 35 of this bulletin that the larger machines do considerably more work per day. By referring to the chapter on The Farm Tractor on page 31 it will be seen that the tractor and large horse teams do much more work per day, and at a much smaller cost per acre, than is possible with a two-horse team. The two-horse team is a very expensive method of doing many field operations. It is true that larger equipment costs more than small equipment and on very small farms it may not pay to buy it but on any farm of sufficient size, it is money well spent. It is possible that on some small farms the co-operative ownership of some larger, labour-saving machines may be undertaken. With certain friendly neighbours it might be wise to buy co-operatively some large machines which would be too expensive to own individually.

CROP YIELDS
AT THE
CENTRAL EXPERIMENTAL FARM
COMPARED WITH
AVERAGE YIELDS IN ONTARIO



The substitution of a larger percentage of more profitable for less profitable crops is a problem which takes long study to accomplish successfully. It takes several years to learn which crops give best results over a period of years and which fit in best with the other crops in the rotation and other enterprises on the farm. Because one crop gives more apparent profit than some other, does not always mean that it should take its place. The labour required to grow this crop may come at a season of the year when it conflicts with that required for other crops. However, it is possible to select the more profitable crops from those that belong to a group which require their labour at the same seasons of the year. This is a very important study to determine which crops are the most profitable. Undoubtedly the market price of the crop, or the animals to which the crops are fed, has a very important bearing upon the profit. No one can accurately predict the price and this makes the selecting of the best crop more or less a matter of chance. On farms where there is more than sufficient labour available for the production of the crops now being grown, it would be wise to substitute a certain acreage of crops having a higher value per acre. In this way the revenue from the farm will be increased. The object should always be to adopt a rotation which includes crops which do not conflict with each other in their labour requirements, which give the highest profit per acre and which provide for the full time work of the available manual and horse labour.

For more economical production of farm crops in Eastern Canada, larger sized farms or a greater area of land under cultivation would seem to be necessary. This is such an individual question varying so considerably with the size and type of each farm and with the labour available to do the work, that it is impossible to do more than merely draw attention to certain facts. By referring to the chapter on The Changes in the Number and Size of Farms on page 41 of this bulletin it will be seen that the average farm in Eastern Canada has only 39·5 acres of land in crop of which 48·5 per cent is in hay. While there are undoubtedly a large number of farms of greater size than this, and while some of the smaller farms are devoted to gardening or fruit or derive some income from sources outside the farm, nevertheless, it is clear that, in so far as the growing of the main farm crops is concerned, a larger acreage would most certainly reduce the cost of production. The overhead expenses for buildings, machinery and management are all heavier on the small acreage. It is evident that nearly as much equipment is required for a small acreage as for one very much larger and that the usual machinery on the small acreage does not cover as much work per day or do the work as economically. Larger teams and wider implements are used on the larger farms, so that a greater area may be covered by one man and at less cost per acre. However, owing to the small acreage on many farms in Eastern Canada, larger equipment may not be justified. Therefore, in making any change in the arrangement or size of the farm business, it is extremely important to proceed slowly in order to learn for certain if the proposed changes are really profitable for any particular farm. In this way, information will be acquired as one progresses and disastrous losses may be avoided.

Cost of production studies offer an intelligent means of improving the financial aspect of farming Substituting more profitable for less profitable crops is one important factor. Sunflowers produce a larger yield per acre than corn in the cooler regions of Canada.

WEIGHTS AND MEASURES

FRENCH AND ENGLISH EQUIVALENT MEASURES

One French *arpent* is equivalent to 191·835 English linear feet. In area, one *arpent* is equal to 0·8448 of an acre, and one acre is equal to 1·1836 *arpents*. One *minot* is equal to 1·073 bushels.

HOW TO MEASURE AN ACRE

One acre contains 160 square rods, 4,840 square yards or 43,560 square feet. If the length or width of any field be known, the required width or length to enclose an acre may be found by dividing the known distance in feet into the number of square feet in acre.

WEIGHTS OF AGRICULTURAL COMMODITIES

Pounds per Measured Bushel

Grains—	Pounds
Barley	48
Beans	60
Buckwheat	48
Corn (grain)	56
Corn (cob)	70–72
Oats	34
Peas	60
Rye	56
Wheat	60
Grasses—	
Brome grass	14
Canada blue grass	14
Kentucky blue grass	14
Meadow fescue	22
Orchard grass	14
Red top (in chaff)	14
Red top (chaff free)	30
Timothy	48
Western rye grass	14

Alfalfa and Clovers—	Pounds
Alfalfa	60
Alsike clover	60
Red or Mammoth clover	60
Sweet clover	60
White Dutch clover	60
Other Seeds—	
Flax	56
Hemp	44
Mangel seed	50
Potatoes (tubers)	60
Sunflowers	24
Turnip seed	50
Other Measurements—	
1 bag of potatoes	90 net
1 barrel of potatoes	165 "
1 barrel of potatoes	180 gross
1 barrel of flour	196 net
1 bushel of mangels	50 net
1 bushel of turnips	50 "

ESTIMATING GRAIN IN A BIN

To estimate the amount of grain in a bin, take the measurements of length, width and height of the grain in the bin. Obtain the total cubic feet of grain and then divide this by $1\frac{1}{4}$ to find the number of bushels in the bin.

CAPACITY OF SILOS (TONS)

Based on King's Table of Silage Weights

Depth of silage in feet	Inside diameter in feet					
	10	12	14	16	18	20
18	22·55	32·47	44·33	61·12	73·29	90·32
20	26·15	37·66	51·26	66·95	84·74	104·60
22	29·89	43·04	58·59	76·52	98·84	119·60
24	33·83	48·72	66·32	86·61	109·60	135·30
26	37·98	54·69	74·44	97·23	123·00	151·90
28	42·22	60·80	82·76	108·10	136·80	168·90
30	46·65	67·18	91·44	119·40	151·10	186·60
32	51·14	73·65	100·24	135·90	165·70	204·60
34	55·81	80·37	109·39	142·87	180·82	223·24
36	60·51	87·13	118·60	154·90	196·04	242·03

King intended the above data to apply 48 hours after settling, but later tests have shown that with well matured corn they are approximately correct after settling is complete. Tests made at Nebraska immediately after filling ceased show that King's method gives results that are 10 per cent too high. Thus a reduction of 10 per cent from the estimate given in the above table will give a figure applicable to a silo that has been just filled.

ESTIMATING WEIGHT OF HAY IN STACKS

There is no accurate method of finding the weight of hay in a stack except by weighing it, but a number of methods are used for estimating it. All methods are designed to get as accurately as possible the number of cubic feet in the stack. This is then divided by the number of cubic feet per ton of hay. The same principle is followed in estimating the hay in a barn. The volume of hay is found and this is divided by the cubic feet per ton.

To estimate the volume or number of cubic feet of hay in a stack, the procedure is to find the length and width of the stack and measure the distance over the stack from the ground on one side to the ground on the other side. This last measurement is found by throwing a rope over the stack. These three measurements are multiplied together and from one-quarter to one-third of this product will give the number of cubic feet in the stack. If the stack is so built that it slants toward the top from close to the bottom of the stack, one-fourth of the product is taken; if the stack goes up perpendicular or straight for about half its height and then slopes toward the top, one-third of the product is taken.

The most difficult problem is to estimate the number of cubic feet of hay required to equal one ton. Rules vary widely in different localities. One rule states that when hay has stood less than one month it requires 580 cubic feet of hay to make a ton, when it has stood one month 512 cubic feet, five or six months, 422 cubic feet, and when it has stood one year, 343 cubic feet. If it is at all possible, it is very much more accurate to weigh the hay or at least to weigh one stack before estimating the weight of similar stacks.

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