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THE UNIVERSITY OF MINNESOTA

GRADUATE SCHOOL

Report

of

Committee on Examination

This is to certify that we the undersigned, as a committee of the Graduate School, have given Walter Joachim Koppen final oral examination for the degree of Master of Science . We recommend that the degree of Master of Science be conferred upon the candidate.

Minneapolis, Minnesota

May 19 1919

W. G. Brierley  
Chairman

J. W. Leck

A. S. Ruggles

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Report

of

Committee on Thesis

The undersigned, acting as a Committee of the Graduate School, have read the accompanying thesis submitted by Walter Joachim Koppen for the degree of Master of Science.

They approve it as a thesis meeting the requirements of the Graduate School of the University of Minnesota, and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science.

*W. G. Brierley*  
Chairman

*F. W. Peck*

*A. G. Ruggles*

*May 19* 1918

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The Cost of Apple Production in  
Thirty-five Representative Orchards in Minnesota.

A Thesis submitted to the  
Faculty of the Graduate School of the  
University of Minnesota

by

Walter J. Koppen  
In partial fulfillment of the requirements  
for the degree of  
Master of Science

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COST OF APPLE PRODUCTION IN THIRTY-FIVE REPRESENTATIVE  
ORCHARDS IN MINNESOTA

INTRODUCTION

Object of the Survey

The question frequently arises whether apples can be profitably produced in Minnesota; and, if so, in what sections and by what methods. In order to determine the present status as well as the possibilities in fruit production in Minnesota and to arrive at a knowledge as to what the difficulties are that confront the fruit grower, the Minnesota Experiment Station has undertaken a survey of the fruit industry of the state. Data have already been taken on the status of the apple, strawberry, and raspberry and the survey is to be continued through two more seasons. Additional growers will be interviewed from time to time. The tables presented in this thesis have been arranged from the data already obtained for apples, as filed with the Horticulture Division, University Farm. The field work was done during the spring and summer of 1918 and during the first two months of 1919.

## History of Orcharding in Minnesota

When Minnesota was admitted to the Union in 1858 it was generally believed that the winters of this region were entirely too severe for fruit trees to live and produce. In 1854 Peter Gideon set out the first apple orchard in the Minnetonka region. Year after year he planted trees only to see them succumb to the rigors of the climate. About 1862 he raised a seedling which he named the Wealthy and which has since become one of the leading commercial varieties of the United States. In 1857 another pioneer, J. S. Harris, planted his first orchard at La Crescent. Though he had his ups and downs, he made a notable exhibit of native apples at the State Fair in 1866. The country was then thinly settled, trees had to be shipped in from the East, and failure meant real sacrifice; yet the early fruit growers persisted in their attempts. The granting of premiums by the Minnesota State Fairs for apple exhibits, the organization of the Minnesota Horticultural Society in 1867, the introduction and distribution of Russian varieties commencing the same year, the establishment of private and semi-public trial stations from time to time in the next three decades, the elimination of many varieties in the test winters of 1872-73 and 1884-85, and, above all, the indomitable spirit of a host of pioneers

who refused to be disheartened by failure after failure combined in giving impetus to the industry and in securing definite results until, by 1900, it became fairly well known what varieties would succeed and in what regions. The commercial orchards used in this survey have been planted mostly since 1900. In the last twenty years a number of diseases and pests, unknown or scarce in earlier days, and aided by the failure of many growers to take combative measures, have resulted in many good orchards falling behind in normal production; but this condition is being remedied.

#### Extent of Apple Growing in Minnesota

There are practically no apples raised in the northern half of Minnesota. The principal commercial orchards are found in the region of Lake Minnetonka and in the central southern and the southeastern parts of the state. Occasional commercial orchards are found west of the Twin Cities to the Dakota line and in southwestern Minnesota. Aside from orchards large enough to be called commercial, almost all the farmers in southeastern Minnesota and many in other sections have from a dozen to a hundred bearing apple trees each. This probably accounts for the estimate of the Bureau of Statistics, U. S. Department of

Agriculture, that an average of 1,123,000 bushels of apples were produced annually in Minnesota during the years 1914-18. A fair estimate of the production in commercial orchards is about 75,000 bushels annually. This estimate is based on observation and record in making this survey. Of course, the number of Minnesota grown apples to reach the market will greatly exceed this latter number. The localities from which survey data have been taken are shown on the map in Figure 1.

#### ACKNOWLEDGEMENTS

Acknowledgement is due to the several County Agents for assistance in securing the necessary data; also to Professors W. G. Brierley, F. W. Peck, and A. G. Ruggles for helpful suggestions in the preparation of this thesis.

#### LITERATURE REVIEW

On the cost of producing apples no previous work has been done in Minnesota. A very complete set of surveys was made in the far West by the U. S. Department of Agriculture. Five irrigated fruit sections located in Washington, Oregon, Idaho, and Colorado were visited in 1914 and 1915 and while only one season is used in each case in arriving at the costs, the results are very complete since every conceivable cost has been levied against the apple

orchard. It was found that the cost of producing a box of packed apples delivered to the association ranged from 71¢ in the Payette Valley to \$1.02 in the Hood River district.

In the eastern part of the United States considerable work was done in New York state, especially in Niagara County. Other sections in which cost of apple production was studied include New Jersey, West Virginia, Maine, Connecticut, Indiana, and Eastern Canada. The methods used and extent of the surveys were widely different. Some investigators considered interest on investment as a legitimate charge; others did not; some secured data from only one orchard; others from a region; some obtained one seasons's figures; other took the results of several seasons. Widely divergent methods in the eastern investigations make a comparison of costs rather difficult

Graphical comparisons of results obtained under similar methods are found in Figures 2, 3, and 4.

#### METHOD OF SURVEY

The investigator with prepared blanks interviewed each orchardist personally. Emphasis was placed upon normal conditions and in all cases three to five year estimates were secured. Extremes in estimates were thrown out. Copies of the survey blanks used are inserted following the bibliography.

Thirty-five records are included in this report. Four of the orchardists from whom records were obtained showed little inclination to care for their orchards and made little effort to dispose of the crop; hence they are considered representative of a smaller group of orchardists rather than of the majority and are treated as a separate unit for a basis of comparison. In the same way one extra high yielding orchard which has received much more than ordinary care is also considered separately. Thirty orchards are averaged in obtaining the general practice. All the averages used in the tables are weighted.

#### RESULTS OF THE INVESTIGATION

##### The Orchards Used in the Survey

Thirty-five orchards considered in this survey total 187.5 acres. The thirty orchards used in obtaining the average vary in size from 2 to 15 acres, averaging 5.3 acres, and totaling 159 acres. There are 125 trees to the acre, the range being from 65 to 300. This amounts to the same as if the trees were planted 18 by 20 feet apart. Crowding of trees is largely the result of the experimentation and recommendation of earlier days, often aided by the activities of the nursery agent. Many leading commercial fruit growers now say that they would plant trees farther apart than the trees stand at present in their orchards and favor 20 by 20 feet as a minimum; but are rather inclined to

recommend 20 by 24 feet. The age of the trees ranges from 9 to 27 years, the average being 15 years. A typical Minnesota commercial apple orchard is shown in the photograph on Plate I.

There was some winter-killing, especially during the winter of 1917-18--- amounting to 10 per cent in some cases. A number of the orchards were also weakened by disease. One such, too far gone to be used in this survey, is shown in Plate I.

#### The Orchard Management

There is a sod mulch in most Minnesota orchards. In some cases the grass is cut and used as hay; but in most cases the grass is cut once or twice a year and left in place to rot, and so this has been considered as the general practice. A number of the grass mulches consist of more weeds than grass and in such cases hand scything is resorted to. A few orchards and parts of others are intercropped with small fruits, vegetables, corn, or clover. An occasional orchard is kept under cultivation. Illustrations of these practices are found on Plates II and III.

Two types of marketing apples are followed. About three-fourths of the marketed apple crop is packed in barrels; a very few in boxes. The other growers sell loose in package. For this purpose a number of bushel baskets or

boxes are kept on hand. The package is not sold with the apples and is returned to the grower. There are always some of the bushel baskets or boxes--about 15 per cent--that are broken or lost at the market and so need to be replaced each year. As the items of cost vary with the method of crop disposal, the two have been separated in the presentation of the data. In obtaining the average of both methods, where an item occurs that is used in one method but not in the other, consideration is given to the fact that one method is used three times as much as the other. For example, if the item occurs under barrel marketing and not under marketing loose in baskets three-fourths of the item amount is taken as the average because three-fourths of the crop is marketed in barrels.

Eleven per cent of the apple crop is stored for a period of from two to four months. The storage place is generally an ordinary cellar, either under a building or a special root cellar. Infrequently a cold storage building is to be found in connection with the orchard. Estimates show about 10% loss due principally to shrinkage. Stored apples do not always bring higher prices because sold later in the year, according to the testimony of some growers; but there are more growers who generally secure an increase in sale price ranging from 25¢ to 50¢ a bushel.

## Yields and Prices Received

The average yield is found to be 133 bushels per acre. Of this amount 123 bushels per acre are actually sold; of the remaining, one bushel per acre is generally reserved for home use and 9 bushels represent culls. The proportion of culls is small owing to the absence of grades and the disposal of poorer apples on local markets. In years when a large crop is general the lower prices result in quite a proportion of apples being fed to hogs.

The 123 bushels per acre actually sold brought the average of \$1.106 per bushel. Apples for home use are chargeable at the market rate. The culls are considered to have the standard value of 15¢ a bushel.

## Facts of Cost

### I. Labor Requirements

#### Manuring

For the smaller orchards, especially those on general farms, manure is obtained from stock on the farm itself. Some of the larger orchards are situated so they can be supplied from stock yards and livery barns. Only 43% of the orchards receive a regular manuring. For each ton of manure applied it takes 2.07 hours and 4.14 horse hours. The average amount applied per acre is 4.22

tons annually. Results secured in the better orchards show that this is hardly enough. Twice that amount would be much better. Some of the best growers apply 12 tons per acre.

### Pruning

Tree growth in Minnesota is much less per season than in many apple regions and so it is to be expected that less time is spent in pruning. However, the smaller time per acre may be partially accounted for by the fact that many orchards are neglected in the matter of pruning; hence the wide range in time spent from 5 man hours to 39 man hours per acre. A comparison of the pruning practice of twelve growers whose principal income is from apples with that of thirteen growers who are primarily in other phases of farming shows the former to spend half again as much time as the latter in pruning.

The age of the tree does not have any material effect on the time required for pruning. The same thing was found true by the U. S. Department of Agriculture investigators in the Hood River country.

A summary of pruning practices is given in Table I.

Table I

Age of Trees	No. of Orchards	No. of Acres	No. of Trees Pruned Per 10 Hours	Average No. of Trees Per acre	Man Hours per acre	Man Hours per Tree
9-14	11	72.0	81.6	122	14.95	.122
15-20	11	48.5	92.0	134	14.57	.108
21-27	3	9.5	104.0	94	9.00	.096
Average 15			88	126	14.36	.114

Hauling and Burning Brush

Brush from pruning is disposed of by hauling to convenient places and burning the piles. The most common crew used for this work consists of one man and two horses. The cheapest method seems to be with two men and one horse, but as only one orchardist followed this method the evidence is not conclusive. A comparison of crew effectiveness is shown in the Table II.

Table II

Kind of Crew	No. of Men	No. of Horses	No. of Orchards	No. of Acres	Man Hours Per Acre	Horse Hours Per Acre
1	2	2	17	87	2.63	5.26
2	2	2	5	24	6.15	6.15
2	1	1	1	14	1.43	.72
Average					3.17	4.92

### Spraying

Spraying is more prevalent now than it was a few years ago. More power sprayers are in use than barrel sprayers and each year the power sprayer is gaining in favor. An average of 2.81 acres per day is covered when using a barrel sprayer, whereas the use of a power sprayer enables the orchardist to cover an average of 4.34 acres per day. The 2-man, 2-horse barrel outfit and the 3-man, 2-horse power outfit are the most prevalent and also the cheapest in point of time per tree, except for dust spraying. Only one orchardist has tried dust spraying and his experience is in line with what has been found elsewhere--namely, dust spraying is a great labor saver. Whether this saving of labor is offset by the added cost of material and by the effectiveness of the spray is a question still to be decided in Minnesota.

Six growers spray once a year, fifteen growers spray twice a year, and two growers spray three times a year. At each spraying an average of 125 gallons per acre or 1.14 gallons per tree is applied. This is not as much as is applied per tree per spraying in many other fruit sections. Where trees are sprayed regularly twice each year this amount is sufficient according to some of the best orchardists and their orchards bear them out in such a contention. The general practice is to use a combination

spray-- 3 pounds of lead arsenate paste or  $1\frac{1}{2}$  pounds lead arsenate powder with 50 gallons of water into which is stirred 1 gallon of lime sulphur for every 40 gallons of spray mixture. A dormant spray is very seldom used. The first spraying is given when the blossom petals are falling and the second a few weeks later. In wet springs it would be better to give a spraying when the blossoms just show pink in order to catch the early scab infection. The cost per tree, when averaging all methods, is \$0.0229 for labor and \$0.0171 for material-- a total cost per tree of \$1.04 per spraying.

Two sprayings are usually given in this state. Table III, which follows, shows data for one spraying.

Table III

No. of Records	No. of Acres	Outfit			Man Hours Per acre	Horse Hours per acre	Age	Trees per acre	Acres per Day	Time per Tree in hours	
		Kind	Men	Horses						Man	Horse
2	26.0	Barrel	3	2	8.7	5.8	13.0	105	3.46	.0828	.0552
5	15.5	Barrel	2	2	11.1	11.1	13.4	170.4	2.13	.0651	.0651
2	6.0	Barrel	1	2	5.83	11.66	10.0	100	1.77	.0588	.1166
<u>9</u>	<u>47.5</u>	Barrel	Average		<u>9.11</u>	<u>8.27</u>	<u>13.0</u>	<u>125.6</u>	<u>2.81</u>	<u>.0725</u>	<u>.0657</u>
3	15.5	Power	4	2	6.26	3.13	21.8	90.5	6.74	.0691	.0345
6	33.5	Power	3	2	7.38	4.92	13.8	128.6	4.56	.0573	.0382
3	17.0	Power	2	2	10.6	10.6	13.7	129.3	2.1	.0819	.0819
<u>12</u>	<u>66.</u>	Power	Average		<u>7.94</u>	<u>5.96</u>	<u>15.6</u>	<u>120.0</u>	<u>4.34</u>	<u>.0661</u>	<u>.0496</u>
1	15	Power (Dust)	2	2	1.33	1.33	13.5	130.0	15.0	.0102	.0102
<u>1</u>	<u>2</u>	Hand	<u>1</u>	<u>0</u>	<u>7.5</u>	<u>0.0</u>	<u>18.0</u>	<u>136.0</u>	<u>1.33</u>	<u>.0551</u>	<u>0</u>
23	130.5	Grand Average			7.6	6.18	14.5	123.3	4.96	.0616	.0501

Number of gallons of dilute spray per Acre -- 125.00

Number of gallons of dilute spray per Tree -- 1.14

### Mowing

In the sod mulch orchards the grass is cut once a year, sometimes twice. For this purpose a mower is used, though hand mowing is resorted to by some orchardists. The grass may be used as hay or, as is more commonly done, it remains to rot. Twelve orchardists who followed the common practice furnished data which summarized in Table IV, follows.-

Table IV

No. of Records	No. of Acres	No. of Men	No. of Horses	Man Hours Per Acre	Horse Hours Per Acre
9	34	1	2	3.11	6.23
<u>3</u>	<u>17</u>	<u>1</u>	<u>1</u>	<u>2.00</u>	<u>2.00</u>
12	51		Average	2.74	4.82

### Picking

Picking into boxes or baskets takes 56.99 man hours per acre or  $\frac{.42}{\text{man}}$  hours per bushel. At this rate one man picks 25 bushels in 10 hours. In fruit regions of the far West a picker picks two to three times as much per day, probably accounted for because the yield per tree is two to three times as great, thus allowing the picker to spend less time in moving.

### Hauling from Orchard

Satisfactory data on the labor required in hauling from the orchard to the sorting place or to storage seemed to be hard to obtain. Estimates place the requirement

at 3.37 man hours and 6.74 horse hours per acre.

### Sorting and Packing

The majority of growers sort their apples for disease and usually for size also. Practically no attempt is made at establishing grades. Occasionally the sorting is done in the orchard, but usually it is done in some special place before barreling or before hauling to market loose in basket. Where packing is done the barrel is the standard package used. The item of packing does not affect the orchardist who sells loose in baskets or boxes. One man packs 17 barrels (51 bushels) in a 10 hour day. Sorting requires 15.05 man hours per acre, packing where practiced requires 25.75 man hours per Acre.

### Hauling to Market

The distance to market or loading place ranges from one-half to 7 miles. The number of bushels hauled per load ranges from 5 to 76, an average of 32½ bu. Such a small number of bushels for the average load makes the cost per bushel mile (\$.023) a little high. The smaller growers haul 5 to 20 bushels whenever going to town with other things; the large growers, who are primarily in the apple business, haul from 30 to 76 bushels per load. Salient facts regarding hauling to market are shown in Table V.

Table V

	Number	Range
Growers reporting	16.00	
Acreage reported	88.00	
Distance hauled in miles	2.15	$\frac{1}{2}$ to 7
Bushels per load	32.5	5 " 76
Man hours per acre	11.42	3 " 50
Per bushel	.0929	.0296 " .625
Per bushel mile	.0432	.016 " .18
Horse hours per acre	21.55	6 " 100
per bushel	.1753	.0296 " 1.25
Per bushel mile	.0815	.032 " .36
Cost per bushel mile	\$ .023	\$ .0048 " .099

## II. Material Costs

Material costs are generally cash costs.

Spray materials used amount to  $7\frac{1}{2}$  pounds of lead arsenate powder, or 15 pounds of the paste and 6.25 gallons of lime sulphur per acre for the two sprayings. The price of spray materials has doubled since 1914. To arrive at a normal figure the average of 5 years (1914-18) has been taken and found to be 20¢ a pound for lead arsenate powder (10¢ a lb. for the paste) and 13¢ a gallon for lime sulphur in quantity. Single pounds or gallons or small quantities cost considerable more in proportion.

Manure, while not always paid for in cash, is a legitimate charge. The growers who have bought it have

paid from 75¢ to \$1.50 a ton. Its value is generally considered higher. In this survey it is given the average price paid of \$1.25 a ton.

Growers who barrel apples pay cash for barrels. The average price for the 5 years previous to 1918 was 36¢ a barrel. Forty-four and four-tenths barrels per acre are used by orchardists who barrel apples.

Growers who market in returnable baskets have a cash charge for replacement of baskets lost or broken each year. The replacement charge amounts to 15% of the total basket value kept on hand of \$13.06 per acre. Fifteen per cent of the \$13.06 an acre basket value is \$1.96 per acre charge for the item of replacement.

### III. Fixed Costs

Interest on investment is charged at 6%. In estimating the value of an orchard, the added value due to location in a city or near a summer resort lake is not taken into consideration. Only the added valuation due to the bearing trees is used. Each grower was asked what he would sell the orchard for as it stood, leaving its location out of consideration. The estimates range from \$150 to \$750 an acre, the average being \$503 an acre.

A tax charge of .5 to 1% is arbitrarily placed against each acre of orchard.

Spraying equipment, averaging in value to \$17.13 an acre, is charged 6% interest and 12½% depreciation.

Other equipment, such as tools, ladders, tables, implements, etc., amounting to \$9.86 an acre, is charged 6% interest and 10% depreciation.

Returnable baskets to the value of \$13.06 an acre, which are used by some growers from year to year for harvesting and hauling, are charged 6% interest.

#### IV. Overhead

To allow for minor items and occasional charges which come up in any business it is customary to make an overhead charge. Gasoline for sprayers, extra hauling, etc. are items which might be included in such a charge. In farm management work it is customary to charge 3% of all operating costs for overhead.

#### Uncommon Charges

Some operations and charges are so uncommon as not<sup>to</sup> be included in the general summary of normal costs. They are listed here as a matter of record. Owing to the very small number of estimates the results may not be as accurate as desirable. These uncommon labor requirements are shown in Table VI.

Table VI

Operation	Man hours per Acre	Horse hours per Acre
Plowing	5.	10
Harrowing	2.4	4.8
Resetting trees	3.	
Scything	6.75	
Thinning	10.	
Propping	1.	

It is not common in Minnesota to have special apple buildings. An orchardist who does should charge 3% of their original value for depreciation and 6% interest on depreciated value. Any supplies kept on hand from year to year should also be charged 6% interest.

It is customary to sell apples on the local market or else F. O. B. at the shipping point and the average prices used in this survey are based with that in mind. But it is well to remember that a few growers who ship their apples pay freight each year and also a commission of 15% on the selling price. Apples in cold storage may cost around 5¢ a box. Buying trees for replacing those lost during the year may also call for a cash outlay.

#### APPLICATION OF COST FACTORS

##### Table of Costs

Price is the changing factor in cost and so in computing the cost of producing apples for any certain time or period of time it is necessary to use current prices of known quantities. The first thing then is to know what amount of work is performed in the orchard operations and what quantities of materials are used. Any orchardist can approximate this closely for his own orchard if he has had a few years experience in the business; otherwise, if just starting in, the orchardist should rely upon averages

such as those in the following tables. After the amount is known, the current price is applied if making an approximation for one year; otherwise an average of prices is used. The orchard is given a fair valuation and the customary interest charge is applied. After the value of equipment and buildings is determined an interest and depreciation charge is made. Minor items are fairly well estimated.

In the illustration presented in Table VII of the application of the data the average of thirty orchards is given. In applying the material the following factors are considered,-

(a) Man labor is figured at 25¢ an hour; horse labor at 15¢ an hour.

(b) 4.23 tons of manure are applied to the acre; for each additional ton applied add 2.07 man hours and corresponding horse hours.

(c) Two sprayings is the general practice. If only one spraying is given take one-half the given figures; if three sprayings are given add one-half.

(d) The operations of packing and hauling to market are figured with 123.3 bushels per acre actually sold; the other operations involve the 133 bushels per acre yield. Amounts of marketable apples and yields for the types of orcharding are given later.

Table VII-Part I  
Barrel Marketing

Labor Costs

	Man Hours per A	Horse Hours per A.	Cost per Acre	Cost per Bushel
Maintenance				
Manuring	5.58	11.16	\$3.07	\$.022
Pruning	13.49		3.37	.024
Hauling and Burning Brush	2.61	3.92	1.24	.009
Spraying	14.74	11.22	5.37	.039
Mowing Grass	2.71	4.32	1.33	.01
	<u>39.13</u>	<u>30.62</u>	<u>14.38</u>	<u>.104</u>
Handling				
Picking-loose in boxes	60.01		15.00	.109
Hauling from Orchard	3.49	6.98	1.92	.014
Sorting	15.62		3.91	.028
Packing	25.75		6.44	.048
Hauling to Market	11.22	20.71	5.91	.044
	<u>116.08</u>	<u>27.69</u>	<u>35.18</u>	<u>.243</u>
	<u>155.22</u>	<u>58.31</u>	<u>47.56</u>	<u>.347</u>

Material Costs

Spray Materials		\$ 2.08	.015
Manure		3.36	.024
Barrels		15.98	.12
		<u>21.42</u>	<u>.159</u>

Fixed Costs

Interest on Investment		\$ 31.29	.227
Taxes		2.61	.019
Spray equipment-interest		.86	.006
depreciation		1.79	.013
Other equipment-interest		.40	.003
depreciation		.66	.005
		<u>37.61</u>	<u>.273</u>

Overhead Cost

Overhead-3%		<u>3.30</u>	<u>.023</u>
Total Costs		\$ 109.79	\$ .802

Table VII- Part 2

Loose Marketing

Labor Costs

	Man Hours per A.	Horse Hours per A.	Cost per Acre	Cost per Bushel
Maintenance				
Manuring	14.44	28.89	\$7.94	\$.065
Pruning	16.47		4.12	.034
Hauling and Burning Brush	4.57	6.54	2.12	.017
Spraying	16.3	15.08	6.33	.052
Mowing Grass	2.8	5.6	1.54	.013
	<u>54.58</u>	<u>56.11</u>	<u>22.05</u>	<u>.181</u>
Handling				
Picking-loose in boxes	51.55		12.89	.106
Hauling from Orchard	3.08	6.16	1.69	.014
Sorting	13.78		3.45	.028
Hauling to Market	15.69	31.39	8.63	.085
	<u>84.10</u>	<u>37.55</u>	<u>26.66</u>	<u>.233</u>
	<u>138.68</u>	<u>93.66</u>	<u>48.71</u>	<u>.414</u>

Material Costs

Spray Materials	\$ 2.72	.022
Manure	8.71	.072
Basket replacement	1.96	.016
	<u>13.39</u>	<u>.11</u>

Fixed Costs

Interest on Investment	\$ 27.84	.229
Taxes	2.32	.019
Spray equipment-interest	1.44	.012
Depreciation	3.00	.025
Other equipment-interest	1.20	.01
Depreciation	2.00	.016
Interest on Baskets	.78	.006
	<u>38.58</u>	<u>.317</u>

Overhead Cost

Overhead- 3%	3.02	.025
Total Costs	\$ 103.70	.866

Table VII- Part 3

Combined Barrel and Loose Marketing

Labor Costs

	Man Hours Per A.	Horse Hours Per A.	Cost per Acre	Cost per Bushel
Maintenance				
Manuring	8.77	17.54	\$4.83	\$.036
Pruning	14.36		3.59	.027
Hauling and Burning Brush	3.17	4.92	1.53	.012
Spraying	15.2	12.36	5.65	.042
Mowing Grass	<u>2.74</u>	<u>4.82</u>	<u>1.41</u>	<u>.011</u>
	<u>44.24</u>	<u>39.41</u>	<u>17.01</u>	<u>.128</u>
Handling				
Picking-loose in boxes	56.99		14.24	.107
Hauling from Orchard	3.37	6.74	1.85	.014
Sorting	15.05		3.76	.028
Packing	17.16		4.29	.032
Hauling to Market	<u>11.44</u>	<u>21.59</u>	<u>6.10</u>	<u>.05</u>
	<u>104.01</u>	<u>28.33</u>	<u>30.24</u>	<u>.231</u>
	<u>148.25</u>	<u>67.74</u>	<u>47.25</u>	<u>.359</u>

Material Costs

Spray Materials	2.31	.017
Manure	5.27	.04
Barrels	11.99	.09
Basket replacement	<u>.49</u>	<u>.004</u>
	<u>20.06</u>	<u>.151</u>

Fixed Costs

Interest on Investment	30.18	.227
Taxes	2.52	.019
Spray equipment-interest	1.03	.008
Depreciation	2.14	.016
Other equipment-interest	.59	.004
Depreciation	.99	.007
Interest On Baskets	<u>.20</u>	<u>.002</u>
	<u>37.65</u>	<u>.283</u>

Overhead Cost

Overhead - 3%	<u>3.14</u>	<u>.024</u>
Total Costs	\$ 108.10	\$ .817

### Normal Profits

The net profit from an orchard indicates whether it is a paying business beyond merely returning interest the same as if its value in money was invested in securities or elsewhere. If a man invested his money and labor elsewhere than in an orchard he would expect legitimate returns. For that reason his total returns from the orchard business must include net profit, interest on investment and equipment, and wages for his labor. Whether he is to be given more than ordinary wages because he manages the business depends on the viewpoint; in the illustration here given the net profit is considered as a reimbursement for his managerial ability. Another way of looking at it is to say that net profit is just that much added interest and then figure total interest as the reimbursement for the owner's physical and mental labor in the orchard. Still another way is to consider net profit as added wage for the owner's time and show how much per hour or per day his time is then worth. It is also of interest to show how many bushels of marketed apples per acre must be produced to return cost of production including interest and to return interest on total investment only.

What may reasonably be expected in the way of profits from Minnesota orchard is shown in Tables VIII and IX.

Table VIII. Net Profit

	Barrel Marketing	Loose Marketing	Combined Marketing
Bushels marketed per Acre	123.3	101.4	123.3
Price per bushel	\$ 1.131	\$ 1.034	\$ 1.106
Bushels used in home	1.0	1.0	1.0
Value per bushel	\$ 1.131	\$ 1.034	\$ 1.106
Bushels of culls	3.7	19.4	8.7
Value of culls per bushel	\$ .15	\$ .15	\$ .15
-----			
Receipts per Acre	\$ 152.45	\$ 108.79	\$ 138.78
Cost per Acre	<u>109.79</u>	<u>103.71</u>	<u>108.07</u>
NET PROFIT per Acre	42.66	5.08	30.71
-----			
Receipts per bushel mar- keted	\$ 1.131	\$ 1.034	\$ 1.106
Cost per bu. marketed	<u>.802</u>	<u>.866</u>	<u>.817</u>
NET PROFIT PER bu. mar- keted	.329	.168	.289
-----			
Receipts per bu. of total yield	\$ 1.104	\$ .893	\$ 1.043
Cost per bu. of total yield	<u>.795</u>	<u>.851</u>	<u>.813</u>
NET PROFIT per bu. of total yield	.309	.042	.23

Table IX. Returns for Interest and Labor

	Group-1 Barrel Marketing	Group-2 Loose Marketing	Group-3 Combined Marketing
Per Acre			
Net Profit	\$ 42.66	\$ 5.08	\$ 30.71
Interest on investment	31.29	27.84	30.18
Interest on equipment	1.26	3.42	1.82
Owner's labor	<u>15.28</u>	<u>19.03</u>	<u>16.53</u>
Total returns	90.49	55.37	79.24

	Group-1	Group-2	Group-3
Per Bushel Marketed			
Net Profit	\$ .329	\$ .168	\$ .289
Interest on investment	.227	.229	.227
Interest on equipment	.009	.028	.014
Owner's labor	<u>.111</u>	<u>.156</u>	<u>.124</u>
Total returns	.676	.581	.654

The owners in the first group average 61.1 hours of their own time per acre in the care of the orchard; the second group, 76.12 hours; the combined group, 66.11 hours. They are given credit at 25¢ per hour.

Counting net profit as added interest, and exclusive of fair wages for the owner's labor, the following table shows the percentage made on the total investment,-

	Group 1.	Group 2	Group 3
Total investment in land and equipment	\$ 542.45	\$ 521.06	\$ 533.25
Percentage made	13.86%	6.97%	11.75%

After making interest on investment, if net profit is considered added wage for the owner's labor, the

results then show a return of 94.8¢ an hour for the owners of Group 1 for actual time spent in the orchard, 31.7¢ and hour in Group 2, and 71.4¢ an hour in the combined group.

The following number of bushels per acre should be marketed to return cost of production including interest on investment and to return interest on investment only.

To return cost of production	Group 1 97 bu.	Group 2 100 bu.	Group 3 97.7 bu.
To return interest on total investment	28.8 bu.	30.2 bu.	29. bu.

#### Possible Profits

The smaller profits on the part of the growers who market loose in package is due to the fact that so many of the growers who fall in this class, being primarily engaged in some other phase of farming, pay little attention to the orchard and consider it as a secondary issue. They market only part of the crop, usually in a jumbled mass, for what they can get. The result is a decreased yield and a lower price. The loss on growing a large proportion of the crop not marketed takes away half the net profit made on the apples that are marketed.

Either method can be made profitable. To bring out this point and at the same time show the possible profits which may be derived from Minnesota orchards, an example of each is given in Table X. Only marketable apples are considered, the very small proportion of culls having been averaged in with the price.

Grower No. 17, located 50 miles west of Minneapolis, has a well cared for orchard, markets in barrels, and is primarily in the apple business. The orchard of 10 acres, with trees 9 to 17 years (average-13 years) of age and a five year average yield of 270 bushels per acre, selling for \$1.50 a bushel.

Grower No. 28, located near St. Paul, markets loose in baskets, and is also primarily engaged in apple raising. His orchard of 4 acres, age 9 to 14 years (average 10 years) has a three year average yield of 138 bushels per acre, selling for \$1.64 a bushel. This grower's management varies from the general practice only in that the orchard receives an extra heavy coating of manure each year. Considering its age the orchard makes an excellent showing.

Table X

Summary of Costs

	Grower No. 17 Per Acre	Per Bushel	Grower No. 28 Per Acre	Per Bushel
Labor Costs	\$ 22.75	¢ .084	\$ 30.30	¢ .220
Maintenance	57.20	.213	18.80	.136
Handling	45.35	.168	20.87	.224
Material Costs	127.57	.472	62.85	.455
Fixed Costs	7.59	.028	4.28	.031
Overhead	<u>260.46</u>	<u>.964</u>	<u>137.10</u>	<u>1.066</u>
Total Costs				

Profits

Receipts	\$ 405.00	¢ 1.50	\$ 226.32	¢ 1.64
Cost of Production	<u>260.46</u>	<u>.964</u>	<u>137.10</u>	<u>1.066</u>
NET PROFIT	<u>144.54</u>	<u>.536</u>	<u>89.22</u>	<u>.574</u>

Returns for Interest and Labor

Net Profit	\$ 144.54	¢ .536	\$ 89.22	¢ .574
Interest on Investment	45.00	.166	45.00	.326
Interest on Equipment	2.10	.008	3.20	.023
Owner's Labor	<u>22.50</u>	<u>.083</u>	<u>24.62</u>	<u>.178</u>
Total	<u>214.14</u>	<u>.793</u>	<u>162.04</u>	<u>1.101</u>

Comparative Profits

Heretofore only 30 representative orchards- numbers 1 to 30- have been considered. An interesting comparison may be made of the results from these orchards with the results obtained from orchards little taken care of and from which the owners make little effort to dispose of the crop, and also with a high yielding orchard that receives good attention.

The four poorly cared for orchards - numbers 31, 32, 33, and 34 - total 27½ acres; trees average 14.8 years of age and yield 69 bushels to the acre. Of the

yield 7 bushels per acre are sold for 75¢ per bushel and of the remaining 62 bushels a few are kept for home use and the rest generally not disposed of.

Orchard No. 35, well cared for and high yielding, is one acre with trees 15 years of age yielding 500 bushels. Of the yield, 300 bushels are packed and sold for \$1.63 a bushel, 165 bushels are sold on the place for \$1.25 a bushel, 10 bushels are kept for home use, and 25 bushels are culls, etc.

Tables XI and XII show the costs and profits generally found with the orchards just described.

Table XI

	Orchards 1-30	Orchard 31-34	Orchard 35
Receipts per acre	\$ 138.78	\$ 15.15	\$ 712.50
Cost per acre	<u>108.07</u>	<u>30.99</u>	<u>195.42</u>
Net Profit per acre	30.71	15.84	517.08
Net Loss per acre	- - - - -	- - - - -	- - - - -
Receipts per bushel marketed	\$ 1.106	\$ .75	\$ 1.50
Cost per bushel marketed	<u>.817</u>	<u>.573</u>	<u>.473</u>
Net Profit per bushel marketed	.289	.177	1.027
Net Loss per bushel marketed	- - - - -	- - - - -	- - - - -
Receipts per bu. of total yield	\$ 1.043	\$ .220	\$ 1.425
Cost per bu. of total yield	<u>.813</u>	<u>.449</u>	<u>.391</u>
Net Profit per bu. of total yield	.230	.229	1.034
Net Loss per bu. of total yield	- - - - -	- - - - -	- - - - -

Table XII

Returns for Interest and Labor

	Orchards 1-30	Orchards 31-34	Orchard 35
<b>Per Acre</b>			
Net Profit	\$ 30.71		\$ 517.08
Net Loss		\$ 15.84	
Interest on inv. and equip.	32.00	17.28	60.30
Owner's Labor	<u>16.53</u>	<u>3.28</u>	<u>25.90</u>
	79.24	3.72	603.28
-----			
<b>Per Bushel Marketed</b>			
Net Profit	\$ .289	\$ .177	\$ 1.027
Interest on inv. and equip.	.241	.250	.121
Owner's labor	<u>.124</u>	<u>.043</u>	<u>.062</u>
	.654	.469	1.210
-----			
<b>Per Bushel of total yield</b>			
Net Profit	\$ .230		\$ 1.034
Net Loss		\$ .229	
Interest on inv. and equip.	.241	.251	.121
Owner's labor	<u>.123</u>	<u>.033</u>	<u>.052</u>
	.594	.055	1.207

CONCLUSIONS

A consideration of the data presented here warrants some general conclusions; but it must be borne in mind that additional data may call for a revision of some of the following conclusions,--

Commercial apple growing is entirely confined to the southern half of Minnesota.

It is impractical to run an orchard in conjunction with a general farm of any size; work on one is neglected for the other.

Small fruits and apples make a good profitable combination.

The most successful orchardists consider mulch crops the best type of management.

In general the orchards are not manured heavily enough. This is especially true where the mulch crop is cut and hauled away.

More attention needs to be paid to the items of pruning and spraying.

Barreling apples is much more common than boxing apples. There are few standards of pack and grade.

Marketing loose in baskets is preferable where a ready market can be secured.

The complaint that prices of apples are low and that it is hard to get rid of the product is not justifiable in view of the fact that such a large proportion of the growers do succeed in getting fair prices and in disposing of all their crop. It has been found that neglected orchards, rather than lack of market, have most commonly, because of poorer apples, caused lower prices to be received.

In localities around small towns where the local market is likely to be overstocked because every nearby farmer has from a dozen to a hundred trees, the recourse of the orchardist is to barrel and ship.

Growers west and south get good prices by disposing of crops in South Dakota; working up a name and trade aids materially. Reliable commission houses in the Twin Cities and elsewhere can be and are utilized by

growers of apples in quantity.

As so little of the data was taken in the Minnetonka region it is well to mention the fact of that region being a large quantity apple producing area and that the orchardists there market apples through a successful Fruit Grower's Association at Excelsior.

A reduction in the cost of production per acre or per bushel does not necessarily mean increased efficiency. Either a lack of work or increase of yield may cause a reduction. However, net profit is always high or low as the yield is high or low.

The data shows that orchards in Minnesota return a fair interest on investment and compensation for labor on a par with other farm crops.

#### SUMMARY

Thirty-five representative orchards considered total 187.5 acres.

Thirty orchards used to determine the normal average total 159 acres, averaging 5.3 acres each. Trees average 15 years of age, ranging from 9 to 27 years. There are, on the average, 125 trees to the acre, the extremes ranging from 65 to 300.

Sod mulch is the common type of management in Minnesota. Barrel marketing is more common in the orchards

considered than marketing loose in baskets. About 11% of the apple crop is stored for a period of 2 to 4 months.

The average yield is 133 bushels to the acre of which 123.3 bushels are actually marketed at an average price of \$1.106.

Common operations are manuring, pruning, hauling and burning brush, spraying, mowing, picking, hauling from orchard, sorting, packing, and hauling to market.

Material costs, fixed costs, and overhead are charged average rates where orchardists have estimated and fair rates on items like interest on investment--taking a period through the years 1913-1917 mainly.

It costs 81.7 ¢ a bushel to produce marketed apples. A net profit of 29 ¢ per bushel of marketed apples is realized.

The cost per acre to produce apples, when the total yield, marketed and non-marketed, is considered is \$108.07; the return per acre is \$138.78; the net profit per acre is \$30.71

Considering net profit as added interest to the 6% normally charged on investment, the orchards return 11.75% on a total investment of \$533.25 per acre. Of the total investment, \$503.00 is for the present orchard value per acre and \$30.25 is for equipment investment per acre.

To return cost of production including interest 97;7 bushels of apples should be grown and marketed per acre; to return interest on investment only (at 6%) 29 bushels should be grown and marketed.

Commercial orchards, well taken care of, return in net profit \$90 to \$144 and acre; an exceptional orchard realizes \$517.08 per acre in net profit; poorly cared for orchards do not return interest on investment.

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**INTER CROP.**

**No. 3**

Kinds.....

Operation	Number Operations	Number Men	Number Horses	Hours per Day	Acres per Day	Normal Time per Acre		Cost
						Man	Horse	
								\$
Seed Cost								
Other Cash Cost								

Estimated value of inter crop.....Value of orchard for pasture.....

Value of fuel from orchard.....

Notes on Interplanting: .....

**DIRECT EXPENSE, Other than Labor (Normal)**

Item	Amount Used			Usual Price per Unit	Total Cost	Cost per Acre	Remarks
	Unit	Amount	Per Acre				
Cover Crop							
Manure							
Fertilizer							
Barrels							
Spray Materials							
Nails							
Board of Men							
Paint							
Cash Rent							
Freight							
Storage							
Commission							





Figure 2

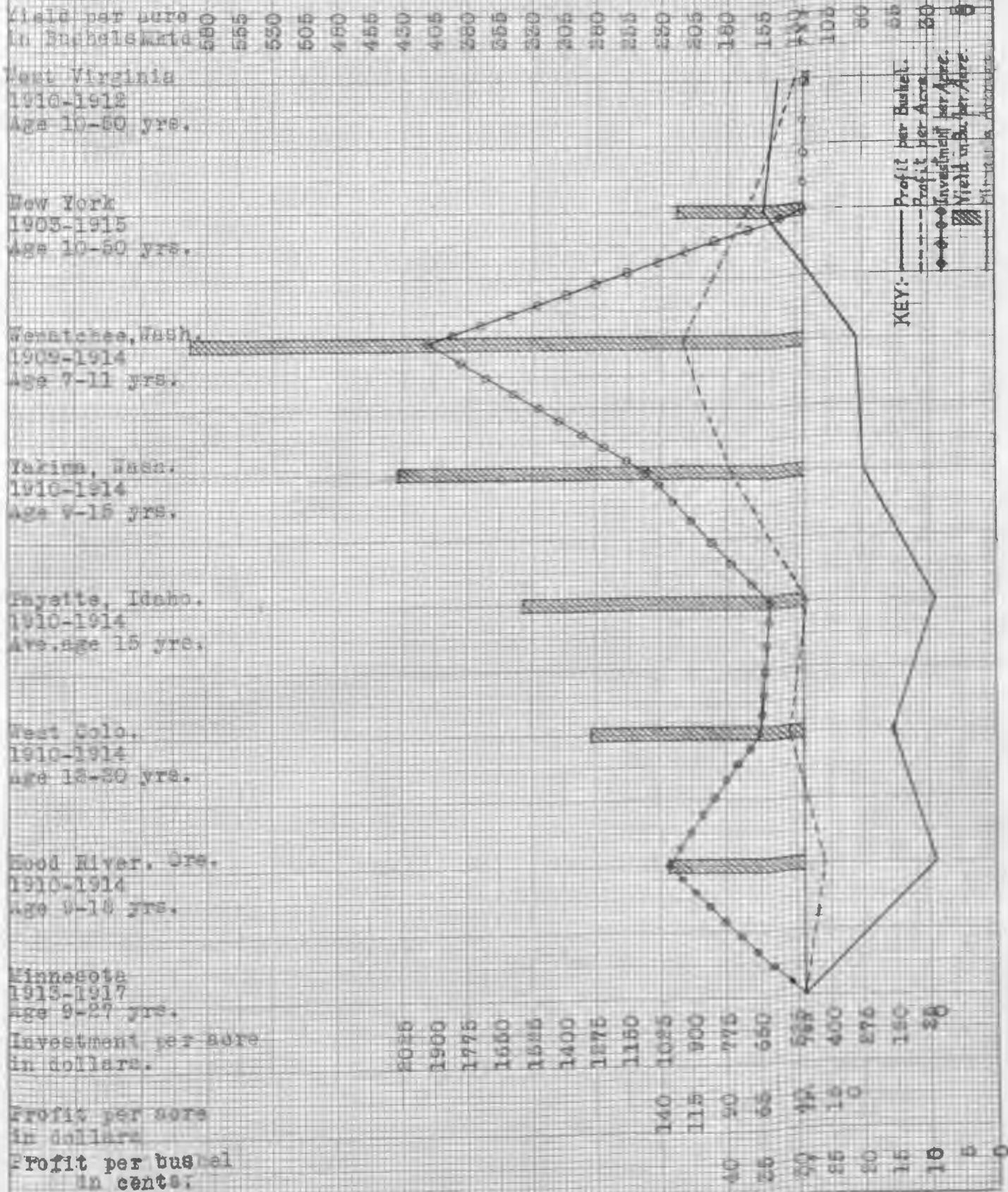


Figure 3

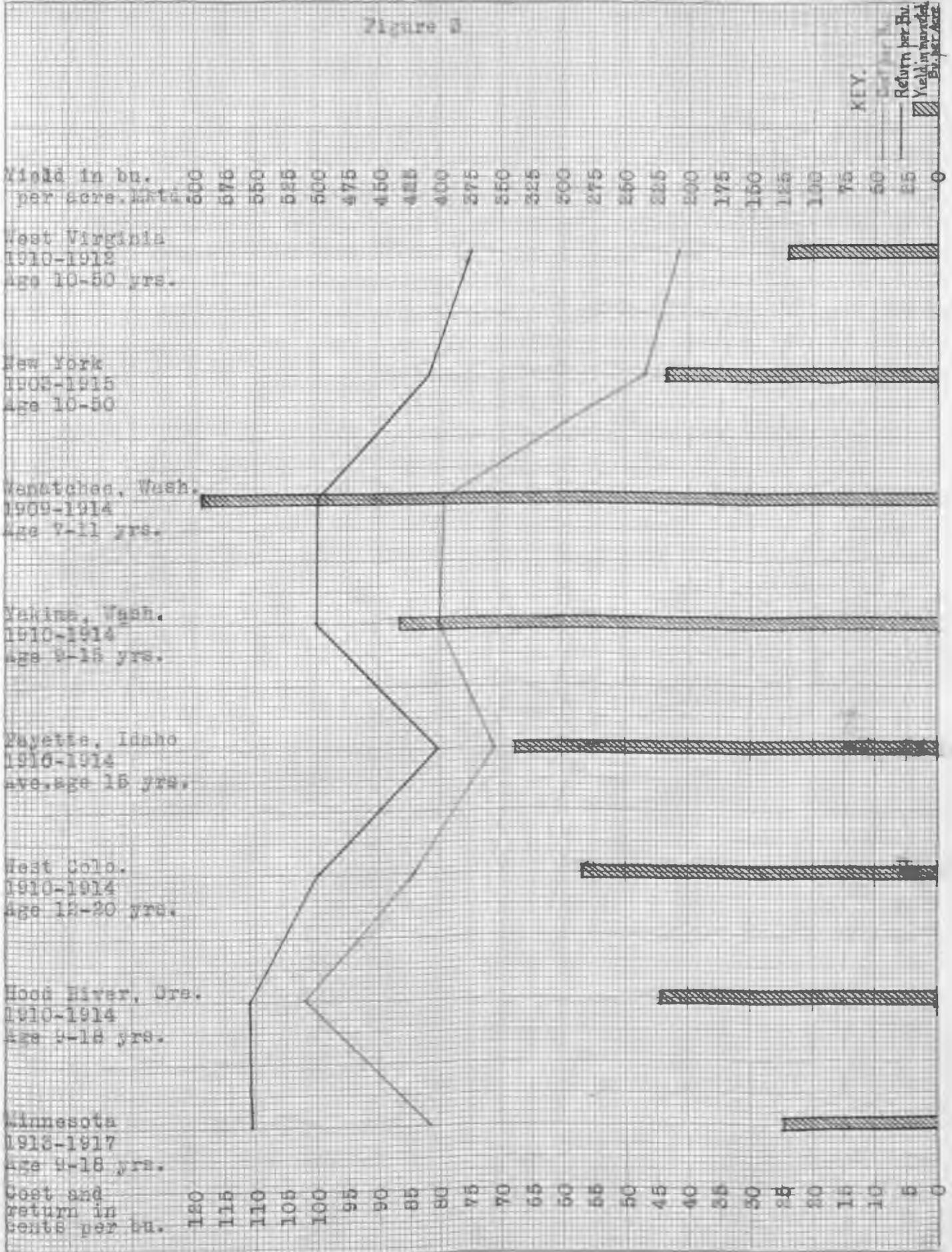


Figure 4

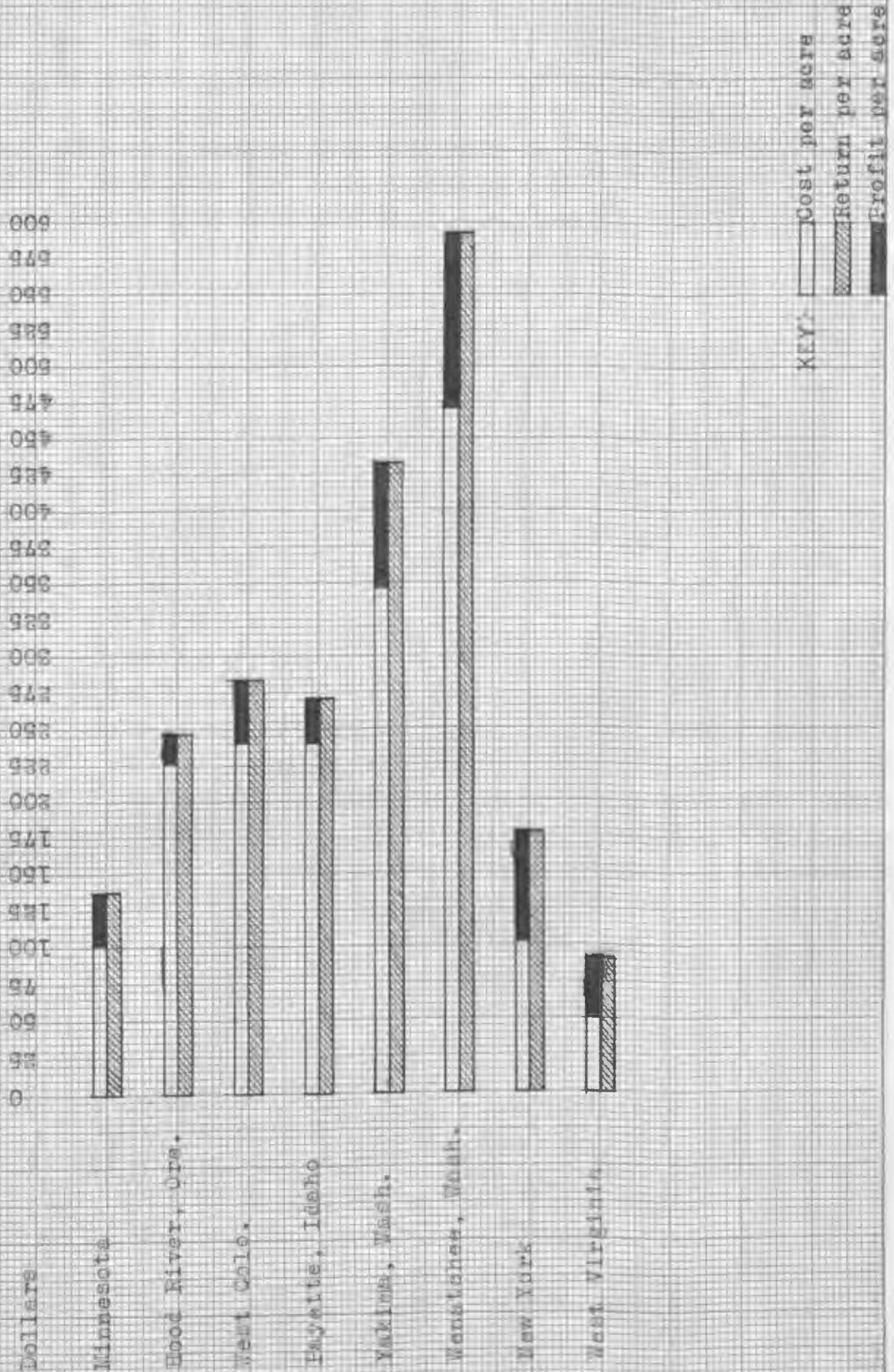


PLATE I.

1.- Wealthy trees weakened by winter killing and probably sunscald and attacked by secondary organisms. Photo taken May 22, 1918, Nobles County.

2.- A Minnesota commercial orchard. Houston County. Photo by W. G. Brierley.

PLATE I.

1



2



PLATE II.

1. Orchard intertilled with corn or some other crop for past seven years. The trees have remained vigorous. Martin County.

2. Orchard of Peter apples which has been cultivated thoroughly for seven years. No winter killing is in evidence. McLeod County.

PLATE II.

1



2



PLATE III.

Grass mulch in orchard - the common practice in Minnesota. The tree in the foreground is 42 years of age. Nobles County.

PLATE III.

