1-1-1915

An Apple Orchard Survey of Berkeley County

E. C. Auchter

June, 1915 Bulletin 151

West Virginia University
Agricultural Experiment Station
MORGANTOWN, W. VA.
DEPARTMENT OF HORTICULTURE

An Apple Orchard Survey
OF
Berkeley County

BY
E. C. AUCHTER

The Bulletins and Reports of this Station will be mailed free to any citizen of West Virginia upon written application. Address Director of Agricultural Experiment Station, Morgantown, W. Va.

THE STATE OF WEST VIRGINIA

Educational Institutions

THE STATE BOARD OF CONTROL

JAMES S. LAKIN, President.....Charleston, W. Va.
A. BLISS McCRUM,.....Charleston, W. Va.
J. M. WILLIAMSON.....Charleston, W. Va.

The State Board of Control has the direction of the financial and business aairs of the state educational institutions.

THE STATE BOARD OF REGENTS

M. P. SHAWKEY, State Superintendent of Schools,
President .....Charleston, W. Va.
GEORGE S. LAIDLEY.....Charleston, W. Va.
ARLEN G. SWIGER.....Sistersville, W. Va.
EARL W. OGLEBAY.....Wheeling, W. Va.
JOSEPH M. MURPHY.....Parkersburg, W. Va.

The State Board of Regents has charge of all matters of a purely scholastic nature concerning the state educational institutions.

The West Virginia University

FRANK B. TROTTER, LL.D.....Acting President

AGRICULTURAL EXPERIMENT STATION STAFF

E. DWIGHT SANDERSON, B.S. Agr.....Director
BERT H. HITE, M.S.....Vice-Director and Chemist
W. E. RUMSEY, B.S. Agr.....State Entomologist
N. J. GIDDINGS, M.S.....Plant Pathologist
HORACE ATWOOD, M.S. Agr.....Poultryman
W. H. ALDERMAN, B.S. Agr.....Horticulturist
I. S. COOK, Jr., B.S. Agr.....Agronomist
L. M. PEAIRS, M.S.....Research Entomologist
*O. M. JOHNSON, B.S. Agr.....Farm Management
E. W. SHEETS, M.S. Agr.....Animal Husbandry
C. A. LUEDER, D.V.M.....Veterinary Science
R. R. SNAPP, B.S. Agr.....Assistant in Animal Husbandry
*J. B. HUYETT, B.S. Agr.....Assistant in Animal Husbandry
†L. I. KNIGHT, Ph.D.....Plant Physiologist
A. L. DACY, B.Sc.....Associate Horticulturist
FRANK B. KUNST, A.B.....Assistant Chemist
CHARLES E. WEAKLEY, Jr.....Assistant Chemist
J. H. BERGHUIS - KRAK, B.Sc.....Assistant Chemist
FIRMAN E. BEAR, M.Sc.....Soil Investigations
HUBERT HILL, B.S., M.S.....Assistant Soil Chemist
ANTHONY BERG, B.S.....Assistant Plant Pathologist
E. C. AUCHTER, B.S. Agr.....Assistant Horticulturist
L. F. SUTTON, B.S., B.S. Agr.....Assistant Horticulturist
R. R. JEFFRIES, B.S. Agr.....Assistant Horticulturist
H. L. CRANE, B.S. Agr.....Assistant Horticulturist
W. B. KEMP, B.S. Agr.....Assistant Agronomist
HENRY DORSEY, B.S. Agr.....Assistant Agronomist
E. L. ANDREWS, B.S. Agr.....Assistant in Poultry Husbandry
G. L. THOMPSON, B.S. Agr.....Assistant in Dairy Husbandry
*A. J. DADISMAN, M.S. Agr.....Farm Management
*C. H. SCHERFFIUS.....In Charge of Tobacco Experiments
O. M. KILE, B.S. Agr.....Editor
W. J. WHITE.....Bookkeeper

*In co-operation with U. S. Department of Agriculture.
†In co-operation with the University of Chicago.

An Apple Orchard Survey of Berkeley County

By E. C. AUCHTER.

INTRODUCTION.

In the last decade, fruit growing has developed and increased so rapidly in "The Little Mountain State," and especially in its eastern panhandle section, that in order to answer intelligently the many inquiries, and to know the actual facts concerning this great industry, an orchard survey with special reference to apples was undertaken in Berkeley County, the largest fruit producing county of the state.

Berkeley County is located in the extreme eastern section of the state and is one of the counties which make up the "Eastern Panhandle." It is a part of the famous Shenandoah Valley region, noted for its ideal climatic conditions, fertile soils, big crops, hospitable homes, improved roads, splendid transportation facilities and nearness to the large eastern markets—Washington, New York, Philadelphia, Richmond, Norfolk and Pittsburgh, all being within ten hours ride of Martinsburg, the county seat.

With the above natural advantages, it is not surprising that the crops have thrived and the farmers have flourished. Although general farming, trucking and stock raising have all been successful, the growing of fruit has seemed to outstrip all other branches of agriculture. This has been due, in part, to the large areas of rich limestone soils, the long sunshiny days, cool nights, and plentiful rainfall, all of which have combined to make apples of such color and quality that they are now recognized not only in this country, but are sought for abroad.

Orchard surveys are by no means new. The Cornell University Agricultural Experiment Station at Ithaca started this kind of work in 1903, publishing its first report* in 1905. Since that time it has published several other orchard survey bulletins† and similar surveys of other counties are still unpublished. The Oregon Station has also carried on this line of work and has published the results of several of its surveys[1]. Recently the Iowa[2] and West Virginia[3] Stations have

*Warren, G. F.—Cornell Univ. Agr'l. Expt. Sta. Bul. 226.
†Warren, G. F.—Cornell Univ. Agr'l. Expt. Sta. Bul. 229.
Cummings, M. B.—Cornell Univ. Agr'l. Expt. Sta. Bul. 262.
Martin, H. M.—Cornell Univ. Agr'l Expt. Sta. Bul. 307.
[1]Lewis, C. I.—Oregon Agr'l. Expt. Sta. Bul. 99.
Lewis, C. I., Bennet, S. L. and Vincent, C. C.—Oregon Agr'l. Expt. Sta. Bul. 101.
[2]Green, Lawrenz—Iowa Agr'l. Expt. Sta. Bul. 153.
[3]Jeffries, R. R.—W. Va. Agr'l. Expt. Sta. Bul. 147.

published the results of orchard surveys. Thus while we have this sort of data for the northern, western and northwestern states, it was thought that data of similar nature for the middle south and in a more or less mountainous region would not be amiss.

In orchard survey work, all the orchards in a certain section or county are visited and a complete record of each orchard, is obtained wherever possible. The records contain such information as acreage, varieties, age of trees, cultural methods, fertilizers used, kinds and amounts of sprays, yields, incomes etc. When this mass of data from all the orchards has been worked up, some very definite conclusions can be drawn. Factors such as cultural methods versus yields, or fertilizers versus incomes, and many others can be correlated. Thus it is not necessary to carry on numerous experiments in a county to determine the best methods of management to use for if enough orchards are included in the survey to make the data reliable, the survey will answer such questions. It is hoped that this bulletin will not only record the extent of the industry but will also answer satisfactorily many practical questions concerning the proper management of commercial orchards in the Eastern Panhandle, and will in addition give reliable figures on orcharding in the middle southern states so that this industry may be compared with that of the northern, western and northwestern states or of any other section.

EARLY HISTORY OF BERKELEY COUNTY ORCHARDING.

The horticultural history of West Virginia, as well as of Berkeley County, probably dates back to March 18, 1774 when George Washington leased to one William Bartlett, 125 acres of land in the "Barrens of Bullskin," a part of the present Berkeley County. It was stipulated in this long-time lease that the leasee should within seven years plant one hundred winter apple trees, forty feet apart each way, and one hundred peach trees and should keep them well pruned and fenced in from the animals. While there were probablby

AUTHOR'S ACKNOWLEDGEMENTS.—The necessity for an orchard survey in the Eastern Panhandle of West Virginia and the value of such a publication to the State and country as a whole was first pointed out by Professor W. H. Alderman, Horticulturist. His many valuable suggestions and help in outlining the work have added materially to the value of this bulletin.

I wish to thank the four hundred or more fruit growers, who so willingly gave the data concerning their orchards and who did all in their power to aid with the work. I might mention particularly the help and valuable suggestions given by Chas. Thatcher, H. L. Smith, I. W. Wood and many others, but to give a complete list would mean to name all the growers, so acknowledgement is here made to the fruit growers of Berkeley County.

smaller orchards before this time, it is doubtful if any had been attempted as large as the one contracted for by Washington. It is a tribute to him that he recognized at this early date the suitability of Berkeley County for fruit growing.

Although we see that there were probably many small orchards at an early date, it was not until 1851 that the first real commercial orchard was planted in Berkeley County. In that year W. S. Miller, a farmer near Gerrardstown, against the advice of freinds and neighbors, planted sixteen acres of apples, peaches and plums. The beginning of the Civil War

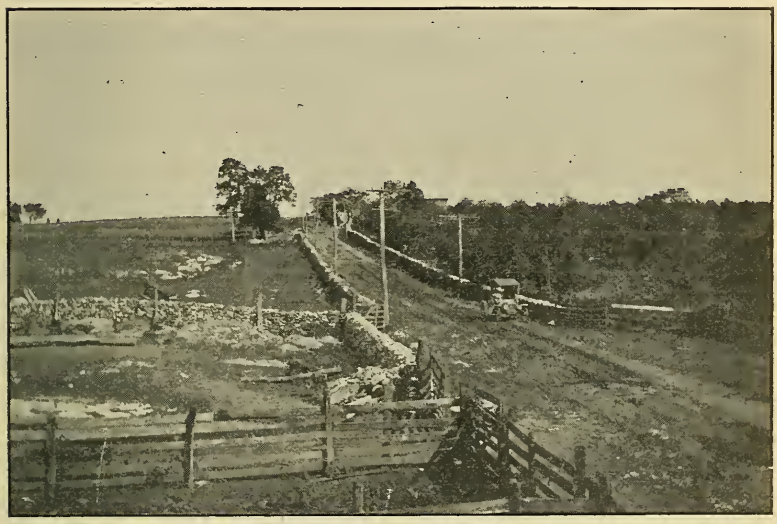


FIG. 1—A typical Berkeley County scene. Note the rolling type of land and the outcrops of limestone at the left.

found Mr. Miller with a large number of nursery trees, which he had grown himself and for which there was now no market. Accordingly the trees were planted on his own farm, which increased his plantings considerably, and at the close of the war his orchards included four thousand bearing peach trees. It is also worthy of note that Mr. Miller's farm was a part of the now famous, "Apple Pie Ridge." Since his trees did so well and returned such a profit, it was not long before many of his neighbors also began to plant extensively.

Commercial orchard planting in Berkeley County thus dates back to the Civil War period, although there were many earlier home orchards that yielded fruits for the soldiers in the Civil War. Many of these trees are still standing. As time went on, Mr. Miller increased his planting operations until

finally he had matured on his own farm four thousand apple and twenty-five thousand peach trees, besides large numbers of plum, pear, quince and cherry. Mr. Miller left a family of eleven children. Six sons and two daughters of this family are now engaged in successful fruit growing—in fact the orchard interests of this family are probably larger than those of any other family in the world.

From these early holdings by Mr. Miller the industry in Berkeley County has increased from year to year until it now includes 11,813 acres of orchard consisting of 583,657 trees.

THE FIELD WORK OF THE SURVEY.

The data for this survey was secured during the summers of 1912 and 1913. The author did the field work from

ORCHARD SURVEY
West Virginia Agricultural Experiment Station

Fruit _____ Project No. _____ Survey No. _____
Date _____ 191--

County _____ Location of Orchard _____
Owner _____ P. O. _____
Tenant, if any _____ Operated by owner, tenant for _____ years
Age Trees _____ No. Trees _____ Acreage _____
Elevation _____ Exposure _____ Planting plan _____
Soil type _____ Drainage _____
Soil Management, Sod; Pasture, Cut for hay, Cut for mulch; Times cut _____ Condition _____
Cultivated, When plowed _____ Times harrowed _____ Cultivation ceases _____ Condition _____
Sod and Cultivation; Years in sod _____ Years cultivated _____ Condition _____
Cover crops, Kind _____ Amount seed per acre _____
When planted _____ Condition _____
Fertilizers, Kind _____ Times applied _____
Amount per acre _____ Frequency _____
Pruning, Heavy, Moderate, Light, Winter, Spring, Summer; Method _____
_____ Frequency _____ Character _____
Fungous troubles _____ Insects _____
Spraying, During last 10 years _____
Present practice; Number applications and material, Dormant _____ Summer _____
_____ Outfit _____
Amount of spray per application; Dormant _____ Summer _____ Time required; Dormant _____ Summer _____
Varieties _____
Variety notes _____

	1907			1908			1909			1910			1911			1912		
	1st Bbl	2nd Bbl	Culls Cwt	1st Bbl.	2nd Bbl.	Culls. Cwt.	1st Bbl.	2nd Bbl	Culls Cwt.	1st Bbl.	2nd Bbl.	Culls Cwt	1st Bbl.	2nd Bbl.	Culls Cwt	1st Bbl.	2nd Bbl.	Culls Cwt.
Yield																		
Price																		

No. Pickers used in 1911 _____ Time employed _____ Price per day, bbl. _____ No. Packers _____
Time employed _____ Price per day, bbl. _____ Cost of bbls., boxes _____ Cost hauling _____
Cost storage _____ How sold _____
Remarks _____ Observer _____

FIG. 2—Sample of Survey blank used.

July 22 to August 10 in 1912 and was assisted by Mr. R. R. Jeffries, Assistant Horticulturist of this Station from June 11 to July 24, 1913 when the work was completed. Every orchard in the county, of five acres or more in area, was visited

and the information desired was obtained from the owners. The character of the questions asked and the data obtained can be seen by referring to the sample survey blank, (Fig. 2).

It often happened that the same man owned several different orchards either on his home farm or in different sections of the county. Since these orchards all varied as to size, age, cultural methods, etc., a separate blank was used for each orchard and it was considered as a separate orchard, although owned by the same man. In this way. the survey shows many more orchards than owners, and in some of the following tables the owners may be the unit while in others it may be the orchard, according to which unit presents the results most accurately. In orchards under five acres in size records were made of acreage, age, number of trees, cultural methods etc., but the different management problems and yields were not considered, since most of the orchards were either too young or else old and neglected and had ceased to be commercial propositions. In a very few instances some data was obtained by letter.

The Accuracy of the Reports. Since practically all of the data was secured from the owners themselves, many of whom kept an accurate set of books which were kindly opened for inspection, and since these figures and answers were checked up by a visit to all of the orchards, the results and conclusions drawn in this bulletin should be reliable.

Character of Orchards Used in the Records. All orchards above five acres and those set out prior to 1903 were used in making up most of the following tables. Although most of the trees bear at eight and nine years of age it was thought best not to use younger than ten-year-old orchards in this work wherever yields and incomes were figured, as there could then be no doubt that the figures would be from bearing orchards.

THE APPLE INDUSTRY OF THE UNITED STATES.

The outlook for orcharding. The one question which seems always to have puzzled the minds of prospective fruit growers is identical with the one which the pessimist on this subject makes strong use of in his arguments against fruit raising; namely, "Is there not already an overproduction of apples?" Instead of theorizing on this subject and continuing to give "our own opinions," let us consult the actual statistics.

TABLE I.—*Comparison of population figures, in the United States, by decades.*

Year	Population of the U. S.	Increase over preceding Years' Number	Per cent	Adjusted per cent of Increase*
1870	38,558,371	7,115,050	22.6	22.6
1880	50,155,783	11,597,412	30.1	26.0
1890	62,947,714	12,791,931	25.5	24.9
1900	75,994,575	13,046,861	20.7	20.7
1910	91,972,266	15,977,691	21.	21.

*In 1870 there was a deficiency in the enumeration of the population in the Southern States, which resulted in an overstatement in 1880. In 1890 the Indians were enumerated for the first time in the United States census, thus is order to make allowances for these occurences and in order to make the figures comparable, the percentages were given their proper adjustments for these years.

Table I shows the population of the United States, not including its possessions, as enumerated at each census from 1870 to 1910, inclusive, together with the percentage of increase during each decade, also the adjusted percentage* of increase.

TABLE II.—*Table showing the commercial production of apples in bbls. in the United States yearly from 1889 to 1914*.*

Years	Yield in Barrels	Five Year Average Yields	Population in the United States
1889	47,701,666		
1890	26,714,000		62,947,714
1891	66,302,333		
1892	40,178,666		
1893	38,257,666	43,830,866	
1894	44,882,666		
1895	73,200,000		69,471,144
1896	77,533,333		71,000,000 Approx.
1897	54,576,000		
1898	37,353,666	57,509,133	
1[illegible]	58,465,666		
[illegible]	68,643,333		75,994,575
1	45,166,666		
02	70,776,666		
03	65,226,666	61,655,799	
904	77,876,666		
1905	45,406,666		
1906	72,240,000		
1907	39,853,333		
1908	49,646,666	57,004,666	
1909	48,707,333		
1910	47,213,333		91,972,266
1911	71,340,000		
1912	78,406,666		
1913	48,470,000	58,827,666	
1914	84,387,666		99,300,000 Approx.

*The above records were obtained through the courtesy of the United States Department of Agriculture, Bureau of Crop Estimates. The yields for the years 1889, 1899 and 1909 are from the United States Census, while those for the other years are the yearly estimates of the Bureau. Each year the Bureau has estimated in percentage the apple crop of the United States. These percentage estimates have been published in the Crop Reports and The Agricultural Outlook. The above yields are the interpretation in barrels of these percentage estimates by the Bureau. the Census figures being used as a basis. The Census records were given in bushels but these figures were changed to read in barrels in above table, three bushels being considered equal to one barrel. The yearly estimates exclude Floridia, North Dakota and Louisiana, which had 40,333, barrels in the Census year 1889, 24,000 barrels in 1899 and 13,666 barrels in 1909, which were included in the totals for these years. It can be seen that the total production from these states, would not materially change the above yearly figures.

From a study of Table I it can be seen that the population of the United States has increased approximately one-fourth during each of the two decades from 1870 to 1890 and one-fifth during the two decades from 1890 to 1910.

From a study of Table II it can be seen that the production of apples in the United States has been fluctuating more or less from 1890 up to the present time. There seems to have been no uniform increase or decrease. The large crop years are found in 1895, 1896, 1900, 1902, 1904, 1906, 1911, 1912, and 1914. It can be seen that the recent large crops have been practically no larger than those found in the years 1895 and 1896, except the unusually large crop of the past year, which was the largest in history. During the off years the crop has generally been light. From 1907 to 1911, the production did not reach fifty million barrels in any one year.

Probably a fairer and more accurate method of studying these figures would be to study the average production in barrels in the United States over five year periods. These figures are also shown in Table II. It can at once be seen that during the five year periods from 1894 to 1913, (twenty years) the average production has been approximately the same, in fact the average production between the five years, 1899 to 1903, was a little larger than during any other five year period up to the present time.

Thus a comparison of Tables I and II shows that while there has been a steady increase in the population of the United States during the past twenty years, that the apple production has not increased in proportion, but has just about held its own.

Taking the last decade, that from 1900 to 1910, we see from Table I that the population has increased 21%. On the other hand a study of Table II reveals the fact that the ten year average production of apples, from 1900 to 1910, has increased only .5% over the ten year average production from 1890 to 1900. Looking at these results from a different viewpoint—that of production per capita, we find that in 1896, the production per capita in the United States was 3.27 bushels; in 1900 it amount to 2.71 bushels, while in 1910 it fell to 1.54 bushels. Although the crop of 1914 was the largest that we have ever had, there is still to be considered the fact that the population has increased approximately 27,300,000* since 1896. As a result even with the extraordinary large crop the production per capita last year was only 2.55 bushels which is still below that of 1896 and 1900.

*The increase for the last four years is figured to be the same yearly as during the preceding ten years.

Some probable reasons, why the production has not increased considerably over former years, are:

1. That large numbers of bearing apple trees are dying yearly. It is not an uncommon sight to see an old orchard of from three to five acres slowly dying and being removed here and there. When all such orchards aver the United States are added together the result is often unbelievable. The census figures of 1910 show that there were approximately fifty million less bearing apple trees than in 1900. The recent great plantings are known by nearly everyone, but the steady dying off of the old trees is little considered.

2. That inexperienced men, such as lawyers, clergymen, bankers, etc. are trying to grow fruit.

3. That the wrong methods of culture, spraying, etc. are being used in many cases.

4. That many orchards are being neglected and the scale and insects are coming in and taking possession.

5. That a great many orchards have been and are being set out on very poor and unfavorable sites, and as a result a great majority of them will never be a factor in fruit production.

Thus, as to the outlook for fruit growing the actual figures show that there has been neither a steady increase nor decrease in apple production in the United States during the past twenty years, but that the average production over five year periods has been practically the same. In the meantime the population has been increasing steadily, so that at the present time there would be less fruit produced per capita than formerly even with a considerably increased production. It seems that with the much better methods of grading packing and marketing our fruit than those which we have had in the past, together with the increasing export trade and the increase in population, that the industry should be a safe and profitable one, even if the total production should increase somewhat in the coming years. It is a fact that the average price per barrel of apples has been higher on the eastern markets during the last ten years than the previous ten.* The right man in the right place, who uses correct methods of growing and marketing his product has seemingly little to fear from the question of over-production of apples.

*Knapp, H. B. Cornell Univ. Agr'l. Expt. Sta. Cir. 22.

The Importance of the Apple Industry in the United States and West Virginia.

According to the 1910 census, the value of all orchard fruits in the United States was $140,867,000, which was 2.6% of the total value of all farm crops produced. This value is 68.2% greater than it was in 1899. Apples are by far the most important of these fruits. Their value in 1909 being 59.1% of the above fruit valuation. Some idea of the size of this industry in the United States is given in the following tables:

FIG. 3—A peach orchard on the red shale land in the Back Creek Valley. Note the thrifty appearance of the trees.

TABLE III.—*Relative rank in apple production, in 1909, of the fifteen leading fruit producing states. From the census of 1910.*

State	Yield in Bushels	Rank
United States	147,522,318	
New York	25,409,324	1
Michigan	12,332,296	2
Pennsylvania	11,048,430	3
Missouri	9,968,977	4
Kentucky	7,368 449	5
Iowa	6,746,668	6
California	6,335,073	7
Virginia	6,103,941	8
North Carolina	4,775,693	9
Ohio	4,663,752	10
Tennessee	4,640,444	11
West Virginia	*4,225,163*	*12*
Maine	3,636,181	13
Colorado	3,559,094	14
Nebraska	3,321,073	15

TABLE IV.—*Relative rank in value of apple crop. in 1909. of fifteen leading states. From census of 1910.*

State	Value of Crop	Rank
United States	$83,231,492	
New York	13,343,028	1
Michigan	5,969,080	2
Pennsylvania	5,557,616	3
Missouri	4,885,544	4
Iowa	3,550,729	5
Colorado	3,405,442	6
Virginia	3,129,832	7
Kentucky	3,066,776	8
Ohio	2,970,851	9
Washington	2,925,761	10
California	2,901,662	11
West Virginia	*2,461,074*	*12*
Tennessee	2,172,475	13
Maine	2,121,816	14
Illinois	2,111,866	15

TABLE V.—*Relative rank in total number of bearing apple trees. in 1910. of the fifteen leading states. From census of 1910.*

State	Number of Bearing Apple Trees	Rank
United States	151,322,840	
Missouri	14,359,673	1
New York	11,248,203	2
Illinois	9,900,627	3
Ohio	8,504,886	4
Pennsylvania	8,000,456	5
Arkansas	7,650,103	6
Michigan	7,534,343	7
Virginia	7,004,548	8
Kansas	6,929,673	9
Iowa	5,847,034	10
Indiana	5,764 821	11
Kentucky	5,538,267	12
North Carolina	4,910.171	13
Tennessee	4,838,922	14
West Virginia	*4,570,948*	*15*

TABLE VI.—*Relative rank of fifteen leading states according to total number of apple trees (bearing and non-bearing). in 1910. From census of 1910.*

State	Number of Trees Bearing and Non-Bearing	Rank
United States	217,114,688	
Missouri	17,984,506	1
New York	14,076,716	2
Illinois	12,448,928	3
Arkansas	11,590,192	4
Ohio	10,943,132	5
Pennsylvania	10,501,641	6
Virginia	10,440,139	7
Michigan	9,787,415	8
Kansas	8,045,989	9
Washington	7,872,039	10
Iowa	7,761,359	11
Indiana	7,726,795	12
Kentucky	7,644,564	13
West Virginia	*7,342,973*	*14*
Tennessee	6,956,168	15

A study of the above tables will no doubt surprise many. We find that West Virginia not only ranks well in one table, but holds a fairly uniform rank in all of them. Thus in comparison with other states West Virginia ranks twelfth in production, twelfth in total value of her crop, fifteenth in total number of bearing apple trees, and fourteenth in total number of (bearing and non-bearing) apple trees. A recent estimate in Farmers' Bulletin 645 shows that West Virginia was eighth in total apple production in 1914.

FIG. 4—One of the many young apple orchards in Berkeley County.

These figures themselves show the importance of this industry in West Virginia and the prominence of the state as an apple producer. There is no doubt but that the middle southern Atlantic states are an important factor in the apple industry of the United States.

THE STATUS OF THE APPLE INDUSTRY IN WEST VIRGINIA.

The total value of all orchard fruits in West Virginia according to the 1910 census is $3,040,192. This is approximately seven and one-half per cent of the total value of all farm crops produced in the state. The following table gives a summary of the production of orchard fruits in West Virginia with their corresponding values and number of bearing and non-bearing trees.

TABLE VII.—*Production of orchard fruits in West Virginia during 1899 and 1909. together with the value of each and the number of bearing and non-bearing trees.*

Crop	Trees of Bearing Ages 1910	Trees not of Bearing Age 1910	PRODUCTS		
			Quan. in Bushels 1909	Value in Dollars	Quan. in Bushels 1899
Orchard Fruit, Total	6.770,384	4,589,587	4,709,959	3,040,192	7,642,193
Apples	4,570,948	2,772,025	4,225,163	2,461,074	7,495,743
Peaches & Nectarines	1,424,582	1,441,188	328,901	368,584	18,100
Pears	154,908	102,826	29,916	32,101	19,475
Plums and Prunes	234,859	125,079	32,948	48,522	19,123
Cherries	332,429	124,567	79,723	111,043	87,828
Apricots	1,947	1,201	124	185	145
Quinces	50,708	22,702	13,163	18,676	
Mulberries	3		21	7	
Unclassified					1,779

From a study of Table VII we see that with a production of 4,225,163 bushels valued at $2,461,074, the apple is the most important of West Virginia's orchard fruits. In fact, the figures show that in 1909 apples constituted approximately 90% of the total production of fruits and that their value in

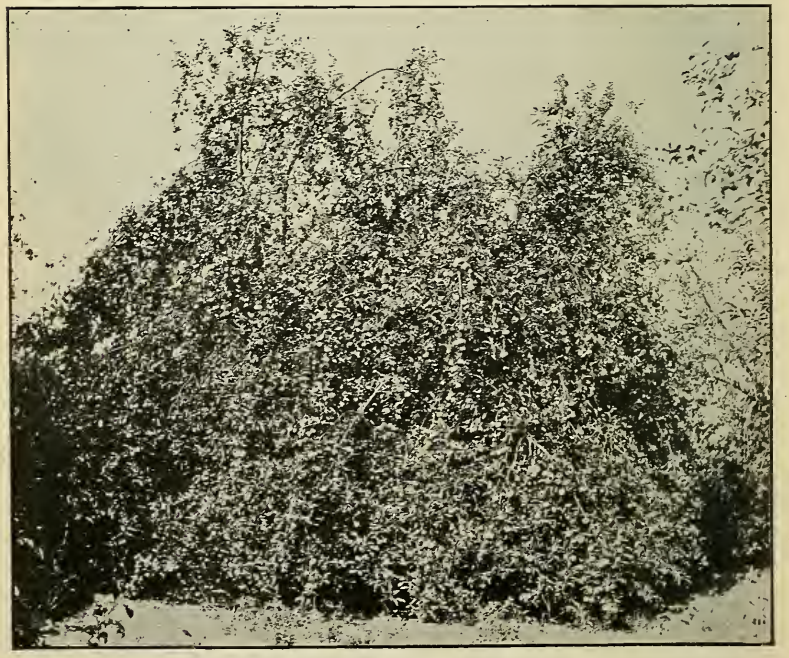


FIG. 5—One of the trees which helped produce 600 barrels per acre one year. Note the spreading low type.

West Virginia was approximately 81% of the total. Peaches and nectarines together were next in importance. A large number of peach trees have recently been set in the mountainous sections of the state, Mineral, Grant, Hardy, and Hampshire being among those counties to plant the heaviest. When these come into bearing, the above percentages will probably be changed to quite an extent. In fact the report of the past year (1914) shows that the peach industry has already become an important one in the state. 1,164 carloads were shipped out of the Eastern Panhandle in 1914 as compared to 176 carloads in 1909. Thus it is safe to say that the apple will not constitute so large a percentage of the crop in West Virginia in the next census report.

Increase in Plantings.

It is also interesting to note that West Virginia is increasing her plantings in this fruit rapidly. Many states are planting very heavily. Some of them (Washington, Oregon, Minnesota, North Dakota, South Dakota, Louisiana, Montana, Idaho, Wyoming, Colorado, New Mexico and Utah) having more non-bearing trees than bearing according to the 1910 census. West Virginia has nearly twice as many bearing trees as non-bearing but stands high, in comparison to the other states, in total number of non-bearing trees as shown by the following table:

TABLE VIII.—*Table showing the relative rank of the twenty leading states, as regards the number of non-bearing apple trees. Census of 1910.*

State	Number of Non-Bearing Apple Trees	Rank
United States	65,791,848	
Washington	4,862,702	1
Arkansas	3,940,089	2
Missouri	3,624,833	3
Virginia	3,435,591	4
New York	2,828,515	5
West Virginia	*2,772,025*	*6*
Illinois	2,548,301	7
Pennsylvania	2,501,185	8
Ohio	2,438,246	9
Michigan	2,253,072	10
Oregon	2,240,636	11
Tennessee	2,117,246	12
Kentucky	2,106,297	13
Oklahoma	2,060,384	14
Colorado	1,972,914	15
Indiana	1,961,914	16
Iowa	1,914,325	17
North Carolina	1,835,337	18
Minnesota	1,571,816	19
Idaho	1,539,896	20

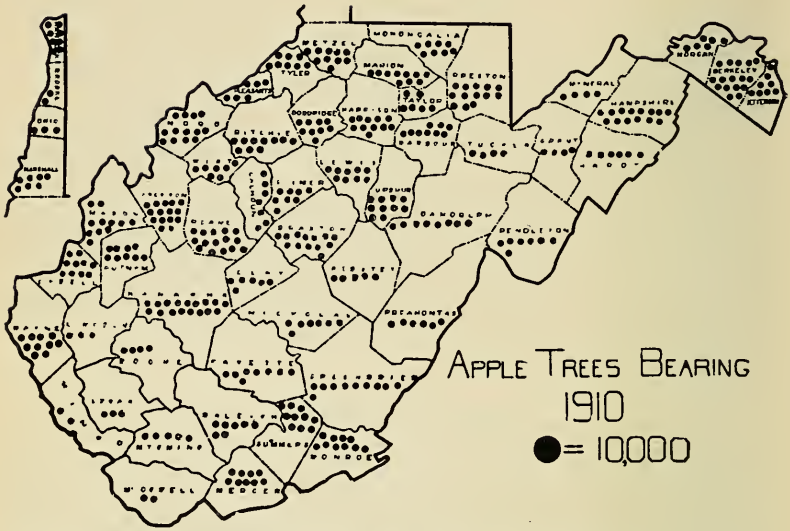


FIG. 6—Distribution of bearing apple trees in West Virginia in 1910. Note that they are scattered rather uniformly over the state.

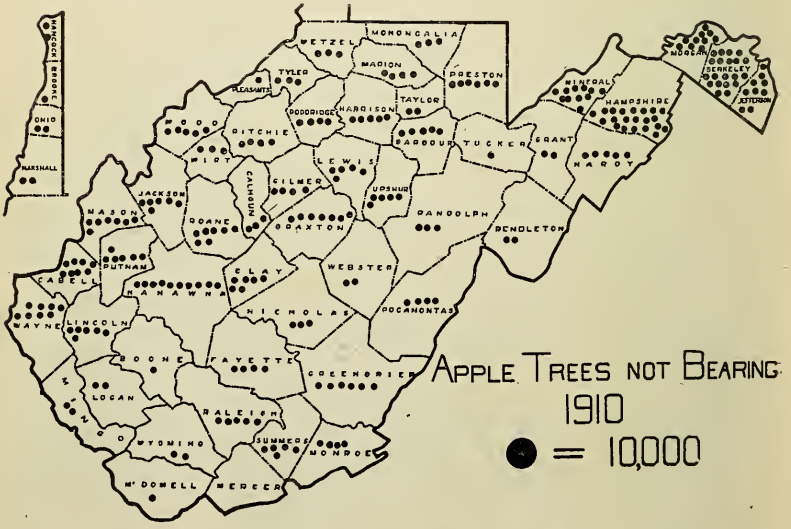


FIG. 7—Distribution of non-bearing apple trees in West Virginia in 1910. Note that the recent plantings are most numerous in the Eastern Panhandle.

Since Table VIII is for non-bearing trees only, and not the total number of trees, we can not draw many safe conclusions from it as regards the future producing power of the state. For instance there are probably many states with a greater total of trees than those among the first six mentioned and which would thus rank higher in total production. However, the above table gives some idea of where the greatest plantings are being made. (Figs. 6 and 7 show where the heaviest plantings are being made in West Virginia.) This shows that West Virginia ranks sixth in total number of non-bearing trees. Thus if her plantings are kept at the same rate for a few years, she will soon be a considerable factor in apple production. It will be noticed that the middle southern states, (Virginia, West Virginia, Kentucky, North Carolina and Tennessee) are all in this list.

Yields in West Virginia Counties.

Knowing something of West Virginia's rank as to production, number of trees, etc. in comparison to the other states and that the apple constitutes a large percentage of her orchard fruits, let us make a closer study of this industry within the state.

TABLE IX.—*The relative rank in apple production of the ten leading apple producing counties in West Virginia.. Taken from the 1900 census and abstract of census for 1910.*

County	Number Trees Bearing, 1899	Bushels Produced	Number Trees Bearing, 1909	Bushels Produced	Rank in 1909
Berkeley	180,496	211,892	166,118	246,508	1
Kanawha	215,799	190,886	173,125	235,963	2
Braxton	152,751	383,694	128,679	184,081	3
Raleigh	97,139	214,517	73,390	165,802	4
Lincoln	94,177	59,338	90,210	160,964	5
Roane	150,776	118,591	146,017	153,601	6
Jefferson	106,702	120,716	77,537	143,129	7
Harrison	172,256	314,207	110,474	142,364	8
Wayne	131,755	115,942	104,069	141,284	9
Barbour	109,674	345,631	96,390	127,205	10

A study of the above table shows Berkeley County, of the Eastern Panhandle, to be the largest apple producing county of the state. It can be seen that a few years ago, before so many of the young trees had come into bearing, other counties surpassed it. However, the total production of the county has been increasing rapidly and the past year (1914) approximately 750,000 bushels of apples were produced, as compared to the 246,508 bushels which were enough to give it first rank in 1909. It is the industry of this county that has

been studied carefully. Facts concerning the methods of orchard management with the yields, incomes and costs of such management are found in the following pages.

NUMBERS OF ACRES AND TREES OF THE DIFFERENT FRUITS IN BERKELEY COUNTY.

According to the 1910 census Berkeley County comprises 325 square miles or 208,000 acres, 116,914 acres of which are in improved farm lands. Results of this survey show that there are 583,657 apple trees growing on 11,813 acres of land in the county. This means that there are 36.3 acres of apples per square mile in the county and that 10.1% of the farm land is planted in apple orchards.

TABLE X.—*Number of acres and age of trees in the county in apple orchards of five acres or more.*

	AGE OF TREES			
	1 to 7 Years Non-Bearing	8 to 20 Years Bearing	21 Years and Over, Bearing	Total Acres and Trees (All Ages)
Number of acres.....	6,185	4,623.6	396	11,204.6
Number of trees.....	337,796	207,567	14,700	560,063

TABLE XI.—*Number of acres and age of trees in the county in apple orchards less than five acres in size.*

	AGE OF TREES			
	1 to 7 Years Non-Bearing	8 to 20 Years Bearing	21 Years and Over, Bearing	Total Acres and Trees (All Ages)
Number of acres.....	191.5	210.7	206.2	608.4
Number of trees.....	6,919	8,796	7,879	23,594

TABLE XII.—*Number of acres and age of trees of all the apple orchards from one-half acre and up.*

	AGE OF TREES			
	1 to 7 Years Non-Bearing	8 to 20 Years Bearing	21 Years and Over, Bearing	Total Acres and Trees (All Ages)
Number of acres.....	6,376.5	4,834.3	602.2	11,813
Number of trees.....	344,715	216,363	22,579	583,657

As stated previously, data as to yields, incomes and the like was secured only on the commercial orchards of five acres or more, however a record of all home orchards from one-half acre up to five acres was obtained and tabulated. Since many of the apple orchards bear some fruit in their eighth and ninth years, all acres and trees below 8 years old were put in one class and called non-bearing, while those above 8 years old were considered bearing. Table X gives the total number of acres and the number of trees, of bearing and non-

bearing ages, of all orchards above five acres in size, while Table XI gives the same classification for orchards below five acres in size. In Table XII both of the above tables are combined into one in order to show the total number of acres and trees in the county. A study of Table X reveals the fact that in the commercial orchards there are very few trees above 20 years old. It also shows that there are more acres and trees of non-bearing age than of bearing age—in fact 60% of the trees are not yet bearing in the commercial orchards. Table XI (home orchards) shows about the same number of acres and trees of the different ages, which is about what we should expect when trees are set out for home use. In this group only about 31 acres are over 35 years old and the total acreage in the group is only a small part of the total acreage in the county. In studying Table XII we find that the total acreage of apples in the county is 11,813 while the total number of trees is 583,657. This table shows likewise that there is a comparatively small acreage of apples over 20 years old and that the apple industry is a comparatively young one. It shows also that there are fewer acres and trees of bearing age than non-bearing, there being 238,942 bearing trees on 5436.5 acres as compared to 344,715 non-bearing trees on 6376.5 acres.

TABLE XIII.—*Summary and classification of all fruits in the county.*

Fruit Classification	Number of Acres	Number of Trees
Total apples (all ages)	11,813	583,657
Total non-bearing apples	6,376.5	344,715
Total bearing apples	5,436.5	238,942
Total non-bearing peaches		120,719
Total bearing peaches		27,929
Total pears (all ages)	288	18,623
Total plums (all ages)	30	6,250
Total cherries (all ages)	6	290

Table XIII gives the number of acres and trees of all fruits grown commercially in Berkeley County, according to figures of this survey. It can be seen that at the present time the apple is by far the most important fruit. A few years ago, the peach industry was an important one in the county, but peach yellows played havoc with the orchards and for a time scarcely any peaches were planted. Many peach fillers were also removed to avoid crowding the apples. It is interesting to note (Table XIII) that peaches are being planted again. The figures show that there are now about four and one-half times as many non-bearing peach trees as bearing. Another interesting point noticed in Table XIV is the fact that more than two-thirds of the non-bearing peach trees are found in the country back of North Mountain. However, most of the

bearing trees are found on the east side of the mountain. This means that the bulk of the Berkeley County peach crop in the future will be produced back of the mountain. Probably the largest per cent of the crop will be shipped from the Baltimore & Ohio station at North Mountain. Pears, plums and cherries are not of very much commercial importance. The plum growers claim that the crop is lost by frosts so often that it does not pay to grow this fruit commercially. It happens that all of the plum orchards are on the lower lands and it is doubtful if this same trouble would be experienced on the higher lands with northern exposures. To all appearances pears and cherries do well and it seems that more of these delicious and profitable fruits should be grown. The reason given for not planting more pears, is that the twig or fire blight can not be controlled. As a matter of fact, the growers are not using scientific methods in their attempts to control this disease. Authorities* claim that if the half-dead and cankered trees found along the fence rows are cut down and burned; if the wounds made in pruning, as well as the pruning tools are sterilized with corrosive sublimate, 1 part to 1000; and if the diseased blossoms, twigs and shoots are burned when removed, the blight can be satisfactorily combated. If then it is only the matter of fighting this one bacterial disease intelligently it would seem that more pears could be planted with profit.

Orchard Distribution in the County.

North Mountain extends across Berkeley County in a northeastern and southwestern direction a little to the west of the center of the county. About one-third of the total area of the county lies back of this mountain, between it and the Third Hill Mountain and is known locally as the Back Creek Valley. In recent years, many large company orchards have been planted in this valley, mostly along the western side of the North Mountain and the eastern side and foothills of the Third Mountain. It is in this section that most of the young peaches of the county are found. More than one-half of the total number of pear trees are, likewise, found in this region. In fact it is doubtful if the residents of the county themselves realize how much fruit is planted back of the mountain.

*Pickett, B. S.—Illinois Agr'l Expt. Sta. Cir. 172.
Whetzel and Stewart—Cornell Univ. Agr'l Expt. Sta. Bul. 272.

TABLE XIV.—*Summary of the acres and trees of the different fruits in Back Creek Valley.*

Fruit Classification	Number of Acres	Number of Trees
Apples (non-bearing)	2,284.5	91,427
Apples (bearing)	1,389.2	66,423
Total apples (all ages)	3,673.7	157,880
Peaches (non-bearing)		85,390
Peaches (bearing)		7,081
Pears (all ages)	185	10,455

By comparing the number of acres and trees in Tables XIII and XIV we see that very nearly one-third of the total acreage of apples in the county is found in the Back Creek Valley, likewise we see that nearly two-thirds of the total number of peach trees and over one-half of the pear acreage are found in this section. The greater part of these plantings are found in the Hedgesville district.

By far the thickest and heaviest plantings in the county are found about a mile east of the North Mountain on what is known as the Apple Pie Ridge. This ridge extends through the central part of the county parallel to the North Mountain and is about 75 feet higher than the valley between the ridge and the mountain. Orchards are planted on each side of this ridge as well as on its top and an almost unbroken chain of trees is found from Hedgesville to the southwestern border of the county which joins Frederick County, Virginia—a distance of about seventeen miles. (See map.)

The next heaviest plantings are found on the limestone area between the Apple Pie Ridge and the Cumberland Valley Railroad. These plantings extend across the county for about fifteen miles and the orchards are quite thick in many places.

The orchards in the northeastern and eastern parts of the county, that is, in the Falling Waters and Opequon districts are more scattered. Now and then some large orchards are found, but for the most part the orchards are smaller and fewer in these districts. Few orchards are found in the southeastern part of the county in the territory south and east of Martinsburg between the Baltimore & Ohio Railroad and the Jefferson County border.

Number of Acres, and Trees of Different Ages.

TABLE XV.—*Showing the plantings by years from 1863 to 1913.*

Date of Planting	Age of Trees	*No. of Orchards	Per Cent of Orchards	No. of Acres	Av. Size of Orchards Planted	Per Cent of Total Acreage
1913	1	26	6.1	1,327.5	51.6	11.8
1912	2	57	13.5	2,603.5	45.7	23.1
1911	3	19	4.5	599.	31.5	5.3
1910	4	8	1.9	114.	14.2	1.
1909	5	15	3.5	322.	21.5	2.8
1908	6	30	7.1	485.5	16.2	4.3
1907	7	28	6.6	728.5	26.	6.4
1906	8	28	6.6	589.	21.	5.2
1905	9	34	8.	653.	19.2	5.8
1904	10	25	5.9	861.	34.4	7.6
1903	11	13	3.	290.	22.3	2.5
1902	12	16	3.8	516.	36.	4.6
1901	13	14	3.3	209.5	14.9	1.8
1900	14	16	3.8	343.1	21.4	3.
1899	15	19	4.5	352.	18.5	3.1
1898	16	8	1.9	189.	23.6	1.6
1897	17	6	1.4	260.	43.3	2.3
1896	18	11	2.6	182.	16.5	1.6
1895	19	0	0	0	0	0
1894	20	16	3.8	182.	11.4	1.6
1893	21	1	.2	10.	10.	.09
1892	22	5	1.1	91.	18.2	.8
1891	23	1	.2	13.	13.	.1
1890	24	1	.2	19.	19.	.2
1889	25	6	1.4	88.	14.6	.7
1888	26	2	.5	11.	5.	.1
1887	27	0	0	0	0	0
1886	28	3	.7	47.	15.6	.42
1885	29	0	0	0	0	0
1884	30	5	1.1	42.	8.4	.37
1882	32	1	.2	4.	4.	.03
1879	35	3	.7	17.	5.6	.15
1877	37	1	.2	37.	37.	.33
1874	40	1	.2	8.	8.	.07
1863	50	2	.5	11.	5.5	.1

*The total number of orchards may vary in the different tables of the bulletin as the total acreage on one farm (orchards of different ages) is used as one orchard in some tables, while the separate orchards classified as to ages, exposures etc. may be used in other tables, thus apparently increasing the number of orchards. The exact number of commercial orchards in the county is 247.

Table XV, as well as the remaining tables in the bulletin, deals only with the orchards classified in Table X, that is, the commercial orchards of five acres or more. A close study of the table gives a fairly good idea of when the heaviest plantings were made in the county. Figures for last year (1914) are lacking, but it is safe to say that very few plantings were made. The greatest plantings were made in the years 1912 and 1913. During these two years one-third of the total acreage of the county was planted. A large amount of this acreage was set out by orchard companies, which were organized as a result of the large yields and attractive incomes received by the fruit growers during the years 1909, '10, and '11. As a matter of fact, in their eagerness to get into the orchard business, many companies overlooked the fact that a

good site for the orchard is an essential factor in successful fruit growing. A great deal of land, not particularly well suited for orchards, because of adverse soil conditions, distance from shipping points, etc., was planted. Naturally the company orchards were of large acreage and we find that many of the largest orchards were planted in these years. By glancing down the column headed the "per cent of total acreage," we can see how young the apple industry really is in Berkeley County. Fourty-four per cent of the acreage was planted between the years 1909 and 1913; 29.3% between the years 1904 and 1908 inclusive, and 20.9% between the years 1896 and 1903 inclusive. Thus in the last 18 years, between 1896 and 1913 inclusive, a little over 94% of the total acreage of the county has been planted.

The total acreage planted yearly before 1895 was not very large and fluctuated considerably, varying from 0 to 182 acres. Beginning with 1896 the plantings increased gradually each year until 1904. From that year to 1908, the acreage planted yearly was much larger. It then decreased slightly until the the years 1912 and 1913, when the heaviest plantings were made.

The oldest commercial orchards are 50 years old. There are two of these orchards, each about five acres in area. The oldest large commercial orchard found—37 acres in area—was 37 years old.

RELATION OF AGE TO YIELD AND INCOME.

TABLE XVI.—*Showing the yields and incomes derived from orchards of different ages.*

Age of Orchards	*Av. No. of Orchards Included	*Av. No. of Acres, Each Age	Yield per Acre (bbls.) 4 yr. av. 1909, '10, '11, '12	Gross Income per Acre, 4 yr. av. 1909, '10, '11, '12
8 to 10 years	30	908	10.6	$ 25.62
11 to 14 years	34	821	39.7	92.96
15 to 18 years	12	288	50.8	114.92
19 to 22 years	6	90	69.3	151.23
23 to 26 years	4	52	37.7	91.99
27 to 30 years	2	47	47.	103.30
31 to 34 years	1	5	30.	60.00

*The number of orchards and acreage given is the average used for each year in the group, thus the total number of orchards and acres used in the group 8 to 10 would be 90 and 2724 respectively. The same orchard is often found in different groups if records on its yield and income for those years were available. Thus there are not as many separate orchards and acres of a certain age as the table might indicate.

Orchards from 19 to 22 years old are giving the largest yields and incomes per acre. (In this table and the remaining tables, the gross income refers to sales of barreled apples, ex-

clusive of culls.) Orchards from 15 to 18 years are also giving satisfactory returns. It can be seen from the table that orchards in the Eastern Panhandle come into bearing at an early age and reach their period of greatest yield and income in about ten years or at about the age of 20 years. Jeffries† has found the same to hold true in Jefferson County. This fact is certainly well worth considering and is an advantageous one for the fruit growers in West Virginia. Apple growing is much more attractive when men realize that some returns can be obtained in from 8 to 10 years, and the fact that good returns can be expected in from 15 to 20 years will cause many more men to go into the business than if they thought it would be necessary to wait 15 to 20 years before any returns could be expected. A man past the prime of life can set an apple orchard not only with the hope that it will benefit his son some day, but that he himself will reap the harvest.

This is the bright side of the age question, but there is also a dark side to it at present. Not only can we assume from the table that the apple orchards begin to decline after they reach the age of 30 years, but many of the growers themselves think and say that after 25 to 30 years, the orchards begin to decline. This condition is certainly a serious one, since in many states, the apple orchards are just nicely getting started at that age and are ready to still return a good profit per acre for more than 30 years longer. Surveys* of different counties in New York State show the largest returns per acre from orchards of 40 to 55 years of age and many orchards older than these bear profitable crops.

Although it is probably a fact that the earlier bearing, faster growing varieties in West Virginia do reach maturity sooner and become unprofitable at an earlier age than trees of some of the other states, still there is no apparent reason why they should be allowed to decline as young as they now do. The soil is strong, there is plenty of rainfall, most of the trees are well fed (Tables XXX and XXXI), and therefore they should be more productive for a much longer period. There are very few old orchards (Table XV) of any size in the county and the fruit growers do not realize that the older orchards can be profitable. It seems to be a sort of accepted opinion among them that apple orchards after 30 years become unprofitable, so they look for this decline, put more of their time on the older crops, and naturally the orchards, with

†Jeffries, R. R.—W. Va. Agr'l. Expt. Sta. Bul. 147.
*Warren, G. F.—Cornell Univ. Agr'l. Expt. Sta. Bul. 226; page 311.
Warren, G. F.—Cornell Univ. Agr'l. Expt. Sta. Bul. 229; page 483.
Cummings, M. B.—Cornell Univ. Agr'l. Expt. Sta. Bul. 262; page 289.
Martin, H. M.—Cornell Univ. Agr'l. Expt. Sta. Bul. 307; page 183.

poorer care, do decline. It is a fact that the collar blight has been especially severe in some orchards causing many of the trees to die before the age of 30, and other orchards on poor soil and partly neglected have declined at an early age. However, if the growers would thin the fruit on the young trees and thus not allow them to weaken themeselves by overbearing; if they would continue to give the thirty-year-old orchards good care; would scientifically fight the collar blight*; and, above all, if they would assume the attitude that the orchard ought to bear profitably for many more years, it seems that more profitable returns could be obtained for a much longer period than at present. This will probably be found to be the case when more orchards become old. There are many small home orchards an acre or more in size, from 35 to 55 years old, that are still healthy and bearing good crops. One orchard about 40 years old, has a five year average yield of 64½ barrels per acre and a five year average income of $150.00 per acre. Why cannot more old orchards be as profitable?

THE SIZE OF ORCHARDS.

TABLE XVII.—*Distribution of commercial orchards according to size.*

Size of Orchards in Acres	Number of Orchards	Per Cent of Total Orchards
5 to 9	47	19.
10 to 19	61	24.6
20 to 29	35	14.1
30 to 39	24	9.7
40 to 49	18	7.2
50 to 59	7	2.8
60 to 69	9	3.6
70 to 79	7	2.8
80 to 89	6	2.4
90 to 109	6	2.4
110 to 129	7	2.8
130 to 149	3	1.2
150 to 169	5	2.
170 to 200	3	1.2
201 to 250	3	1.2
250 to 300	2	.8
300 to 400	1	.4
400 to 450	2	.8
450 to 500	1	.4

Table XVII classifies the orchards according to size†. A study of the table shows that the largest number of orchards are found to be from 10 to 19 acres in size. In fact, the orchard of 15 acres is the one most often found in Berkeley County. Forty-five per cent of the orchards are from 10 to 50 acres in size. However, this does not mean that there are not a great many orchards larger than 15 acres in size. The table shows several orchards in each of the groups from 50 to

*The total acreage that is under one management on one farm is considered as one orchard, even though of various ages.

†Giddings, N. J.—Report of W. Va. State Hort. Soc., 1913, pages 15 - 19.

150 acres; two or three orchards in each of the groups above this size; two orchards from 400 to 450 acres; and the largest orchard is 487 acres. As a result of these larger orchards, we find that when all the orchards in the county are averaged together the average orchard is 45 acres. Thus the typical orchard found is of 15 acres, while the average size of orchards is 45 acres.

The Relation of Size to Yield and Income. Since there are so few of the large orchards of bearing age, no definite conclusions can be drawn as to the influence of size on yields

FIG. 8—A young and an old orchard on Apple Pie Ridge. Note the partial method of cultivation.

and incomes. There may be a limit to the size of orchards which we should plant. In other words, there is the danger of having such a large acreage that it will not receive as good care as an orchard of smaller size. The question would then arise, "Would not just as large total returns be realized from a smaller acreage, handled better?" This is the question to be considered in Berkeley County before the large company orchards are planted.

Of course, some of the large orchards, which are being managed equally as well as the smaller ones, are returning

just as large yields and incomes per acre as the well cared for smaller orchards. One well cared for orchard of 110 acres yielded a three year average of 68.2 barrels and an income of $174.08 per acre, while another of 240 acres yielded a three year average of 74 barrels per acre and an income of $172.07 per acre. These orchards are both yielding as well as the better orchards of smaller size. However, these orchards are exceptional and from general observation it seems that in Berkeley County, due to less intensive methods, most of the very large orchards will not be as profitable per acre as the smaller ones which are operated in connection with general farming. The yields and incomes of a few large orchards as compared with those of smaller orchards are discussed in another connection under Table XXI. In this case, the large orchards are not as profitable per acre as the smaller ones of the same age.

Thus this survey indicated that there is a limit to the size of orchards, which should be planted and managed by one man or company. This size will of course be influenced by several factors such as the capability of the manager, care and thoroughness of the work done, and money available for operating expenses. It seems to be a fact that the largest orchards generally do not receive as intensive culture and general good care as the smaller ones and as a result not as large returns per acre are obtained. Many growers have more orchard than they can properly care for. The total returns would probably be just as large from a smaller acreage given proper attention. It is unfortunate that more of the large orchards are not bearing so that more results could be cited and conclusions drawn as to the approximate size of orchard beyond which it would not be profitable to plant unless considerable capital were available for operating expenses. This will be an interesting point to study in the future.

DISTRIBUTION OF TOTAL NUMBER OF ORCHARDS AND ACRES, AS TO SLOPE OR EXPOSURE.

TABLE XVIII. *Orchards classified as to exposure.*

Slope or Exposure	Number of Orchards	Per Cent of Orchards	Number of Acres	Per Cent of Acres
East	167	38.3	4,242.6	37.8
West	70	16.1	1,713.5	15.3
E. & W. ridge	47	10.8	1,438.	12.8
N. & S. ridge	5	1.1	56.	.05
Southwest	7	1.6	97.5	0.8
South	4	.9	192.	1.6
All	6	1.3	124.	1.1
Southeast	29	6.6	485.5	4.3
North	10	2.3	171.	1.5
Northeast	17	3.9	209.5	1.8
Northwest	16	3.6	271.	2.4
Level	57	13.1	2,204.	19.6

Table XVIII classifies the orchards as to exposure or the direction in which they slope. As can be seen by the table, there are orchards of almost every slope, in Berkeley County, although the greater part of the county is not hilly or steep enough to make the exposure of much importance. While the largest percentage of orchards have an eastern slope, it is not a very decided slope in many cases. In some orchards however, as those planted along the eastern foothills of the Third Hill Mountain, the slope is decided. There are about half as many orchards with a western slope as with an eastern one. Many of the orchards on the Apple Pie Ridge extend down on each side of the ridge and thus have both exposures and are classified under the East and West Ridge group. Thirteen and one-tenth per cent of the orchards comprising 19.6% of the acres are level. Thus in Berkeley County the apple orchards have been planted on the best soils regardless of exposure. It is generally accepted, however, that those orchards with eastern or southeastern slopes generally produce the highest colored fruits. This probably comes from the fact that they get the direct rays from the sun earlier and during a longer period of the day. In sections where the prevailing western winds are strong, the eastern slopes are then to be preferred, not only because the young tree will grow straighter, but because the danger of losing the crop through high winds will be lessened. Since most of the orchards with western, northwestern and southwestern exposures in Berkeley County are along Apple Pie Ridge, the North Mountain nearby, prevents any very high west winds and thus the above disadvantages of these exposures are not met with in Berkeley County. The three year average yields of orchards with western, eastern, southeastern, northeastern or northwestern exposures, as well as those orchards with level sites, do not vary enough (4.6 bbls.) to be considered. Of course, in the case of peaches and plums which are often damaged by spring frosts, it would be well to plant these fruits on northern or northeastern exposures in order to retard the bloom somewhat in those regions where early frosts are common. In all cases the orchards should be planted at as high an elevation as possible, in order to escape killing frosts which are so common in the lower sections. In Berkeley County, the different elevations would not vary enough to cause a difference in the choice of varieties.

DISTRIBUTION OF ORCHARDS AS TO PLANTING PLANS.

TABLE XIX.—*Number of orchards and acres set at different distances.*

Plan	Distance apart in feet	Number of Orchards	Per Cent of Orchards	Number of Acres	Per Cent of Acres
Square	18 x 18	2	.5	15.	.13
	20 x 20	5	1.2	162.	1.14
	25 x 25	9	2.1	202.	1.79
	28 x 28	4	1.	28.5	.25
	30 x 30	139	33.2	3,034.6	27.
	32 x 32	6	1.4	91.	.80
	33 x 33	56	13.4	998.5	8.88
	34 x 34	1	.2	17.	.15
	35 x 35	30	7.2	414.	3.48
	36 x 36	55	14.1	2,126.	18.93
	38 x 38	1	2.	20.	.18
	40 x 40	26	6.2	671.	5.97
Tl. Square System...		334	80.5	7,779.6	68.70
Rectangular	15 x 25	1	.2	7.	.06
	17 x 30	2	.5	31.	.28
	18 x 36	2	.5	140.5	1.25
	18 x 40	1	.2	30.	.27
	20 x 25	3	.7	63.	.56
	20 x 30	16	3.1	777.5	6.91
	20 x 35	2	.5	197.	1.75
	24 x 30	5	1.2	88.	.78
	30 x 33	1	.2	7.	.06
	30 x 35	10	2.4	413.5	3.68
	30 x 40	10	2.4	198.	1.76
	33 x 36	1	.2	24.	.21
	35 x 38	4	1.	83.5	.75
	35 x 40	5	1.2	76.	.69
	36 x 40	12	2.9	460.	4.09
	40 x 45	1	.2	14.	.12
Tl. Rectangular System		76	17.4	2,610.	23.3
Quincunx	35 x 35	4	.9	423.	3.7
	36 x 36	1	.2	25.	.22
	40 x 40	3	.7	225.	2.
Tl. Quincunx System		8	1.8	673.	5.92
Hexagonal	20 x 30	1	.2	142.	1.26

Eighty per cent of the orchards in Berkeley County are planted on the square system, 18.1% on the rectangular system, 1.8% on the quincunx system and .2% on the hexagonal system. Thus it can be seen that the square system is the one preferred by orchardists. In this system the largest number of orchards are planted 30 x 30 feet, although many of them are found 33 x 33, 35 x 35 and 36 x 36 feet. Many of the earlier orchards were planted 30 x 30 feet but the present tendency is to increase this distance to 36 x 36 feet, as the older orchards planted 30 x 30 feet are found to be a little too close. No doubt the returns will be just as large if not larger where the trees are planted 36 x 36 feet, as each tree will then have more soil to feed from and the danger from crowding will be lessened. In this state where the trees do not grow as large as in some other states, this distance seems to be about right.

Orchards should never be planted less than 30 x 30 feet or some of the trees will have to be cut out to avoid crowding when they reach bearing age. Some orchardists are now planting 40 x 40 feet. As can be seen from the table many varied and different distances are used. Very few orchards were set by the quincunx system (4 trees at the corners of a square and one in the center) and only one by the hexagonal method.

Varieties.

The varieties of apples first planted in Berkeley County and now found in nearly all of the orchards twelve years or more of age, are the Ben Davis, York Imperial, Grimes, and Arkansas (Mammoth Black Twig). At the present time the bulk of the crop is composed of the above varieties with the Ben Davis and York Imperial leading. However in the last few years the choice of varieties has changed considerably. Very few Ben Davis are now being planted, but the Stayman Winesap, an apple of much higher quality and of greater demand on the market, is taking its place. Fewer York Imperials and more Arkansas (Mammoth Black Twig) are being planted yearly. The reasons given for this are that the York Imperial does not keep as well as formerly and is not commanding as high a price as the Arkansas. However some growers condemn the Arkansas (Mammoth Black Twig) because it is a shy bearer. The Grimes is not being planted as heavily as usual, because of its great susceptibility to collar blight, but methods of combating this trouble have been suggested by Professor Giddings* of this station and it is hoped that the loss of Grimes from this trouble will not be so heavy in the future.

The Jonathan, another apple of high quality, is also being planted to a greater extent than ever before. Other varieties found in smaller quantities are the Delicious, Northwestern Greening, Wealthy, Gano, Yellow Transparent, and Arkansas Black. A few growers reported Lawver, Winesap, and Akin. However, not many of these varieties are grown and the commercial varieties are found in the four or five specially mentioned above. Farmers' Bulletin 641 gives an estimate as to what percentage of the total, each variety constitutes in the state of West Virginia. It is interesting to trace the plantings and see how the tendency now is to plant varieties of a higher quality than those planted formerly. Unquestionably, the demand for quality rather than quantity has brought

*Giddings, N. J.—Report of W. Va. Hort. Soc., 1913.

about this change. Often as much money can be made from an attractive well packed box of high quality apples as from a carelessly packed barrel of a poorer variety.

DISTRIBUTION OF ORCHARDS AS TO MANAGEMENT.

TABLE XX.—*Number of orchards and acres under different management.*

Management	Number of Orchards	Per Cent of Orchards	Number of Acres	Av. Size in Acres	Per Cent of Acres
Renters	12	4.6	128.	10.7	1.2
Managers	51	19.7	1,979.	38.8	17.7
Owners	151	58.3	3,474.6	23.1	31.
Companies	45	17.3	5,623.	125.	50.1

Table XX is a classification of the acres and orchards in Berkeley County according to ownership and management. As can be seen, there are very few orchards rented outright. Many men instead of renting their farms, hire a man by the month to do the work, in a degree under their supervision. The owners then generally move into town. Such orchards are classified under the head "managers." In the case of the term "owners" the owner of the orchard himself is living on the farm and running the orchard. Many orchards, as before stated, are owned by orchard companies. Men of various occupations, believing that the returns from orcharding would be profitable on a large scale have formed companies and planted extensively. A manager is then hired, as in any other business, to oversee the general work. The orchards and acres owned in this way are classified under the head "companies." A study of the table shows that while 58.3% of the orchards are managed by the owners, only 31% of the total acreage is so managed. Likewise only 17.3% of the orchards are owned and managed by companies but 50.1% of the total acreage is owned by them. The reason for this is that the company orchards are of much larger acreage. The column showing the average size in acres for each group, emphasizes this fact. It can be seen that the average size of all company orchards is 125 acres, while the orchards next in average size are those under the head "managers" followed by "owners" and "renters." The average size of the rented acreage is small. This looks as if there must be money in the fruit business otherwise there would probably be more orchards rented outright by the owners. Thus 50% of the apple acreage in the county is owned by orchard companies although the largest number of orchards are managed by the owners.

RELATION OF MANAGEMENT TO YIELDS AND INCOMES.

TABLE XXI.—*Yields and returns under different ownership and management.*

Management	No. of Acres	No. of Orchards	Yield in Barrels				Gross Income Per Acre			
			1910	1911	1912	3 Year Av.	1910	1911	1912	3 Year Av.
*Companies	483	7	14.98	22.93	22.	19.97	$ 40.97	$ 55.13	$ 43.18	$ 46.43
Managers	541	22	28.92	38.78	29.79	32.49	68.92	86.16	65.74	73.60
Owners	1245	51	40.5	65.6	40.7	48.9	94.28	148.74	87.67	110.23
†Renters	32	2	56.	52.	34.	47.3	128.00	130.00	65.50	107.83

*Orchards in this group are all young orchards (10 to 13 years) so are not comparable with the other figures.

†Yields and incomes can not fairly be compared, as only two orchards are found in this group.

In Table XXI the figures for company orchards can not fairly be compared with the yields and incomes under the other groups, as all the company orchards in this table are from 10 to 13 years old. Yearly figures were obtained from some of the older company orchards, but the number of older orchards were so few that no definite conclusions could be drawn from them. If figures could be obtained from these company orchards in another 10 years, some very interesting and valuable conclusions might be drawn as to the value of this form of orchard management. By referring to Table XVI however, if we should average the yields and incomes, found in the groups of orchards from 8 to 10 years and 11 to 14 years old, we would have some orchards of approximately the same age to compare with the company orchards. The three year average of the county, for such orchards, is 25 barrels yield and $59.29 income per acre. By referring to Table XXI it can be seen that the company orchards are not doing quite as well as this average. From general observation it seems that this fact holds true quite generally for the first three crops, the company orchards seemingly not bearing as large crops as soon as the others. It is questonable if these large orchards will ever be as profitable per acre as the smaller ones. With such large acreages the ordinary orchard operations are not carried on as thoroughly nor is the same careful management given as in the case of the smaller orchards. Now and then a company orchard with a well trained manager, plenty of money for operating purposes, and an efficient working force, is just as profitable as the smaller orchards, which are managed by the owners them-

selves, but these cases are exceptional. Returns from one well managed 14-year-old company orchard show 39.7 barrels per acre and $93.75income per acre. Another orchard, 15 years old, shows 47 barrels per acre and $118.32 income per acre. These results are equal to those found in Table XVI under these same ages. However, most of the company orchards are not worked as intensively as the smaller ones and probably less money per acre is generally spent on them. The survey indicated that the largest orchards are not returning the largest total incomes. Fruit companies, organized in the future, will do well to consider, before planting heavily, whether they will have sufficient capital to work the orchard thoroughly, otherwise it will probably pay to plant a smaller acreage and give this proper attention.

There is a large enough acreage in each of the groups "managers" and "owners" so that some conclusions can be drawn. These figures seem to prove conclusively that the orchards which are being worked by the owners themselves are returning the best yields and incomes, (16.5 barrels per acre and $36.63 per acre more on the average). While the returns from the rented orchards show up well, the figures are based on only two orchards and thus are not as reliable as if a larger number of orchards could have been used.

Returns from Orchards Better than the Average.

TABLE XXII.—*Returns per acre on eight well-cared-for orchards averaging 16 years old.*

No. of Orchards	No. of Acres	Yields in Bbls. per Acre				Gross Incomes per Acre			
		1910	1911	1912	3 yr.	1910	1911	1912	3 yr.
8	162	81.4	110.5	82.1	91.3	$201.58	$275.21	$198.30	$225.03

It must be remembered in studying the tables in this bulletin that in nearly all cases where yields and incomes are found they are the average returns of all orchards, good and bad. As a result, although the figures are comparable in each table, the yields and returns may seem low in some. In order to show that many of the well cared for orchards are doing better than these averages, Table XXII is given. The orchards in this table are all well managed orchards. They are sprayed three times, fertilized, pruned regularly, and a system of clean culture and cover crops is followed. They show what can be expected when proper care is given. Not by any means, are these orchards the best in the county, several others are producing even greater yields and incomes. One orchard of 33 acres produced a gross income in 1909 of $11,887.45 or $360.22 per acre, while in 1911 the same or-

chard returned a gross income of $12,130.61 or $367.60 per acre. Yields and incomes for this orchard in 1910 are lacking but even if there had been no returns, (which is improbable) the three year average income per acre would still be $242.60. Another 22 acre orchard 19 years old produced $370 per acre the same years. Of course the exceptional income of $2000 per acre has been obtained as in every other state. Table XXII does not give the exceptional yields and incomes but gives a fair idea of what can be expected from well cared for orchards. Sometimes, however, unlooked-for things happen and crops may be lost for two or three years in succession. This happened in Berkeley County in 1912, when a severe hail storm struck Apple Pie Ridge in the fall and destroyed the crop; the next year, 1913, the crop was lost by two severe freezes, which were quite general in the Eastern United States. When such things happen the fruit business does not look very profitable.

RETURNS ON ORCHARDS POORER THAN THE AVERAGE.

TABLE XXIII.—*Returns per acre on eight poorly cared for orchards.*

No. of Orchards	No. of Acres	Yields in Bbls. per Acre				Gross Incomes per Acre			
		1910	1911	1912	3 yr.	1910	1911	1912	3 yr.
8	201	11.1	20.7	16.8	16.2	$25.20	$42.60	$31.40	$33.06

Table XXIII is given to compare with Table XXII. Some orchards in Berkeley County are far below the average. The yields and returns are shown from a like number of orchards as in Table XXII. In this case, although they are of the same age, the orchards are not well cared for. They are sprayed irregularly, seldom pruned, fertilized very lightly, and seldom plowed. They show that such management will not pay. By a good system of management these orchards could again be made quite profitable and it would pay to rejuvenate* them.

THE SOILS OF BERKELEY COUNTY.

Area and Location of Different Soil Types. In general, the soil of Berkeley County is similar to the rest of the soil throughout the Shenandoah Valley. For the most part it is of limestone formation. The weathering of the limestones has gone on to a considerable depth, but there are still many outcrops of the limestone in the county. This limestone contains

*Alderman, W. H.—W. Va. Agr'l. Expt. Sta. Bul. 141.

a fairly high percentage of calcium carbonate and is used extensively for agricultural, building, and manufacturing purposes. It is also used for constructing roads, the value of which can be seen by the good pikes in Jefferson and Berkeley counties.

There seem to be, however, about five soil types in Berkeley County and probably the best way to give their ap-

FIG. 9—An Apple Pie Ridge orchard, showing the slope of the ridge and the orchard implements used.

proximate location and extent is to start at the western border of the county and work eastward to Jefferson County. As stated previously, North Mountain extends across Berkeley County in a northeastern and southwestern direction, a little to the west of the center of the county. About one-third of the area of the county lies back or west of this mountain and is known as "Back Creek Valley." On the west side of this valley along the base of the Third Hill Mountain there is a strip of red shale land about one and one-half miles wide and twenty miles long with an average elevation of about 800 feet. The rest of the Back Creek Valley is for the most part a yellow shale, except for two or three small outcroppings of limestone in the Tomahawk and Jones Springs sections. At the east base of North Mountain there is a strip of land about

one mile wide, of yellow and black shale extending across the county. Adjoining this strip of shale on the east is the famous Apple Pie Ridge. The soil on this ridge is what is known locally as "Apple Pie Ridge Soil," a variation of the limestone soil. The ridge is about a mile wide and 75 feet higher than the valley between it and the North Mountain. The true limestone soil begins at the east base of Apple Pie Ridge and extends east just past the Cumberland Valley Railroad almost to the chain of limestone quarries which extends through the county. At about this location, especially in the eastern and southeastern parts of the county, the yellow shale is again found. This soil extends over the rest of the county, excepting a strip of black shale found near the Jefferson County border. Thus it can be seen that there are about five different parallel soil types in the county.

Description of the Soils. There has never been a soil survey made for Berkeley County, so, for the most part we have no scientific description of the soils. However, some of them have been studied in neighboring counties.

The So-Called "Limestone Soil" is scientifically known and described as "Hagerstown Loam." A full description and mechanical analysis of this soil can be found in the publication cited below*. It is known locally as a very good soil for general agricultural purposes as well as for fruits, and is found all through the Shenandoah Valley. Little lime is used on this soil although many hold that its use is beneficial. Much commercial fertilizer is used. A rotation of corn, wheat, and clover with the addition of barnyard manure keeps the soil in a high state of productiveness.

The Apple Pie Ridge Soil. The soil on Apple Pie Ridge varies somewhat from the Hagerstown loam (limestone), in that small flakes or bits of shale and soapstone are found through it. The small flakes keep the soil from baking down hard and cracking and as a result it can easily be worked up by harrows even after it has been idle for some time. As a whole it is a well drained, mellow, rich and warm soil, seemingly adapted to all kinds of general farming as well as being especially adapted to fruit growing. No technical description of this particular soil has ever been made.

"The Black Slate" Soil. The soil commonly called "Black Slate Soil" is described in the soil survey of the Leesburg

*Carter, W. and Lyman, W. S.—Soil Survey of the Leesburg Area, Virginia, U. S. Dept. Agr. Bureau of Soils, Advanced Sheets, 1903.

area as Hagerstown Shale Loam. The description can be found in that publication. On the surface and throughout the soil and subsoil, small broken shale fragments occur, sometimes forming not more than fifteen per cent of the soil mass, and at other times making up practically the whole soil mass. The soil is generally underlaid by a bed of broken shale. This soil is locally called slate land and is not considered as valuable for agricultural purposes as the two preceding soils. The addition of cover crops and stable manure is very beneficial.

The Yellow Shale Soil. No technical description is found of this soil. It is made up of a yellow shale and soapstone. As in the slate land, the soil is sometimes made up of a high percentage of shale while at other times the percentage runs lower. This land is not as desirable for agricultural purposes as the two soils first described. It is a thinner and poorer soil needing considerable fertilizer and manure to produce good crops. Trees show lack of care quickly on this type of soil.

The Red Shale Land. Although no technical description of this soil has been made in the county, it is recognized as Penn Sandy Loam. Red sandstone and shale fragments usually form five to twenty per cent of the soil mass. The type is derived from Triassic red sandstone. The topography varies from rolling to moderately hilly. This soil is a little too thin for the best development of apples but is especially well adapted to peaches. The ground is easily tilled.

Drainage of Soils. Practically all soils in the county are naturally well drained. Here and there an orchard would be benefited somewhat if tile drainage were practiced, but these cases are exceptional.

RELATION OF SOILS TO YIELDS AND INCOMES.

TABLE XXIV.—*Yields and incomes per acre on different soil types.*

Soil Type	No. of Orchards	No. of Acres	Av. Age of Orchards	3 yr. Av. Yield in Bbls.	3 yr. Av. Income (Gross)
Apple Pie Ridge	32	941	17	54.5	$130.00
Hagerstown Loam (Limestone)	32	710	17	47.	$100.00
Hagerstown Shale Loam (Black Slate)	9	200	15	18.	$ 38.00
Yellow Shale or Soapstone	11	367	15	20.	$ 43.00
Penn Sandy Loam (Red Shale)	2	56	16	33.3	$ 73.34

Table XXIV gives some idea as to the comparative values of the different soils for apple production. From these results it is seen that somewhat more profitable results are found on the average from those orchards growing on the Apple Pie Ridge soils. However, many well cared for orchards on the limestone soils are as profitable as those on Apple Pie Ridge. The red shale lands are giving the next highest returns and these are followed by the yellow shales, while the lowest returns are found on the black slate lands. Some few orchards on the yellow shale soils, which are fertilized liberally with the addition of leguminous cover crops, are growing nicely; however, it is questionable if they will ever be very profitable, unless this artificial feeding is constantly kept up. Although this soil is cheaper to buy in the start than the limestone soil, it is doubtful if in the long run, it will prove as profitable an investment. Those shale soils in which considerable clay is found, as in the soils back of North Mountain seem to be better suited for trees than the straight shale soils containing no clay. Trees show lack of care and decline quickly on these soils unless well managed. Since peaches do better on lighter soils than apples, they would probably thrive better on the shale soils than do apples. This is found to be true, especially on the red shale soils; here peaches are doing especially well. (See Fig. 3.)

SOIL MANAGEMENT.

TABLE XXV.—*Treatment of bearing orchards in 1914. (Orchards ten years old and up included in this class.)*

Treatment	No. of Orchards	No. of Acres	Per Cent of Orchards	Per Cent of Acres
Tilled since bearing, 5 yrs. or more (Trees 15 yrs. or over)	24	739.	14.9	19.7
Tilled since bearing, 1 to 4 yrs. (Trees 10 to 14 yrs.)	35	1,289.4	21.7	34.6
Tilled most of time since bearing	8	154.6	4.9	4.3
Alternate tillage and sod	22	438.	13.6	11.7
Sod most of the time	16	296.	9.9	7.9
Sod since bearing, 1 to 4 yrs. (Trees 10 to 14 yrs.)	33	602.	20.5	16.
Sod since bearing, 5 yrs. or more (Trees 15 yrs. or more)	23	226.	14.9	6.

A study of the above table shows that 54.3% of the total acreage of bearing orchards in Berkeley County is cultivated yearly from the time the orchards come into bearing; 22% is left in sod; 11.7% alternately tilled and left in sod, while the remaining 12.2% is divided between being tilled most of the time and left in sod most of the time. In those orchards listed

as sod, the grass is generally cut as a mulch. In some cases it is uncut while in a very few cases the orchards are pastured with hogs. Pasturage is not a general practice, however, in Berkeley County. The general practice therefor, is to cultivate the orchards yearly from the time they come into bearing. The wisdom of this method is proved in Table XXVI.

THE RELATION OF SOIL MANAGEMENT TO YIELD AND INCOME.

TABLE XXVI.—*Three year average yields and income per acre of bearing orchards under different cultural methods.*

METHOD	No. of Orchards	No. of Acres	Yields in Bbls.			3 Year Average	Gross Income			3 Year Average
			1910	1911	1912		1910	1911	1912	
Tilled since bearing, 5 years or more	16	641.	46.8	82.4	46.8	58.7	$117.80	$194.55	$107.02	$139.79
Tilled since bearing, 1 to 4 years	21	752.	31.3	46.6	36.5	38.1	79.00	110.95	82.54	90.83
Tilled most of time	7	107.	59.	58.2	46.1	54.4	150.89	126.00	116.27	131.05
Alternate tillage and sod	14	243.5	27.2	36.5	29.	30.9	59.45	71.49	54.70	61.88
Sod most of time	8	171.	21.1	51.	35.6	35.9	39.56	103.86	40.79	61.40
Sod since bearing, 1 to 4 years	15	243.	18.7	29.8	25.1	24.5	44.83	71.14	50.43	55.47
Sod since bearing, 5 years or more	12	148.	29.2	49.1	20.5	32.8	64.36	100.56	36.31	67.08

It can readily be seen that the system of clean cultivation and cover crops is the most profitable one to use in Berkeley County. Since records were obtained on a number of orchards from 10 to 14 years old and also from orchards 15 years and up, it was decided to place the young orchards and the older orchards in separate groups. This explains the classification of orchards in the above table. We see that the highest yields and incomes are found from those orchards 15 years or more in age, which are cultivated yearly, and when we compare this group with orchards of the same age, but left in permanent sod, we find a difference in yield of 26 barrels per acre and $72.71 income—or in other words the tilled orchards are returning 108.3% more per acre than the sod orchards. Possibly some of the orchards in the sod groups have not received as good care in other respects as the tilled groups, but even so, this difference in care would not account for the decided returns in favor of tillage. With this decided difference the chance of experimental error is lessened. Now and then a sod that is manured heavily and has a heavy growth of grass which is kept cut and mulched about the trees, is returning good yields and incomes, but these orchards are the

exceptions. In most of these cases the conditions are favorable for sod-mulch culture. It must be remembered that these figures are the average of all orchards so the yields and incomes for all groups are probably low.

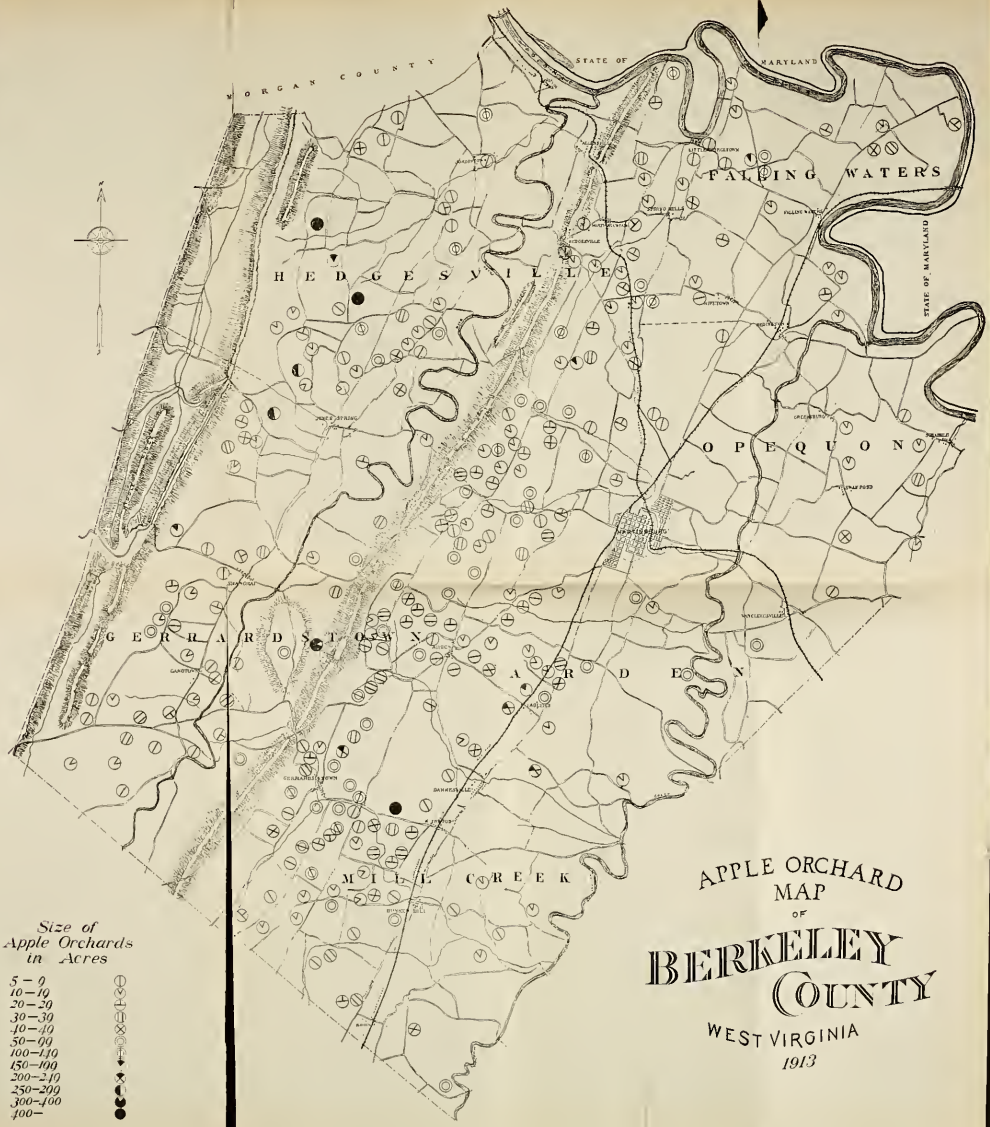
When we compare those orchards from 10 to 14 years old, tilled since bearing, with those of the same age left in sod, the difference again is nearly as striking in favor of tillage. Here the tilled orchards are returning 63.7% more income per acre. Similar results are found when comparing those orchards tilled most of the time with those orchards left in sod most of the time. The returns are larger in these groups than they are from the orchards in either of the groups from 10 to 14 years old, since the orchards in most cases are older. From the results of those orchards tilled one year and left in sod the next, it would seem that this practice was not very beneficial. These orchards evidently do not adjust themselves to either method. This fact is interesting and will bear watching. Thus, from the above results, clean cultivation and cover crops are to be recommended for Berkeley County and the Eastern Panhandle. Similar results were found in Jefferson County*. It may be that some orchards are too steep to allow of entire cultivation, but in these cases, the tree rows should at least be cultivated. The topography of Berkeley County is such that probably 90% of the orchardists could use clean cultivation and cover crops or a slight modification of this system. Many of the best fruit men are already using this method; many more of them should adopt it.

TABLE XXVII.—*Soil management of bearing orchards in 1913. (Ten years and older.)*

Management	No. of Orchards	No. of Acres	Per Cent of Orchards	Per Cent of Acres
Tillage and cover crops	56	1,895.	35.	50.1
Tillage only	14	468.	9.	12.3
Tree rows tilled, sod between	8	151.	5.	4.
Generally tilled but neglected this year	12	269.	7.5	7.1
Tilled and farmed	16	265.	10.	7.
Sod—pastured	10	99.	6.2	2.3
Sod—grass cut and left	23	402.5	14.3	10.6
Sod—grass cut for hay	3	29.	1.8	.78
Sod—neglected	18	229.	11.2	6.

A study of the above table shows that many more orchardists were using some form of tillage in 1913 than were using sod culture in their bearing orchards. Fifty per cent of the acreage was under clean cultivation and cover crops, while 12.3% was tilled with no cover crop added. Many of the fruit growers neglected the usual tillage methods in their

*Jeffries, R. R.—W. Va. Agr'l. Sta. Bul. 147.



APPLE ORCHARD MAP OF BERKELEY COUNTY

WEST VIRGINIA

1913

orchards this year, because of the loss of the crop, due to the spring freezes. The same condition was found in many of the young orchards, as shown in Table XXVIII. Where orchards were in sod, the general method was to cut the grass and leave it as a mulch. A number of sod orchards were pastured by hogs, while only three orchards were found in which the grass was being removed as hay. Thus in a normal year practically 80% of the total bearing acreage in the county receives some form of tillage; while 20% is left in sod.

TABLE XXVIII.—*Soil management of non-bearing orchards in 1913. (Classified as to age.)*

Age of Orchard	Cultivated Crops, Number Acres	Cereals in Orchard, Number Acres	Hay Cut from Orchard Acres	Hay Left in Orchard Acres	Clean Cultivation Only, Number Acres	Clean Cultivation and Cover Crops Acres
1 year	436	113	216	327	225	100
2 year	703	909	226	502	214	32
3 year	157	72	97	26	100	25
4 year	0	67	0	47	0	0
5 year	35	68	0	65	36	164
6 year	39	57	34	100	112	150
7 year	101	58.5	12	121	20	448.5
8 year	89	40	41	175	26	193
9 year	41	32	49	155	102	264
Total all ages	1601	1,416.5	675	1,498	835	1,376.5
Per cent of total acres under each treatment	21.6	19.3	9.1	20.2	11.2	18.6

Table XXVIII shows how the young orchards, (those not considered in the yield and income tables) are managed in Berkeley County. The table is so arranged as to show how the orchards of each age are managed. For instance it can be seen that of the total acreage of one-year-old orchards, 436 acres are growing a cultivated crop, while 113 acres are in cereals, etc. Finally at the lower part of the table is shown the total acreage of young orchards in cultivated crops, cereals, cover crops, etc. This table shows that the largest acreage of cultivated crops and cereals is found in the orchards from one to three years old, while a small acreage of tillage and cover crops is found in orchards between these ages. It is also shown, unfortunately, that a large acreage of these young orchards is in sod, either cut as hay or left in the orchard—sometimes cut but more often not. As a matter of fact, very few of these orchards have a very heavy sod in them, but simply have been neglected so that a volunteer crop of grass and weeds took possession and it was necessary to list them as sod. It is doubtful if as high a percentage will be found in the future, as the fruit men had hard years in 1912 and 1913 and thus did not work the orchards as well as usual.

In the orchards between seven and nine years of age, inclusive, the tendency is to use clean cultivation and cover crops with very few acres of cultivated crops or cereals. The sod acreage is also less.

Of the cultivated crops, corn constitutes by far the largest acreage. Some potatoes, tomatoes and truck crops are grown, but the per cent of the total acreage is small. Of the cereals, wheat is the one most commonly grown. Some rye and buck-

FIG. 10—A young orchard, showing a good cover crop of cow peas.

wheat are also grown. As can be seen, the largest acreage (more than 64%) of all the cereals grown is found in the two-year-old orchards. The reason for this is found in the fact that many of the orchardists use a rotation of corn the first year, wheat the second and often hay the third, in the young orchards. It is now a generally accepted fact among the best orchard men that cereals and hay should not be grown in an orchard. Either grow hay or grow orchard; both of them together cannot do well. While many of the growers leave a strip of cultivated ground around the tree rows, which helps to a great extent, still if a rotation were used which substituted a cultivated crop for the wheat and hay, better results would be obtained. Some orchardists do this; more ought to. In those orchards using clean cultivation only, it most certainly would pay to sow a cover crop (preferably a

legume) about August 1st. This would not only protect the soil from washing over winter but would supply plenty of organic matter in the spring to plow under. We can not get too much organic matter in our soils. Finally, the table shows that 51.4% of the total acreage of the young orchards is tilled, 19.3% is in cereals and 29.3% is in a poor sod.

ORCHARD FERTILIZATION.

TABLE XXIX.—*Table classifying the orchards as to fertilization: both bearing and non-bearing orchards considered.*

Treatment	*No. of Orchards	No. of Acres	Per Cent of Orchards	Per Cent of Acres
NONE	138	2,904.6	33.5	25.9
Stable manure	99	2,064.5	24.	18.4
Stable manure and commercial fertilizer	19	605.	4.6	5.3
Commercial fertilizer	155	5,630.5	37.7	50.3

*There are not as many orchards in the county as it would seem from the table. In the large company holdings there may be five or six orchards of different ages, each one managed a little differently, thus in these cases each must be listed separately, seemingly making a large total number of orchards. This same trouble is found in several of the other tables, thus the per cent of acres rather than the per cent of orchards is often the best index to use. The exact number of orchards in the county as stated previously in 247.

It seems to be a general practice in Berkeley County to fertilize orchards in one way or another; 66.3% of the orchards and 74% of the total acreage received some form of fertilizer while 25.9% receive none whatever. Commercial fertilizer was applied to 50.3% of the acreage while 18.4% had stable manure applied. A small percentage use both manure and commercial fertilizer. The following tables classify the fertilization of bearing and non-bearing orchards, explaining the kinds and amounts used.

TABLE XXX.—*The fertilization of orchards under ten years old.*

Treatment	*No. of Orchards	No. of Acres	Per Cent of Orchards	Per Cent of Acres
NONE	91	1,934.	40.	26.1
Stable manure	47	1,469.	20.7	19.8
Commercial fertilizer	78	3,644.5	34.3	49.2
Stable manure and commercial fertilizer	11	354.	4.8	4.7

*Each orchard on the farm classified separately, thus the total number appears large; number of acres is a fairer index.

Table XXX shows how the young orchards are being fertilized in Berkeley County. In this table we see that 60% of the orchards and 73.7% of the total acreage receives some form of fertilizaton. This table shows that although the number of orchards receiving commercial fertilizer is not as

large as the number receiving none, still the acreage is nearly double, therefore fertilizer is being applied to the large orchards in the county. Many of the company orchards are found in this class. About one-fourth of the orchardists who apply fertilizers to the young orchards apply bone meal at the rate of one handful or one pint, in the hole, when the trees are set. A few report raw bone, steamed bone and dissolved bone. This means that if raw bone is applied the fertilizer is made up of about 3.5% to 4% of nitrogen, and 20% of phosphoric acid, while if steamed bone is applied it is made of about 1.8% to 2% nitrogen and 25% to 28% of phosphoric acid—more nitrogen and less phosphoric acid in one case than in the other. Judging from the tree growth, these seem to be very good fertilizers. Nearly one-half of the men use a complete fertilizer on the young trees every year or two. In some cases this is a good fertilizer analyzing about 4% nitrogen, 8% phosphoric acid and 10% potash, while in others it is a very low grade fertilizer of about 1% nitrogen, 6% phosphoric acid and 2% potash, or poorer. This low grade fertilizer is of seemingly little value to the tree. A few of the young orchards are fertilized only as the crops growing in them are fertilized.

In those orchards where manure was applied, a light application was made every year in one-third of them and every other year in one-fifth of them, while many of the orchards received an application every six to eight years. The amounts applied varied considerably from 20 to 40 pounds on the one and two-year-old trees, to from 250 to 300 pounds on the eight and nine-year-old trees. The lighter applications were applied oftener in all cases.

In those orchards receiving both commercial fertilizer and manure, one-half of the orchards received light applications of both the same year while about one-half received manure one year and commercial fertilizer the next.

TABLE XXXI.—*The fertilization of orchards more than ten years old.*

Treatment	No. of Orchards	No. of Acres	Per Cent of Orchards	Per Cent of Acres
NONE	47	970.6	25.5	25.5
Stable manure	52	595.5	28.2	15.6
Commercial fertilizer	77	1,986.	41.9	52.2
Stable manure and commercial fertilizer	8	251.	4.3	6.6

The above table shows that the older orchards are being fertilized in approximately the same manner as the younger ones, as regards the percentage of acres fertilized by the different methods. Approximately the same percentage of acreage in each case received respectively, no fertilizer, stable ma-

nure, commercial fertilizer, or both the manure and commercial fertilizer. This might lead us to think that the same orchardists with different aged orchards applied to both cases, but this does not always hold true. Of the bearing orchards 74.4% receive fertilizer of some sort, 25.5% receive none. In these orchards, as in the younger ones, (Table XXX), commercial fertilizer is the treatment most commonly used. Commercial fertilizer is applied to 52% of the acreage, 15.6% received manure while 6.6% received a combination of both.

The commercial fertilizer used in the bearing orchards is a complete one, analyzing comparatively high. The ones most commonly used analyze either 4% nitrogen, 8% phosphoric acid and 10% potash or 4% nitrogen, 8% phosphoric acid and 7% potash. They are commonly called by the fruit men, "Orchard Special" and "Bone, Blood and Potash." The amounts applied annually vary from 300 to 600 lbs. per acre, 400 lbs. being the usual application in most of the cases. This amount is often put on in two applications, one-half in May and one-half in June. In a few cases raw bone and steamed bone meal are used, while a complete fertilizer of low grade is seldom used on bearing orchards.

In those orchards receiving manure alone it is generally applied each year, varying from three to ten tons per acre, although many orchards apply it as it is made. Where both are applied on the orchards, most of the manure is generally put about the poorer trees. The application will probably average about four tons per acre, yearly, with some men applying as high as sixteen tons while others apply as low as one ton, putting is only about the trees.

RELATION OF FERTILIZER TO YIELD AND INCOME PER ACRE IN CULTIVATED ORCHARDS.

TABLE XXXII.—*All orchards in this table tilled since bearing.*

TREATMENT	No. of Orchards	No. of Acres	Av. Age of Orchards	Yield in Barrels			3 Year Av. Yield	Gross Income			3 Yr. Av. Income
				1910	1911	1912		1910	1911	1912	
Tilled and commercial fertilizer	6	330	14	41.35	58.4	44.1	47.95	$ 94.07	$131.22	$ 87.12	$104.13
Tilled, cover crops and commercial fertilizer	15	500	15	39.5	57.69	46.6	47.93	95.98	136.76	108.68	113.80
Tilled, cover crops and manure	8	172	14	42.66	75.98	33.21	50.61	104.61	160.92	75.84	113.79
Tilled, cover crops, manure and commercial fertilizer	5	236	15	52.8	91.84	51.08	65.24	132.64	252.44	125.23	170.27

Table XXXII gives the results of fertilizing tilled orchards by different methods. In order to reduce the possible effect that sod culture might have, the orchards in this county were separated as to cultural methods as well as fertilizer methods. In this way we eliminate at least one factor and thus make the results just so much more accurate. The fertilizer results obtained in former surveys would have been much more reliable had this been done. In some cases it was probably impossible to make this division, but so many different factors might enter into a survey table, that whenever one is eliminated, the experimental error is considerably reduced. Likewise the orchards in this table are of practically the same age, which also cuts down the chance for error. The advisability of eliminating the sod factor it at once seen by referring to Table XXXII. In this table no tilled orchards are found that received "no fertilizer." Thus had all the orchards in the county been included in one final table giving yields and incomes, irrespective of cultural methods, it would have been the sod culture that affected the results rather than the lack of fertilizer. This might not happen in any other county and with a large enough number of orchards the experimental error would probably not be great, as the tilled orchards would probably balance the sod and the average would be fair, however, results were as above stated in this county.

From the above table, it is plain that those tilled orchards which receive both stable manure and commercial fertilizer are giving the best yields and incomes. The character and amount of this fertilizer and manure were discussed under Table XXXI. Likewise it appears that either commercial fertilizer or stable manure are giving about the same results. It is unfortunate that data could not be obtained on any tilled orchards receiving no fertilizer so that it could be seen whether it paid to apply fertilizers or manure. We can surmise, however, from the results of Table XXXIII that both are beneficial. Orchards with and without cover crops, both receiving commercial fertilizers are compared. These figures show a benefit from cover crops of $9.67 per acre, however, there would probably be a greater difference in favor of cover crops, if those orchards listed without cover crops had not had a rank growth of cheat grass spring up of its own accord. This of course added green manure, which is one function of the cover crop, so these orchards were better off than if nothing had been on the ground over winter. Leguminous cover crops, such as clover, cowpeas, or soy beans are valuable both as nitrogen gatherers and for the organic matter which they add to the soil. Most of the fruit growers are using a cover crop; more of them should.

RELATION OF FERTILIZER TO YIELD AND INCOME PER ACRE IN SOD ORCHARDS.

TABLE XXXIII.—*Orchards included in this table have been in sod since bearing.*

TREATMENT	No. of Orchards	Av. Age of Orchards	No. of Acres	Yield in Barrels			3 Year Av. Yield	Gross Income			3 Yr. Av. Income
				1910	1911	1912		1910	1911	1912	
Sod, and none	8	17	107	17.36	25.64	13.71	18.9	$ 42.69	$ 48.37	$ 25.98	$ 39.01
Sod and commercial fertilizer	7	14	145	16.36	21.63	20.7	19.56	40.30	46.91	43.65	43.62
Sod and manure	11	16	126	37.4	65.19	30.88	44.49	73.40	137.46	65.64	92.16

Table XXXIII shows the effects of fertilizers and manure on sod orchards. It is plainly evident that barnyard manure is very beneficial when applied to orchards in sod, 25.6 barrels and $53.15 more per acre being derived when manure is added. Or, in other words, the yields and incomes are nearly two and one-half times greater. A profit is also shown from the use of commercial fertilizer but this is not as marked as when manure was applied. It is a fact that the lower grades of fertilizers were found on the sod orchards. Orchards where the soil culture was poor were generally not given as much care in the other operations either. Thus it is probable that a higher grade of fertilizer might have given a little better result. In Table XXXII, we see that in tilled orchards commercial fertilizer is giving about the same results as manure, thus it would seem reasonable to conclude that if a man were going to apply commercial fertilizer and could buy only a small amount, he had better put this fertilizer on tilled orchards and save his manure for any sod orchard that he may have. From the results of both tables it appears that if plenty of barnyard manure could be secured it would not be necessary to buy any commercial fertilizer, no matter what the orchard culture. However, sufficient quantities can not be generally obtained so commercial fertilizer must be resorted to.

FIG. 11—A good crop of hay; but hard on the trees.

CHARACTER, FREQUENCY, TIME, DEGREE, AND TYPE OF PRUNING.

TABLE XXXIV.— *Pruning data on young orchards.*

	No. of Orchards	No. of Acres	Per Cent of Orchards	Per Cent of Acres
CHARACTER OF THE WORK				
Good	29	2,257.	17.6	29.8
Fair	77	3,511.5	47.	46.4
Poor	58	1,797.	35.3	23.7
FREQUENCY OF PRUNING				
Every year	120	6,432.5	71.8	86.
Every other year	8	261.	4.8	3.4
Occasionally	30	620.	18.	8.2
Never	9	164.	5.3	2.2
TIME OF PRUNING				
Winter	21	1,776.5	13.1	24.9
Spring	139	5,312.	86.9	74.6
Summer	1	27.	.6	.3
DEGREE OF PRUNING				
Heavy	25	1,731.	15.8	23.8
Moderate	58	3,134.5	36.7	43.1
Light	75	2,395.	47.4	33.
TYPE OF PRUNING				
Open head	29	2,148.5	17.	29.9
Central leader	53	2,356.	31.1	32.4
Natural growth	88	2,682.	51.8	37.3

TABLE XXXV.— *Pruning data on bearing orchards.*

	No. of Orchards	No. of Acres	Per Cent of Orchards	Per Cent of Acres
CHARACTER OF THE WORK				
Good	20	492.	14.	13.9
Fair	70	1,684.	49.3	47.7
Poor	52	1,348.5	36.6	38.2
FREQUENCY OF PRUNING				
Every year	88	2,425.	56.8	66.2
Every other year	11	147.	7.09	4.
Occasionally	41	892.5	26.4	24.4
Never	15	194.	9.7	5.3
TIME OF PRUNING				
Winter	23	822.	16.4	21.8
Spring	114	2,654.5	81.4	70.3
Summer	3	296.	2.1	7.8
DEGREE OF PRUNING				
Heavy	7	184.	5.	5.2
Moderate	57	1,605.	40.4	45.2
Light	77	1,735.5	54.6	49.2
TYPE OF PRUNING				
Open head	34	717.	21.8	19.2
Central leader	55	1,457.	35.2	39.1
Natural growth	67	1,544.5	43.	41.5

Character of Pruning. Pruning is one of the most neglected of orchard operations in Berkeley County. It is surprising to find this one operation so poorly done when the other branches of work, such as spraying, fertilization and cultural operations are carried on in an intelligent manner. Less than one-half of the orchard pruning could be ranked as even fair, about one-third is poor, while only about 15% of the orchards are well pruned.

FIG. 12—An apple tree before pruning. Too many main limbs have been left to form the head.

Freqency of Pruning. In most cases the orchards are pruned each year, although in Table XXXV we find that about 25% of the bearing orchards are pruned only occasionally. A few of the orchards are pruned every other year and about the same number receive no pruning whatever.

Time of Pruning. About 80% of the orchards are pruned in the spring, 15% to 18% in the winter and 2% in the summer. This summer pruning is a recent custom, which is not much more than an experiment in most orchards. Unless carefully and scientifically done, the practice should be abolished.

Degree of Pruning. About one-half of the older orchards are pruned lightly and one-half moderately. In the younger orchards about 15% of them are pruned heavily, 46.4% lightly and 36.7% moderately. Thus, as is natural, the younger orchards are pruned somewhat more heavly.

Type of Pruning. In many orchards no definite system of pruning is carried out. The trees are just allowed to grow and the pruning consists of topping them back a little each year (Fig. 13). About 50% of the orchards are so pruned. 30% of the orchards are pruned by the central leader system, while the other 20% are pruned with open heads.

The General Character of the Pruning with Recommenda-

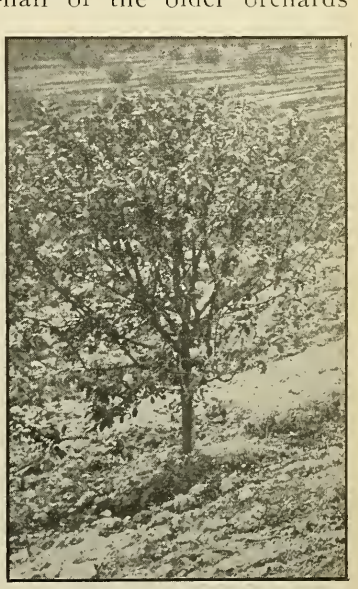


FIG. 13—Illustrating the type of pruning in Berkeley County. The top only has been bobbed back. Too many main limbs have been left.

FIG. 14—Too many long slender limbs with bearing wood only at their ends. Results of poor early pruning.

tions. The fruit growers of Berkeley County in general are very reluctant about thinning out the trees when young and cutting them back strong enough. Too many main limbs are allowed to come out together to form the head. As many as grow are generally left (Fig. 12) with very little cutting back. In most cases the trees are just allowed to grow naturally and the tops are bobbed off (Fig. 13). Of course this sort of pruning soon makes a thick dense tree composed of several slender branches. As a result the trees are not as strong as they should be and whatever fruit is borne on the inside of the tree is generally small, green and worthless. Many of the growers are now realizing these mistakes, and are trying to correct them in the old trees and avoid them in the new plantings.

There are two general systems of pruning; the central leader and the open head systems. In the first case, the central leader is not removed from the young tree, (Figs. 16 and 17) while in the second case it is cut out (Fig. 15).

In some states the open head is desired in order to let in the sunlight to color the fruit. However, in West Virginia there is no trouble about coloring the fruit when the central leader system is used and since this system generally makes a

FIG. 15 — An open headed tree, started low but pruned up high. Note the weak crotch.

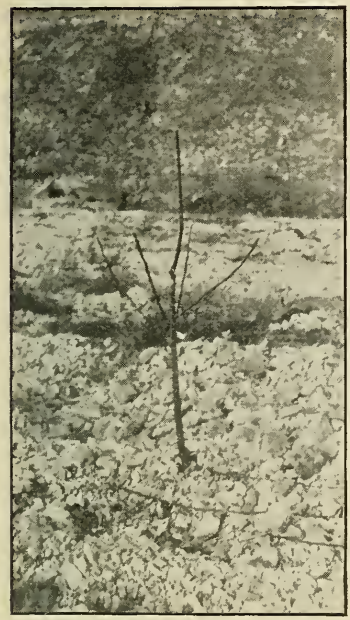


FIG. 16—A two year old tree properly pruned by the central leader system. Only four main branches have been left.

stronger tree, with more bearing surface, it is to be recommended. With this system, the weak crotches so often found in open headed trees, are avoided. During the first year's growth, many buds will generally grow out into branches below the place where the yearling tree was cut off (24 inches). The next spring not more than four of these limbs should be left to form the head. These should be evenly spaced about the trunk and should be cut back from one-half to three quarters of their length, depending upon the vigor of the individual limbs. The weaker the limb, the heavier it should be cut back and vice versa. The central leader should be cut back in proportion (Fig. 16). The third spring, those branches which have grown out from the main scaffold limbs at the head should be thinned down to from two to three per limb, provided they are out far enough from the head (about twelve inches), and should be cut back from one-half to two-thirds of their growth, again depending upon their vigor. If these side branches are too close to the head they should all be cut off except one and this one should be cut back. The central leader in the meantime will have continued its growth and should now be cut off about thirty inches above the head. The

FIG. 17 — An older tree showing three scaffolds of limbs. Note the distance between scaffolds and the general stocky appearance.

FIG. 18—A central leader tree in the spring. It will be thick enough by summer time.

fourth spring the limbs, which will have grown out from the side laterals left the previous year in the first scaffold, should be cut back from one-quarter to one-third of their growth. This is the year to pick out the second scaffold of limbs on the central leader about thirty inches above the first. This second scaffold should consist of three or four evenly placed limbs and most of the others between scaffolds should be cut off although it would be well to leave one here and there about the leader, shortened back. These few limbs left will leaf out and shade the trunk besides helping to make food to be stored in the tree. After forming this second scaffold, the central leader can then be cut out or left shortened back as before. Eventually a third head can be formed if desired (Fig. 17) but in most cases two heads, or two scaffolds are sufficient. After the fourth year the pruning should be light. Very little, if any, cutting back should be done in the first scaffold, while the second scaffold may be pruned back somewhat and trained similar to the first one. There should by this time be no big limbs to be cut out, only now and then a cross limb or a limb that is crowding. As a result of this continued heavy cutting back and thinning the first three or four years, a good stout trunk and main limbs will have been formed so that the tree will not only be able to bear future large crops without danger of breaking down, but the fruit on the inside as well as the outside will develop and color uniformly.

As regards the older trees, stubs should never be left to rot back, and thus allow the decay to reach the heart wood. Cut the limbs off close to the ones from which they spring and paint over the large wounds with white lead to which has been added a little lamp black to darken it. In the case of thinning out the limbs in trees that are too thick, do not cut out all of the limbs in one year, but gradually accomplish your purpose in two or three years. No detrimental effect to the tree will then result.

FIG. 19—A commercial orchard in which the central leader system of pruning has been uniformly carried out.

ORCHARD INSECTS AND DISEASES.

Berkeley County has its share of diseases and insects. Of the insects, San José scale, codling moth, green aphis and woolly aphis are invariably found. Besides these, the scurfy scale, curculio and tent caterpillar are sometimes troublesome. Although San José scale and codling moth are found in prac-

FIG. 20—The roots of a ten year old tree affected with woolly aphis. Note the small amount of roots and their gnarled and warty appearance.

tically all orchards, these insects are well held in check by the thorough sprayings given the orchards. The green aphis likewise is being combated successfully on the young trees either by spraying or dipping the limbs in Black Leaf 40, a tobacco decoction. Woolly aphis on the roots seems especially bad in many of the young orchards. Trees affected are easily recognized by their stunted and sickly appearance. The roots as well as the tops grow but little and soon become gnarled and warty in appearance. Figure 20 shows the size and condition of roots on a ten-year-old tree badly infested with the woolly aphis. When the trees are planted with the aphids already on the roots, they rarely reach bearing age. Trees from the nursery with aphids on their roots should never be planted unless it is known that they have been fumigated or the roots dipped in lime sulphur solution 1 to 10 either at the nursery or in the orchard before planting. Where the trees are found to be infested after they are two or three years old the soil should be removed for a depth of six to eight inches and tobacco dust should be placed about them before the soil is put back. Ordinary lime and sulphur at San José scale strength applied about the roots, will probably also aid in keeping this pest under control. Stimulating the growth of the trees by extra cultivation and the use of fertilizers may enable them to withstand the attacks of the insect.

Of the diseases, the collar blight, apple or cedar rust and leaf spot are causing the most damage, although the black rot, twig blight and bitter rot are serious in some orchards.

The collar blight is supposedly a bacterial disease, which affects the tree at about the surface of the ground although the trouble often extends up the trunk some distance, as well as down into the roots. The Grimes seems especially susceptible to this disease, although some other varieties are troubled with it also. It seems to show up at about nine to twelve years after planting. At that time it is a pitiful sight to see row after row of the Grimes trees die out. The only recommendations* at present are to make careful yearly inspection of the trees in the spring and wherever the trees show a sunken discolored area of bark just above the ground, this dead bark should be cut out. Care should be taken, particularly around the edges, to get well back into healthy green bark. (Fig. 21.) If necessary the dirt should be removed from the roots and the diseased portions cut from them also. These wounds should then be washed with corrosive sublimate and left for a few days. Upon examination if the disease seems to have been all cut out the first time and has not started up

*Giddings, N. J.—Twentieth Annual Report of W. Va. State Hort. Soc., 1913.

within the bark again, the wounds should be painted thoroughly with white lead. Care should be taken to disinfect the cutting implements with corrosive sublimate also, as this disease can be carried by the tools.

FIG. 21—Collar blight has been cut from this tree. It would have been much better to have cut it out sooner had it been noticed.

Cedar rust is a fungous disease which spends about three months of its life on the apple tree and twenty-one months on the cedars. This disease has been quite serious in Berkeley County for the past three years. Certain varieties, noticeably the York Imperial, are especially susceptible to the rust, while others as the Arkansas (Mammoth Black Twig) and Grimes are more resistant. Both the foliage and the fruits are affected. Figure 22 shows the character of the injury on the apple. Where the outbreak is bad, the trees become defoliated early in the season and from this time on the fruit develops very little. Spraying does not seem to be practical in fighting this disease; it is rather a case of cut down the cedars. By this means the host upon which fungus passes seven-eighths of its life history is destroyed, and the fungus is likewise

eliminated. Professor N. J. Giddings* of this station has recently published a circular on cedar rust, which should be obtained and read by every fruit grower in the county.

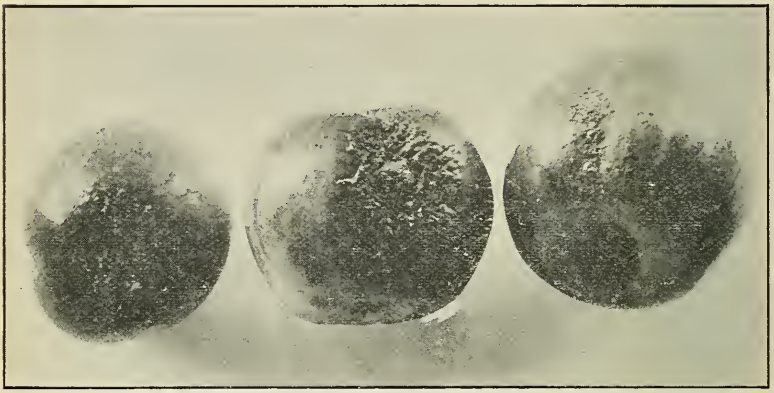


FIG. 22—Injury on fruit caused by cedar rust. Leaves are also affected.

The leaf spot is generally controlled when the ordinary lime and sulphur (summer strength) is applied carefully after the blossoms fall. A thorough spraying at this time would likewise do much to keep the black rot in control. General sanitary methods such as the removal of mummied fruit and dead and diseased cankered limbs would help a great deal in the control of these troubles. Where bitter rot is prevalent, three or four sprayings of Bordeaux mixture 3-5-50 should be applied every two weeks beginning about July first. This is a disease of the ripening fruit, the outbreaks of which are worse after a period of hot and rainy weather.

Where twig and fire blight is found the affected parts should be removed and burned. Care should be taken to sterilize the pruning implements with corrosive sublimate, as this disease can easily be carried from tree to tree by the tools. A more detailed discussion of this trouble is found under Table XIII where pears are discussed.

SPRAYING PRACTICES.

Spraying has taken its place as one of the necessary orchard practices in Berkeley County. Practically every orchardist sprays. Many of the young trees are sprayed for San José scale from the third year on. Most of the orchards

*Giddings, N. J. and Berg. A.—W. Va. Agr'l. Expt. Sta. Cir. 15.

after they come into bearing are sprayed three times. The first spray is applied as a dormant spray before the buds open. Concentrated lime and sulphur 1 to 8 is the spray used. The second spray consists of lime and sulphur 1 to 40, with 2 pounds of arsenate of lead to every 50 gallons of spray, and is applied just after the blossoms fall. This is the spray, which should be applied with especial thoroughness, for if properly done, the codling moth, black rot and leaf spot will all be held well in check. The third spray is generally applied either three weeks after the second spray, using the same materials,

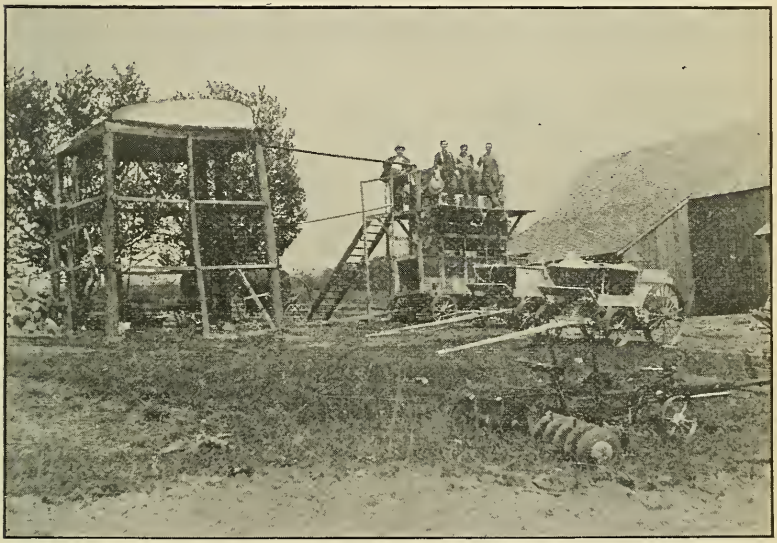


FIG. 23—An outfit for making lime and sulphur solution at one Berkeley County orchard.

or in some cases it is applied about the middle of July, when it is for the purpose of controlling the second brood of codling moth and preventing the bitter rot. Bordeaux mixture should be the fungicide used at this time, as it is more successful against bitter rot. In many cases the growers make their own lime-sulphur (Fig. 23); others buy the concentrated solution already prepared. The gasoline power outfits most commonly used are the Hardie, Deming, New Way, and Domestic. These outfits have a capacity varying from 150 to 250 gallons. Probably the Domestic is in most common use. This outfit is a simple one and has the advantage that its factory is at Shippensburg, Pennsylvania, not far from Berkeley County. Since repairs etc. can be obtained quickly by train, the growers like to handle this outfit. However, all of the above makes

seem to be giving satisfaction. A few compressed air outfits are being used. Where the ground is level, generally two horses and two men work at each outfit, but in many cases four mules and three men are needed. Since most of the men spray three times no figures can be shown as to the relation existing between the number of sprays and yields and incomes, but the amount of spray used on trees of different ages and the cost of spraying was ascertained.

The Amounts of Spray Used on Trees of Different Ages.

TABLE XXXVI.—*Amounts of spray used at different ages.*

Age of Trees (years)	No. of Orchards	No. of Trees	*Amt. of Dormant Spray Used per Tree (gallons)	Amt. of Codling Moth Spray per Tree (gallons)
2 to 5	9	37,087	.54	.....
6 to 7	20	33,583	1.75	1.6
8 to 11	37	59,828	2.21	1.88
12 to 13	14	9,240	3.2	2.32
14 to 17	28	29,379	4.9	4.29
18 to 24	9	4,697	7.	5.4
25 to 30	6	2,454	4.28	5.6

*Diluted spray as it comes from the tank.

Table XXXVI is interesting in-as-much as it gives us some idea as to the average amount of spray put on trees of different ages. The amounts of spray applied at each application increases gradually with the age of the trees until those trees from 18 to 24 years are reached. Here we find 7 gallons of spray being applied during the dormant season and 5.4 gallons during the codling moth spraying. It is generally thought that it takes more material for the codling moth spray than the dormant spray, but this table shows that in the case of Berkeley County, at any rate, the reverse is true. In every case, less spray is required for the second spraying. This may be due in part to the fact that discs with exceptionally large holes are used for the dormant spraying while some of the growers use the finer nozzles for the summer sprays. Some growers use about the same amount of spray at each application, while some use more at the second and third spraying. There is no doubt but that more spray is wasted with the coarse disc nozzle than would be the case if nozzles having smaller holes in the disc were used. The smaller sized hole would make a finer mist, which would probably be more successful in controlling the fungous diseases, with less injury to the fruit and foliage.

From the table we see that on the average it takes from five to seven gallons of spray for the bearing trees. The probable reason for the apparently lesser amounts of spray used on

the trees from 25 to 30 years old than from 18 to 24 years, lies in the fact that these orchards were smaller and more or less neglected and were sprayed with a barrel outfit. Men get tired sooner than engines.

Cost of Spraying.

The cost of spraying will vary of course under different conditions. The age of trees, contour of the land, kind of outfit, number of men and horses used and several other such factors all enter in to vary this cost. Table XXXIX gives the average cost of spraying trees of different ages as found in Berkeley County.

TABLE XXXVII.— *Cost of the dormant spraying.*

Age of Trees	No. of Orchards	No. of Trees	Cost of Dormant Spray per Tree (Materials and Labor)
2 to 5	8	7,387	.015c
6 to 7	16	26,304	.031c
8 to 11	26	47,016	.054c
12 to 13	9	6,846	.061c
14 to 17	23	26,129	.092c
18 to 24	7	3,697	.131c
25 to 30	4	990	.093c

TABLE XXXVIII.—*Cost of codling moth spray per tree. (Second spray.)*

Age of Trees	No. of Orchards	No. of Trees	Cost of Codling Moth Spray (Material and Labor)
2 to 5	2	651	.0125*
6 to 7	6	7,559	.02
8 to 11	8	13,663	.035
12 to 13	7	6,144	.04
14 to 17	10	16,312	.052
18 to 24	2	1,124	.088
25 to 30	2	640	.05

*Cost of applying Black Leaf 40 for green aphis, after the leaves have opened.

TABLE XXXIX.—*Total cost, per tree, of three sprayings in Berkeley County.*

Age of Trees	Cost of 1st Spray	Cost of 2nd Spray	Cost of 3rd Spray[1]	Total Cost of Spraying[2]
2 to 5	.015	.0125	.....	.0275
6 to 7	.031	.02	.....	.051
8 to 11	.054	.035	.044	.133
12 to 13	.061	.04	.05	.151
14 to 17	.092	.052	.065	.209
18 to 24	.131	.088	.11	.329
25 to 40	.093	.05	.062	.205

[1] This is estimated as one-fourth more than the cost of the second spraying as no figures were obtained in Berkeley County.
[2] No depreciation on outfit or interest on investment was charged.

Tables XXXVII and XXXVIII show the cost for the first and second sprayings respectively. Table XXXIX sum-

marizes these two tables and gives the total cost of three sprayings. The results found for the first two sprayings are the actual figures from the growers themselves. The cost of the third spraying is estimated, since no figures were obtainable. From general observations the third spraying will cost about one-fourth more than the second and it is so estimated in the table. The cost of the dormant spraying is seen to be the most expensive. This spraying is done much more thoroughly than the others and of course more lime and sulphur is used, which probably accounts for the higher costs. More spray is wasted also, which helps run up the cost. In figuring up the cost of spraying, lime and sulphur was figured at twelve cents a gallon and arsenate of lead at eight cents a pound. The cost of man and horse labor was figured as indicated in Table XLI. Thus the cost of spraying bearing trees from 15 to 20 years old, exclusive of depreciation and interest will vary from twenty to thirty cents per tree. Somewhat similar results have been found by other investigators*. In these cases their results are higher or lower according to their local conditions.

Cost of Board and Lodging per Day and per Month in Berkeley County.

TABLE XL.—*Cost of board and lodging per day and per month.*

Rate	Cost per Meal	Cost per Three Meals	Cost of Lodging	Total Cost of B'd. & L'dging
Day	$ .152	$ .456	$ .116	$ .57
Month	4.56	13.68	3.48	17.10

In order to figure the labor cost as correctly as possible figures were obtained from twenty-two of the fruit men regarding the cost of meals and lodging. In those cases where labor was paid by the day with board, the value of this board was added to the salary and the real charge entered against each account. The results show the cost per day and month of board and lodging. From these figures it can be assumed that when a man is paid by the day or month with board, he is really getting 57 cents a day or $17.10 a month more than actual cash received. Some growers with large camps were feeding the men good meals at a cost of eight and ten cents, while the cost was much higher in other cases. It is interest-

*Chandler, W. H.—Mo. Agr'l. Expt. Sta. Bul. 102.
Goodwin, W. H.—Ohio Agr'l. Expt. Sta. Bul. 216.
Howard, W. L.—Mo. Agr'l. Expt. Sta. Bul. 124.
Arnold, J. H.—U. S. Dept. Agr. Bul. 29.

ing to see that the cost of board and lodging is very similar to that found in Minnesota* and other eastern states†.

The Cost of Man and Horse Labor.

Figures were obtained from twenty-eight fruit growers regarding the cost of horse labor and from a large number of others concerning the cost of man labor. The averages of these figures were taken. Table XLI gives the results.

TABLE XLI.— *Cost of man and horse labor per day.*

Cost of Day Labor with Board	Cost of Day Labor without Board	Cost of Single Horse	Cost of Two Horses and Driver	Cost of Four Horses or Mules and Drivers
$1.25	$1.42	$ .835	$3.12	$4.76

A study of the above table shows that on the whole, man and horse labor is not expensive in Berkeley County. Many men receive only one dollar per day, while other run as high as $1.75 and $2.00 per day. This makes an average of $1.42 a day without board. These figures were used when finding the cost of spraying and hauling.

COST TO PICK, PACK AND HAUL THE CROP.

Figures were obtained on what it cost to pick, pack and haul the crop from 52 orchards. These figures covered the costs on 63,763 barrels. The varieties were mostly Ben Davis, York Imperial, Arkansas (Mammoth Black Twig) and Grimes. Results are shown in the following table:

TABLE XLII.— *Cost to pick and pack a barrel of apples.*

No. of Orchards	No. of bbls. Considered	Cost per bbl. to Pick	Cost per bbl. to Pack	Total Cost to Pick and Pack per bbl.	Cost of bbls. (3 yr. av.)
52	63,763	$ .157	$ .083	$ .24	$ .32

TABLE XLIII.—*Cost of hauling different distances per barrel.*

Distance Hauled	Cost per barrel to Haul
1 mile	.03
2.3 miles	.055
4 miles	.07
5.6 miles	.08
7 miles	.11
8.9 miles	.16 to 17
11 miles	.18

*Peck, F. W.—Minn. Agr'l Expt. Sta. Bul. 145.
†Funk, W. C.—U. S. Dept. Agr. Farmers' Bul. 635.

From Table XLII we see that it costs 15.7 cents to pick and 8.3 cnts to pack a barrel of apples in Berkeley County. The total cost to pick and pack is 24 cents per barrel By referring to Table XLIII we find the cost per barrel of hauling different distances. When these figures were added to the cost of picking and packing, we have the total cost of picking, packing and delivering. The price of the barrels (32 cents) can be added to this if desired. These costs are very similar to those found in the state of New York*.

It was found that a man picked 13 barrels per day on the average. The men packed an average of 23.8 barrels per day for each man around the table. While it is seen that these figures are rather low, this is due mostly to the very incompetent transient help that must be used at this time. Wages are correspondingly low with this help so that one balances the other, and the final cost of picking and packing is about what it should be.

POORER GRADES OF FRUIT AND BY-PRODUCTS.

Without doubt a considerable amount of the "drops" and "culls" go to waste in Berkeley County. At the present time the Cumberland Valley Fruit Products Company (a vinegar plant) is the only large by-products plant in the county. This up-to-date plant has a yearly output of from 8,000 to 10,000 barrels of pure apple cider vinegar. This means that from 125,000 to 150,000 bushels of apples are used. Most of these apples come from Berkeley County, either hauled in or shipped in by the carload lot from stations along the Cumberland Valley Railroad. In some years, however, apples are bought from nearby states.

Besides this plant there are three custom cider presses in the county, one at Tablers, one at Nollville and one at Lupton Brothers near Martinsburg. These presses use from 5,000 to 8,000 bushels of apples yearly. With the exception of these plants there are no others except one or two home screw presses. The only evaporator in the county—the one at Inwood—burned last year.

There is no doubt but that two or three evaporators would pay in the county. Authorities estimate than from 25 to 35 percent of the poorer grades in the county go to waste. Certainly it is a fact that the growers can not afford to allow this waste. While the returns would not be much per acre in many cases, still in others it is an important factor. If nothing is done with the fruit, it is a total loss. It is these small

*Hedrick, U. P.—N. Y. Gen. Agr'l. Expt. Sta. Bul. 376.
Miller, G. H.—U. S. Dept. Agr. Bul. 130.

profits and losses which often decide the success or failure of a business. Apple growing is not excepted.

TABLE XLIV.— *Returns from poorer grades of fruit.*

Year	No. of Orchards	No. of Acres	Av. No. of lbs. per Acre	Av. Gross Returns per Acre
1909	9	162	1878	$5.39
1910	11	229	1800	5.30
1911	30	736	2078	6.51
1912	17	355	1744	5.69

Table XLIV shows the average receipts per acre received by some of the orchardists who sold the poorer grades from the orchard. While this amount is not large per acre, it counts up quickly in a hundred acre orchard. Some growers realize from $15 to $20 per acre from the poorer grades. As can be seen an average four-year price of thirty cents per hundred has been received for the apples. There is need for more by-products plants in the county and more attention should be given to the poorer grades of fruit.

YIELDS, MARKETS, PRICES AND INCOMES.

Yields. Berkeley County is already producing considerable fruit each year. As yet hardly half of the trees are in bearing. In ten years from now when all the trees in the county bear a heavy crop the marketing problem will be an important consideration.

TABLE XLV.—*Approximate total yield for the entire county.*

Year	Barrels
1910	108,000
1911	178,920
1912	138,240
1913	60,000
1914	250,000

The estimates for the first three years were found by multiplying the total number of bearing trees in the county by the average yield per tree found in Table XLVI. The estimates for the last two years are from the growers and buyers. In 1912, the cedar rust and a hail storm which swept along Apple Pie Ridge in the fall reduced the crop. In 1913 two severe freezes in the early spring destroyed the crop. In 1914 the crop was exceedingly large, as was the case over the entire country.

TABLE XLVI.— *Average yield per tree.*

Year	Barrels
1910	.96
1911	1.42
1912	.96
1913	.41
1914	1.73

The yield per tree for the first three years was found by dividing the average yield per acre (Table XLVII) by the average number of trees per acre. In the case of the last two years the total estimated yields were divided by the total number of bearing trees to get the yield per tree. Many individual orchards of course yielded higher than this average; others yielded lower.

TABLE XLVII.—*General average yield and income per acre.*

Year	No. of Orchards	No. of Acres	Total Yield in bbls.	Av. Yield in bbls. per Acre	Total Gross Income	Av. Gross Income per Acre
1910	95	2358	81,587	34.6	$194,322.78	$ 82.41
1911	95	2358	120,494	51.1	268,010.28	113.66
1912	95	2358	82,058	34.8	174,869.28	74.16

Three year average yield per acre 1910, '11, '12.....40.2 bbls.
Three year average gross income per acre 1910, '11, '12 $90.08

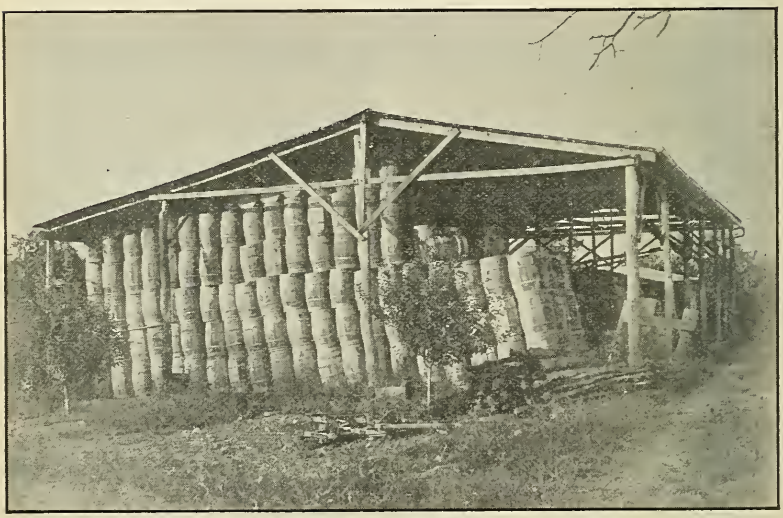


FIG. 24—Preparing for the crop. It pays to have barrels on hand early.

Markets and Incomes. The bulk of the Berkeley County apple crop is sold in barrels (Figs. 24 and 25). A few orchardists box their higher quality apples, such as the Grimes and Jonathan and claim that the returns are enough greater to pay them to do it. There is no doubt but that more boxing will be done in the future when the younger plantings of Stayman Winesap, Jonathan and Delicious come into bearing. The growers are realizing more and more that a product of higher quality is being constantly demanded on the market. The day

when everything could be put into a barrel and sold has passed.

A large proportion of the crop is bought each year by commission men from New York, Baltimore, Washington, Pittsburgh, and other eastern cities, although Rothwell & Company, a local produce concern handles a considerable portion of it. Some fruit is exported each year and the famous Gold Medal brand is becoming known in foreign countries as well as at home. Conditions are ideal in Berkeley County to form a strong co-operative fruit growers' association, as far as inspecting, grading and shipping the fruit goes. No doubt if the growers would combine and pull together, a strong and valuable association could be formed. This is especially desirable when we know that heavy plantings of young trees will soon come into bearing. The principles of forming such an association are explained in a recent book by G. Harold Powell*.

Table XLVII gives the average yield and income per acre for 1910, '11 and '12, for all orchards over ten years old from which data could be obtained in Berkeley County. Ninety-five orchards and 2358 acres were used in obtaining these results. The three year average yield and gross income per acre for the county is 40.2 barrels and $90.08 respectively. This average was much less in 1913, due to the spring freezes.

TABLE XLVIII.—*Average price per barrel and yield and income per tree.*

Year	Price per Barrel	Average Yield per Tree (bbls.)	Av. Gross Income per Tree
1910	$2.38	.96	$2.29
1911	2.22	1.42	3.15
1912	2.13	.96	2.04

Three year average price per barrel.....$2.25
Three year average yield per tree.....1.11 bbls.
Three year average gross income per tree.....$2.49

Expenses and Net Income per Acre. In order to get some idea as to the average net income per acre, the total cost of producing a barrel of apples must be known. Unfortunately such figures are scarce. However, the actual cost of producing a barrel of apples over a ten year period as given by the New York Experiment Station† is as follows:

*Powell, G. Harold—Co-operation in Agriculture, The Macmillan Company, New York City, 1913.

†Hedrick, U. P.—New York, Geneva Agr'l Expt. Sta. Bul. 376.

Items	Cost per Barrel
Interest on investment	$ .21
Taxes	.012
Tilling	.063
Pruning	.03
Spraying	.096
Cover crop	.023
Superintending orchard	.25
Picking, packing, sorting and hauling	.244
Cost of barrels	.36
Total cost per barrel to produce	$1.29

While these figures are taken from New York orchards they are fairly adaptable to our conditions and serve as a guide in fixing this charge. By referring to Tables XXXIX and XLII it will be seen that the costs of spraying as well as

FIG. 25—Method of hauling the crop in Berkeley County.

picking, packing, sorting and hauling found in Berkeley County are very similar to those of New York. Several of the fruit growers in the county who keep accurate costs of all orchard operations say that it costs from $1.00 to $1.25 per barrel to produce apples. Therefore it seems safe to say that it costs $1.25 per barrel to produce apples in Berkeley County.

Referring to Table XLVII we see that the three year average price per barrel was $2.25. By subtracting the cost of production ($1.25) from this amount we have a net income of $1.00 per barrel. Since the average yield per acre was found to be 40.2 barrels, multiplying this figure by $1.00 gives an average net income of $40.20 per acre to the Berkeley

County fruit growers. It must be remembered that this is the average for all orchards; the well cared for orchards are returning a much larger net income per acre. (Table XXII.)

TABLE XLIX.—*Distribution of orchards according to three year average yields.*

Yield per Acre in Barrels	Number of Orchards	Per cent of Orchards	Number of Acres	Per cent of Acres
0 to 19	27	28.1	684.	26.9
20 to 39	27	28.1	646.5	26.9
40 to 59	19	20.	344.	14.2
60 to 79	13	13.4	582.	24.1
80 to 89	6	6.	142.	5.9
90 to 99	2	2.	26.	0.9
100 to 109	1	1.	19.	1.
110 to 119	0	0	0	0
120 to 139	0	0	0	0
140 to 150	1	1.	6.	.3

TABLE L.—*Distribution of orchards according to three year average incomes.*

Income per Acre in Dollars	Number of Orchards	Per cent of Orchards	Number of Acres	Per cent of Acres
0 to 19	5	5.2	207.	8.3
19 to 39	23	23.9	442.	17.
40 to 69	17	17.6	365.5	14.7
70 to 99	14	14.5	364.	14.6
100 to 129	15	15.5	444.	17.9
130 to 159	5	5.2	64.	2.6
160 to 189	7	7.2	411.	16.5
190 to 209	4	4.1	111.	4.4
210 to 239	3	3.1	42.	1.7
240 to 269	1	1.	13.	.5
270 to 300	2	2.1	25.	1.

Tables XLIX and L classify the orchards in the county as to yields and incomes. It will be remembered that in Table XLVII we found that the three year average yield and income per acre for the county was 40.2 barrels and $90.08 respectively. By studying the above tables it can be seen how many orchards are yielding above and how many below these averages. Practically one-half of the total orchards and acres are not producing as high yields as the average for the county. However several orchards are far above this average, ten of them producing over twice as much as the county average.

It is found that when Table L is studied, practically the same results are true as regards income. About one-half of the orchards are returning an income below the average of the county, and one-third of the orchards are returning a profit twice as large as the average. Thirty-eight percent of the orchards and 44.6 percent of the acreage is returning a gross income of over $100.00 per acre. Eight orchards have a three year average income of over $200.00 per acre. It is the large number of poorly cared for orchards on poor soils, which brings the three average yield and income down to

the figures mentioned. Would it not pay to give these orchards a little better care and thus reach the yields and incomes obtained by the better orchards? It will be interesting for each grower to study his particular orchard with reference to the last two tables. Note whether it falls below the average or above. If below, better care should be given it, if just a little better than the average make it still better.

SUMMARY.

Extent of the Survey. During the summers of 1912 and 1913 every commercial orchard in the county was visited and records of it were obtained—a total of 247 orchards comprising 11,204.6 acres.

The Apple Rank of West Virginia and Berkeley County. According to the 1910 census West Virginia has a fairly high and uniform rank as a fruit state in comparison to the other states in the Union. She stands twelfth in total production, twelfth in total value of her crop, fifteenth in total number of bearing apple trees, and fourteenth in total number of non-bearing apple trees. In a recent estimate of Farmers' Bulletin 695, West Virginia ranked eighth in total apple production in 1914. She now stands sixth in total number of non-bearing apple trees. Berkeley County in the Eastern Panhandle is the largest apple producing county in the state and the remaining summary concerns the industry in that county.

Number of Acres and Trees in the County. There is a total of 11,813 acres and 583,657 apple trees in Berkeley County. Of these amounts, 11,204.6 acres and 560,063 trees are in orchards of five acres or more in size. This leaves 608.4 acres and 23,594 trees found in orchards of less than five acres. Considering the trees as bearing at eight years old we find that in the commercial orchards 60% of the trees are not yet bearing. The industry is comparatively young. Very few trees are over twenty years old.

Classification of Fruits in the County. The apple is by far the most important fruit in the county. Peaches are next in importance, followed by pears, plums, and cherries.

Geographical Distribution. The heaviest plantings of apples in the county are found along Apple Pie Ridge, just east of North Mountain. This ridge extends in a northeast and southwest direction through the approximate center of the county. Plantings are also found just east of the ridge in the Hagerstown Loam (Limestone) area. More than one-third of the total acreage of apples in the county is found back of North Mountain in Back Creek Valley. Two-thirds of the total number of peach trees and more than one-half of the total pear acreage is likewise found in this valley. The plantings are much lighter in the northeastern (Falling Waters)

district and the southeastern part of the county between the Baltimore & Ohio Railroad and the Jefferson County border. See map.

Age of Trees in Relation to Yield and Income. The orchards as a whole are young in Berkeley County; 94% of the total acreage of the county has been planted in the last 18 years; 33% of the acreage was planted in the years 1912 and 1913 and the trees are now two and three years old; 44% of the acreage was planted between the years 1909 and 1913 inclusive; 29.3% between the years 1904 and 1908 inclusive, and 20.9% between the years 1896 and 1903 inclusive. The oldest commercial orchards are some five acres in area and are 50 years of age, there being two orchards of this same age and size. The oldest large commercial orchard is one of 37 acres and is 37 years old.

The largest yields and incomes are being obtained from those orchards between 19 and 22 years of age, although there is no reason why older orchards with good care should not be equally as productive and profitable. When more of the orchards get older no doubt it will be found that the older orchards will be just as profitable.

The Size of Orchards. The orchards in the county vary from 1 to 487 acres in size. The typical orchard is about 15 acres in area although the average sized orchard, due to so many large company orchards, is 45 acres. There are more than 30 company orchards, all being over 100 acres in size.

A definite relation of size of orchard to yield and income unfortunately could not be obtained, since so many of the large orchards were of non-bearing age and reliable data could not be had. The survey indicates however that the largest orchards are not the most profitable.

Exposure or Slope. The exposure or slope of the orchards is not an important factor in Berkeley County. All exposures are found but in many cases the term is only a relative one as most of the orchard sites are not steep or hilly enough to make their exposures important.

The exposures, likewise have little if any effect on the yields and incomes. It is rather a question of soils and good management. Those orchards with southern or southeastern exposures probably have a little better colored fruit, and danger from winds is lessened. In the hilly sections, the orchards should be planted high enough to be above the frost line.

Planting Plans. The square system of planting is the most popular; 80.5% of the orchards are planted by this system. The rectangular system is the next in importance, leaving only a very few orchards planted by the quincunx and hexagonal systems. Most of the orchards have been planted 30 x 30 feet although there is a tendency in later years to plant trees a little farther apart. Most of the orchards are now being planted either 33 x 33 or 36 x 36 feet.

Varieties. Most of the bearing trees in the county are Ben Davis, York Imperial, Grimes and Arkansas (Mammoth Black Twig) although in the recent plantings there is a tendency to eliminate the Ben Davis and cut down the number of York Imperial. The varieties now being planted are all high quality ones, such as the Stayman Winesap, Jonathan, Grimes, Arkansas (Mammoth Black Twig), and Delicious. Several York Imperials are still being planted and some growers report the Lawver, Akin, Northwestern, Arkansas Black and Yellow Transparent. Generally only three or four varieties are found in a commercial orchard.

Management of Orchards. Orchards are managed in one of four ways in Berkeley County, either by renters, owners, managers hired by owners, or by orchard companies.

The renters are so few in the county (only two orchards) that they need hardly be considered. Some men have moved off of the farm and have hired a man by the month to work it. The management of the orchards under this head is classified as "Managers." About 19% of the orchards are so managed. Owners living on their own farms manage 53.3% of the orchards, however since the average size of the orchards is not large in this class, only 31% of the acreage is so managed. Although only 17.3% of the orchards are managed by orchard companies, still due to the large average size of the orchards, over 50% of the acreage is managed in this way.

Those orchards managed by the owners themselves seem to be giving the largest yields and incomes, although enough data could not be obtained from the company and rented orchards to accurately compare with that from those orchards managed by owners and managers. Indications are that the company orchards are not being worked as intensively as the smaller orchards and thus are not yielding as high returns per acre. A smaller acreage handled better will probably return as large total profits.

Soils and Their Relation to Yield and Income. There are five general soil types in the county. At the western border

along the base of Third Hill Mountain is a strip of "Penn Sandy Loam" (red shale). The rest of the valley up to North Mountain is a yellow shale, except some small outcroppings of limestone areas in the Tomahawk and Jones Springs sections. Just east of North Mountain is a strip of Hagerstown shale loam (black slate). Adjoining this shale on the east is the Apple Pie Ridge soil, a variation of the Hagerstown loam (limestone). Between the Apple Pie Ridge and the chain of quarries which extends through the county east of the Cumberland Valley Railroad is found the Hagerstown loam (limestone) while most of the remainder of the county to the Jefferson County border is made up of yellow shale, except a narrow strip of black slate land at the extreme eastern end.

The largest yields and incomes are being obtained on the average from those orchards planted on the Apple Pie Ridge soil, followed closely by those on the limestone soils. The orchards on the Penn sandy loams (red shales) are returning the next highest profits, followed by those on the yellow shales and Hagerstown shale loam (black slate). Peaches are doing especially well on the Penn sandy loam (red shale). Drainage is not an important factor in the county, although tile drains would help in some orchards.

Cultural Methods and Yields. Clean cultivation with cover crops is the popular method of handling orchard soils. Cultivation yearly from the time they came into bearing has been practiced in 54.3% of the orchards; 11.7% are alternately tilled and left in sod; 12.2% have been either tilled or left in sod most of the time, while only 22% have been in sod since bearing.

The three year average income (1910, '11 and '12) for orchards that have been cultivated five years or more since bearing is 108.3% greater than for those orchards which have been in sod continually for the same length of time. Other comparisons found in Table XXVI are likewise in favor of cultivation rather than sod.

The non-bearing orchards are generally intercropped with corn, although in many, a three year rotation of corn, wheat and hay is used. It would be better if some cultivated crop could be substituted for the cereals and hay.

Orchard Fertilization and Incomes. Seventy-four percent of the non-bearing orchards receive fertilizer of some sort, 49% is commercial fertilizer, the remaining percentage is either manure or both manure and commercial fertilizer. The common practice is to put a handful of bone meal in the hole

at planting, although some complete fertilizers are used.

Of the bearing orchards 75% also receive fertilizers of some sort, 52.2% of this amount is commercial fertilizer, in most cases being a high grade complete fertilizer analyzing about 4% nitrogen, 8% phosphoric acid and 10% potash.

Stable manure on sod orchards gave the highest yields, Table XXXIII, while in cultivated orchards, about the same yields were obtained from the use of either manure or commercial fertilizer, Table XXIV. The greatest yields were obtained when both were used. If plenty of stable manure could be obtained, commercial fertilizers would not be necessary but since enough is not available, they must be resorted to.

Pruning. Pruning has not been as well done in the county as the other orchard operations. About 80% of the orchards are pruned in the spring, varying in degree from light to moderate. There has been very little system to the pruning and in most cases it has been poorly done.

The trees as a rule have not been cut back enough when young and too many main limbs have been left to form the head. Thick trees made up of slender limbs have resulted.

Diseases and Insects. The most common insects found in the county are San José scale, codling moth, green aphis, and woolly aphis. These are all being well controlled except the woolly aphis on the roots.

The diseases most troublesome are collar blight, apple or cedar rust, and leaf spot, although the black rot and twig blight are serious in some orchards. The collar blight is especially bad on the Grimes. It should be cut out when found and the wounds painted with white lead. The cedar trees should be cut down to prevent apple rust, since this rust fungus passes seven-eighths of its life on the cedar. Spraying is not practical in combating this disease.

Spraying. Practically every orchardist in the county sprays. Three sprayings are generally made, one before the leaves come out, one just after the blossoms fall and one either three weeks later or else about the middle of July. Lime and sulphur is used both as the contact spray and as the fungicide (summer spray), when diluted. Arsenate of lead is the poison used.

More spray is being applied at the first spraying than the second. From five to seven gallons is put on each bearing tree eighteen years or more in age. The total cost per tree for the three sprayings is from twenty to thirty cents.

Cost of Board and Lodging. The average cost of board and lodging per man on the farm was fifty-seven cents per day or $17.10 per month.

Cost of Man and Horse Labor. Labor with board costs $1.25 per day on the average. Without board the cost is $1.42. Single horse labor cost 83½ cents per ten hour day, two horses and driver receive $3.12, while four horses or mules and driver receives $4.76.

Cost to Pick, Pack and Haul. It costs 15.7 cents to pick, and 8.3 cents to pack or a total of 24 cents to pick and pack a barrel of apples in Berkeley County. Hauling costs from 3 to 18 cents per barrel, where apples are hauled from one to eleven miles. Barrels cost 32 cents on the average.

Poorer Grades of Fruit. There is one large vinegar plant of from 8000 to 10000 barrels output yearly and three smaller custom cider presses in the county. About 175,000 bushels of the poorer grades of fruit are handled yearly by these plants. About 25% of the poorer grades of apples still go to waste. Evaporators would pay in the county. More of the growers should pay attention to the poorer grades. The four year average gross returns have been above $5 per acre, while some men have realized as high as $15 and $20 per acre from this fruit.

Yields. The average yields per acre have been: 1910, 34.6 barrels; 1911, 51.1 barrels, and 1912, 34.8 barrels, with a three year average yield of 40.2 barrels per acre. The three year average yield per tree was 1.11 barrels.

Prices. The average price received per barrel have been: 1910, $2.38; 1911, $2.22; 1912, $2.13. The three year average price was $2.25 per barrel. The poorer grades have sold at 30 cents per hundred pounds.

Markets and Incomes. Most of the fruit is sold in barrels, either to commission men in the eastern cities or locally to Rothwell & Company, produce dealers.

The average gross income per acre has been: 1910, $82.41; 1911, $113.66; 1912, $74.16. The three year average gross income per acre was $90.08. The well cared for orchards have done much better than this average. (Table XXII.)

The cost to produce a barrel of apples is $1.25. Since the three year average gross price per barrel was $2.25, this leaves a net profit of $1.00 per barrel. With 40.2 barrels per acre yield, this means that apples are netting $40.20 per acre.

Orchard Distribution as to Yield and Income. About 50% of the orchards in the county are producing below the average, in yield and income, others are yielding twice as much. Better care should be given the poorer orchards, so that this general average yield of 40.2 barrels and $90.08 gross income per acre will be greatly increased in the next few years.