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CREW WORK, COSTS, AND RETURNS IN COMMERCIAL ORCHARDING IN WEST VIRGINIA.

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INTRODUCTION.

One of the most highly developed enterprises illustrating the principles of farm management is that of commercial orcharding. There is a lack of concrete data available to the public, however, on the costs of various operations connected with orcharding, as well as the net returns which may be expected in a series of years under varying conditions. Also there is a lack of specific information in regard to the organization of labor on fruit farms, the rate of work for each operation, and the kind and number of operations necessary to insure success.

Like every other business enterprise it must be recognized that the cost of operations, labor units, and standards of labor in the orchard vary with conditions, the principal determining factors being land features, such as soil, topography, climate, distance to shipping point, and markets. Those interested in orcharding as a practical business enterprise should know what these cost units and standards of labor ought to be under these specified conditions when directed by a trained and experienced manager, as well as to know the results of average experiences. Such data enable one to measure his success along any one of these lines and they also furnish a scientific basis for calculating the profits that might reasonably be expected in orcharding.

The writer has attempted in this bulletin to summarize and analyze the experiences in orchard management of individuals who have been pioneers in the development of this industry in a region which undoubtedly has many favorable locations for profitable fruit raising. This region lies in the drainage basin of the Potomac River in West Virginia. It is intended to interpret the orchard management achieved by these pioneers in a way to assist them in its further development and to enable others to profit by the results of past experience.

A great waste of resources has been sustained in gaining this experience. One large orchard company alone estimated its losses during the past 21 years, due to inexperience and lack of knowledge of peach growing in this section, at \$100,000. The loss for the same reason for more than a century to small farmers carrying on the industry can hardly be estimated. This loss has been due (1) to a lack of knowledge of the control of fungous diseases and insect pests; (2) to a lack of knowledge of the natural and economic advantages necessary in selecting the orchard site, such as soil and weather conditions, enabling one to avoid expensive methods of control; and (3) to inexperience in methods of management.

At the present time there is great interest in orchard enterprises, and many seem to be led to invest their savings in them with no knowledge whatever of the factors which must inevitably determine the success of such enterprises. Such may have an opportunity to profit by the principles worked out by past experience.

The fact is emphasized in this bulletin that the specific operations described in some detail are meant to explain the organization of the fruit farm and to determine costs and that they are not presented to give information regarding the technical operations of fruit production.

SOURCES OF INFORMATION AND METHOD OF INVESTIGATION.

The facts and conclusions stated herein have been worked out from data obtained in a study of the history of orchards which have survived during the past 10 or 20 years and on several of which accurate financial records have been kept. These orchards are well distributed over the area described and are located on various soil types, mostly confined, however, to the red soils and "chert" soils. Some of these orchards have yielded large profits to the owners; some have probably not yet paid expenses after 8 or 10 years.

Besides analyzing the financial records of these orchards, each one has been studied with reference to its location and to the various operations performed which are necessary to its maintenance and profit. Many of them have been visited at intervals during the past two years in order to become acquainted with the managers and to see the actual work as it was being carried on. This has been done to determine the causes of the large variation in the costs of operating expenses and to determine the limiting factors in the yield and quality of peaches, probably the most important facts from the standpoint of profit.

A careful field study has been made of the soil, topography, and climatic conditions of this section, and the official data on these subjects have been analyzed and correlated with the field study.

This has been done to provide a proper basis for estimating the value of natural advantages, such as soil, relative elevations, and exposures, in lessening the cost of production. Experienced orchardists in this section have estimated the value of these natural advantages very closely in so far as past experience has thrown light on the subject. Good evidence of this is the fact that orchards are already planted on such favorable sites or the land is bought and held at a value commensurate with such advantages as it is believed to possess.

Estimated yields for the bearing period of such orchards are based on averages, as are also the prices given. The variations are also given and the causes of these variations stated, in so far as they could be determined.

The cost units and standard units of labor given have been worked out from data furnished by a few orchardists who have given particular attention to this problem in orchard management. The most accurate and completely worked-out data along this line were furnished by two orchardists in particular whose training and experience have peculiarly fitted them for this work.

DESCRIPTION OF THE REGION.

The orchards studied are located in the mountainous section of West Virginia in the basin of the Potomac where during the past 10 years not less than 2,500,000 fruit trees have been set out. Probably most of these have been planted during the past four years.

The higher elevations of this section have long been considered well adapted to the raising of peaches. The steep mountain ranges with narrow valleys make air drainage good and furnish such locations as are believed to be favorable for the vigor and health of the trees. Some orchards are planted on various slopes and at different elevations, within certain limits, in order to vary as much as possible the ripening period of the same variety, thus avoiding a rush at picking time.

The benefit of air drainage is shown in the fact that in the year 1912, after one of the most severe winters known to the older inhabitants, the peach crop was especially good on certain elevations where conditions of air drainage were good. On these elevations the buds were not killed, while lower down in the valleys not only the buds but in many cases the new wood was killed, so that the entire top of the tree had to be removed and a new one allowed to grow. The lowest temperatures occurred during the month of January, when the lowest temperatures observed on the tops of some of the higher mountains were 7° to 9° F. below zero, while in the valleys the temperatures at the same time were as low as 20° to 30° below zero.

The two types of soil considered most favorable for peach orcharding in the mountainous section of the basin of the Potomac are the "chert" soils (fig. 1), derived from a limestone which in the process of disintegration has left hard, flinty, loose rocks lying on top of a rich, dark loamy, sometimes sandy, soil, and the red soils (fig. 2) derived from a red and pink shale and sandstone.

The chert land usually drains well and does not wash, except in particular cases where the land is very steep and is underlain by a hard, impervious clay. It is usually found on the sides and tops of



FIG. 1.—Typical chertland, showing the rock on the surface.

long steep ranges, such as Romney Mountain, just west of Romney, or on the tops and sides of the knoblike mountains near Keyser, W. Va. Besides being very fertile, the loose rock lying on the surface holds the moisture, a condition found to be very important in peach growing.

The red soils are found principally on the east slopes of mountain ranges and high valleylike areas between the hills, known locally as "levels." These lands as a rule have a more level topography and are usually free from large, loose stones. On the hillsides, however, these soils are shallow, sometimes being only a few inches deep over the sandrock or shale lying beneath. Two and four horse implements

are worked to advantage on such soils, thus lessening the cost of cultivation, while on the chert lands one and two horse implements must be used.

Rainfall¹ is an important factor in peach growing and is believed to have much to do with the development of fungous diseases and the market quality of peaches. Then, too, frequent rains during the picking season lessen the chance of getting them on the market at the proper time.

The average rainfall in this section in the valleys is about 35 inches a year, as compared with about 50 inches on the higher parts of the

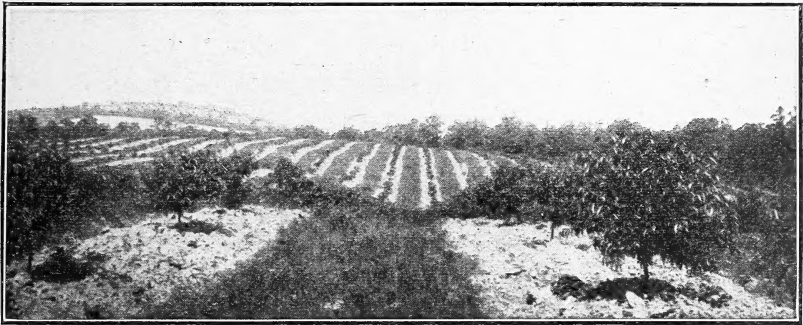


FIG. 2.—Typical red-soil topography. The trees have been “opened” at the base for the operation of “worming.”

Allegheny Mountains to the west. The fact that rainfall increases generally with the elevation makes it probable that the orchards located on the tops of mountains from 1,500 to 2,000 feet in elevation receive a greater rainfall than 35 inches.

GENERAL SCHEME OF ORCHARD PLANTING.

Peach trees may be regarded as fillers among the more permanent apple trees in many orchards planted in this section during the past 10 years, and they are so distributed in planting that the apple trees are 36 to 40 feet apart in the row each way. This practice seems to be due to the following facts: Experience has demonstrated that in this section the average profitable life of a peach tree is about 12 to 14 years, so that in this developmental stage it was believed that if the peach orchard paid only the expense of bringing the apple orchard to the bearing stage it might prove a wise undertaking. In the past the disease known as yellows has destroyed many orchards, greatly increasing the element of chance in the enterprise.

In order to distribute better the labor of picking and to take advantage of the possible changes in market prices, many varieties are

¹The effect of climatic conditions, soils, topography, and other physical features on orchards is being observed and studied by the Office of Field Investigations in Pomology, Bureau of Plant Industry. Such facts are considered in this bulletin only to the extent of throwing light on farm-management problems.

planted which ripen at different periods. Some orchardists plant the same variety on different slopes or at different elevations in order to further control the ripening period, having found that the western and northern slopes on high elevations tend to retard the ripening.

The following varieties,¹ arranged in the order of their ripening period and the number of trees of each kind, were planted several years ago on one of the newer orchards of this region. Except one variety (the Waddell), all have given good results.

	Trees.		Trees.
Waddell.....	500	Fox (<i>Fox Seedling</i>).....	500
Carman.....	500	Stevens (<i>Stevens Rareripe</i>).....	500
Hiley.....	500	Beers Smock.....	5,000
Belle (<i>Belle of Georgia</i>).....	500	Wonderful.....	2,000
Reeves (<i>Reeves Favorite</i>).....	1,000	Salway.....	2,000
Elberta.....	4,000		

Another selection of varieties known to do well in this section and which extends the picking period longer is as follows:

Greensboro, Fox (<i>Fox Seedling</i>).	Mount Rose, Geary (<i>Geary Holdon</i>).
Carman, Walker (<i>Walker's Variegated Free</i>).	St. John, Heath (<i>Heath Cling</i>).
Hiley, Stevens (<i>Stevens Rareripe</i>).	Oldmixon Free, Salway.
Belle (<i>Belle of Georgia</i>), McCollister.	Early Crawford, Bilyeu.
Champion, Smock.	Elberta.

The period during which peaches are marketed in this section is about 10 weeks, from July 20 to October 15.

The fact must be taken into account that the season of ripening depends on the physical conditions previously mentioned, and under such varying conditions the order of ripening of closely related varieties may be reversed.

Corn, cowpeas, tomatoes, and all garden vegetables are raised in many orchards as subsidiary crops to supply food for the farm household and the laborers. The canning industry has long been a profitable one in this region, and several orchard companies have installed canning factories to can such fruit as may not be shipped profitably and to can tomatoes, which they believe may be profitably raised during the year, especially when the fruit crop fails.

COST OF VARIOUS ORCHARD OPERATIONS.

CLEARING LAND FOR ORCHARDS.

Much of the land being planted in orchards in this section needs to be cleared.² The cost of clearing in a manner suitable for orchard

¹ Before selecting varieties, pomologists who have studied the experience of orchardists in this section should be consulted. Certain groups of varieties are practically failures on red soils, while they may do well on chert lands. The problem of the adaptation of varieties to soils, climate, and elevation is being investigated by pomologists of the United States Department of Agriculture and the experiment stations.

² Goats are being tried by several orchardists to assist in the process of clearing. Good results are reported, but there are not sufficient data upon which to base an estimate of the economic value of the practice.

planting is from \$10 to \$30 per acre, depending on the amount of timber growth and also upon the manner of cutting down the trees. Some leave the stumps, allowing the process of decay to remove them. In other cases dynamite is used to blow them out. Others cut the trees off level with the ground, so that the stumps will not interfere seriously with the cultivation. This practice increases the cost of clearing.

When a contract is let for clearing land under average conditions, the cost is about \$20 per acre. On the steep, stony mountain land the cost has been \$25 to \$40 per acre. If it is desired to remove the stumps as well as to clear the land in the manner above described, the cost ranges from \$50 to \$60 per acre. In some cases the timber may be sold at a profit, thus reducing the cost of clearing land.

PLANTING.

The laying-off of the land for planting is done preferably in the fall, the operation requiring, after the land is measured and the stakes are set, one man, two horses, and a plow. This crew should be able to cover about 25 acres per day. Trees are bought in the fall at prices ranging from 5 to 7 cents and are usually heeled in until the soil is in condition for planting in the spring.

The holes for planting are made in two ways, digging with mattocks and shovels or by dynamite, a practice recently adopted by several orchardists. Two men should dig the holes and set 125 trees per day, the average cost of these operations being 2 cents per tree. When dynamiting the holes, the crew may be five men, one man to drive the hole with a 10-pound sledge hammer and 3-foot steel bar, one to cut the fuse and charge, one to tamp the holes, and two to set the trees. This crew should set 125 trees per day at a cost of 5 cents per tree. Another method of organizing the crew to make the work cost about the same is for three men to drive holes on five rows, one man for each row with a box of dynamite, fuse, etc., to charge the holes and prepare the fuse for lighting, and one man, usually the foreman, to light the fuses on all five rows. Five men follow these to throw out dirt from holes. Four men in two groups set the trees.

The season for planting is either in the fall or in March or April. Spring planting seems to be the most common in this section.

CULTIVATING.

The season for cultivation is April to August. The general rule is to begin cultivating as early in the spring as the soil will permit. On the smoother, level lands, such as red soils, the disk harrow is used first and is then followed by a spring-tooth harrow. Two sections of the spring-tooth harrow may be separated and connected by iron bars in such a way as to permit the harrow to work up close

to the tree row without crowding the horse or mule against the tree. An extension disk harrow is sometimes used for the same reasons, but is drawn by four horses, with one team in the lead. One man sits on the machine to operate and guide the outfit, while another man rides the wheel horse and drives the team. This manner of driving a 4-horse team is the common one in this section, and it is obviously the best in the orchard. Some orchardists prefer to plow the land before harrowing and use the disk little, if at all.

The horse implements found by experience to be most serviceable on such lands are the 1-horse single-shovel plow, the bar-share plow (a term applied by West Virginians to the common chilled plow), and the spring-tooth harrow.

On the stony land the ordinary cultivation with horse implements will not always keep down weeds and sprouts, so that the operation of sprouting is one that adds to the cost of cultivation. On the rich chert lands the weeds and sprouts grow vigorously and rapidly. It is believed that by thoroughly sprouting the land this operation may later be dispensed with, as the sprouts interfered with in this way will cease attempting to grow.

Cultivation for the control of moisture is not considered such an important operation on the land covered thickly with rock, but on the exposed soils it must be continuous during the growing season, especially when trees are bearing fruit. Cultivation is often continued up to the time peaches are picked, since it seems to delay ripening, thus furnishing the manager an effective means of control when it seems wise to delay ripening a few days. Some growers believe that cultivation increases the size of peaches, thus furnishing another reason for thorough cultivation. Such facts explain to some extent why in this section of West Virginia the cost of cultivation increases with the size of the fruit crop. This is partly due, however, to the fact that there is a natural tendency to cut down expenses when the crop fails. The promise of a good crop also encourages expenditure not only to save the crop but to benefit the growth of trees for future crops.

The average orchard is gone over from three to six times a year with horse implements, and the newly cleared land is sprouted two or three times besides. Few orchardists in this section give absolutely clean cultivation, however. Clean cultivation on the red soils costs about \$10 per acre, while on chert lands it costs about \$15 per acre. The best orchard managers use a cover crop on the smooth lands. This is usually rye, although some have had success with crimson clover. The cost of the cover crop is about \$2 per acre.

The cost of cultivation may be said to vary between \$5 and \$15 per acre, the variation being due to character of soil, topography, and the number of times it seems wise and economical for the owner to

cultivate. Clean cultivation on the more level and smooth lands requires that they be gone over with horse implements six to eight times, and they should have a cover crop during the winter.

USE OF FERTILIZERS.

It is common practice in this section to use commercial fertilizer,¹ especially on the red soils and other soils derived from shale and sandstone rock. Most of the orchards located on the chert lands have not been treated with fertilizers, as the soil is rich and holds moisture well. Fertilizer on the thinner soils is applied at the rate of about 250 to 500 pounds to the acre.

Fertilizers may be applied economically at a cost of about \$6.25 per acre for the best grades. An easy method of application is to use an 8-foot drill.

In order to reduce the operating expenses, many growers use commercial fertilizers sparingly, but this practice is not recommended by the best orchardists, because of its importance as a factor in yields, and the fertility of the poorer soils should be increased if a profitable apple orchard is expected to follow the peaches. Mixtures commonly used are the 4-8-5 and 4-8-11 formulas.²

PRUNING.

Pruning is done in the winter and early spring when the weather is favorable, generally in March and April. The number of trees that a man may be expected to prune in a day varies, of course, with the size and character of the tree as well as the expertness of the man. Under average conditions, however, 1,000 one-year-old trees per day should be pruned by one man, 500 two years old, 200 three years old, and 125 four years old. Peach trees are not allowed to develop large heads, so that after the trees are four years old one man may be expected to prune about 100 trees per day. These same data would apply to apple trees up to 6 or 7 years of age.

SPRAYING.³

The spraying outfit on the more level, smooth lands consists of a tank, a 3 or 3½ horsepower gasoline engine, and other fixtures mounted on a truck and hauled by a 2-horse team. The number of trees an outfit and crew may be expected to spray in a day will vary, of course, with the size of the trees, the character of the land on which the spray-

¹The fertilizer need of the soil for peaches is a very important factor in orchard management and such needs are different in different places. The West Virginia Agricultural Experiment Station is conducting experiments on various soil types to determine the fertilizer needs.

²The figures in these formulas refer, respectively, to the percentages of ammonia, phosphoric acid, and potash in the fertilizers.

³Only such details of spraying are given as are necessary to determine the quantity, cost, and time of applying the material. There are bulletins which give valuable and detailed information on spraying, among them being Farmers' Bulletin 440.

ing is done, the convenience of facilities, as well as the purpose for which the spraying is done.

The type of road construction in orchards on slopes of chert land over which spraying outfits must be hauled is shown in figure 3.

Three men operate each outfit and in orchards 6 to 12 years old on smooth land will spray 500 to 600 trees per day when in the dormant state and 800 to 1,000 trees per day when in leaf.¹ These same units would apply to apple trees at about the same age.

As a rule, peach trees are sprayed three times a year—once in March for San Jose scale with the concentrated lime-sulphur solu-



FIG. 3.—The southeastern slope of an orchard on chertland, showing the road construction used in spraying trees and hauling fruit.

tion and twice for brown-rot and scab with the self-boiled lime-sulphur mixture, once soon after the petals fall, and again about three or four weeks later. In the two later sprayings arsenate of lead is added to the lime-sulphur mixture as a remedy for the curculio. A few have found it necessary to make a third application with that mixture during the summer to prevent the brown-rot, especially on the late-maturing varieties.

Some orchardists make their own lime-sulphur solution for San Jose scale at a cost of \$3 to \$4 per barrel. Others buy the solution

¹ The trees are sprayed in the dormant state for San Jose scale, and the bark on the entire tree must be wet with the spray mixture. This operation takes more time for spraying than the operation for brown-rot and curculio, when only the fruit needs to be treated.

at from \$7 to \$9 per barrel, delivered. This is diluted in the ratio of 1 part of the mixture to 8 or 10 parts of water. The homemade solution can not conveniently be made as strong in solution, so that the dilution should be made in the ratio of 1 to 7. Arsenate of lead costs about 7 cents per pound in 100-pound lots. The self-boiled lime-sulphur mixture can be made at a cost of about 25 cents per barrel, using the 8-8-50 formula,¹ and arsenate of lead is used in the ratio 1½ or 2 pounds of arsenate of lead to 50 gallons of water. It takes about 1¼ gallons per tree of mature size when dormant and 2 gallons when in leaf. It would take about the same quantity on apple trees up to 8 and 10 years of age.

"WORMING" FOR THE PEACH BORER.

The peach borer is one of the worst enemies of peach trees in this region. In April of each year a special operation called "worming" is required to deal with this pest. The implements used are a trowel, penknife, and sometimes a piece of wire to aid in digging out the borers. The trees should be gone over twice in order to do the work thoroughly. Under average conditions one man will "worm" 50 full-grown trees a day.

THINNING.

After the "June drop" the fruit may need thinning. This is an operation that adds considerably to the expense of producing the crop. On the average large orchard for varieties which fruit heavily and require thorough thinning one man will thin 20 to 25 trees a day.

TOP BUDDING.

Top budding is sometimes done to change the variety of a tree which has not come true to name, and in some cases it is found best to change the variety in order to get those better adapted to the local conditions.

Three men form the crew for the operation of top budding, one man to trim the branches on which the buds are to be placed, one to place the buds, an operation requiring skillful work, and one to tie. It has been found that three men can perform these operations on 30 to 40 trees a day.

HANDLING THE FRUIT.

In picking fruit, one wagon may be expected to keep a gang of 10 men busy picking 50 baskets to a load and 12 loads a day.

The grading is done as a rule by women, who seem to acquire more expertness for this work than men. One woman will average about 75 baskets a day.

The packers and experts in heading packages are sometimes brought from Florida and are usually paid by the piece. A packer gets 2 cents

¹ Eight pounds each of unslaked lime and flowers of sulphur to 50 gallons of water.

per carrier (about \$2 per day) and will pack, on the average, about 100 carriers a day. Expert packers, however, will pack 150 to 200 carriers and are paid \$2.50 to \$3 a day. An expert in heading carriers receives one-fourth of a cent per carrier and will head 800 to 1,000 carriers daily. The "Delaware" basket, which is estimated to hold half a bushel, is used in this section.

LABOR PROBLEMS.

In this section the conditions under which labor may be employed in orchards and on farms are fixed largely by the mining, quarrying, lumber, and railroad industries. The 10-hour day is quite generally standard in orchard work and the rate of wages at present is 12½ to 15 cents per hour, or 10 cents per hour when board is furnished. However, some orchardists employ labor at \$1 a day and board. The cost of boarding men, including all charges, such as service, interest, miscellaneous expenses, etc., has been 35 to 50 cents per day during the past few years, the average being about 45 cents. In the larger orchards workmen are boarded in camps. Men, mostly foremen with families, who remain on the farm the year round as a rule get \$30 a month, a cottage, garden, and the use of a team free. Other foremen are paid \$1.50 to \$1.75 a day, with similar perquisites.

The distribution of labor during the year is well illustrated on a well-managed 250-acre fruit farm having 17,000 peach trees, 1,000 cherry trees, and about 12,000 apple trees. This orchard employs 16 men, on the average, for about eight months of the year. During the cherry-picking period this force is increased to 20 or 25 men and later to 30 or 35 men when the time for thinning and picking peaches begins. The full force during the picking season has reached 125 laborers on this orchard.

The labor problem is a most serious one in this section. During a large part of the year there is employment for but few men in the orchards, while in the picking season the number required is very large. This problem is most serious for the small grower and for those who are beginning the business. The experienced orchardists have established relations with workmen, as well as with the handlers and distributors of fruit. Some keep a labor directory in which the names and addresses of all who have worked for them are recorded. When wanted for service these men are written to and are asked to bring friends with them.

It is a matter of great interest and importance to note that those who seem to have the least trouble in employing workmen when wanted and in keeping them are those who insist on proper discipline. Rules for this purpose forbid vulgarity and drinking and insist on such sanitary regulations as are consistent with camp life. Managers are also expected to be solicitous about proper food and comfortable

sleeping quarters. Under such conditions young men from schools and colleges find congenial employment, as well as the sons of respectable citizens in the community.

HORSE LABOR.

A man with one horse to plow or cultivate is generally paid \$2 to \$2.25 per day. A man with two horses may receive \$2.50 to \$3.50 per day. Frequently a man with a team is employed by the hour, when he may receive in some sections 30 cents per hour for a 2-horse team or 50 cents per hour for a 4-horse team.

From an accurate record on one farm it cost for the entire year an average of \$13 per month to care for and feed one mule. This did not include the frequent pasturing of the mule on Sundays. Another orchardist found that the cost of keeping a horse during the year was about \$15 per month. The variation is \$8 to \$15 per month, depending largely on the price of feed, which during the past 10 years has varied from \$12 to \$35 per ton for hay and 50 cents to \$1 per bushel for corn. It has been a common practice in this section to sell the mules and horses in the fall when the cultivating season is over and to buy again in the spring when the growing season begins. Not all, however, regard this practice as satisfactory. There is a loss of 10 to 20 per cent in buying and selling in this manner.

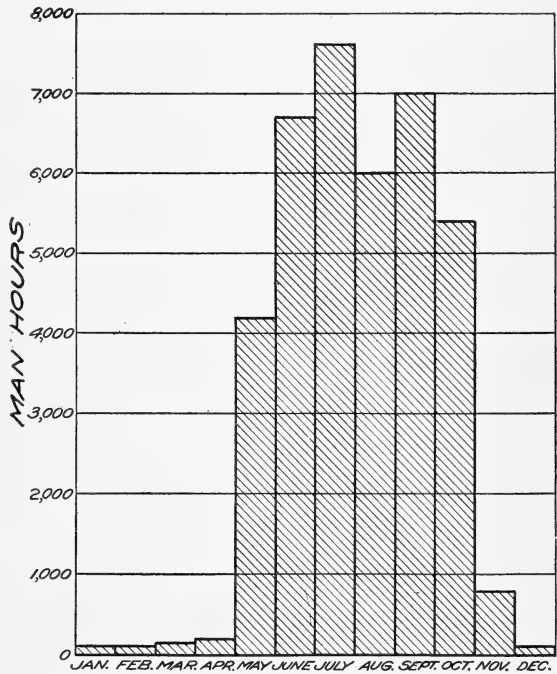


FIG. 4.—Chart showing the number of man hours of labor performed during each month of the year 1911 on a 400-acre peach orchard. This is approximately the amount of time that 20 mules—the proper number for such an orchard—could be used during the year.

Figure 4 shows in graphic form the number of hours of man labor employed on a 400-acre peach orchard during the year 1911. Most of the labor represents work done with teams, and shows quite accurately the relative amount of time 16 mules were employed.

Based on the average number of men and horses employed on six commercial peach orchards in this section of West Virginia it is found that the time of one man for one year is required to care for 2,500 trees, exclusive of the thinning and handling of fruit. This number of trees would cover about 20 acres of land. On these same orchards it would require the labor of one horse or mule to care for 2,300 trees, making, on the average, more than one animal for each 20 acres.

METHODS OF TRANSPORTATION.

Peaches are shipped by express or by freight in refrigerator cars in carload lots. Table I shows the rates per hundredweight to some market points from a station located in about the center of the region investigated.

TABLE I.—*Freight and express rates per hundred pounds on peaches from a station in West Virginia to various market points.*

Market.	Rate per hundred-weight.		Market.	Rate per hundred-weight.	
	Freight.	Express. ¹		Freight.	Express. ¹
Washington, D. C.	\$0.37	\$0.50	Philadelphia, Pa.	\$0.42	\$0.80
Baltimore, Md. ....	.37	.50	Pittsburgh, Pa. ....		.75
Cumberland, Md. ....		.50	Thomas, W. Va. (a typical		
Boston, Mass.		1.50	mining town) .....		.80
New York, N. Y. ....	.42	1.00			

¹ The express rates quoted are for packages weighing 100 pounds and less. Rates for carload lots are less, but the shipper will choose refrigerator cars when shipping in carload lots.

Thomas, W. Va., and Cumberland, Md., are near-by towns that have no transportation advantages as market points.

COST OF EQUIPMENT.

The average cost of equipment on several large orchards was found to be, in terms of the area of the farm, about \$30 per acre. Many are equipped at much less cost. A great saving may be made where companies of large capital construct very cheap cottages for summer camps only. Such companies having orchards in different localities of a section may shift their forces from one orchard to another when needed, thus enabling them to economize in labor. In such cases the total equipment need not cost over \$15 to \$20 per acre.

On a 260-acre orchard the equipment consisted of 1 boarding house, \$900; 1 packing house, \$900; 1 barn, \$900; sleeping quarters for 40 men, \$600; 3 tenant houses, \$1,200; 3 sprayers, \$750; 12 horses, \$2,400; implements and tools, \$500; 4 wagons, \$260; total, \$8,410, or \$32.36 per acre. On a 400-acre orchard the equipment was 5 tenant houses, \$4,000; 10 packing sheds, \$400; camp building, \$1,000; barn with water equipment, \$1,000; 5 spraying outfits, \$1,250; 16 mules, \$3,200; 6 wagons, \$390; harrows, plows, etc., \$500; miscellaneous tools, \$150; total, \$11,890, or \$29.70 per acre.

RELATION OF THE SIZE OF THE ORCHARD TO SUCCESSFUL MANAGEMENT.

The size of an orchard is a very important factor. The small grower of 5 to 20 acres may find the business profitable as one of the enterprises of diversified farming. He must sell in less than carload lots and depend wholly on such prices and such market facilities as are offered at his shipping point, unless, of course, he belongs to an organization which looks after such marketing.

The large grower, however, should have his orchard of such a size and have the varieties so distributed that he may market from day to day in carload lots. Another determining factor in the size of an orchard is that of labor. The small grower may board his workmen



FIG. 5.—An orchard on chert land on top of a mountain, viewed from the valley at a distance of about a mile. The camp for the men is located at the left.

in the family and thus make them feel satisfied socially, but it is found difficult to keep less than from 10 to 20 men together in a group in orchards where they are lodged and boarded under camp-life conditions.

The orchard shown in figure 5 contains 400 acres, all on a mountain top.

DISTANCE OF ORCHARD FROM SHIPPING POINT.

A factor of great importance in peach orcharding is the distance of hauling to the shipping point. The expense of hauling not only increases as the distance increases, but the hauling over the average mountain road for a considerable distance injures the peaches. For

these reasons the experienced growers regard 5 miles as the longest distance peaches should be hauled.

LIFE PERIOD OF PEACH ORCHARDS.

The peach tree normally has a short life and because of this and of the ravages of the yellows and the peach borer, the average life of a peach orchard is comparatively short. While apple trees 12 to 14 years old are coming into their most profitable bearing stage, peach trees have about ended their profitable existence in this particular district.

One orchard of about 30,000 trees in this section when 13 years old bore 50,000 baskets of marketable peaches and netted the owner about \$18,000. The next year it yielded about 13,000 baskets, selling for about \$10,000 and lacked about \$6,000 of paying expenses. If it were not for the fact that many of these trees are fillers in an apple orchard it would probably not pay to risk cultivating it any longer. The owners of this orchard are expecting two more crops. However, the yield would need to be over 20,000 baskets in order to pay operating expenses. This is a critical period and calls for keen judgment on the part of the manager to determine what to do.

Some are experimenting on renewing the head of the tree, a method popularly known as "dehorning." Sometimes the entire head of the old tree is removed and a new head permitted to grow in one year. Unless the tree has been injured by freezing it is generally thought better to cut the trees back gradually. This method promises good results in renewing the vigor of the tree and prolonging its profitable existence. The chert lands promise larger yields and a longer life for peach orchards, but there are not sufficient data upon which to base safe conclusions.

Orchards are more skillfully handled now than formerly, owing to the more general application of scientific knowledge of diseases and insect pests, as well as to recent discoveries along this line, so that the chances in the future are in favor of prolonging the productive life of the trees. Most orchardists know the first symptoms of yellows and remove the tree immediately when such symptoms appear. The State inspectors of orchards have done good service along this line by requiring diseased trees to be destroyed.

It may be safe now to count on 12 to 14 years as the period of profitable existence of a peach orchard in this district, as stated above. The fifth year is generally regarded as the average time when a profitable crop may be expected; however, some orchards have borne profitable crops the fourth year. Thus, a bearing period of 8 years may be expected and on the basis of past experience should yield an average of from 10 to 12 baskets of peaches per tree during the period.

The more skillful and experienced orchardists may get a larger average yield than that mentioned; but it is an important fact to keep in mind that a crop of as much as 3 baskets per tree in one year over a large orchard is an exceptional yield. Taking into consideration the many chances due to weather, diseases, and insect pests, conditions which the most skillful manager can as yet only partially control, a large variation from the average of 10 to 12 baskets in the 8 years can not be expected.

On a very well-managed orchard on red land a calculation was made, based on the history of the orchard, which was 10 years old. It has now reached its maximum vigor and will begin to decline. If the orchard duplicates its production during the period of decline, it will have yielded 13.65 baskets per tree during its life of 14 years. On the same basis it may be predicted that one of the best orchards on chert land at the end of its profitable life at 18 years will have yielded 17 baskets of peaches per tree.

SUMMARY OF COSTS IN PEACH ORCHARDING.

It has been stated that peach orcharding is rarely carried on as a separate enterprise. For this reason it is difficult to determine just what the profits might be. By analysis of the information given, however, it is possible to calculate approximately the profits that may be expected from a peach orchard alone.

The cost of land¹ is an important item of expense, and in the end must be a determining factor in the distribution of the fruit industry, as it is in any other industry.

At the present time land on which peach orchards are developing will cost from \$10 to \$35 per acre, the average price of cleared land being about \$20, which amount will be taken as a basis of calculation. Like all regions where a new industry is developing, the tendency has been to put a speculative value on land. For the purposes of taxation and for use the farmers in this section value such land at about \$8 per acre.

The original cost of land, improvements, planting of trees, equipment, accumulated interest, and the cost of routine operations for the development and maintenance of the orchard may at the end of four years be considered the investment in the business. At this time the orchard should begin to yield an income. By the end of its life the orchard should have paid a reasonable dividend on the investment at 4 years of age and should have returned to the owner or stockholders all its cost except the market value of the land and equipment at the end of the period.

¹ Many years ago peaches were raised for the market in the Shenandoah Valley, but the rise in price of land is admitted to be one of the great factors in pushing these industries into the region of cheaper land to the west.

The cash value of land and equipment will be determined at that time, but it may be assumed to be worth the original cost. The value should not be less if the land has been cultivated and fertilized as specified in this bulletin.

Table II summarizes the costs per acre and per tree of bringing a peach orchard to the bearing stage at the end of 4 years of age and of operating it after this time till 14 years of age, when it may be expected to have lived its period of profitable existence. The conditions specified relating to smooth land are clean cultivation, a cover crop, thorough "worming"¹ and spraying, and \$1,200 per year for the manager. The size of the orchard is assumed to be 200 acres. In the two columns at the right of the second part of the table the costs of operating an orchard on chert lands are summarized.

TABLE II.—*Items of cost of bringing to bearing and operating a peach orchard in West Virginia.*²

Item.	Cost per acre.	Cost per tree.
BRINGING AN ORCHARD TO BEARING.		
Real estate:		
Land	\$20.00	\$0.1538
Equipment	30.00	.2307
Cost of planting orchard:		
130 trees per acre, at 7 cents	9.10	.0700
Planting trees (dynamiting), at 5 cents	6.50	.0500
Plowing and laying off, at \$5	5.00	.0385
Routine operating expenses:		
Interest on capital invested in land and planting of orchard, 4 years, at 6 per cent compound interest	18.50	.1425
Cultivation and care of orchard, first year	14.00	.1076
Cultivation and care of orchard for 3 years more until bearing state, at \$20 per acre ..	60.00	.4615
Salary of manager, 4 years, at \$1,200 per year	24.00	.1845
Total investment, at 4 years	187.10	1.4391

UNITS OF COST FOR OPERATING EXPENSES DURING BEARING PERIOD OF PEACH ORCHARD.

Item.	On smooth land.		On chert land.	
	Cost per acre.	Cost per tree.	Cost per acre.	Cost per tree.
Cultivation	\$10.00	\$0.0769	\$15.00	\$0.1154
Cover crop	2.00	.0153		
Spraying for San Jose scale, ³ each year	4.00	.0310	5.00	.0385
Spraying for fungous diseases and curculio	4.00	.0310	6.40	.0410
Worming	3.00	.0230	3.00	.0230
Interest on investment	11.23	.0864	16.89	.1300
Interest on current expenses	1.25	.0096	1.50	.0114
Fertilizer	6.25	.0480	2.00	.0154
Taxes .....	.50	.0038	.50	.0038
Losses on mules and horses .....	.50	.0038	.50	.0038
Repairs	1.00	.0076	1.50	.0114
Incidental expenses	2.50	.0192	3.00	.0230
Manager, at \$1,200 per year	6.00	.0462	6.00	.0462
Total	52.23	.4018	61.29	.4629

¹ When the trees are "opened" at the base for the operation of "worming" it is recommended by some experienced orchardists that they be gone over twice in order to find all the borers.

² The cost of bringing an orchard to the bearing stage on chert land will be about \$95 per acre more than on smooth land, due (1) to the higher price of land, (2) to the higher cost of cultivation, and (3) to the higher cost of equipment for spraying. The estimated cost, including cost of land, is \$281.50 per acre.

³ The chert lands are steep and stony and also high above the valley, where water in large quantities is not immediately available for spraying. This water is usually lifted by machinery. Roads are built about 200 feet apart in some orchards on which the spraying outfit is hauled. The trees are reached by means of rubber hose 75 to 100 feet long. Spraying is thus more expensive in such orchards.

⁴ Twice a year when fruiting, at \$5 per acre during period.

The costs in commercial peach orcharding, as shown in the tables, are higher than the estimates given by most orchardists in this section. The estimates given by experienced orchardists are no doubt approximately correct for their particular conditions. Few orchardists, however, do as thorough cultivation and spraying as is assumed in working out the unit costs given in the tables. Some orchards on chert land have not yet been sprayed at the age of 8 to 10 years.

Based on such records as could be had and on estimates given by managers the average cost per tree per year for routine operating expenses in this section is about 37 cents. The cost of thinning, picking, packing, and loading on cars the average distance from market is about 18 cents per basket.

In some orchard districts it has been found that the returns bear a close relationship to the expense of production, i. e., increased cost of production within certain limits stands for increased efficiency and a corresponding increase in returns.

The estimates given for the cost of bringing the orchard to the bearing stage through a period of four years vary from 75 cents to \$1.50 per tree. On the basis of common methods of caring for the orchard through this period, the cost would average about 80 cents per tree on smooth land and about \$1 per tree on chert lands. The figures given in Table II are based on the most thorough and approved methods of management, while these lower estimates are based on the methods found in more common practice.

HISTORY OF YIELDS OF REPRESENTATIVE ORCHARDS.

Table III gives the actual yields on several of the large commercial orchards in representative sections of this region.

TABLE III.—*Yields of seven large commercial peach orchards in West Virginia.*

Orchard No.	Number of trees.	Number of baskets.	Failures.	Periods of bearing.	Price per basket.	Soil.
1.....	9,000	18,757	None.....	1910 to 1912	\$0.52	Red.
2.....	8,000	9,363	...do.....	...do.....	.67	Chert and red.
3.....	30,000	63,978	.....do.....	...do.....	.72	Red.
4.....	17,000	116,000	1 year.....	1908 to 1911	.69	Do.
5.....	15,000	191,500	...do.....	1905 to 1912	.74	Chert.
6.....	30,000	52,000	None.....	...do.....	.69	Do.
7.....	35,000	95,000	...do.....	1912	.67	Do.

Taking the above figures as a basis for computing the average yield per tree it is found that each tree may be expected to bear 1.24 baskets per tree during the crop years. On the basis of the above history and the estimates given by growers of long experience in this region it would be safe to count on eight crops of peaches during the life of the orchard. This would give an average of about 10 baskets of peaches per tree for the life period of the orchard. The better

managed orchards may be expected to do much better, of course. From 13 to 14 baskets may be expected from a well-managed orchard on red soil and 15 to 18 on chert soil.

ESTIMATED PROFITS.

The units of cost summarized in the tables and the average yields which may be expected during the life of an orchard furnish a basis for estimating profits.

If 10 baskets of peaches are assumed to be the average yield of a tree during its life under average conditions of management on smooth red-shale land, the total cost of these 10 baskets may be stated as shown in Table IV.

It must be taken into account that the figures given in the table are based on average conditions of management, which, of course, are not as efficient as the conditions assumed in orchards which are described in the pages following.

TABLE IV.—*Cost of peaches, per tree and per basket, on smooth red-shale land in West Virginia, assuming a 10-basket yield during the life of the tree.*

Items of expense.	Per tree.	Per basket.
Cost of tree until bearing stage ¹	\$0.80	\$0.08
Cost of routine operating expenses, 35 cents per tree for 10 years.....	3.50	.35
Cost of handling and packing baskets of peaches during 10 years.....	2.00	.20
Total cost.....	6.30	.63

¹ The cost of bringing the tree to the bearing stage does not include the original cost of land and equipment. These items are assumed to be worth at the end of the period the original cost. Thus, the interest alone on this amount would affect the cost of the tree.

This would make the cost of growing peaches during the period of 10 years 63 cents per basket. It may be doubted whether the peaches grown under such average conditions as are assumed could be expected to bring more than 63 cents per basket. The average price according to the record given is 67 cents per basket. Based on such a price, the average net profit would be 4 cents per basket, or 40 cents per tree for the period.

A particular orchard on smooth red-shale land, operated in the manner specified in this bulletin and having more efficient management, may be expected to give a larger average yield and peaches of better quality, thus commanding a better price. Such an orchard now being operated will have yielded at the end of the period, if the past rate of production continues, 13.8 baskets of fruit per tree. The costs of this orchard, allowing \$1,200 per year for the manager (this item is not counted in the first estimate), would appear about as shown in Table V.

TABLE V.—*Cost of peaches per tree and per basket on smooth red-shale land in West Virginia under more efficient management than the orchard summarized in Table IV.*

Items of expense.	Per tree.	Per basket.
Cost at bearing stage (fifth year).....	\$1.03	\$0.0746
Cost of routine operating expenses, 10 years.....	4.18	.3030
Cost of handling and marketing fruit, 10 years.....	2.75	.2000
Total cost.....	7.96	.5776

The average price for peaches on this orchard has been 69 cents. If this price should continue and the rate of past yields be maintained, a net profit of 11.24 cents per basket may be expected, or \$1.55 per tree.

Another orchard located on chert land and cared for in an up-to-date manner will have produced, on the basis of past records, 16 baskets of fruit at 16 years of age. The average price of peaches from this orchard during the past eight years has been 74 cents per basket. Table VI gives the estimated costs for this orchard.

TABLE VI.—*Cost of peaches, per tree and per basket, on chert land in West Virginia.*

Items of expense.	Per tree.	Per basket.
Cost of the tree until bearing stage.....	\$1.40	\$0.0875
Cost of routine operating expenses for 11 years, at 46.3 cents.....	5.09	.3181
Cost of handling and marketing 16 baskets of fruit, at 22 cents.....	3.52	.2200
Total cost.....	10.01	.6256

At 74 cents per basket this orchard may expect a net profit of 11.44 cents per basket, or \$1.83 per tree.

It would seem from the above analysis that superior and more expensive management as well as exceptional natural advantages will lessen the average cost per basket and will also increase the average market price by producing peaches of exceptional quality. The fact that increased cost per acre and per tree has decreased the cost per basket¹ is explained on the ground that by this expense the yield was increased more proportionally than the amount of such expense. This decrease in cost per basket, of course, could not continue in proportion to the added expense per acre. A point would quickly be reached where the added expense would increase the cost per basket, and if the quality remained the same no economic advantage would be secured. This is an important problem for the manager to work out as his orchard grows.

¹ In mathematical terms these facts may be stated thus: The cost per basket varies directly as the total expense of the orchard and inversely as the total yield.

PRINCIPLES OF ECONOMY IN ORCHARD MANAGEMENT.

The most difficult problem for the farm manager is to determine where to spend more in the line of operations and where to spend less in order to increase net profits.

Land, of course, is a fixed expense expected to be paid for at the outset on the advantages of soil, weather conditions, topography, and distance from shipping point. The statement of costs already given ought to furnish a good basis for calculating the amount which the purchaser of orchard lands can afford to pay. It is very easy to pay an amount that would make it practically impossible to make the proposition profitable, no matter what economy might be used in operation.

Many good orchardists economize on buildings. This may be done with profit in those cases where the buildings for board and lodging, cottages for farmers, and stables for stock are summer quarters only. Packing sheds may be constructed at very little expense also, if regarded as temporary. If the site, however, is to be the home of the manager and foreman the year round, then the buildings must be constructed for home purposes and will cost much more. Barns and other outbuildings would also need to be constructed accordingly.

Two items of greatest expense on the thinner soils are cultivation and fertilization. Probably the great majority of orchardists cut down mostly on these items. No special data are yet available to prove positively that this policy is not wise. The orchard reporting the largest yields and highest average price for fruit, however, is one that follows the practice of clean cultivation and that fertilizes the land liberally at a cost of from \$5.25 to \$6.25 per acre. On the whole, the most promising orchards on the smooth, thin lands are those receiving the most thorough cultivation and fertilization. The economic value of nitrogen applied to peach orchards has long been known, and recent experiments in some of these orchards have verified these conclusions beyond a doubt. Both cultivation and the application of fertilizer are a means of controlling moisture and of building up the soil. This in most cases sustains and makes profitable a future apple orchard.

Some of the orchards on which the yields have been stated have had little expense put on them for spraying. Such orchards are found located on chert land high up on the mountains. These in some cases have not had a bad crop record, but the owners are convinced that they must begin to spray, since fungous diseases injure the quality of the peaches to a large extent and the curculio is also increasing its ravages on such land.

While the cost of spraying is a large item in the expense account it is one of those items which may be expected to directly increase the

profits up to a certain point. Besides, thorough spraying is a means of insuring the crop when once it is set on the trees.

The cost of management is one that varies greatly in this section. The fact that orcharding has been carried on here as an important industry for many years and the further fact that the value of spraying trees for fungous diseases is thoroughly understood and has become an established practice make it comparatively easy to get foremen who are reliable and understand these operations. By combining this knowledge of the foreman with the business knowledge of a banker, a lawyer, or a merchant it becomes possible to cut down the item for management to the nominal sum of \$25 to \$50 per month. At \$50 per month there would be saved on the orchard proposition above discussed \$8,400 during the life period of such orchard. At \$25 per month for management, the amount generally paid for such service, it would save \$12,600. Unless the manager who is paid \$1,200 to \$1,600 per year could in some way increase the profits of the orchard more than this amount, such salaries could not be paid on any economic basis.

A very common method of cutting down operating expenses is the raising of subsidiary crops during the period before the orchard has arrived at the bearing stage, and to some extent afterwards. In this section tomatoes have proved to be the most profitable, and it is believed that they interfere less with the moisture content and fertility of the soil.

On chert lands a crop of corn is often raised during the first year and on such soils it often pays one year's operating expenses.

Nearly all orchardists raise the vegetables used on the table in the camps, but as a rule nothing is raised in the orchards except cover crops after the bearing period begins. Some, however, are experimenting with tomatoes in the peach orchards when the fruit has failed. This practice in some cases is believed to be profitable. Many experienced growers, however, are convinced that it is not an economic practice.

Diversification is the means by which the general farmer has learned to deal with the conditions which he can not directly control. It has proved to be more profitable in the long run, and it is the safer practice, especially for those with limited capital. There is a marked tendency toward diversification in the fruit industry in this section. No orchard company was found which had invested in peaches or apples alone. Some have combined cherries and pears, and a few are taking up small fruits, trucking, and alfalfa.

The smaller growers as a rule attempt to raise feed for the stock. As already stated, the teams are idle more than half the year. This fact suggests the possibility of a system of management being

worked out by which the feed bill of the teams could be greatly reduced. On a 200-acre orchard the feed for teams costs about \$1,200 per year, which amounts in 14 years to \$16,800, a sum which would materially increase the dividends of the company if it could be earned by the teams when idle.

SOME CONCLUSIONS.

If a record could be obtained of every peach tree which has been set out during the past 25 years in the section of West Virginia under discussion it would, no doubt, show that costs had far exceeded receipts in peach orcharding. The same fact would probably be true of mining. In such enterprises the expectation of unusual profits causes many people who know little about the details of managing them to take chances in winning the unusual profits. The result is that many have lost money and a very few have made the unusual profit. Thus, there is an economic waste which society ought not to permit. This can be prevented only by making it possible for individuals to profit by the experience which has been won at so great a cost.

With the most favorable conditions that can be reasonably expected and under the most skillful and experienced management average dividends of over 25 per cent are practically impossible, but at an average price of 65 cents per basket a good manager might reasonably expect to pay 10 per cent dividends on the money invested. It is true that an orchard now and then has paid over 100 per cent. This is unusual, and the history of these same orchards will demonstrate that the net yearly profits for the life period can not be expected to exceed those of average well-managed legitimate business enterprises.

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