

Cost and Efficiency in Producing Walnuts in Western Oregon

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FOREWORD

THIS publication is the final one of a series based on cost-of-production data obtained from walnut and filbert growers for the years 1929, 1931, 1932, and 1933 and on data on the cost of establishing nut orchards for the years 1919 to 1934. Reports previously published by the Oregon Agricultural Experiment Station dealing with various phases of this research work, carried on co-operatively with the Bureau of Plant Industry, United States Department of Agriculture, include the following: "Cost of Producing Walnuts in Oregon for the Year 1929" (mimeograph, January 1931) Circular of Information 50; "Cost of Establishing Walnut Orchards in Oregon" (mimeograph, November 1931) Circular of Information 64; "Cost of Producing English Walnuts in Oregon for the Year 1931" (mimeograph, October 1932) Circular of Information 81; "Costs and Practices in Establishing Walnut Orchards in Oregon" June 1933, Station Bulletin 315; "Cost and Efficiency in the Filbert Enterprise in Oregon," June 1937, Station Bulletin 351.

This, the third and final number of the bulletin series, presents a much more complete analysis of the cost of producing walnuts than was possible in the earlier reports.

In answer to the question as to how applicable the costs found in this study may be for the years ahead, it is pointed out that practices followed in walnut production have not changed materially since 1931. Adoption of the cover-crop disk has proved popular with those growers having sufficient acreage to warrant the investment and sufficient power to handle this implement. The need for spraying to control blight is generally admitted, but the program recommended is relatively inexpensive. Cost of supplies, today, are comparable to those of the period studied. Any important change in the cost of production, therefore, would be due almost entirely to changes in the wage rate of labor.

It is possible for a grower at any time to apply the current prices for any particular year to the amounts of labor and other physical requirements indicated here and thus compute his approximate cost of production.

WM. A. SCHOENFELD,
Director

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SUMMARY

THE SITUATION

Walnuts comprise more than one-third of all the tree nuts consumed in the United States.

Of the average supply of walnuts consumed domestically, California has been producing about 85 per cent and Oregon 4 per cent, the remaining 11 per cent being imported mainly from China, France, and Turkey.

The trend of total net imports of tree nuts has been downward while domestic production has been increasing. The per-capita consumption has been decreasing despite a drastic decline in prices.* Hence profitable production of any of the tree nuts will depend largely on reducing the costs.

TWO-YEAR COST STUDY MADE OF WALNUT PRODUCTION

COST OF PRODUCTION

The 2-year average cost of producing walnuts in Oregon was 13.3 cents per pound on an average yield of 500 pounds per acre. The cost averaged 17.4 cents per pound in 1929 when the yield was 335 pounds per acre, and 9.2 cents per pound in 1931 when the yield was 662 pounds per acre.

PRICES RECEIVED

The 2-year average price received for 3,549,569 pounds of walnuts produced on the 7,080 acres of orchard studied was 13.9 cents per pound, or 15.3 cents per pound in 1929 and 12.5 cents in 1931.

COST ITEMS

Of the \$59.43 cost per acre, interest computed at 5 per cent on the capital investment, as valued by the owner, comprised \$29.55, or 49.7 per cent; man labor (including contract work) \$20.52, or 34.5 per cent; materials, taxes, equipment depreciation and repair, horse work, and miscellaneous, together \$9.36, or 15.8 per cent.

CASH COST

The cash or out-of-pocket cost (exclusive of interest on the investment) averaged \$21.79 per acre, or 4.8 cents per pound, which was 36 per cent of the total cost of production. This cash cost must be met before the farmer

* For the effect of the Walnut Control Board Program see Appendix B, pages 58-59.

SUMMARY—Continued

receives anything for his labor or for the use of his land and equipment.

CONTRACT WORK

Contract work, consisting chiefly of drying, picking, and cultivating, in the order listed, constituted 46 per cent of all labor costs.

WORK IS SEASONAL

The labor program for walnut production is very seasonal and therefore does not provide the operator with a full-time job. Three-fourths of the 60 hours of labor required per acre was harvesting.

ALLOWANCE FOR INTERPLANTING

About two-fifths of the walnut orchard acreage contained filler trees. Tillage costs of a joint nature and taxes on the land were allocated proportionally to the walnuts and filler trees on the basis of land area occupied.

COSTS AND PRICE FACTORS

Yield was the major factor affecting cost, the low-yielding orchards usually having high costs per pound. As long as the cash costs on such orchards are less than the receipts, however, and there is little or no indebtedness, the owners can continue in business. This is true because the alternative uses for the land may be even less favorable than walnut production, and therefore, on a lower valuation of the land and a lower rate of interest charged as a cost, such operators may continue to produce walnuts advantageously.

Hill orchards, as a whole, produced only half the yields, and were less profitable per \$100 of capital investment in orchard than were orchards on valley and bottom land.

The improved varieties (mostly Franquette), though averaging 3 years younger in age, had slightly higher yields per acre and sold at higher prices per pound than seedling varieties.

Failure to remove interplants as the walnut trees matured reduced the productivity of the latter, affected the quality of walnuts in terms of price, and increased the cost per pound, even though the interplants were assumed to carry their share of the cost.

SUMMARY—Continued

Orchards receiving a medium amount of attention, returned more net income above all costs than either those receiving minimum or maximum care, indicating that the elimination of some cultivation of doubtful value would increase labor efficiency and thereby reduce costs.

Size of orchard was directly proportionate to net farm income, but showed only slight relationship to efficiency of operation. Larger yield and more intensive culture on the smaller-sized plantings accounted for most of the differences in labor costs between them and the largest orchards.

Variety, grade, and size of walnuts produced were major factors affecting the price. An improved marketing organization and a high quality of product tend to make satisfactory prices.

INVESTMENT RISKS

Bearing orchards at the time of this study were valued by their owners at an average of \$569 an acre. While operating costs and walnut prices would seem to justify these valuations, the costs do not take into consideration all of the risks involved.

There is a substantial risk from freezing. Many trees were destroyed or badly damaged by freezing in 1919 and 1935. Climatological data at hand are insufficient accurately to forecast this risk, but it must not be overlooked. The risk of freezing seems to be greater on bottom soils than on hill soils, yet these bottom soils produce the higher yields. Whether the greater yields more than offset the greater risk is as yet an unanswered question.

There is also risk in the fact that the price of walnuts is at present dependent to a considerable degree on the action of the Walnut Control Board and on government subsidy. The effect of the control program on price is difficult to evaluate, but the government subsidy has averaged 5 cents a pound on the nuts sold for shelling and export, or the equivalent of $1\frac{1}{2}$ cents a pound on the entire production. The control program has also maintained the price of unshelled nuts at just double the price of nuts for shelling or export.

Cost and Efficiency in Producing Walnuts in Western Oregon*

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OBJECTIVES

The objectives of this study were as follows:

1. To determine the cost of producing walnuts;
2. To determine the major factors in the operation of the walnut enterprise that affect the cost of production;
3. To suggest adjustments within the enterprise that should increase efficiency, reduce production costs, and increase the net income of the farmer.

This study was made at the request of the walnut growers of the State and with their full cooperation. Bulletin 315, "Cost and Practices in Establishing Walnut Orchards in Oregon," was published by the Oregon Agricultural Experiment Station in June 1933.

THE SITUATION

Location of walnut acreage in the United States. The commercial production of Persian or English walnuts (*Juglans regia*) in the United States is confined almost exclusively to California and Oregon. According to one estimate, the commercial walnut orchards in this country in 1934 occupied approximately 166,000 acres (Table 1). California alone reported 139,000 acres, or 84 per cent of the total plantings. The other 27,000 acres, or 16 per cent, was listed as in Oregon, although a small portion of this acreage was actually across the state line in Washington. Of the California acreage, 82 per cent was classified as of bearing age in 1934. In Oregon only 55 per cent of the acreage had attained bearing age, indicating that the development of walnut

* A. S. Burrier (deceased), late head of the Department of Farm Management, jointly with C. E. Schuster conducted the field work and a preliminary analysis of the data. G. W. Kuhlman completed the detailed analysis and wrote the text of this bulletin. Special mention is made here of the discussion on "The Selection of Orchard Soils," by Dr. R. E. Stephenson, Soil Scientist at Oregon State College (see page 39).

ACKNOWLEDGMENTS: The authors express appreciation to the walnut growers who cooperated in this study; to the Eugene Fruit Growers' Association, the North Pacific Nut Growers' Association, and the Oregon Nut Growers' Association; to W. E. Goodspeed, Manager of the Walnut Control Board; to Professor H. D. Scudder for helping launch the project; to J. C. Burtner, Extension Editor, for the use of several pictures; to E. L. Potter, in Charge, Division of Agricultural Economics, and to D. Curtis Mumford, Head of the Department of Farm Management at Oregon State College, for aid in the final revision of the typescript.

production in Oregon has been more recent than in California. In fact, a comprehensive enumeration showed that a majority of the bearing trees in this State were less than 20 years old in 1935.*

Table 1. WALNUTS: TOTAL ACREAGE, BEARING AND NONBEARING ACREAGE, CALIFORNIA AND OREGON, 1930 AND 1934.*

Year	California		Oregon†		Total acreage	Percent- age of acreage in bearing
	Bearing acreage	Non- bearing acreage	Bearing acreage	Non- bearing acreage		
	<i>Acres</i>	<i>Acres</i>	<i>Acres</i>	<i>Acres</i>	<i>Acres</i>	<i>Per cent</i>
1915	34,453	20,363	.....	.....	54,816	63
1920	58,963	14,000	.....	.....	72,963	81
1925	69,629	36,700	.....	.....	106,329	65
1930	97,453	40,111	12,094	13,033	162,691	67
1934	117,504	21,501	15,000‡	12,000	166,005	80

* Data taken from mimeograph report of Walnut Control Board entitled "Certain Exhibits Presented as Evidence at 1935 Walnut Hearing."

† Includes Washington acreage. The 1930 U. S. Census shows about 1,000 acres in Washington, half of which were classified as bearing.

‡ The estimated acreage of bearing walnut trees in Oregon in 1938 was 18,800 acres (Oregon Extension Circular 334).

DISTRIBUTION OF 480,299 WALNUT TREES BY AGE GROUPS

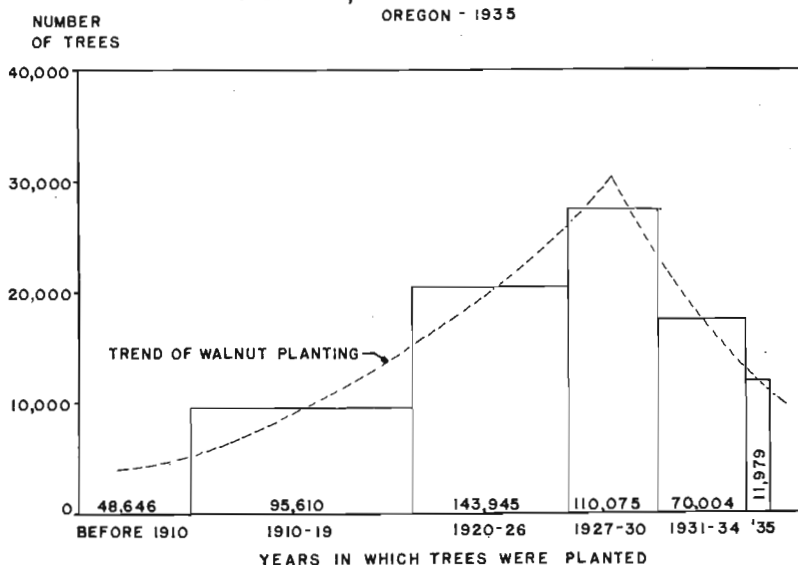


Figure 1. The rate of planting walnut trees reached its maximum in Oregon about 1929. Nurserymen report that the combined volume of new plantings and replacements has been continuing at approximately the 1935 rate. (Source of data: "Special Pacific Northwest Fruit and Berry Survey," Bureau of Agricultural Economics, United States Department of Agriculture.)

* In 1935 the Bureau of Agricultural Economics of the United States Department of Agriculture, in cooperation with Oregon State College, directed a detailed survey of the fruit and berry plantings in Oregon. Some of the findings in that survey are referred to in this study.

Many Oregon plantings not yet in full bearing. In 1935 there were 480,299 walnut trees in the 16 Oregon counties, which include practically all of the commercial plantings in the State (Table 2). The blocks in Figure 1 represent the number of trees remaining from plantings made during the specified interval of years, and the broken line shows the approximate number of trees for each year. Apparently the net annual rate of walnut plantings in Oregon reached its peak about 1929 and declined considerably thereafter. Of all walnut trees in the State, 39 per cent were less than 9 years old in 1935. Trees of this group were considered as nonbearing. Thirty-one per cent of the trees were from 9 to 15 years old. These trees generally were in bearing but at only a fraction of their ultimate capacity. Thirty per cent of all the walnut trees were 16 years or older. This group accounted for the bulk of the crop, yet obviously many of these plantings had not attained the age of full production.

Table 2. WALNUTS: NUMBER OF TREES, ACREAGE, AND PRODUCTION; BY COUNTIES, OREGON, 1934*

County	Number of trees		Acreage	Production
	Total	Average per acre		
			<i>Acres</i>	<i>Pounds</i>
Yamhill	119,602	20	5,980	1,496,400
Washington	93,359	26	3,591	1,211,400
Marion	78,962	23	3,433	980,840
Lane	45,390	27	1,681	872,200
Polk	40,436	29	1,394	306,000
Clackamas	39,879	24	1,662	285,000
Linn	22,723	21	1,082	262,920
Douglas	9,835	24	410	243,120
Benton	7,596	26	292	87,840
Jackson	4,877	25	195	21,760
Multnomah	3,845	27	142	76,560
Josephine	811	....†	34	15,120
Hood River	429	....†	18	5,020
Baker	263	....†	11	2,400
Wasco	195	....†	8	3,300
Umatilla	118	....†	5	3,960
TOTAL	468,320†	23.5	19,938	5,873,840

* From Special Pacific Northwest Fruit and Berry Survey, Oregon, Walnuts and Filberts: in charge of the Bureau of Agricultural Economics, U. S. Department of Agriculture (July 1937).

† Data were not given by counties. In such cases the acreage was computed on the basis of 23½ trees per acre.

‡ Does not include the 1935 plantings, estimated at 11,979 trees. (See Figure 1.)

Table 3. WALNUT TREES: DISTRIBUTION BY SIZE OF PLANTINGS, OREGON, 1935, 472,737 Walnut Trees*

Acres of walnuts per farm†	Plantings	Percentage of trees	Trees per farm	Walnut acreage per farm
	<i>Number</i>	<i>Per cent</i>	<i>Number</i>	<i>Acres</i>
Less than 1	3,712	6	7	0.3
1 to 5	1,184	12	50	2.0
5 to 20	928	40	204	9.0
20 to 40	129	17	636	27.0
40 or more	57	25	2,035	86.0
All plantings	6,010	100	79	3.3

* Does not include the plantings made in 1935 in 10 counties, estimated as numbering 7,562 trees.

† Acreage was computed by dividing the total number of trees by 23½, which was the average number of trees per acre in the survey.

Most Oregon plantings small in acreage. Of the 6,010 walnut plantings enumerated in the 16 Oregon counties growing walnuts commercially in 1935, 3,712 or considerably more than half contained less than one acre each (Table 3). The three groups having the larger acreages (100 trees or more) numbered only 1,114 orchards, or less than one-fifth of all orchards, but contained 82 per cent of all the trees. In 1934 these three groups produced about 81 per cent of the total crop in Oregon. It is largely this portion of the crop that at present concerns those who are responsible for maintaining a satisfactory market for walnuts.

Trend of walnut production and imports. Although the bearing acreage of walnuts has been increasing rapidly for a quarter of a century, the rate of expansion apparently has been declining since 1930 (Table 1). In Oregon this downward trend has been further accelerated since the freeze of 1935. The estimated bearing walnut acreage in Oregon in 1938 had reached 18,800 acres. The decrease in rate of planting cannot be attributed to a lack of suitable soils, for a considerable amount of land adapted to walnuts is still available for new planting.

In addition to the effect that new plantings coming into production might have on the domestic supply, there is the somewhat unpredictable factor of what the ultimate production of the present bearing acreage will be when the trees have attained full growth.

Table 4. MOST IMPORTANT TREE NUTS: ANNUAL PRODUCTION AND IMPORTS,* UNITED STATES AVERAGE OF 5-YEAR PERIOD, 1933-34 TO 1937-38†

Kind of nuts	Pounds produced			Pounds imported	Total supply‡	Percentage of total supply
	Oregon	California	United States			
	1,000 pounds	1,000 pounds	1,000 pounds	1,000 pounds	1,000 pounds	Per cent
Walnuts	4,200	90,760	94,960	12,067	107,027	34.5
Pecans			67,662		67,662	21.8
Almonds		24,280	24,280	21,113	45,393	14.7
Brazil nuts				38,108	38,108	12.3
Cashew nuts				21,003	21,003	6.8
Chestnuts				16,777	16,777	5.4
Filberts	2,844		3,268	7,845	11,113	3.6
Pistachio nuts				2,755	2,755	.9
TOTAL	7,044	115,040	190,170	119,668	309,838	100.0

* Imports: Year ended June 30 (tonnage of walnuts, almonds, brazil nuts, and filberts has been converted to the unshelled basis because they are imported both shelled and unshelled. Cashew nuts are imported only as shelled nuts (kernels) and are so reported here.)

† Agricultural statistics, 1939; U. S. Department of Agriculture.

‡ The value of tree nuts exported averaged only \$2,108,000 per year between 1933-34 and 1937-38. Tree-nut imports averaged \$14,746,000 per year during this period.

The annual domestic production of walnuts during the 5-year period ending with 1937 averaged 94,960,000 pounds (Table 4). An average of 12,067,000 pounds (in-the-shell basis) was imported annually during this period. Although some walnuts were exported, the production and imports, which together amounted to an average of 107,027,000 pounds per year, may be considered as the approximate walnut consumption in the United States.

China has been the main source of walnuts imported into the United States (Table 5). France ranked second, Turkey third, and Italy fourth in volume of walnuts shipped to this country during the 5-year period, 1933-1937.

Table 5. WALNUTS: AMOUNT AND PERCENTAGE IMPORTED INTO THE UNITED STATES BY MAJOR SOURCES OF IMPORTS, 1933-34 TO 1937-38*

Country from which imported	Amount imported			Percentage
	Shelled	Unshelled	Total†	
	<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>	<i>Per cent</i>
China	3,010,600	.....	7,168,100	59.4
France	963,000	21,000	2,313,800	19.2
Turkey	489,800	.....	1,166,200	9.7
Italy .....	.....	130,000	130,000	1.1
Other Europe	333,000	4,000	796,800	6.6
Other countries	188,200	44,000	492,100	4.0
TOTAL IMPORTED	4,984,600	199,000	12,067,000	100.0

* Agricultural Statistics, 1939; U. S. Department of Agriculture.

† Unshelled basis; conversion factor used, 100 pounds unshelled equals 42 pounds shelled.

COMPETITION FACTORS

Walnut growers face competition from *all* tree nuts both domestic and imported (Figure 2).

PRODUCTION AND IMPORTS OF TREE NUTS, UNITED STATES
5-YEAR AVERAGE, 1933-34 TO 1937-38
(SOURCE: AGRICULTURAL STATISTICS, 1939)

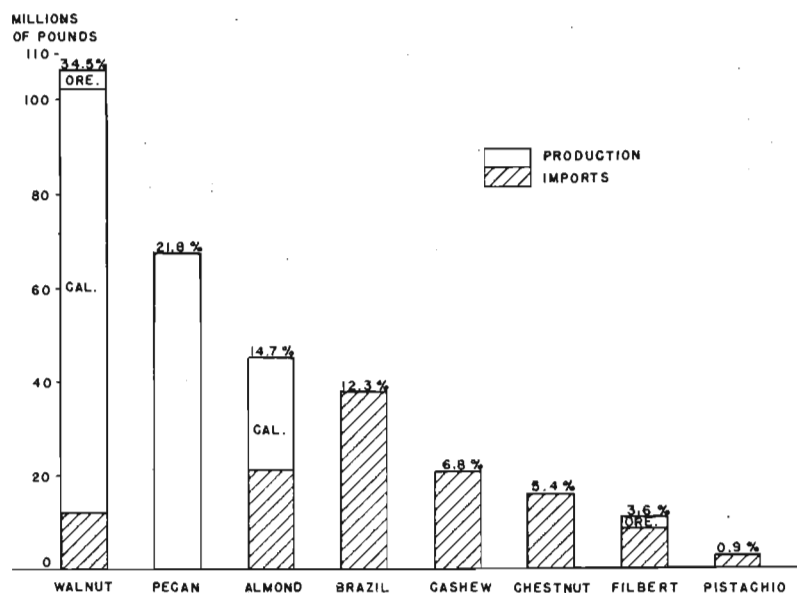


Figure 2. The tonnage of walnuts, pecans, almonds, Brazil nuts, and filberts is reported here on the in-the-shell basis.

Tree-nut production increasing. The production of tree nuts in the United States has been steadily increasing for many years. Whereas the aver-

age aggregate domestic production of walnuts, pecans, almonds, and filberts during the 5-year period ending with 1924 was only 93,000,000 pounds of unshelled nuts per year, the production during the 5-year period ending with the 1937 crop was 190,170,000 pounds per year.

Imports declined. The value of total tree-nut imports has decreased since the World War period (Table 6). The aggregate quantity of nine tree nuts imported during the 5-year period ending with June 1930 amounted to approximately 91,000,000 pounds on the shelled basis, compared with only 73,000,000 pounds during the 5-year period ending with June 1939. While the steady increase in the volume of nuts imported since the low point of 1932-33 indicates some recovery in the domestic market demand or the consumer purchasing power, it also indicates a continued competition from foreign-produced tree nuts despite the present low prices in this country.

Table 6. VALUE OF IMPORTS, EXPORTS, AND NET IMPORTS OF ALL TREE NUTS, UNITED STATES, 1919-20 TO 1937-38

(Compiled from U. S. Yearbooks of Agriculture)

Year	Imports	Exports	Net imports
1919-20	\$59,659,000	\$1,972,000	\$57,687,000
1920-21	24,301,000	1,791,000	22,510,000
1921-22	33,069,000	1,559,000	31,510,000
1922-23	25,913,000	1,406,000	24,507,000
1923-24	25,665,000	1,174,000	24,491,000
1924-25	35,134,000	1,100,000	34,034,000
1925-26	31,403,000	1,289,000	30,118,000
1926-27	33,079,000	1,667,000	31,412,000
1927-28	29,472,000	1,524,000	27,948,000
1928-29	31,203,000	1,523,000	29,680,000
1929-30	24,739,000	1,398,000	23,341,000
1930-31	17,737,000	1,169,000	16,568,000
1931-32	13,491,000	1,028,000	12,463,000
1932-33	7,876,000	736,000	7,140,000
1933-34	9,893,000	2,667,000	7,226,000
1934-35	12,203,000	1,516,000	10,687,000
1935-36	15,959,000	1,911,000	14,048,000
1936-37	19,705,000	2,153,000	17,553,000
1937-38	15,970,000	2,292,000	13,678,000
AVERAGE	\$24,552,000	\$1,573,000	\$22,979,000

Tree-nut consumption. After 1926-27 the imports of tree nuts declined more rapidly than domestic production increased, and the total consumption, as represented by domestic production plus net imports declined. Thomas* stated that tree-nut consumption from 1921-22 to 1926-27 fluctuated around 3 pounds per capita; by 1929-1932 the level of consumption had dropped to 2.6 pounds per capita; and during the 3 years 1932-33 to 1934-35 it was 2 pounds per capita.

Walnuts exceed any other tree nut. Walnuts comprised 34.5 per cent of the 309,838,000 pounds total domestic supply of all tree nuts during the 5 years 1933-34 to 1937-38 (Table 4 and Figure 2). Nearly 40 per cent of the tree nuts used in the United States during that 5-year period were imported and about 60 per cent were produced domestically.

Almond consumption trend downward. Almond consumption in the United States has declined steadily since the World War. In 1919-20 and

* Data from an article by M. M. Thomas originally published in Market News Service (November 27, 1935), Bureau of Agricultural Economics, U. S. Department of Agriculture, and subsequently in "Norpac News" (July 1936).

1920-21 almonds ranked first with 30 per cent of total consumption, while from 1933-34 to 1937-38 they ranked third with less than 15 per cent of the total.

Pecan consumption increasing. Pecan consumption has risen irregularly from 15 per cent of the total in the period 1919-20 to 21.8 per cent of the total during the period 1933-34 to 1937-38.

Cashew nuts make rapid gains. In 1929-30, the consumption of cashew kernels in the United States was only about $3\frac{1}{2}$ million pounds. In 1936-37 it was more than 25 million pounds of kernels or a sevenfold increase in the seven-year interval, and the trend is still upward.

Filberts of local importance. Filberts, although comprising less than 4 per cent of all tree nuts consumed in the United States, are of major interest to Oregon nut growers because this State at present produces 87 per cent of the domestic crop. Furthermore, nearly three-fourths of the filberts used in the United States during this 5-year period were imported. Obviously the Oregon nut grower is interested in the possibility he has for eventually producing more of the filberts as well as the walnuts consumed in this country. Simultaneously, however, these growers are facing constantly increasing competition, not only with each other, but also from growers of other tree nuts, particularly to the extent that competitors are able and willing to increase the attractiveness of their respective products to the consumer.

Peanuts may compete. The price of peanuts has always been much lower than prices of tree nuts and peanut consumption much higher. The seasonal farm price of peanuts averaged about 3 cents a pound during the period 1933 to 1938, compared to 11 cents for the tree nuts. During the depression years following 1930, therefore, part of the consumers' nut expenditures may have shifted to peanuts, because of their lower price. In the two years, 1931-32 and 1932-33, the consumption of peanuts, as edible nuts and in the form of peanut butter, and the total quantity of peanuts produced were both at a record high level. Consumption of peanuts in these forms averaged 800 million pounds for these 2 years (compared to 300 million pounds of tree nuts) or 24 per cent larger than the average from 1927-28 to 1930-31. The average tonnage harvested annually during the latter period also increased 25 per cent over the average of the earlier period. Consumption in the next two years dropped again, but the production did not show a corresponding decrease. The consumption of peanuts has averaged between 2 and $2\frac{1}{2}$ times the total consumption of all other nuts in recent years. It may be questionable, however, to what extent peanuts compete with walnuts in normal times.

TREND OF TREE-NUT PRICES

Since Oregon and California produce practically all of the walnuts grown in this country, it would at first glance appear that, except for the imports, the price would be determined largely by the extent of this production (Table 7 and Figure 3). Further analysis, however, reveals other factors affecting the price of walnuts. Although the trend of production in these two states has been distinctly upward, considerable fluctuations have occurred in the tonnage produced from year to year, but the price curve only partly reflects these fluctuations (Figure 4).*

* Since the commercial production of nuts in Oregon is relatively new, statistics are available for a comparatively short period of time. The Federal filbert-price data extend back only to 1929, and even the prices for Oregon walnuts were not included in the Agriculture Yearbook prior to 1924. The prices of the improved pecans in the United States are available since 1922.

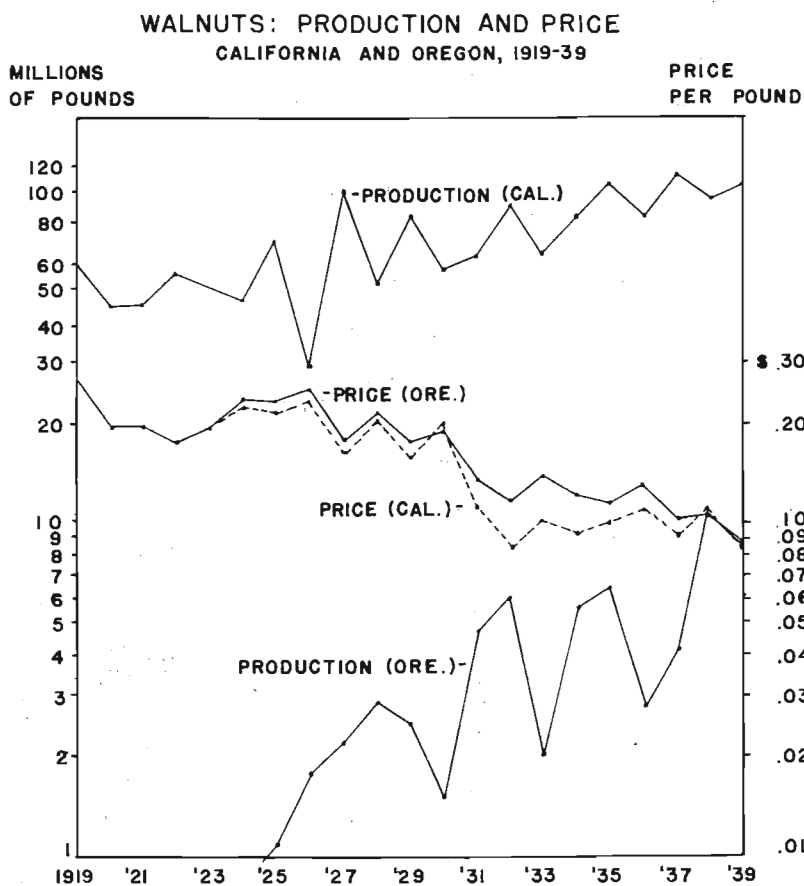


Figure 3. Use of semilogarithmic scale shows clearly the extent of the annual fluctuations in production of walnuts in each of the two states. (Agricultural Statistics, 1940.)

Apparently the demand for the limited production of the choice or improved pecans was strong for a number of years, the December 1 price in 1922, 1923, and 1924 being more than 40 cents a pound. By 1931, however, the price had dropped to 13.8 cents a pound. Prices for walnuts also remained fairly high through 1930. Following 1930, the prices of almonds, filberts, walnuts, and the improved pecans all declined abruptly, averaging during the 8-year period, 1931 to 1938, about 11 cents a pound. The effect that quality has had on the price of nuts is illustrated in the case of pecans, the improved varieties continuing to sell at prices slightly above the price of walnuts, while the price of seedling pecans generally ranged below the prices of all the other tree nuts.

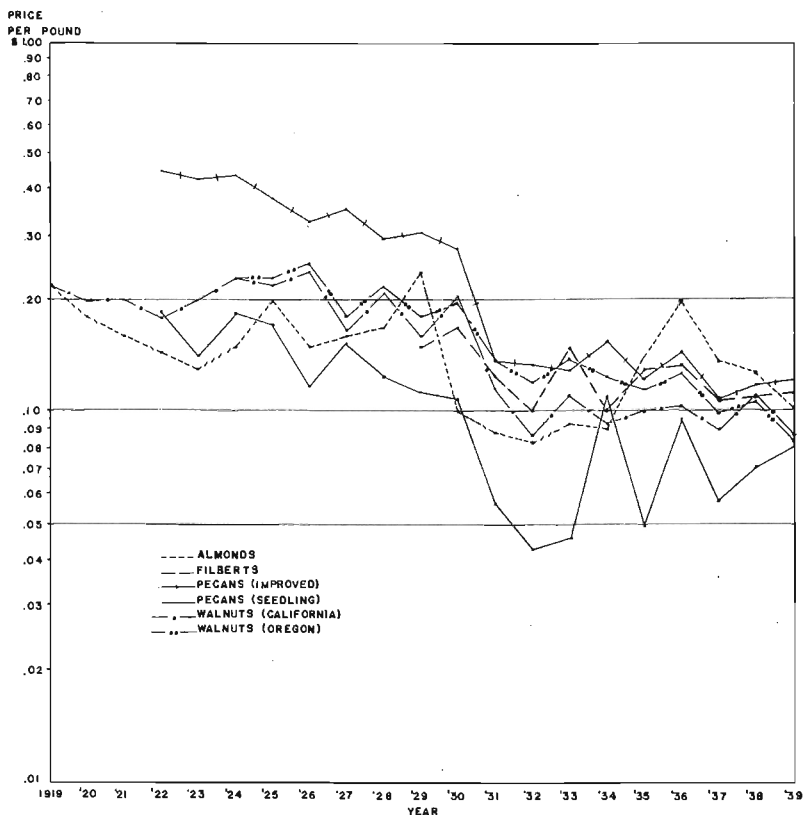


Figure 4. Season average price to growers for almonds, filberts, and walnuts; December 1 average price for pecans, United States, 1919-1939. The average of the last eight annual price quotations is about 11 cents per pound. (Source: Agricultural Statistics.)

Table 7. WALNUTS, PERSIAN (ENGLISH): PRODUCTION AND SEASON-AVERAGE PRICE RECEIVED BY FARMERS, OREGON AND CALIFORNIA, 1919-1939*

Year	Oregon		California		Total production in the United States
	Production	Price per pound	Production	Price per pound	
	<i>Pounds</i>		<i>Pounds</i>		<i>Pounds</i>
1919	460,000	\$0.27-1/2†	60,000,000	\$0.27-1/2	60,460,000
1920	500,000	.20	45,400,000	.20	45,900,000
1921	700,000	.20	46,000,000	.20	46,700,000
1922	800,000	.18	58,000,000	.18	58,800,000
1923	900,000	.20	53,000,000	.20	53,900,000
1924	900,000	.24	48,400,000	.23	49,300,000
1925	1,100,000	.24	72,000,000	.22	73,100,000
1926	1,800,000	.25	30,000,000	.24	31,800,000
1927	2,200,000	.18	102,000,000	.16-1/2	104,200,000
1928	3,000,000	.22	51,800,000	.21	54,800,000
1929	2,500,000	.18	84,000,000	.16	86,500,000
1930	1,500,000	.20	58,000,000	.20-1/2	59,500,000
1931	4,800,000	.13-3/4	63,200,000	.11-2/3	68,000,000
1932	6,000,000	.12	91,000,000	.08-3/4	97,000,000
1933	2,000,000	.14	64,000,000	.11-1/8	66,000,000
1934	5,600,000	.12-1/2	86,000,000	.09-3/8	91,600,000
1935	6,400,000	.11-1/2	104,000,000	.10-1/8	110,400,000
1936	2,800,000	.12-3/4	83,800,000	.10-8/10	86,600,000
1937	4,200,000	.10	116,000,000	.09	120,200,000
1938	11,000,000	.10-3/4	90,600,000	.11-1/8	101,600,000
1939	8,600,000	.08-1/2	106,000,000	.08-2/3	114,600,000
AVERAGE	3,227,000	\$0.17-4/10	72,057,000	\$0.16-1/8	75,284,000

* Agricultural Statistics, 1940, U. S. Department of Agriculture.

† From 1919 to 1923, inclusive, prices are those for California walnuts, no prices being given for Oregon walnuts.

Tariff affects price. Since imports make up a large percentage of the tree nuts consumed in the United States, the rate of import duties on the various tree nuts may be an important factor in determining prices and consumption. Tariff rates on nuts have been increased twice since the World War, first by the Tariff Act of 1922 and again by the Tariff Act of 1930.*

The tariff rate on almonds was raised to 5½ cents a pound, unshelled, and 16½ cents, shelled, in 1930, and imports for the 5-year period ending with June 1939 declined to 30 per cent of the total for the 5-year period ending with June 1930. Likewise the tariff on filberts was raised to 4 cents, unshelled, and 10 cents, shelled, and imports dropped in the same proportion as almonds for the periods cited. The tariff on walnuts was raised to 5 cents unshelled, and 15 cents, shelled, and imports dropped to less than one-fifth.

Walnut growers operate under marketing agreement. The walnut industry has been operating under a Federal Marketing Agreement since October 1933. Exports made since then have been part of the control program

* The following are basic tariff rates per pound on importations of specified tree nuts quoted by the United States Customs Service, October 1939:

	Not shelled	Shelled
	<i>Cents</i>	<i>Cents</i>
Almonds	5½	16
Cashew	Free	2
Chestnuts	Free	12½
Brazil	½	2½
Filberts	5	10
Pecan	5	10
Pignolia nuts	2½	5
Pistachio nuts	2½	5
Walnuts	5	15

instituted under the agreement. Protection of the domestic unshelled nut market has been the chief aim of the program, and this aim has been accomplished by diverting a portion of the merchantable crop into the export and the domestic shelled markets, sales in these markets being made at prices lower than those prevailing in the protected markets. (See Appendix B for a statement regarding the Walnut Control Board Program.)

NEED FOR ECONOMIC RESEARCH

In the light of all the foregoing facts it is evident that the individual walnut grower cannot hope to have his investment safeguarded merely by having the domestic output of walnuts adjusted to the local demand or even to the world market, but must keep his costs of production in line with the long-time average income possible to him from the operation of his orchard.

The established walnut grower is familiar with the fact that his walnut planting usually involves a high investment in land and trees, owing partly to the fact that a long waiting period must elapse before the orchard produces sufficiently to pay its way. Many orchardists have at some time suffered the losses accompanying insect infestations and disease. At irregular intervals they have experienced the effects of unfavorable weather conditions, particularly a severe freeze, which not only curtailed production temporarily, but sometimes resulted in partial or complete loss of the trees and therefore of much of the investment. Sometimes, however, farmers who have never produced walnuts, attracted by the widely reported though infrequent high yields or the high prices obtained in the past, are not aware of the serious hazards of the enterprise.

Some farmers are not familiar with methods of studying the various factors affecting their cost of production. The information presented in this bulletin is designed to be helpful to present walnut growers interested in avoiding an unwise increase in the total walnut acreage, but more particularly to serve as a guide to those farmers who are still in the process of considering whether or not to include a walnut planting in their farm organization plan.

COSTS THE BASIS FOR IMPROVING INCOME

The following analysis reveals that the costs of the different operations varied among growers, some having costs considerably above, and others considerably below the average. The findings should be especially helpful to the grower having higher-than-average costs in any phase of his production. By ascertaining the items on which he is expending more than the average of all growers and by recognizing the fact that certain of his costs are high, the individual grower should be enabled to focus his attention on these items and thus try to work out means for reducing such costs so as to leave a larger margin of profit from his production.

DESCRIPTION OF THE STUDY

Selection of orchards. A comprehensive study of walnut-production costs and practices was conducted by the survey method in cooperation with growers scattered throughout the important walnut-producing counties of Oregon (Figure 5). The study was begun in 1929 and continued for 3 years. Production records were taken of practically all available orchards considered as being of commercial size. Few orchards of less than 5 acres were included, chiefly owing to the difficulty of obtaining satisfactory labor data on these

small tracts, which were often cultivated in conjunction with other orchard acreage on the farm.

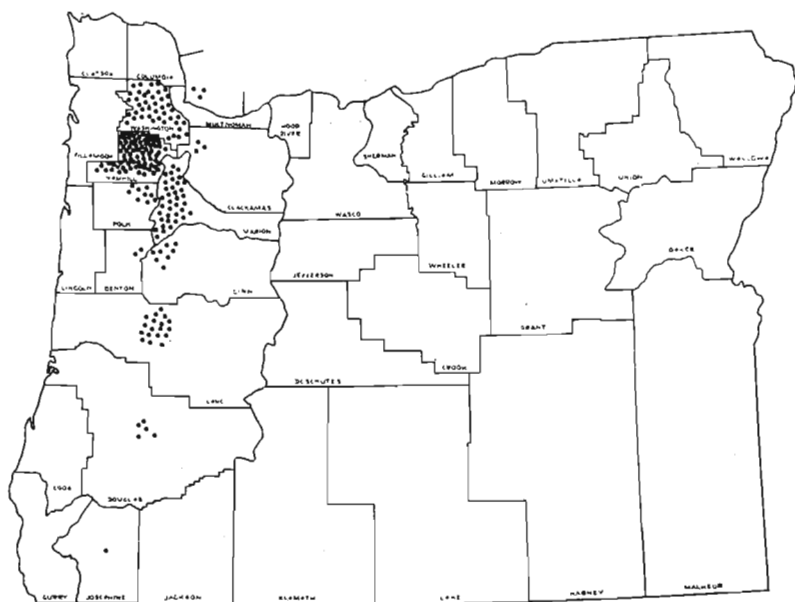


Figure 5. Of the total bearing walnut acreage in 1938, estimated as 18,800 acres, 94 per cent was in the Willamette Valley and 5 per cent was in Douglas, Jackson, and Josephine Counties in Southern Oregon.

Extent of the study. The records taken represented about one-fourth of the total crop in the State. A large portion of the remaining acreage was either in small tracts or scattered outside the main walnut areas.

Complete or partial cost records were obtained on 204 different walnut plantings, of which 68 were exclusively bearing trees; 63 had both bearing and nonbearing trees; and 73 had only nonbearing trees. The 204 orchards contained 3,945 acres of bearing and 2,974 acres of nonbearing trees, or a total of approximately 7,000 acres.

Complete cost records were obtained for 3,807 acres of the bearing and 1,182 acres of the nonbearing orchards. The costs of production were obtained

Table 8. WALNUTS: NUMBER, ACREAGE, PRODUCTION, AND AVERAGE YIELD OF BEARING ORCHARDS STUDIED, OREGON, 1929 AND 1931

Year	Farms	Total acreage	Production	Yield per acre
	<i>Number</i>	<i>Acres</i>	<i>Pounds</i>	<i>Pounds</i>
1929	122	3,471	1,161,574	335
1931	116	3,609	2,387,995	662
ALL RECORDS	238	7,080	3,549,569	498*

* The 6-year average of yields, 1927-1932, on approximately 60 per cent of the orchards studied, where such information was available, was 518 pounds per acre. This would indicate that the average yield of nearly 500 pounds per acre reported in this study was fairly representative of average conditions for the longer period cited.

on 122 bearing orchards for the 1929 crop, and on 116 bearing orchards for the 1931 crop. As far as possible the same orchards were studied each year. Thus the study includes records on 107 orchards for the 2 years', and records on 24 orchards for 1 year's production, or a total of 131 farms. Preliminary analysis of these records was reported in Circulars of Information 50 and 81 of the Oregon Agricultural Experiment Station.

Walnut yields in Oregon generally were low in 1929 (Table 8). The following year even worse conditions resulted in a practically complete failure of the walnut crop in many sections of the State. Since a summary of such adverse conditions as occurred in 1930 would not represent the actual status of walnut production over a longer period of years, the cost-of-production phase of the study was postponed until 1931, when yields were generally satisfactory. Thus the data reported in this bulletin, including one poor crop year, 1929, and one good crop year, 1931, should provide a representative basis for studying the enterprise.

During 1930 records were obtained for 54 nonbearing plantings covering the costs of establishing the walnut orchard up to the twelfth year, when it was considered to have begun profitable production.* The analysis of those records was published in June 1933 as Bulletin 315, "Costs and Practices in Establishing Walnut Orchards in Oregon," Oregon Agricultural Experiment Station.

DESCRIPTION OF FARMS

In Oregon, as a rule, the walnut enterprise is part of a diversified farming system. Some of the larger walnut farms studied, however, were quite specialized, as shown by the fact that on 54 per cent of them the walnut acreage amounted to at least half of the total crop land, and on 37 per cent of them three-fourths of the tilled land was in walnuts.

The average size of the farms on which production-cost records were taken was 117 acres, of which 75.8 acres was tilled land (Table 9). Walnut trees (including nonbearing trees) occupied an average of 38.1 acres or about half of the tilled land and one-third of the total farm area. Fruit enterprises and nut trees other than walnuts averaged 13.3 acres per farm; all other crops, 24.4 acres; and pasture and waste, 41.6 acres. The numbers of livestock on these farms were not recorded in this survey.

Table 9. WALNUT FARMS: UTILIZATION OF ACREAGE ON FARMS STUDIED, OREGON, 1929-1931

Item	Size of farm Acres	Percentage of total acreage Per cent
Bearing walnuts	29.8	25.4
Nonbearing walnuts	8.3	7.1
Other fruits and nuts	13.3	11.4
Other crops	24.4	20.7
TOTAL TILLED LAND	75.8	64.6
Pasture and waste	41.6	35.4
TOTAL ACRES	117.4	100.0

* Experience of growers indicated that the beginning of the twelfth year marked the average age at which nonbearing trees began producing sufficiently to pay all costs of production.

CAPITAL INVESTMENT

Nature of orchard investment. The capital investment involved in a walnut planting is usually large. A long period of years and considerable expense is required to establish and bring the trees to the age of profitable bearing. In the study of costs of establishing 54 walnut orchards in Oregon during the 11-year period 1919 to 1929 the cost per acre charged in the walnut planting averaged \$347.* This cost embraced two items; namely, the estimated value of the land, averaging \$157 per acre, and the cumulative year-to-year expense, averaging \$190 per acre, for the trees planted and their maintenance, taxes on the land, and interest compounded annually on the investment involved in the walnut planting. The costs of starting a walnut orchard varied widely with the location and with the different methods of management followed.

About four-fifths of the growers interviewed had intercropped the space between the rows of young walnut trees. From the standpoint of growing-cost, obviously the utilization of that space is important. For those tracts planted solely to walnuts the charges incurred averaged \$309 per acre, all of which must be considered as invested in the walnut enterprise, in addition to whatever the land itself was worth. On the other hand, where "filler" trees or intercrops were also grown and bore a proportionate part of the cost, the charges against the walnut plantings averaged only \$99 per acre exclusive of the value of the land. The growers' estimates of the latter item ranged from \$40 to \$500 an acre, varying with the type of soil, productivity, and location of the tract. It was assumed that, as a whole, the intercrops paid their way and hence neither costs nor returns resulting from their presence were considered in computing the cost of establishing the walnuts.

Table 10. WALNUTS: THE CAPITAL INVESTMENT PER ORCHARD AND PER ACRE OF BEARING TREES; BY MAJOR ITEMS, OREGON, 1929-1931
Average size of bearing walnut orchards was 30 acres

Item	Records containing the item	Investment per orchard reporting the item	Investment per orchard (all orchards)	Investment per acre (all orchards)
Bearing walnuts	238	\$16,928	\$16,928	\$569
Tractor*	131	249	137	4
Other machinery*	212	89	80	3
Drier*	97	954	389	13
Other buildings*	93	106	41	2
ALL ORCHARDS	238	.....	\$17,575	\$591

* The amount of equipment investment shown here is based on the proportion of the use chargeable to the bearing walnut orchard in relation to total use for the year.

The value of the bearing walnut acreage and equipment used in production, as estimated by the 131 growers who cooperated in this present study, averaged \$17,575 per orchard (averaging 30 acres) and \$591 per acre (Table 10). The value of the orchard planting itself ranged from \$200 to \$1,200 an acre, averaging \$569 or 96 per cent of the total investment involved. At first glance this average inventory value that growers placed on their bearing orchards might appear to be high in comparison with the average cost of \$347 per acre for growing an orchard to bearing age, or through the first 11 years. This, how-

* Bulletin 315, Oregon Agricultural Experiment Station, "Costs and Practices in Establishing Walnut Orchards in Oregon," page 17.

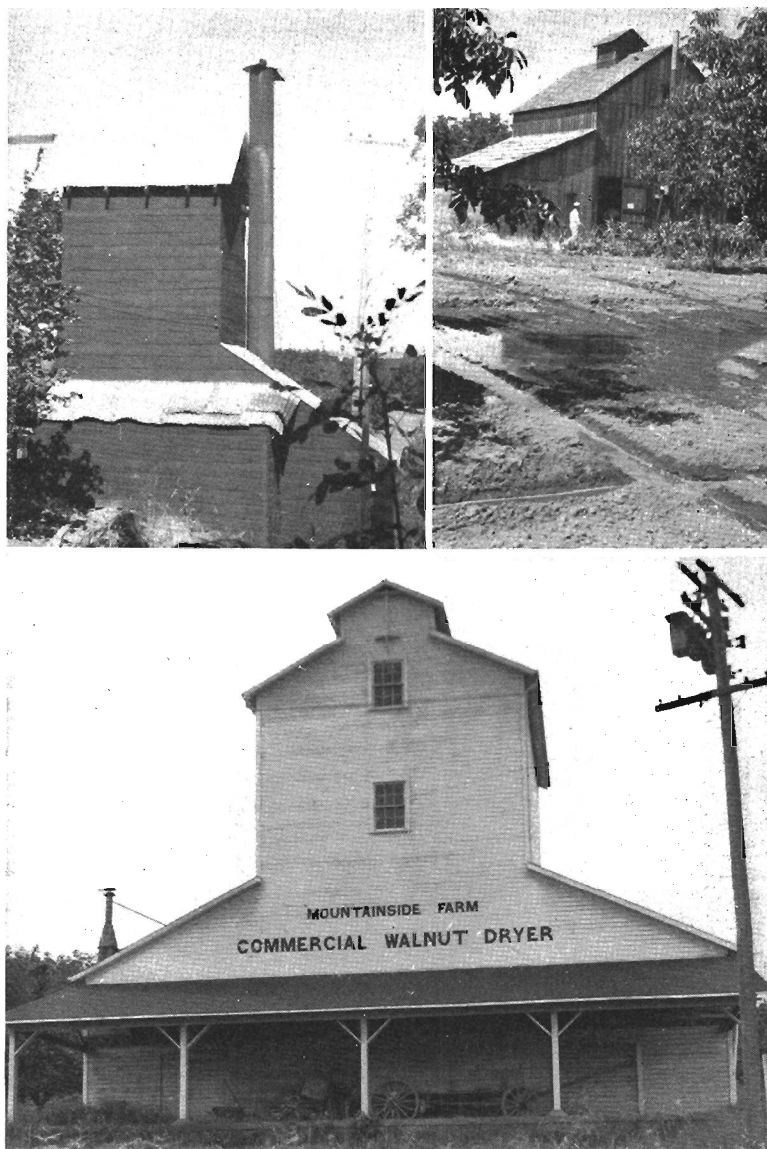


Figure 6. *Upper left:* This drier was built by the farmer himself, at a cost of approximately \$500 for materials and equipment. *Upper right:* A farm drier having additional space for housing farm machinery and for temporary storage of walnuts. *Lower:* One of the more elaborate driers found in walnut and prune regions.

ever, is not necessarily the case. These bearing orchards undoubtedly were much more valuable by reason of greater productivity at their average age, which was 22 years in 1931, than were the young groves at the end of 11 years. Furthermore, the older orchards, having survived serious hazards or risks ordinarily not reflected in the costs shown for establishing new plantings, would probably be worth more than the average cost involved in the process of growing the trees only to bearing age. Results obtained from a large number of farm records representing different enterprises reveal the fact that farmers' estimates of values tend to be closely correlated with yield and returns.

Presence of interplants complicates cost work. Since two-fifths of the bearing orchards studied still contained "filler" trees at the time that the cost records were obtained, it was necessary to adopt arbitrarily an accounting procedure for determining the costs of producing walnuts under those conditions. Presumably the presence of interplanted trees would affect the productivity and therefore the investment value assigned specifically to the walnut planting, and also the annual cost chargeable to the walnut crop.

Inasmuch as the need for removal of the interplanted trees was already past due, in most cases, the growers' estimates of the orchard value reflected the status of the walnut trees only, thus regarding the "filler" trees as no longer having any value. The operating costs, including taxes, however, were proportioned to walnuts and to the interplants according to the estimated share of the land utilized by each. Neither costs nor returns from interplants were considered in determining the cost of producing the walnuts.

Equipment investment. The value of equipment used in walnut production was almost negligible compared with the value of the orchard. Machinery and buildings were generally used jointly for several farm enterprises. For example, the portion of the tractor investment charged to walnuts was only \$249 per farm reporting this item; other tillage machinery, \$89; and other buildings (besides the drier), \$106. For a number of the orchards that were cared for by a neighbor on a custom-work basis such items would not even appear on the record as investments.

Great variations were found in the type of driers and equipment used on individual farms in this study (Figure 6). Of the 51 driers used in 1931, 21 were described as prune driers, 21 were built for walnut drying, and the remaining 9 included a miscellaneous lot of shelters, ranging from space in the house or barn to a shed structure permitting maximum circulation of air.

The capacity of the driers as well as the proportion of the total year's use that was chargeable to walnuts varied greatly from farm to farm. Expressed in terms of the inventory value of the building and its equipment, the portion ascribed to walnut drying averaged \$954 per drier operated. For the ten driers in Washington County the share of the drier investment charged to walnuts averaged \$2,391 per drier, but some of these had been built to dry prunes and were therefore unnecessarily expensive for walnut drying.

The average total investment of \$17,575 per bearing walnut planting studied comprised more than half of the entire farm investment of approximately \$34,000, indicating the relative importance of this enterprise on these farms.

THE COST OF WALNUT PRODUCTION

The average cost of producing walnuts in Oregon was \$59.43 per acre, or 13.3 cents per pound, during the two-year period including 1929 and 1931

(Table 11). The cost in 1929 was \$58.11 per acre, which at a yield of 335 pounds per acre was 17.4 cents per pound. The cost in 1931 was \$60.74 per acre, which at a yield of 662 pounds per acre was 9.2 cents per pound.

Table 11. WALNUTS: COST OF PRODUCTION, BY YEARS, AND THE 2-YEAR AVERAGE, OREGON, 1929 AND 1931.

For 238 cost records on 7,080 acres of bearing orchards, producing 3,549,569 pounds of walnuts.

Item	Cost per acre			2-year average cost per 100 pounds*	Percentage of average cost per acre
	1929	1931	2-year average		
<i>Labor cost</i>					<i>Per cent</i>
Contract work	\$ 5.11	\$10.31	\$ 7.71	\$ 1.55	13.0
Hired labor	8.60	6.89	7.75	1.80	13.0
Operator and family labor	4.74	5.38	5.06	1.12	8.5
TOTAL MAN LABOR	\$18.45	\$22.58	\$20.52	\$ 4.47	34.5
HORSE WORK	\$ 1.02	\$.59	\$.80	\$.20	1.3
<i>General expense</i>					
Property tax	\$ 2.22	\$ 2.79	\$ 2.50	\$.54	4.2
Fertilizers	1.45	.71	1.08	.27	1.8
Spray materials .....	.37	.36	.36	.08	.6
Use of automobile and truck .....	.30	.29	.30	.07	.5
Tractor fuel and repair	1.13	1.03	1.08	.25	1.8
Miscellaneous†	1.12	.89	1.01	.24	1.7
TOTAL GENERAL EXPENSE	\$ 6.59	\$ 6.07	\$ 6.33	\$ 1.45	10.7
DEPRECIATION OF EQUIPMENT ..	\$ 1.99	\$ 2.47	\$ 2.23	\$.48	3.8
COST EXCLUSIVE OF INTEREST	\$28.05	\$31.71	\$29.88	\$ 6.60	50.3
INTEREST ON INVESTMENT AT 5 PER CENT	\$30.06	\$29.03	\$29.55	\$ 6.70	49.7
TOTAL COST	\$58.11	\$60.74	\$59.43	\$13.30	100.0
Cost per hundredweight	\$17.40	\$ 9.20	\$13.30	.....	.....
Price per hundredweight	\$15.32	\$12.45	\$13.88	.....	.....
	<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>		
Yield of walnuts per acre	335	662	498	.....	.....

* In order to avoid third-place decimals the cost items have been reported here on the hundredweight basis instead of the pound basis. To find cost per pound, therefore, the dollar values may be read as cents.

† Miscellaneous items include fuel for drier and camp use, fire- and accident-insurance premiums, rent for hired equipment, building repair, rodent poisons, sacks, water, power and light, and telephone.

Cost defined. The total cost as herein presented includes both the cash expenditures and estimates of noncash items. Costs include: (1) wages covering the work done by the operator and members of his family, hired labor, and contract work; (2) a charge for horse work; (3) outlay for materials and repairs; and (4) interest at 5 per cent on the capital investment. The cost statement (Table 11) is itemized in such a manner that costs exclusive of interest may be observed as well as the complete cost. Thus the study shows that the cost of producing walnuts exclusive of the interest charge on capital was \$28.05 per acre in 1929 and \$31.71 per acre in 1931, or an average of 6.6 cents per pound for the 2 years.

Cash and noncash costs. Those expense items that are generally considered as the cash costs of producing walnuts in Oregon averaged \$21.79 per acre, or 4.8 cents per pound (Table 12). This portion of the expense, constituting 36 per cent of the total cost, must be paid by the grower before he receives anything for his own and unpaid family labor, for use of his horses, for interest on his orchard investment, and for depreciation and interest on his equipment and farm buildings. Obviously, the grower who had his property all paid for was in a favorable position, even under the adverse conditions of 1929, to weather an era of low prices. On the other hand, the boom prices paid for some orchards in the past, when walnuts were selling at high prices, usually can no longer be justified, if a fair rate of interest on such an investment is expected. In other words, *total* cost in its relation to the average price obtainable for the product is the long-time determinant or measure of the profitability of an enterprise.

Table 12. WALNUTS: CASH AND NONCASH COSTS OF PRODUCTION, OREGON, 1929 AND 1931

Two-year average yield of 498 pounds per acre

Item	Cash cost	Noncash cost	Your orchard*	
			Cash cost	Noncash cost
<i>Cost per acre</i>				
Hired labor	\$ 7.75	.....	.....	.....
Contract work	7.71	.....	.....	.....
Property tax	2.50	.....	.....	.....
Fertilizers	1.08	.....	.....	.....
Spray materials .....	.36	.....	.....	.....
Use of automobile and truck .....	.30	.....	.....	.....
Tractor fuel and repair	1.08	.....	.....	.....
Miscellaneous expenditures	1.01	.....	.....	.....
Operator and family labor		\$ 5.06	.....	.....
Horse work .....		.80	.....	.....
Depreciation of equipment		2.23	.....	.....
Interest on investment at 5 per cent		29.55	.....	.....
TOTAL COST PER ACRE	\$21.79	\$37.64	.....	.....
COST PER 100 POUNDS	\$ 4.80	\$ 8.50	.....	.....
	<i>Per cent</i>	<i>Per cent</i>		
PERCENTAGE OF COST	36	64	.....	.....

* This space may be used to calculate the total cash and noncash production costs on any walnut orchard for any particular year. See Table 16 for suggestions on how to figure man-labor costs.

Any grouping of items into cash and noncash costs necessarily is somewhat arbitrary. Taxes, materials, and hired or contract labor are definitely cash items. Payment of the so-called noncash costs, on the other hand, often is only deferred for a time. The replacement of machinery, buildings, and livestock eventually necessitates cash outlay. The payment of interest and mortgage installments is an immediate cash outlay for the farmer who is using credit, and universally the producers use that portion of their income which in the cost statement is represented as operator and family wage, depreciation, and interest (on their equity), to provide their family with the necessities of life and the additional items that, taken as a whole, constitute their standard of living. The division of costs in Table 11 should therefore be considered as indicating the minimum cash outlay required to produce a crop of walnuts and the maximum

deferment of costs in the event that returns are inadequate to meet total costs.

In the final analysis of the situation an enterprise cannot long survive in present-day economy unless it is able to pay all costs including interest and perhaps a fair profit or compensation for risk in addition.

COST DATA CAN BE APPLIED TO YOUR ORCHARD FOR ANY YEAR

The average production requirements in terms of labor and materials and their costs should be of particular interest and value to those walnut growers who do not keep records themselves. Any grower, by referring to Table 16, may readily draw up a list of the operations performed in his orchard during any season, together with an estimated wage for each type of work listed. The total cost of this labor may then be brought to Table 12, where space is provided for recording all of the items in the cost of producing walnuts. Thus the grower has a convenient method of briefly analyzing his own enterprise in relation to the average results found by this study. This method of comparison is also useful in planning the budget for the year ahead.

MAJOR ITEMS OF COST IN PRODUCING WALNUTS

Interest computed at 5 per cent on the average amount of the capital investment represented by the walnut orchards and equipment, and wages at the prevailing rates for work performed during the year, together constituted 84.2 per cent of the total cost of production for the 2 years of the study. Obviously, these two items offer to growers the most opportunity for reducing costs. The trend of interest rates appears to be downward, indicating that perhaps the rate for the walnut investment should be reduced accordingly; and lower returns per acre for walnuts tend to force the capital value of plantings downward.

Interest. The interest charge of \$29.55 per acre was the major item of cost in producing walnuts, constituting half the total cost for the year. Interest on the average valuation of the orchard was \$28.45 per acre and 6.5 cents per pound of nuts produced, or 96 per cent of the total interest. The balance of the annual interest charge, or \$1.10 per acre, was on equipment and buildings used in walnut production. As has been mentioned, low investment per acre for machinery and buildings was generally achieved through utilizing some of the equipment for other farm enterprises, by operating fairly large walnut acreages, by renting out equipment, or by hiring custom work.

Labor costs. The average yearly cost of all the man labor and contract work used in producing walnuts in Oregon was \$20.52 per acre, or 4.47 cents per pound (Table 11). Of this labor cost, \$7.75 or nearly two-fifths was for labor hired by the year, month, day, or hour, as the case might be; a similar amount, \$7.71, was for contract work; and only \$5.06 or a fourth of the total was for the operator's labor (including supervision) and for unpaid family labor. The proportions of these items varied considerably for the 2 years of the study. Obviously, the big difference in the average yield obtained each year affected the total labor requirements. This difference, however, was offset by a decline of about 25 per cent in wage rates from 1929 to 1931.

Hours and wage rates. All operations in walnut production except the contract work were recorded on the hour basis, and the wage rates include the

value of lodging, board, and other perquisites furnished in addition to or in lieu of a cash consideration. Wage rates for the operator and the unpaid family labor were based on the prevailing wage paid to hired help performing the same type of work (Table 13).

Table 13. WALNUTS: NUMBER OF HOURS, RATE, AND COSTS PER ACRE FOR SPECIFIED TYPES OF LABOR USED, OREGON.

Kind of work	1929			1931		
	Labor	Wage per hour	Cost per acre	Labor	Wage per hour	Cost per acre
	Hours	Cents		Hours	Cents	
Hired labor	23.7	36.3	\$ 8.60	25.3	27.2	\$ 6.89
Operator's direct labor	7.6	36.0	2.75	6.8	31.1	2.12
Supervision	2.6	57.0	1.47	4.0	68.5	2.74
Unpaid family labor	1.5	34.0	.52	1.9	27.6	.52
TOTAL	35.4	38.0	\$13.34	38.0	32.3	\$12.27

The input of man labor per acre (other than contract work) for this large group of orchards varied less than 3 hours from one year to the other, indicating that the operations had become standardized.

Contract work. Contract drying comprised 40 per cent of the cost of all contract work on walnuts, picking 39 per cent, and cultivating 16 per cent, or a total of 95 per cent for these three jobs. More than half of the walnuts were custom-dried and half were picked on a contract basis.

The average rates paid per hundredweight for picking and for drying walnuts, when done on a contract basis, were as follows:

Year	Picking		Drying	
	Green basis	Dried basis	Green basis	Dried basis
1929.....	\$0.99	\$1.40	\$0.93	\$1.30
1931.....	.86	1.20	.83	1.16

The rate paid for contract work such as drying and cultivating includes cost of fuel and rent of equipment in addition to man and horse labor.

Cost of operating driers on the farm.* Artificial nut drying is practically a necessity in Oregon in order to preserve the nuts and to bring moisture content to a point where moisture equilibrium will prevail as to weight of the packaged product during shipment and in markets where the bulk of production is consumed. The quicker ripe nuts can be harvested, washed, and dried the better quality of kernel is produced.

Forty-six per cent of the walnut production represented in this study was dried on the farm. The average cost of operating the farm driers was \$1.73 per hundredweight of walnuts (dry basis) in 1929 and \$1.20 per hundredweight in 1931 (Table 14). The cost in 1929, because of the small crop handled, considerably exceeded the average custom rate of \$1.30 paid per hundredweight. The cost in 1931 corresponded closely with the average custom rate of \$1.16 paid that year. As standardization and marketing of the walnut crop centers more and more in the hands of the grower associations, the latter are also doing

* For information on drying walnuts see Circular of Information 201, Oregon Agricultural Experiment Station.

more of the drying in the association plants scattered conveniently throughout the producing areas.

Table 14. WALNUTS: AVERAGE COSTS OF DRYING THE CROP ON THE FARM, OREGON. Data include costs on 536,024 pounds in 1929, 1,078,214 pounds in 1931

Item	1929		1931	
	Cost per 100 pounds dried basis	Percentage of total drying cost	Cost per 100 pounds dried basis	Percentage of total drying cost
		<i>Per cent</i>		<i>Per cent</i>
Man labor	\$0.62	36.0	\$0.34	28.2
Fuel, repairs, insurance, etc. ....	.40	23.0	.23	19.4
Depreciation .....	.39	22.7	.36	29.7
Interest .....	.32	18.3	.27	22.7
TOTAL DRIER EXPENSE	\$1.73	100.0	\$1.20	100.0

Horse work. Although horses were used on 83 per cent of the orchards in this study in 1929, and on 68 per cent in 1931, the extent to which they were used in walnut production was negligible.

Disking, for example, was done with horses in only seven of the 116 orchards in 1931, and plowing in 24 orchards. Sixty-three of the 116 orchard operators owned tractors in 1931. In addition, practically all of the orchard cultivation on a contract basis was done with tractors.

General expense. The annual cost of materials, property tax, and other miscellaneous items in walnut production averaged \$6.33 per acre for the 2 years of the study, or 10.7 per cent of the total cost. The property tax was the largest item in this group, averaging \$2.50 per acre. Expense for fertilizers and the cash outlay for tractor repairs and fuel each averaged \$1.08 per acre. All the minor items of expense together amounted to \$1.67 per acre.

Depreciation. The annual cost or charge for depreciation on farm equipment and buildings used in producing walnuts was computed by multiplying the rate (percentage obtained by dividing the years of remaining life or usefulness of the article into 100 per cent) by its inventory value. This total charge averaged only \$2.23 per acre, or 3.8 per cent of the total cost of production (Table 11). The amount increased from \$1.99 per acre in 1929 to \$2.47 per acre in 1931. This difference was due largely to the difference in drier facilities required for the respective crops. As already indicated, these drying costs do not include expenditures for custom drying but apply only to costs incurred by cooperators who operated their own walnut driers. The annual rate of depreciation on driers averaged 6½ per cent on the basis of the present valuation. The rate on "other buildings" (generally the machine shed) was 8 per cent; on general machinery, 14 per cent; and on the tractor, 19 per cent. The rates on the basis of prices for new equipment would be about half as much as these figures, assuming that on the average this equipment has depreciated 50 per cent since the time it was acquired.

The question of whether the orchard had increased or decreased in value during the year was not taken into account. As a whole, these orchards were increasing in productivity as the trees continued to grow. Some orchards, however, were showing the effects of crowding, wrong choice of tree varieties, and unsuitable location.

SEASONAL DISTRIBUTION OF MAN LABOR

The labor requirements for walnut production do not seriously interfere with those for the grain and hay crops commonly grown on diversified farms in the region. In 1931, when walnut yields were approximately normal, three-fourths of the labor was for harvesting and preparing the crop for market (Table 15).

Table 15. WALNUTS: HOURS AND COSTS OF ALL MAN LABOR (INCLUDING SUPERVISION) PER ACRE, OREGON, 1931.

For 3,609 acres producing 662 pounds of walnuts per acre.

Kind of work	Time			Cost of labor			Percent- age of labor cost
	Hour- labor	Contract jobs	Total	Hour- labor	Contract jobs	Total labor	
	<i>Hours</i>	<i>Hours</i>	<i>Hours</i>				<i>Per cent</i>
Nonharvest	10	2	12	\$ 3.62	\$ 1.87	\$ 5.49	24.3
Harvest	28	20	48	8.65	8.44	17.09	75.7
TOTAL	38	22	60	\$12.27	\$10.31	\$22.58	100.0

Pruning and cultivation were the two major preharvest operations (Table 16). An average of 5.4 hours of man labor per acre was expended for cultivation, including hoeing around the trees. Picking required an estimated average of 31 hours of labor per acre, some of which was done by women and children.

Aside from harvesting operations, the monthly labor requirements on an average-sized walnut orchard of 30 acres were relatively small (Figure 7). During the 5 months from the first of February through June, when the preharvest labor requirements were heaviest, the walnut enterprise occupied only about one-third of the operator's time. The monthly distribution of the labor

Table 16. WALNUTS: DISTRIBUTION OF MAN-LABOR REQUIREMENTS AND COST PER ACRE; BY OPERATIONS, OREGON, 1931

Operation	Number of hours	Cost of work*	Percent- age of labor cost	Your orchard†	
				Hours	Cost
			<i>Per cent</i>		
Fertilizing	0.5	\$ 0.21	0.9	.....	.....
Pruning	4.1	1.35	6.0	.....	.....
Spraying .....	.4	.19	.8	.....	.....
Cultivation	5.4	2.71	12.0	.....	.....
Miscellaneous	1.6	1.03	4.6	.....	.....
TOTAL NONHARVEST	12.0	\$ 5.49	24.3	.....	.....
Shaking	3.4	\$ 0.94	4.1	.....	.....
Picking	31.0	7.83	34.7	.....	.....
Overseeing pickers	1.1	.38	1.7	.....	.....
Sacking and hauling	1.4	.62	2.7	.....	.....
Washing and drying	7.1	5.07	22.5	.....	.....
Miscellaneous	4.9	2.25	10.0	.....	.....
TOTAL HARVEST	48.0	\$17.09	75.7	.....	.....
ALL LABOR	60.0	\$22.58	100.0	.....	.....

* Contract work includes use of any equipment involved.

† This space may be used to calculate the cost of man labor on any walnut orchard for any particular year.

load is based on the *approximate* time of performing the various jobs pertaining to walnut production. Individual farmers, of course, vary their procedure somewhat from the program shown in order to fit the needs of their particular conditions. For example, part of the pruning has sometimes been done as early as December instead of in the later winter months. The post-bloom spray applications now recommended for control of blight are made in May. Harvesting on some of the seedling orchards begins in the latter part of September, while harvesting of some Franquettes on hill soils extends into November. The bulk of the work at harvest time is done by hired help, largely on a contract and piece-work basis. Speed is necessary in order to avoid losses from rains, which usually threaten at harvest season.

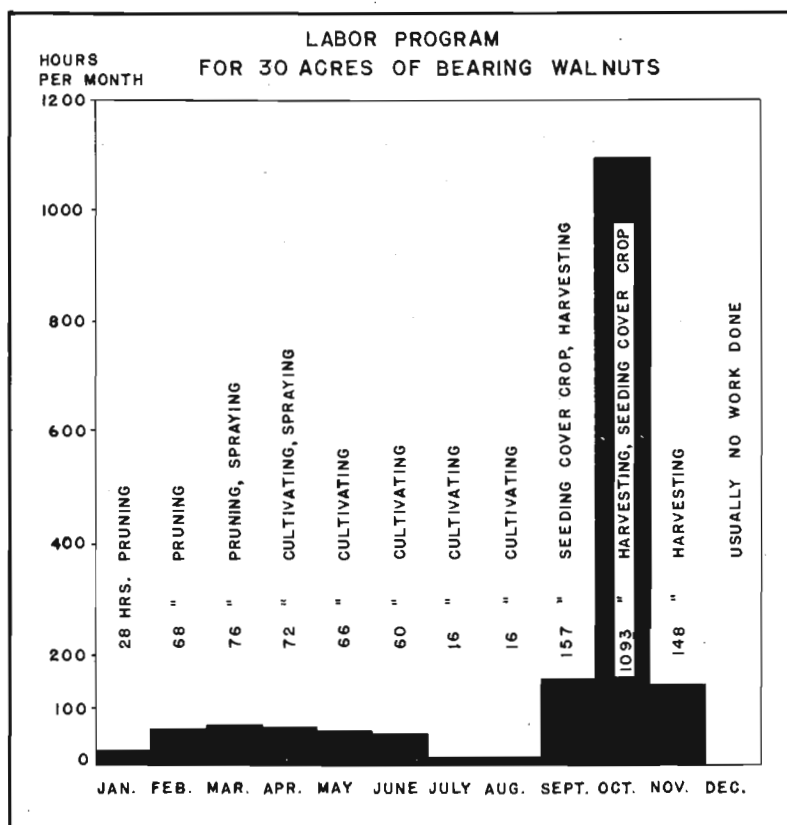


Figure 7. The man labor required in the production of walnuts was recorded by the type of work done and its distribution by months. On the basis of the average labor required annually per acre, the estimated total requirement for a 30-acre orchard would be 1,800 hours. Assuming 25 eight-hour days (200 hours) per month as a full-time job, a 30-acre walnut enterprise provides full-time work for the operator only a few months of the year.

VARIATION IN THE COST OF PRODUCING WALNUTS

The cost of walnut production for 1929 and 1931 (see Table 11) shows that costs vary considerably from one year to another. While the costs varied somewhat on the acre-basis the variations usually were much wider on the pound-basis. Production costs varied not only from year to year but also from farm to farm during the same year (Figure 8). These farm-to-farm variations are significant, for they denote differences in efficiency, which are sometimes within the control of the operator.

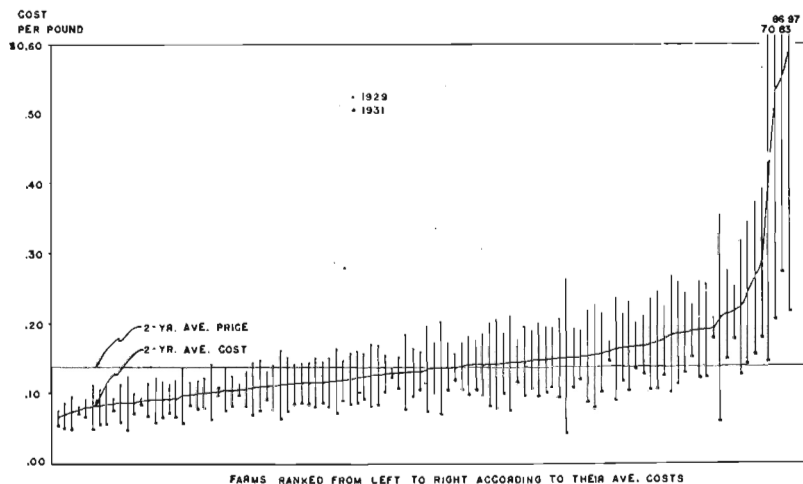


Figure 8. Cost of production varies somewhat on the same farms year after year. Some producers tend to be consistently low, while other producers are erratic.

Even though a favorable relationship existed between average cost (13.3 cents per pound for the average yield of about 500 pounds per acre over the 2-year period) and average selling price (13.9 cents) the high-cost producers were operating at a serious disadvantage. In 1929, when the average selling price was 15.3 cents per pound for the light crop of 335 pounds per acre, three orchards had costs of less than 9 cents, averaging 8.3 cents (Table 17). More than one-fifth of the total number, or 26 of the orchards, had costs of less than 13 cents. One-fourth of the records (30 orchards) showed total costs ranging from 13 to 17 cents. Their costs averaged 15.1 cents per pound, which was approximately the same as the average price (15.3 cents) received for the walnuts. Walnut production for these three lowest-cost groups of operators was a satisfactory undertaking even in a comparatively adverse year. The cash costs on these three groups of orchards averaged only 3, 3.9, and 6 cents per pound, respectively.

On the opposite side of the scale were the 15 high-cost orchards in 1929 with total production costs averaging 48.8 cents per pound. Even in this group the average receipts were sufficient to meet the cash operating expense. Among these high-cost operators, therefore, those who had no indebtedness to contend with could continue in business for a time, provided the relation of

Table 17. WALNUTS: VARIATION IN COST OF PRODUCTION PER POUND, SHOWING RELATION OF COST TO YIELD AND VALUE OF ORCHARDS, OREGON.

Average price for walnuts was 15.3 cents per pound in 1929 and 12.5 cents in 1931.

Cost per pound	Orchards		Production per acre		Orchard value per acre		Total cost per pound		Cash cost per pound	
	1929	1931	1929	1931	1929	1931	1929	1931	1929	1931
	<i>Number</i>	<i>Number</i>	<i>Pounds</i>	<i>Pounds</i>			<i>Cents</i>	<i>Cents</i>	<i>Cents</i>	<i>Cents</i>
Less than 9¢	3	59	845	964	\$560	\$640	8.3	7.2	3.0	3.0
9¢ to 12.9¢	23	43	748	625	700	600	10.5	10.5	3.9	3.8
13¢ to 16.9¢	30	7	357	324	520	400	15.1	14.7	6.0	5.5
17¢ to 20.9¢	31	4	340	137	660	240	18.6	17.9	5.8	7.9
21¢ to 24.9¢	12	1	292	158	660	300	23.0	21.8	8.4	4.5
25¢ to 34.9¢	8	1	198	102	500	300	26.3	27.0	8.8	7.9
35¢ or more	15	1	84	49	460	300	48.8	54.1	15.0	4.7
ALL ORCHARDS	122	116	335	657	\$583	\$555	17.4	9.2	6.1	3.5

price to cash expense did not change adversely. Sooner or later, however, as previously stated, the grower who continues to have total costs greater than the price he receives for his product runs into difficulties. Eventually the farm machinery and equipment need to be replaced, and the farm family living standard depends on receiving a price that will pay both the cash and the non-cash items of production cost. This consideration, of course, is most imperative among the operators who are obligated to meet payment on an indebtedness.

In 1931, when the yields averaged 662 pounds per acre, the variations in costs were much less extreme than in 1929. More than half of the orchards had costs of less than 9 cents per pound, averaging 7.2 cents. Nearly two-fifths of the orchards had costs ranging from 9 to 13 cents per pound. Thus all except 14 of the 116 orchards studied either broke even or made a profit above their total costs that year. Even these few high-cost orchards in 1931 showed substantial returns above their cash costs.

What are the major factors responsible for these variations in cost of production from year to year and from farm to farm, and how can the individual grower improve his situation? Analysis of conditions associated with low-cost production on the farms cooperating in this study is presented in the following sections.

MAJOR FACTORS INFLUENCING COSTS AND INCOME

The foregoing discussion has pointed out that interest and labor constituted the major portion of the total cost of walnut production. Some costs, however, varied widely from farm to farm and sometimes from year to year on the same farm. It is important, therefore, to determine what factors are responsible for these differences, with a view to reducing costs and thus increasing profits or at least reducing losses in the year-by-year operation of the orchard.

The measurable factors found in this study to affect costs and income include yield per acre, size of the orchard, and grade and price of the nuts produced. Yield in turn was studied in its relation to valuation of the orchard, soil type on which the planting was located, fertility practice, pest control, variety of trees, planting system, age of orchard and presence of filler trees, and amount of preharvest labor and machine expense incurred.

YIELD USUALLY A DOMINANT FACTOR IN DETERMINING COSTS AND INCOME

The variations in the average costs of production computed for each of the 2 years included in this study were largely due, as already mentioned, to the difference in the average yield obtained. The main reason for this relationship is obvious. Approximately 75 per cent of the total cost of production is incurred whether any nuts are harvested or not. Consequently, if the yield is small, each pound of nuts bears a larger proportion of this overhead cost than if the yield is large. That there is a relationship between yield and cost was shown when the records were grouped according to production cost per pound (Table 17). In other words, the orchards with low costs had high yields in 1929 as well as in 1931. Furthermore, such orchards had a double advantage over the low-yielding orchards in 1929 because of their high production in a year when the price was good.

The distribution of the 238 individual cost records on the basis of both the yield per acre and the cost per pound for each of the 2 years further emphasizes the fact that low costs are dependent upon obtaining fairly good yields (Figure

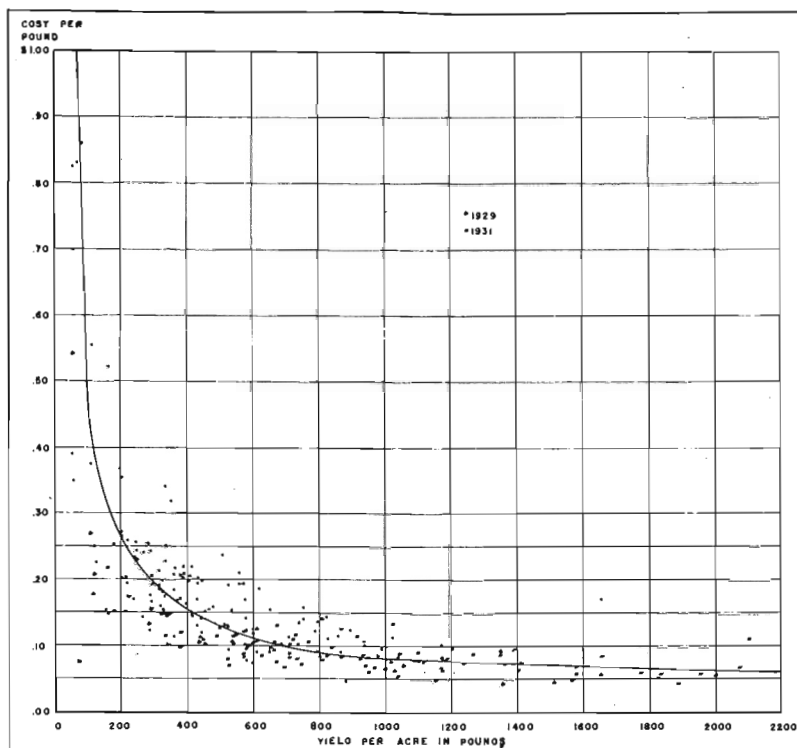


Figure 9. Good yield reduces cost of production. The average price that farmers received for walnuts during the 2-year period was 13.9 cents. On the basis of this average price received, 56 per cent of all the records showed yields large enough to make a profit above their total cost of production.

Table 18. WALNUTS: VARIATION IN YIELD PER ACRE, SHOWING RELATION OF YIELD TO COST PER ACRE AND PER POUND, OREGON, 1931; WITH COMPARABLE DATA FOR 1929.

Yield per acre (1931)	Orchards	Average yield	Average cost per acre	Average cost per pound	Same orchards—1929	
					Average yield	Average cost per pound
Pounds	Number	Pounds		Cents	Pounds	Cents
Less than 400	17	254	\$ 33.94	13.4	145	22.9
400 to 800	46	630	62.14	9.9	342	17.4
800 to 1,200	31	1,002	85.01	8.5	538	15.6
1,200 to 1,600	12	1,391	101.52	7.3	758	14.8
1,600 or more	10	1,849	106.35	5.8	873	11.6
ALL ORCHARDS	116	662	\$ 60.74	9.2	344	16.9

9). Apparently some low-yielding orchards tended to be consistently low with accompanying high costs for both years (Table 18).

The high-yield orchards, of course, had greater total expense or higher costs per acre than the low-yielding ones. Handling of the larger crops involved more facilities. The charges for interest, depreciation, and taxes were higher on the more productive tracts. Somewhat more effort was spent in caring for the orchard, as indicated by slightly larger expenditures on this phase of production. On the other hand, however, the larger yields permitted greater labor efficiency, particularly in the harvesting cost per pound (dried basis) as shown in the following comparison of specified orchards in 1931:

	<i>Harvesting cost</i>
17 lowest-yielding orchards	3.4¢
10 highest-yielding orchards	2.0¢
Difference in efficiency of harvesting	1.4¢

A saving of 1.4 cents a pound in harvesting cost merits consideration, as it would amount to \$25.87 an acre on the average yield of 1,849 pounds obtained per acre on the 10 highest-yielding orchards in 1931.

ORCHARD VALUE AND YIELD

Apparently the growers properly based the valuation of their orchards largely on productivity or quantity of nuts produced (Table 19).

The group of highest-yielding orchards producing an average of 868 pounds of walnuts per acre were inventoried at nearly 4 times the value per acre placed on the group of lowest-yielding orchards producing an average of 210 pounds. Although a higher interest charge resulted from this higher valuation, the group of high-yielding orchards had the lowest total cost per pound among all groups, indicating that the high-yielding orchards were valued more conservatively than the low-yielding orchards.

Table 19. WALNUTS: VARIATION IN VALUE OF ORCHARD PER ACRE, SHOWING RELATION OF INVESTMENT TO YIELD, AND TO COST OF PRODUCTION PER POUND, OREGON, 1929, 1931

Value of orchard per acre	Orchards	Acre- value of orchards	Production per acre	Average cost per pound
	<i>Number</i>		<i>Pounds</i>	<i>Cents</i>
Less than \$400	31	\$269	210	16.2
\$400 to \$599	67	463	413	13.8
\$600 to \$799	66	653	588	12.8
\$800 and over	74	982	868	12.6
AVERAGE	238	\$569	498	13.3

It may be possible to operate a low-yielding orchard at a profit *provided* the capitalized value with its accompanying interest cost is sufficiently low to offset the effect of the low yield. Approximately half of the total cost of walnut production consisted of the interest charge when computed at 5 per cent on the capital investment in the orchard. If the alternative uses to which the land could be put continue to be less attractive than walnut production, then obviously the producer of walnuts will be willing to go on with the walnut enterprise. He can either reduce his capital valuation or accept a lower interest rate or both, and thus continue to compete with the higher-yielding orchards, provided he can produce a quality of product that the market will accept.

YIELD OF WALNUTS ON HILL LAND AS COMPARED TO VALLEY OR BOTTOM LAND

The average yield of walnuts obtained on all of the valley-floor and bottom-land orchards was about twice as large as the yields obtained on all of the hill orchards during each of the 2 years covered in the study (Table 20). The average size of the tracts in the bottom-land group was only 15 and 11 acres for the 2 years, respectively, while the average size of the hill orchards was 39 acres in 1929 and 38 acres in 1931. The trees in the hill orchards were spaced farther apart, and a much higher percentage of the acreage still contained filler trees.

Table 20. WALNUTS: YIELD OF WALNUTS ON HILL LAND AS COMPARED TO VALLEY OR BOTTOM LAND, OREGON

Item	1929		1931	
	Hill land	Valley and bottom land	Hill land	Valley and bottom land
Number of orchards	80	42	79	37
Average acreage per orchard	38	11	39	15
Percentage of acreage interplanted..	46	36	44	23
Average age of trees	20	19	22	21
Number of trees per acre	20	25	20	24
Yield per acre	297	589	569	1,158
Value of orchard per acre	\$537	\$896	\$509	\$817
Total cost of production per acre....	\$ 54.30	\$ 84.00	\$ 56.32	\$ 85.93
Value of walnuts produced	45.40	92.30	69.48	151.65
Net income or loss per acre	\$ -8.90	\$ 8.30	\$ 13.16	\$ 65.72
Return to each \$100 invested*	\$ 3.31	\$ 5.92	\$ 7.60	\$ 13.07

* This is the residual or amount of the receipts remaining after all costs excepting interest on the investment have been deducted.

The relatively greater productivity of the bottom-land orchards, in terms of walnut yields, is reflected in the higher value placed on the plantings by the growers. Although the cost was higher per acre on the bottom-land orchards, the return to the capital investment in these orchards exceeded the return on the hill orchards. While the yield for hill orchards as a whole was low, favorably located hill orchards produced yields comparable to the better valley-floor and bottom-land orchards. On the other hand, some of the poorly located low-land orchards also failed to produce satisfactory yields. Such variation within the soil groups indicates the need for careful study of each tract of soil before planting an orchard.

The low yield on many hill orchards is doubtless due to the shallow depth of the soil. Some of these orchards were located on hill lands that had previously been reduced to an unprofitable degree of fertility for continued grain and hay production. Shallow tree-root development is also found on poorly drained low land. Orchards planted on flat lands having a high water table may appear thrifty for a number of years, but as the trees reach maturity and thus require access to more of the soil resources, the shallow root system becomes inadequate to support the tree properly because the high water table has restricted the downward distribution of the roots. Thus the results are the same as if the orchard had been planted in a shallow soil (Figure 10).

An authoritative statement on the selection of orchard soils, contributed by R. E. Stephenson, Soil Scientist, Oregon State College, is here incorporated

because of the vital relationship of the soil factor to cost and efficiency of walnut production.

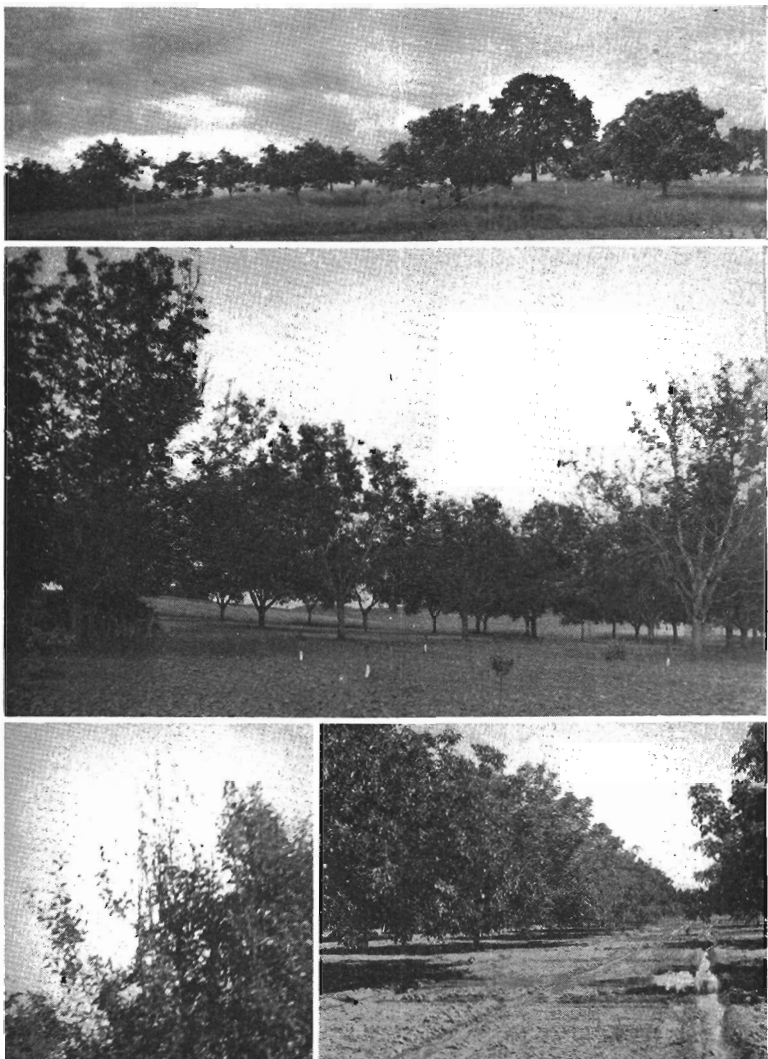


Figure 10. *Top:* These walnut trees, located on extremely shallow hill soil (note large size of lone oak tree), will never develop satisfactory tops because of insufficient soil depth for a good root system. *Center:* Walnut trees on a valley-floor soil are being pulled out because they have never produced profitably despite their large size. Examination of the soil horizon reveals that very little root has been able to penetrate the tight, water-logged subsoil. *Lower left:* "Die-back" is a result of shallow rooting system. *Lower right:* Irrigation, where available, may compensate for some of the difficulty caused by shallow soil conditions.

THE SELECTION OF ORCHARD SOILS*

Effective soil depth determines root penetration and development and is an important factor governing tree growth and production. Soils, from a practical point of view, are only as deep as roots can penetrate and function normally. Differences in soils on which walnut orchards have been growing under favorable and under unfavorable soil conditions are apparent from a study of data obtained and presented in this discussion.

Some soil unsuited for walnut trees. Orchards have failed on those soils that lack depth because of tight horizons, clay pans, rock, or a high water table. The data obtained from an orchard site described as Amity silty clay loam soil are descriptive of soil conditions considered unsuited to satisfactory walnut production (Table 21).

Table 21. PROPERTIES OF A SOIL UNSUITED TO ORCHARDS.

Soil and horizon	Total porosity	Capillary porosity volume	Non-capillary porosity volume	Organic matter	Soluble potassium .05N HCl	Soluble calcium .05N HCl	Available phosphorus
	Per cent	Per cent	Per cent	Per cent	p.p.m.	p.p.m.	p.p.m.
<i>Amity silty clay loam</i>							
0-6 inch	49.2	39.1	10.1	3.71	204	2,100	228
6 inch-12 inch ..	52.7	36.5	16.2	2.93	153	2,540	171
Second foot ..	52.2	38.8	13.4	1.51	181	2,620	160
Third foot	52.7	44.5	7.2	.34	178	3,400	218
Fourth foot ..	49.1	47.5	1.6	.29	196	3,800	.....
Fifth foot	48.7	49.3	-0.6	.25	153	3,100	.....
Sixth foot	49.9	46.6	2.3	.22	194	3,600	.....

Note: Capillary porosity is the pore space that is filled with capillary water at the field moisture capacity. Noncapillary porosity is that portion of the pore spaces that is too large to hold water against gravity. Water enters the soil through noncapillary pores and is either absorbed and held as capillary water or drains away as gravity water. Soils with from 10 or 12 to 25 or 30 per cent of noncapillary porosity are best suited to deep-rooted crops. These soils are well drained, aerated, and oxidized, and permit good root growth and absorption.

This tract of Amity silty clay loam soil was planted to a walnut orchard. The trees grew satisfactorily for a number of years but the anticipated production failed to materialize. Instead, dieback gradually appeared as the trees grew older, and since yields continued to be unsatisfactory part of the orchard was removed. Despite the large size of these trees they were easily removed because they were distinctly surface rooted.

Study of the physical properties of this soil indicates that it is unsuited to deep-rooted plants. The soil is tight and hard in the fourth foot and beyond. This is indicated by the low noncapillary porosity in the fourth-, fifth-, and sixth-foot depths. The noncapillary pores are the large openings that furnish good water penetration, drainage and aeration, and an opportunity for roots to develop and function.

The chemical properties of the soil, unlike the physical, are favorable. There is a rather good supply of organic matter and available mineral nutrients. Calcium, potassium, and phosphorus are satisfactory. Cover crops, which are relatively much shallower rooted than trees, have done well on this soil. According to the owner, heavy growths of cover crops have been worked into

* This section (pages 39-41) is by R. E. Stephenson, Soil Scientist, Oregon State College.

the soil at various times. This has kept the surface soil in good condition and no doubt is responsible in part for the good growth made by the trees in the earlier years, but a favorable supply of nutrients is not sufficient to insure success with an orchard.

The physical properties of the soil are of such importance to plant growth that regardless of the abundance of nutrients those soils that are physically unsuited to a certain type of crop usually cannot be so improved as to overcome a serious physical handicap. The Amity soil referred to has been tile drained, and yet this improvement in drainage does not render the soil suited for walnuts. In other words, the condition of any soil from the 4- or 5-foot level to the 8- or 10-foot level is critical for walnut production. Young trees may grow well for a time, but lack of depth limits tree vigor more and more with age. Already the fact is evident that in many orchards the larger trees have outgrown the soil. Such orchards are "going back," which usually means that they are about through their period of profitable production. Thinning the trees will help in some orchards, but in others it may be best to remove the trees and use the land for other purposes.

Soil suited for walnut trees. Oregon has considerable land suited for walnut production. Much of this land has not yet been planted to orchard and some is still in the uncleared state. The favorable properties of good orchard soils are well exemplified in the Newberg silt loams (Table 22).

Table 22. PROPERTIES OF A SOIL SUITED TO ORCHARDS.

Soil and horizon	Total porosity	Capillary porosity volume	Non-capillary porosity volume	Organic matter	Soluble potassium .05N HCl	Soluble calcium .05N HCl	Available phosphorus
	Per cent	Per cent	Per cent	Per cent	p.p.m.	p.p.m.	p.p.m.
<i>Newberg silt loam</i>							
0-6 inch	63.2	33.7	29.5	3.47	508	4,722	284
6 inch-12 inch ..	55.0	37.8	17.2	2.73	194	4,122	250
Second foot ..	57.3	34.8	22.5	1.70	312	7,524	390
Third foot	59.9	35.2	24.7	.95	284	7,026	462
Fourth foot	60.4	41.3	19.1	.81	.....	.....	.....
Fifth foot	59.5	41.1	18.4	.77	.....	.....	.....
Sixth foot	58.8	39.0	19.8	.72	.....	.....	.....
Seventh foot ..	55.5	43.5	12.0	.70	.....	.....	.....
Eighth foot	59.1	41.4	17.7	.54	.....	.....	.....
Ninth foot	57.6	45.1	12.5	.47	.....	.....	.....
Tenth foot	58.6	50.7	7.9	.39	.....	.....	.....
Eleventh foot...	59.9	48.2	11.7	.26	.....	.....	.....
Twelfth foot....	58.8	51.9	6.9	.....	.....	.....	.....

The soil has a porous, sponge structure as indicated by the high noncapillary porosity. The high capillary porosity indicates good moisture-holding properties. A favorable soil structure is carried to a depth of 12 feet without any obstructing layers. Good orchards are found on Newberg, Chehalis, Willamette, and other soils with similar properties.

Determining the suitability of a soil. Soil structure is best observed from an open trench. Freshly broken chunks of soil that may be taken from the sides of the trench will reveal the natural soil structure. The large non-capillary pores are visible to the eye. The entire soil profile to the depth of root penetration, which may be 10 or 12 feet or more for walnuts, should be examined. The presence of clay pans, compact layers, hardpan, and coarse

sand or gravel in the root zone is likely to prove unfavorable to deep-rooted plants. This is especially true where the crop is dependent upon stored soil moisture for summer growth and production. A 3- or 4-foot root zone has far too little moisture storage capacity in the soil to carry tree crops through the long dry summers without irrigation.

No system of management or fertilization can bring profits from a soil that is unsuited. Shallow soils may produce good grain, and wet soils may produce pasture or hay, but neither are satisfactory soils for orchards. The root system of the plant, produced in the soil, is just as important as the top growth. Unless the soil provides satisfactory depth, drainage, and aeration for adequate root volume and the development of many fine absorbing roots, the top growth and harvest cannot be satisfactory. Records indicate that orchards on the suitable soils are increasing in production, while orchards located on soils that are unsuited are already decreasing in production. In the future, therefore, the grower who recognizes that the orchard should be located on soils that are suited to the growth of a vigorous and productive tree will avoid one of the major hazards in the walnut enterprise.

PRACTICES AFFECTING YIELD

Soil fertility practice and yield. In view of the emphasis placed by Stephenson on the importance of locating the orchard on productive soils, it is of interest to note that 68 per cent of the orchard land in this survey had previously been used chiefly for grain farming, 14 per cent had been in hops or in truck crops, and 16 per cent had been in stumps.

Only about two-thirds of the growers reported using some fertility practice. The cost averaged \$2.46 per acre in 1929 and \$1.43 in 1931. Use of a cover crop sown in the fall, usually consisting of a mixture of oats and vetch seed, was the most common soil-fertility practice followed (Figure 11).

Only 25 of the 77 growers who reported fertility practices in 1929 used manure or commercial fertilizers. In 1931 only 17 of the 70 growers reporting any fertilizing practice used those materials. Application of a commercial fertilizer was usually intended as a stimulant to increase the growth of the cover crop. Its use by walnut growers was generally considered to be of an experimental nature. The data indicate that the orchard operators who used fertilizers and cover crops had slightly higher yields and received a higher price per pound for the walnuts. Although the results more than repaid the nominal outlay made for this purpose, other factors such as quality of soil, age, and variety of planting cannot be ruled out of consideration in this connection.

Spraying and dusting practices and yield. Special practices to combat walnut diseases and insect pests were followed by only 29 per cent of the co-operating growers in 1929 and by 26 per cent of the growers interviewed in 1931. While blight and aphid infestations were the most frequently mentioned causes of damage to the walnut crop during those years, the control program was confined to the application of a general clean-up spray, mainly for removing moss, and to the use of nicotine sulphate for control of aphids. Though the results obtained from these practices cannot be determined from data available in this survey the need of combating diseases and insects admittedly is increasing from year to year. Moreover, careful research indicates that successful



Figure 11. *Upper:* A heavy growth of vetch-and-grain cover crop is ready to be turned under in this orchard located on hill land. The cover crop was drilled early the preceding fall before harvesting the walnuts. *Lower:* Note that this cover crop was drilled close to the trees, insuring the maximum production of green manure.

control of a disease, like blight, for example, is possible only when the recommended control program is followed in every detail over a period of years.*

Varieties of trees and yield. Many of the early orchards were planted to seedling walnut trees. Some of these plantings were later top-grafted in whole or in part. Subsequently the use of grafted nursery stock, chiefly the Franquette and the Mayette, became more common in Oregon. Although the grafted orchards in this study averaged 3 years less in age, the yields exceeded those from the older seedlings (Table 23). Of even more importance, perhaps, was the fact that the grafted walnuts brought a premium of 2.8 cents per pound in 1929 and 2 cents per pound in 1931.

Table 23. WALNUTS: RELATION OF VARIETY OF TREES TO YIELD, VALUE, AND PROFITABILITY OF THE ORCHARD, OREGON.

Item	1929		1931	
	Seedlings	Grafted	Seedlings	Grafted
Number of orchards	70	52	65	51
Average age of trees	21	18	23	20
Pounds walnuts produced per acre..	317	364	622	720
Value of orchards per acre	\$551	\$635	\$525	\$598
Production cost per pound	17.2¢	17.7¢	9.0¢	9.3¢
Walnut price per pound	14.2	17.0	11.5	13.5
Net income or loss per pound	- 3.0¢	- .7¢	2.5¢	4.2¢
Net income or loss per acre	-\$9.60	-\$2.60	\$15.50	\$30.20

Planting systems and yield. The effect that spacing of walnut trees at different distances had on yield was impossible to determine satisfactorily in this study. The influence of other major factors, such as the age and variety of trees, presence of filler trees, and the type of soil, could not be sufficiently excluded to give reliable results. Practices followed, however, are here given as matters of interest, especially in connection with the following discussion on effects of intercropping on cost of production.

The square planting system predominated among the walnut orchards studied (Table 24). More than four-fifths (83.7 per cent) of the tracts were planted in this manner; 11.4 per cent of the tracts were planted on the diagonal system; and only 4.9 per cent on the rectangular system. Moreover, the trend of growers' opinion for future plantings was definitely in favor of the square system.

There are two general points of view regarding the setting of walnut trees. One is that the walnut trees should be planted fairly close with the intention of thinning when crowding threatens. The other is that the walnut trees should be located as they are intended to remain permanently. Most of the growers using the 40-foot square planting distance—by far the most commonly found in Oregon—followed the first plan, while those using the 50- to 60-foot plantings followed the second plan.

The whole matter of planting distance resolves itself into the question of utilizing the space between the trees until they fully occupy the area. Whether

* Records on cost of spraying for walnut blight control were obtained on 484 acres of orchard for the years 1939 and 1940. The nine orchards included, ranging from 8 to 115 acres in size, had each received three spray applications during each season. The total annual cost of spraying averaged \$4.81 per acre and \$5.04 per hour of sprayer operation. Of the cost per acre \$1.72, or 36 per cent, was for the spray materials used; \$1.25, or 26 per cent, was for man labor; and \$1.84, or 38 per cent, was for tractor and sprayer operation. (Note: Latest information about pest control measures may be obtained from the Oregon Agricultural Experiment Station or from the Office of the County Agricultural Agent.)

Table 24. WALNUTS: PLANTING PLANS AND SPACING OF TREES IN BEARING ORCHARDS COMPARED TO INTENTIONS OF GROWERS REGARDING FUTURE PLANTINGS, OREGON, 1930.

Planting plan and spacing	Present plantings		Future plantings	
	Number	Percentage	Number	Percentage
<i>Square</i>				
30 feet	5	3.5	2	1.5
36 feet	5	3.5	1	.7
40 feet	45	32.0	30	22.6
48 feet	5	3.5	3	2.3
50 feet	33	23.5	44	33.1
60 feet	12	8.5	34	25.6
Others	13	9.2	7	5.2
Total for square plantings	118	83.7	121	91.0
<i>Diagonal</i>				
40 feet	1	.7	1	.7
48 feet	1	.7	1	.7
50 feet	4	2.8	2	1.5
64 feet	2	1.4	.....	.....
Others	8	5.8	3	2.3
Total for diagonal plantings....	16	11.4	7	5.2
<i>Rectangular</i>				
45 x 50 feet	2	1.4	.....	.....
50 x 60 feet	1	.7	2	1.5
Others	4	2.8	3	2.3
Total for rectangular plantings..	7	4.9	5	3.8
ALL RECORDS	141	100.0	133	100.0

it is more desirable to set the walnut trees 40 feet apart and take 8 to 10 crops from them before thinning or to interplant or intercrop the orchard with other fruit trees or field crops will depend on the relative profitableness of the different enterprises. In the past, walnuts have been relatively more profitable than most other crops. Under those conditions the plan of close planting has been attractive, whereas on future plantings this practice might prove less satisfactory.

A summary of the opinions of growers regarding the most desirable planting distance for future plantings indicated considerable shift from the present 40-foot spacing to the 50-foot, and from the present 50-foot to the 60-foot spacing.

Intercropping practices. The profitable use of the land in the orchard until the time that it is fully occupied by the walnut trees is usually of major concern to the grower. On the small farm, particularly, it is often economically impracticable to forego the production from this portion of the cultivated acreage during the time that the walnut trees are developing. Walnut growers in Oregon almost invariably have planted filler trees among their walnuts (Table 25).

The choice of trees for use as fillers in walnut plantings has changed somewhat (Table 26). Prunes and filberts have increased in popularity while cherries and peaches have decreased and apple trees have been entirely discarded for this purpose. Prunes and peaches are best adapted of the filler trees providing there is a satisfactory market for those fruits.

Oats-and-vetch hay, or grain hay, grain crops, and clover and alfalfa hay, listed in the order of their importance, accounted for about half of all intercrops

used in young walnut plantings. Corn, potatoes, and hops comprised one-third of such crops; and strawberries and blackcaps one-fifth of the acreage. In this type of intercrop the strawberry is most satisfactory, with potatoes and blackcaps next.

Table 25. WALNUTS: METHODS OF UTILIZING THE LAND AREA OF YOUNG WALNUT ORCHARDS IN OREGON, 1930.

System of planting	Orchards now bearing		Orchards not yet bearing	
	Size	Percentage of acreage	Size	Percentage of acreage
	<i>Acres</i>	<i>Per cent</i>	<i>Acres</i>	<i>Per cent</i>
Walnut trees only	424	11.7	393	20.6
Walnut trees and filler trees	2,847	78.6	368	19.3
Walnut trees and intercrop*	280	7.7	911	47.9
Walnut trees, filler trees, and intercrop	73	2.0	232	12.2
TOTAL	3,624	100.0	1,904	100.0

* Includes annual crops, cane and vine fruits, and hops.

Table 26. WALNUTS: FILLER TREES USED IN YOUNG WALNUT ORCHARDS, OREGON, 1930.

Kind of filler tree	Orchards now bearing		Orchards not yet bearing	
	Size	Percentage of acreage	Size	Percentage of acreage
	<i>Acres</i>	<i>Per cent</i>	<i>Acres</i>	<i>Per cent</i>
Cherries	994	34	56	9
Prunes	948	33	342	57
Apples	506	17	.....	.....
Peaches	318	11	33	6
Filberts	90	3	144	24
Pears	64	2	25	4
TOTAL	2,920	100	600	100

Age and interplants affect yield. Questions are frequently asked regarding the age at which walnut trees reach full production and how long thereafter they might be expected to continue at the maximum rate. Answers to these questions are not yet available because most plantings in Oregon are still young in terms of tree life. The age of the orchards studied ranged from 12 to 40 years, averaging 21 years. Factors such as soil, exposure of the site, care of the tree, fertility practices, rate of planting, and presence of filler trees may influence the age at which maximum production is reached as well as the total life of the tree.

Mention has already been made of the fact that intercropping reduced the cost of bringing an orchard to bearing age (11-year period). The records taken on the bearing walnut orchards show that 43 per cent of the acreage was still interplanted with filler trees at the time of this study. In order to observe the effect of interplants on the cost of production, the records were sorted on this basis and both the interplanted and noninterplanted groups were again sorted according to age (Table 27).

The walnut trees in the groups of interplanted orchards as a whole occupied 55 per cent of the orchard acreage and the filler trees 45 per cent. Cultivation costs and the property tax on the orchards were allocated to walnut production on that basis. Those proportions averaged 33 per cent for the group

Table 27. WALNUTS: RELATION OF AGE OF THE ORCHARDS WITH FILLER TREES AND WITHOUT FILLER TREES, TO YIELD AND COST, OREGON, 2-YEAR AVERAGE 1929 AND 1931.*

Age of planting	Records		Average age of orchards		Production of walnuts per acre		Value of orchard per acre		Cost per acre		Cost per pound	
	With filler trees	No filler trees	With filler trees	No filler trees	With filler trees	No filler trees	With filler trees	No filler trees	With filler trees	No filler trees	With filler trees	No filler trees
	<i>Number</i>	<i>Number</i>	<i>Years</i>	<i>Years</i>	<i>Pounds</i>	<i>Pounds</i>					<i>Cents</i>	<i>Cents</i>
Less than 16 years	12	18	13	14	427	458	\$732	\$537	\$61	\$60	14.3	13.1
16 to 20 years	43	62	19	19	321	559	444	618	44	69	13.7	12.3
21 to 25 years	27	49	22	22	357	753	408	821	41	82	11.5	10.9
26 years and over	7	20	28	31	535	845	591	792	69	93	12.9	11.0
ALL ORCHARDS	89	149	21	21	337	642	\$431	\$695	\$44	\$74	13.0	11.5

* The walnut trees in the interplanted orchards, as a whole, occupied 55 per cent of the land area in those orchards. The proportion averaged 33 per cent for orchards less than 16 years old, 54 per cent for orchards 16 to 20 years, 57 per cent for orchards 21 to 25 years, and 71 per cent for orchards over 25 years of age.

of orchards less than 16 years old, 54 per cent for orchards 16 to 20 years, 57 per cent for orchards 21 to 25 years, and 71 per cent for orchards more than 25 years old.

The deleterious effect on the walnut orchard of leaving the filler trees too long is shown by the estimated valuation that the owners placed on their orchards. The average value of the orchards with filler trees was \$431 per acre compared to \$695 per acre for those with no fillers remaining. These valuations were quite consistent with yields, which averaged 337 pounds per acre for the interplanted acreage and 642 pounds for the noninterplanted orchards. While sharing of the operating costs between walnut and filler trees reduced the cost per acre for the walnuts, the orchards with fillers, as a whole, had a higher cost of production per pound than the orchards without filler trees.

The orchard owner is interested not only in producing at a low cost per pound but also in keeping his capital investment intact. The data show the tendency for yields to decline when filler trees continue to compete with the walnut trees. While the actual amount of crowding or competition may vary considerably, actual inspection of the different orchards clearly indicates that in many plantings (both interplanted and walnuts alone) the trees have been permitted to grow together until not only the production has declined, but the walnut trees themselves in many instances have suffered irreparable damage. Timely correction of crowding, however, will prevent damage from becoming permanent (Figure 12).

Intensity of orchard care and yield. Wide variations in the cost per acre for preharvest labor and machinery operations were found even for the walnut orchards with no filler trees (Table 28). Some relationship undoubtedly exists between the amount of effort expended in the operation of the orchard

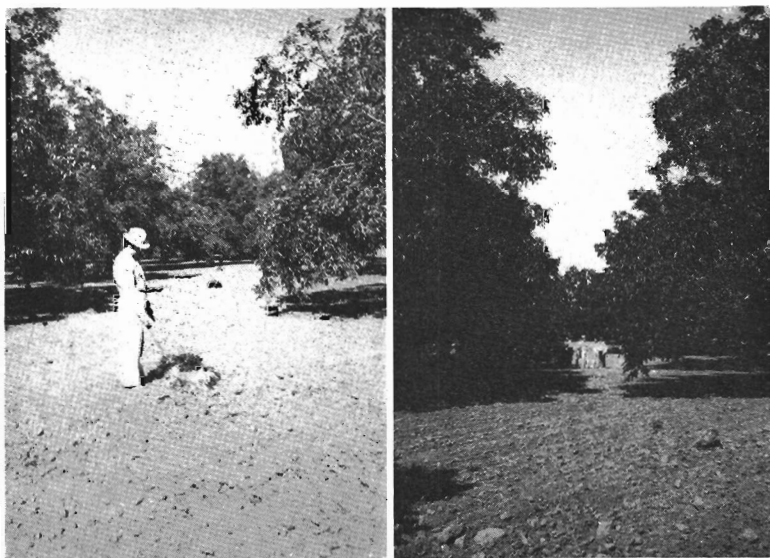


Figure 12. Planted on the 40-foot square, this walnut orchard required thinning before the trees were 30 years old. Though removing alternate trees on the diagonal plan increased the space between rows to 60 feet, the remaining trees are rapidly occupying the additional space provided.

and the yield of walnuts obtained. A study of the net return per acre for the different groups of orchards receiving varying amounts of care indicates, perhaps, that while some growers may have neglected their orchards to some extent, others, in their desire to get the maximum instead of the most economical production, may have been expending too much effort.

Table 28. WALNUTS: RELATION OF PREHARVEST LABOR AND MACHINERY COST TO YIELD AND NET INCOME FOR ORCHARDS WITHOUT FILLER TREES, OREGON, 2-YEAR AVERAGE, 1929 AND 1931.

Item	Preharvest operating cost per acre				All orchards without fillers
	Less than \$5	\$5-\$10	\$10-\$15	\$15 or more	
Number of orchards	9	49	51	40	149
Acres per orchard	26	36	22	14	25
Pounds of walnuts per acre	485	503	768	912	642
Average preharvest operating cost per acre	\$ 4	\$ 8	\$ 12	\$ 21	\$11
Total cost per acre	51	61	80	103	74
Value of walnuts per acre	62	68	109	124	89
NET RETURN PER ACRE	\$11	\$ 7	\$ 29	\$ 21	\$15

SIZE OF ORCHARD AFFECTS FARM INCOME

The yearly return to the operator for his labor and the capital invested in the average walnut orchard (30 acres) was \$987 (Table 29). Half of all the orchards contained less than 15 acres each, averaging 8 acres. This group of operators had the best yield and the lowest cost per pound, but a net income of only \$387 from the walnut enterprise. The group containing the largest orchards had the lowest yield and the highest cost per pound, but the large volume of business provided a net annual income of \$2,415.

Table 29. WALNUTS: RELATIONS BETWEEN SIZE OF ORCHARDS, LABOR AND MACHINERY COST, YIELD, AND RETURN TO OPERATOR'S LABOR AND CAPITAL, BY ACREAGE-SIZE GROUPS, OREGON, 2-YEAR AVERAGE 1929 AND 1931.

Number of acres in orchard	Records	Average acreage per orchard	Average investment per orchard	Preharvest labor and machinery cost per acre	Walnuts per acre	Total cost per pound	Return to operator's labor and capital
	<i>Number</i>	<i>Acres</i>			<i>Pounds</i>	<i>Cents</i>	
Less than 15 ..	116	8	\$ 5,913	\$11	675	11.9	\$ 378
15 to 40	75	22	16,759	11	673	12.4	1,009
40 and over ..	47	95	47,634	7	397	14.4	2,415
ALL ORCHARDS	238	30	\$17,575	\$ 9	500	13.3	\$ 987

RELATION OF OTHER FACTORS TO INCOME

Marketing. Walnuts are a specialty crop and must be sold, for the most part, in a highly competitive and far-away market. Advent of the economic depression concurrently with an ever-increasing annual production of walnuts and other competitive tree nuts, both domestic and imported, has necessitated a progressively more efficient marketing program. The situation has tended to

encourage either the growth of cooperative selling organizations among growers or the adoption of efficient selling policies on the part of the individual large-scale growers as well as the cooperatives, in their efforts to dispose of the crop at satisfactory prices. (See Appendix B for a statement by W. E. Goodspeed, Manager of the Walnut Control Board, Los Angeles, regarding the operations of the Walnut Control Board.)

Cooperative marketing of walnuts was already well established, of course, at the time of this survey, 85 per cent of the crop studied having been handled cooperatively in 1931. Additional data on grades and prices of walnuts for recent years are included in the subsequent discussion, because they have a certain suggestive value in understanding the effect of the developing marketing situation on walnut production in Oregon.

Price variation. The profit obtained from the production of walnuts is that portion of the farm price or total receipts remaining after the producer has deducted all costs involved in production and marketing. Many growers have appeared to be more interested in striving for better prices than in the possibilities of reducing their costs, although this study revealed that costs varied far more widely from farm to farm and from year to year on the same farms than have average prices. Considerable variation also occurred, however, in walnut prices.

Presumably a number of factors were responsible for those price variations. For one thing, improved (grafted) varieties have usually brought better prices than seedlings. For another, some farmers undoubtedly were able to obtain higher prices than others merely by using superior merchandising methods. At any rate, the difference in net return per pound in 1929 varied from a loss of 6 cents for the one-fifth of the orchards receiving less than 12 cents a pound for walnuts to a net gain of 4 cents for the one-fifth of the orchards receiving 18 cents or more, or a total difference in net returns of 10 cents per pound.

Price variations were less extreme in 1931. Half of the entire production studied that year sold for less than 12 cents (averaging 11 cents) per pound, leaving a net gain of 2.2 cents a pound. Forty per cent of the production sold at 12 to 14 cents (averaging 12.9 cents) per pound, leaving a net gain of 2.9 cents a pound. Only 10 per cent sold at 14 cents or more (averaging 15.1 cents), leaving a net gain of 7 cents a pound. While all of these groups showed a net gain from walnuts in 1931, the latter made a very superior showing because of having a combination of good yield and a high price per pound.

FACTORS AFFECTING PRICE

A study of the many factors that may influence price is beyond the scope of this investigation. A recognition, however, of the importance of marketing methods and of quality of product is essential to the understanding of price variations.

Relations of such quality factors as variety, grade, and size to price. While only partial information was available regarding the grades of the walnuts sold by growers who cooperated in this study, enough data were obtained to show the distribution of the production by grade and size and the relation of this distribution to price in 1929 and 1931 (Table 30). Additional and more detailed data of this nature for subsequent years are presented in the following paragraphs.

Table 30. WALNUTS: PERCENTAGE DISTRIBUTION OF SALES BY GRADE AND SIZE, SHOWING PRICES PAID TO FARMERS WHO COOPERATED IN THE COST STUDY, OREGON

Grade and size	1929		1931	
	Percentage of crop	Price per pound	Percentage of crop	Price per pound
<i>First grade</i>	<i>Per cent</i>	<i>Cents</i>	<i>Per cent</i>	<i>Cents</i>
Large	14.9	23.0	18.3	19.6
Fancy	19.6	20.1	27.9	16.3
Standard	10.2	15.7	19.8	11.5
<i>Second grade</i>				
Large	7.1	18.9	3.9	15.9
Fancy	16.2	16.6	4.9	12.5
Standard	13.4	12.3	3.4	9.4
Culls	18.6	10.9	21.8	6.0
TOTAL	100.0	15.3	100.0	12.5

While individual walnut growers properly are interested in the total income from the enterprise, they are also concerned with the effect on their business of the proportion of the crop that falls into the various grades and sizes.

The relation, both of variety and of grade and size within the variety classification of walnuts marketed, to the price received by Oregon growers is shown in the following data representing 14,796,557 pounds of graded walnuts marketed cooperatively during the 7-year period 1932-1938:*

Grade and size*	Franquettes		Soft shells	
	Per cent	Price	Per cent	Price
<i>First grade</i>		<i>Cents</i>		<i>Cents</i>
Large	36	12.4	17	11.0
Fancy	27	10.5	27	9.4
Medium	14	9.1	28	8.0
<i>Second grade</i>				
Large	8	10.1	6	9.2
Fancy	8	9.5	9	8.4
Medium	4	8.3	12	7.3

* The volume of third-grade walnuts amounted to only 3 per cent of the Franquettes and 1 per cent of the "soft shells" (Table 31). The percentage of culls from one year to another has ranged from less than 10 per cent of the crop to more than 50 per cent, averaging around 20 per cent over a period of years. While the growers' return from the culls is not available, it was, of course, negligible compared to the price per pound of the graded stock because the additional cost of shelling is involved. Disposal of culls and, more recently, of surplus graded walnuts, has indicated the development of a steadily expanding market for walnut meats.

A significantly large proportion—36 per cent of the graded Franquette walnuts—were large, first-grade stock, bringing an average price of 12.4 cents per pound. (The average price for all graded walnuts covered during the 7-year period was only 10.6 cents.) Conversely, among the "soft shells" only 17 per cent of the graded stock fell into the top grade (averaging 11 cents per pound) while 40 per cent were of medium size in the two grades, bringing only 8 cents and 7.3 cents per pound, respectively. What then has been the response of walnut growers to this price differential in favor of quality production?

* The price that the grower received is the selling price of each grade, including income from sale of the surplus quotas, less the estimated marketing expense incurred by the cooperative.

Reference has already been made to the fact that many of the walnut plantings in Oregon originally were seedling trees. Since the walnuts from such stock—classified as “soft shells”—usually graded so as to command lower prices than walnuts from grafted stock, growers having seedling trees in their orchards have been top-grafting them as rapidly as circumstances would permit. The relative proportions and the prices per pound for seedlings and Franquettes have been as follows during the 7-year period from 1932 to 1938:

Year	Franquettes		Soft shells	
	Percentage of crop	Price per pound	Percentage of crop	Price per pound
	<i>Per cent</i>	<i>Cents</i>	<i>Per cent</i>	<i>Cents</i>
1932	54	10.4	46	8.1
1933	75	10.3	25	7.4
1934	75	9.7	25	8.1
1935	67	10.9	33	9.5
1936	80	13.3	20	11.5
1937	77	9.4	23	7.6
1938	78	11.4	22	10.1
Average, 1932-1938	71	10.7	29	9.0

On this large volume of graded walnuts the proportion of the “soft-shell” variety produced has varied from 46 per cent of the total production in 1932 to 20 per cent in 1936. A consideration of these figures in the light of the fact that the “soft-shell” plantings are, for the most part, more nearly mature trees than are the Franquettes and are therefore more nearly in full bearing, suggests a permanent reduction in the proportion of “soft shells” produced. It is apparent that the price advantage invariably obtained by the producer of the improved varieties has encouraged the “working over” of seedling trees. (The prices are weighted so as to represent the total value of the graded stock produced each year.)

Further examination of the data at hand reveals wide variations in the proportion of the total graded production falling in the respective grade classifications for each variety (Table 31). For example, the proportion of *first-grade, large-size* Franquettes varied from 26 per cent of the total graded Franquette production in 1932 to 59 per cent in 1937. Even greater variations occurred in the “soft-shell” variety, the proportion of *first-grade, large-size* varying from 8 per cent in 1932 to 26 per cent in 1935 and 25 per cent in 1937.

The importance of producing a large percentage of high-quality walnuts appears when attention is turned to the price differential among the various grade classifications from year to year for each variety (Table 32). This price differential even between the two highest grade-groups of the Franquette variety—*first-grade large* and *first-grade fancy*—was 2.1 cents per pound in 1932, and 1.6 cents in 1937. For identical grade-groups of the “soft shells” the price differential was 4.4 cents per pound in 1932, 1.4 cents in 1935, and 1.2 cents in 1937. As the trend in the margin of profit in walnut production appears to have been definitely downward during the depression period following 1930, the success of this enterprise depends now and possibly will in the future depend increasingly upon obtaining not only good yields but high-quality production.

Table 31. WALNUTS: THE ANNUAL PERCENTAGE AND THE 7-YEAR AVERAGE DISTRIBUTION OF 14,796,557 POUNDS OF GRADED WALNUTS, OREGON, 1932-1938.

	1932	1933	1934	1935	1936	1937	1938	Average
	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>
FRANQUETTES								
<i>First grade</i>								
Large	26	30	40	42	33	59	33	36
Fancy	34	23	19	28	18	13	32	27
Medium	27	7	8	13	9	4	18	14
<i>Second grade</i>								
Large	4	17	12	8	15	14	5	8
Fancy	8	17	10	6	13	7	7	8
Medium	1	6	7	3	7	2	5	4
<i>Third grade</i>								
Large .....	....	....	2	....	3	*	....	1
Fancy .....	....	....	1	....	1	1	....	1
Medium .....	....	....	1	....	1	*	....	1
Total graded Franquettes	100	100	100	100	100	100	100	100
SOFT SHELLS								
<i>First grade</i>								
Large	8	12	16	26	21	25	18	17
Fancy	36	16	15	28	12	19	26	27
Medium	31	18	15	33	14	14	37	28
<i>Second grade</i>								
Large	2	17	14	3	15	13	6	6
Fancy	8	19	17	5	17	11	6	9
Medium	15	18	22	5	13	13	7	12
<i>Third grade</i>								
Large .....	....	....	*	....	3	1	....	*
Fancy .....	....	....	1	....	1	1	....	*
Medium .....	....	....	*	....	4	3	....	1
Total graded Soft Shells	100	100	100	100	100	100	100	100

* Less than half of 1 per cent.

Table 32. WALNUTS: APPROXIMATE AVERAGE PRICES FOR SPECIFIED GRADES AND SIZES AND THE 7-YEAR WEIGHTED AVERAGE OF PRICES OBTAINED BY GROWERS, OREGON, 1932-1938

(The 7-year average price of all graded walnuts was 10.6 cents per pound)

Item	1932	1933	1934	1935	1936	1937	1938	Average 1932-1938
	<i>Cents</i>	<i>Cents</i>	<i>Cents</i>	<i>Cents</i>	<i>Cents</i>	<i>Cents</i>	<i>Cents</i>	<i>Cents</i>
FRANQUETTES								
<i>First grade</i>								
Large	12.9	12.5	11.0	12.1	15.4	10.3	12.8	12.4
Fancy	10.8	9.9	9.1	10.6	13.6	8.7	11.1	10.5
Medium	8.5	9.0	8.4	9.4	11.3	7.0	10.0	9.1
<i>Second grade</i>								
Large	9.0	10.5	9.3	10.2	12.8	8.1	11.1	10.1
Fancy	8.5	8.9	8.7	9.5	12.0	7.9	11.0	9.5
Medium	8.7	6.5	7.9	8.5	10.4	6.7	9.3	8.3
AVERAGE	10.4	10.3	9.7	10.9	13.3	9.4	11.4	10.8
SOFT SHELLS								
<i>First grade</i>								
Large	13.1	8.4	9.8	11.2	13.5	9.4	11.5	11.0
Fancy	8.7	7.0	8.4	9.8	12.4	8.2	11.3	9.4
Medium	6.8	7.3	7.3	8.4	10.7	6.7	9.1	8.0
<i>Second grade</i>								
Large	8.6	8.0	8.6	9.7	12.0	6.8	10.6	9.2
Fancy	7.9	7.0	8.0	8.4	10.8	7.0	9.9	8.4
Medium	6.3	6.8	6.8	7.9	9.7	6.0	7.7	7.3
AVERAGE	8.1	7.4	8.1	9.5	11.5	7.6	10.1	8.9

CONCLUSIONS ON THE SITUATION AND OUTLOOK FOR WALNUT PRODUCTION IN OREGON

Inasmuch as only a few of the commercial walnut plantings in Oregon have reached maturity, the future of the enterprise in this State must still be considered as not fully predictable. Much of the bearing walnut acreage was planted with little or no realization of the adaptability of walnuts either to the site selected for the orchard or to the farm organization as a whole. Many farms do not have land suitable for walnut trees. Often on adjoining farms the conditions are so different that one farmer may be justified in planting an orchard while his neighbor is not. Many of the plantings made on poorly suited land appeared to be satisfactory during the early life of the orchard. Eventually, however, the trees showed the effects of adverse conditions and resulted in a heavy loss to the owner on his investment. He was confronted with the alternative of either low yields, often of a poor quality, or admission of failure by removing the trees. The poor return obtained from the low-yielding orchards during the past decade has stimulated removal of some inferior orchards.

As noted in the preceding section, excessive surpluses and depressed prices led many nut producers to participate in the Walnut Control Board program of the Agricultural Adjustment Administration in an effort to stabilize the domestic supply of nuts and maintain the price structure at so-called "parity" level. An evaluation of the results of the Control Board program is outside the province of this study. The fact, however, that a majority of the producers have seen fit to continue the program year after year from 1933 until the present would indicate that they recognize the need of safeguarding the marketing aspects of this enterprise by some concerted action.

Reduction of the present tariff rate on walnut importations, under present conditions existing in the enterprise, must also be regarded with apprehension by the growers in this region. Since foreign demand for American nuts has never been large, it would appear that exportation of any considerable volume would be in the nature of "dumping" at the resultant low prices that such disposal usually denotes. While some recovery from the low domestic nut prices of recent years is possible whenever the general consumer market improves and the general price level rises, the fact must not be overlooked that many consumers regard walnuts, as well as other tree nuts, as luxury products.

It would appear, therefore, that (1) walnut production should be geared as nearly as possible to supply the domestic market; (2) considerable expansion of this market may be possible by developing a more effective sales policy; and (3) the individual grower's primary concern is to strive for and effect efficiency in his orchard operation by improving the yield and quality of his product, thereby reducing his cost per pound and assuring himself the maximum price for his crop. Rigid adherence to this policy on the part of the grower will enable him to compete most advantageously with other nut producers.

Good farm management practice suggests that, although walnut production usually involves a large investment per acre and requires considerable technical knowledge on the part of the producer, specialization limited to this single enterprise is not advisable for the average farmer. An orchard does not lend itself to a crop-rotation plan, or contribute materially to a livestock-production program on the farm, yet the farmer who adopts a diversified production program is able to employ his farm machinery, his power equipment, and his own and family labor more advantageously over the entire year than can the specialized

walnut grower with the one-crop system. When adverse conditions arise in the walnut enterprise, moreover, the diversified farmer with a relatively small acreage in walnuts along with his other enterprises, is able to retrench more effectively with regard to cash expenditures, such as for labor, because his family is able to substitute in a large part for the hired labor ordinarily employed. The large-scale orchard operator, on the other hand, is much more concerned about the necessity of obtaining good yields and high prices since he is largely, if not entirely, dependent on his receipts from walnuts to pay the operating expense, which often represents a considerable short-term obligation for money borrowed. Consequently, he may face a serious situation whenever his crop yield is small or the price unusually low, for if he has no other resource to draw upon until the next crop is harvested, the financing of future operations, following a disastrous year is often difficult for him and sometimes impossible.

The findings in this study, by pointing out the importance of good yields of high-quality walnuts produced at a reasonably low production cost per pound, should be helpful to the individual grower interested in improving his business. Having the data in terms of physical requirements, such as the hours of labor and machinery used per acre, the approximate cost of production for any other period may be estimated by simply adjusting for any changes in the scale of wages and other items of cost.

Practices followed in walnut production have not changed materially since 1931. Adoption of the cover-crop disk has proved popular to those having sufficient acreage to warrant the investment and sufficient power to handle this implement. The need for spraying walnut trees to control blight is generally admitted, but the program recommended is relatively inexpensive. While cover cropping is being more generally practiced than formerly, it usually entails a very low cost per acre for seed and seeding. Costs of supplies are comparable to those of the period studied. The chief variable in the cost of producing walnuts today compared to the period of the study would be the labor factor. Any difference in the cost of production, therefore, would be due almost entirely to changes in the wage rate for labor. Since there is very little difference in the wage rates today and in 1931 it is apparent that the costs of walnut production found in this study correspond closely to those of today.

Appendix A

METHODS USED IN OBTAINING, COMPILING, AND ANALYZING THE DATA

The data for this study were collected by the survey method, each co-operating grower being visited at the end of each year of the study for the purpose of obtaining a complete business record on the bearing walnut acreage. Analysis of the data was made chiefly by grouping and cross-tabulating. Many of the details entered on the schedule were the farmer's carefully checked estimates. Complete farm records were not common. Schedules were obtained during the winter months when growers were able to spend sufficient time with the enumerator to work out thoroughly all the facts pertaining to the year's operations.

Joint costs. Those farm expenses, both cash and noncash, that were incurred only in part for the walnut enterprise were charged to the walnuts in proportion to the benefit received. The investment in machinery and buildings used jointly was likewise apportioned according to use.

If the walnut planting contained other interplanted trees, the grower was asked to allocate the proportion of the total costs to be borne by the walnuts. This allocation, based on the amount of ground area occupied by the respective kinds of trees, was determined on the basis of the number of trees of each kind regardless of size or productivity. After thus determining the percentage of the land area chargeable to walnuts, this figure was applied to those costs implying joint benefits, such as taxes and cultivation, in determining the portion of such costs chargeable to walnut production.

Taxes. Taxes were computed from data in the county assessor's office, since it was found that the individual farmers did not have a clear conception of how the total property tax was apportioned among the various farm enterprises.

Rent. A few growers rented land, buildings, or equipment. Where rent was not paid in cash but was paid in shares of crop, labor, etc., it was expressed in cash on the basis of market value and was recorded as a cash expense. If a whole farm were rented, the renter was treated as an owner and was charged interest on the investment, taxes, depreciation, etc., in lieu of rent, in order to make all farms comparable on an investment basis.

Drier fuel. Purchased drier fuel was entered at the price delivered to the drier. Where wood was cut by the farmer the stumpage value was estimated, and the value of cutting and hauling was included under labor costs.

Cover-crop seed and fertilizer. Since practically all of the cover-crop seed used was purchased, this item was considered a cash expense. Farm manure was charged at its estimated cash value at the barn. Labor of applying fertilizers was included under labor expense.

Man labor and horse work. A very complete form was used to compile the various labor operations performed in walnut production. Although the *total* yearly labor on an enterprise is an indefinite figure in the minds of many farmers, the grower is quite definite about the labor required for each individual operation. The enumerator recorded for each operation or job the farmer's estimate of the amount of work performed by the farmer, members

of his family, and hired labor. Since most of the estimates were on an hour basis the wage rates were also expressed on the hourly basis, including value of any board and lodging furnished. In other words, the wage rate for family labor was gauged by the wages received by hired labor in the region for comparable work.

In addition to the time that the farmer spends at specified farm jobs he generally puts in a considerable amount of time that should be charged as overhead to the various farm enterprises. Each farmer was asked to apportion his total year's time among his enterprises. From his estimate for the walnut enterprise was deducted the actual time he had spent on the orchard work, and the remainder was then entered as *supervision*.

Work by farm horses was charged at 13 cents an hour. This was the average cost of horse work in the Willamette Valley as reported in Oregon Agricultural Experiment Station Bulletin 250, "Cost of Horse Labor on Oregon Farms." The rate paid for hired horses averaged about 14 cents an hour.

Contract labor. Contract labor, quite common in walnut production, was charged as labor expense, although it often included, of course, the use of equipment and fuel as well as labor.

Interest. The present investment or inventory value of orchard and equipment was determined, and interest was charged uniformly at 5 per cent.

Depreciation. Depreciation on buildings and equipment was obtained by dividing the present or depreciated value by the remaining years of usefulness.

No depreciation was charged against the walnut planting. It is fair to assume that the appreciation on young orchards would offset any depreciation on the older plantings in the large group of orchards studied.

Machinery operation cost. Interest and depreciation on machinery were computed separately from the daily operation costs and entered under those respective headings. Total machinery cost, therefore, may be obtained by adding together the operating costs, interest, and depreciation.

Appendix B

THE WALNUT CONTROL BOARD*

For the seven marketing seasons subsequent to October 1933 the walnut industry in California, Oregon, and Washington (the producing area for walnuts in the United States) has operated under a Federal Marketing Agreement which was executed by the handlers of more than two-thirds of the walnuts produced on the Pacific Coast and approved by growers who produce more than two-thirds of the walnuts.

The purpose of the program is to limit the domestic movement of merchantable unshelled walnuts to a quantity that will satisfy consumer demands, maintain buyer confidence, and promote market stability; while the balance of the merchantable supply, the so-called surplus, is moved into noncompetitive channels at the best obtainable prices. The program's objective is to obtain greater returns for the total crop than could be obtained if the entire supply were forced onto the domestic market without regard for trade demand and the consuming public's ability to purchase.

The Agreement is administered and operated by the Walnut Control Board, consisting of eight representatives of the walnut industry annually appointed by the Secretary of Agriculture, with the assistance of grower and packer nominations, and one member who is not financially interested in the industry. While Oregon growers have produced during this period a proportion varying from but 2 to about 10 per cent of the total Coast production, they are represented on the Board by two of the eight industry representatives.

Just prior to each harvesting season the Board estimates the probable supply of walnuts, including the carry-over, together with probable domestic demand for unshelled nuts. On the basis of this study the Board recommends to the Secretary of Agriculture the percentage of production that may be sold to the general trade in the unshelled form. The remainder, or "surplus" as it is called, is turned over to the Board, which in turn sells this surplus for shelling or export purposes at whatever price it can get. During the past 6 years the Board has on the average handled 30 per cent of the production as surplus and has obtained for this surplus sold for shelling or export a price that has averaged net 50 per cent of the current prices for unshelled nuts.

Prior to the control period practically no domestically produced walnuts were shipped in export. During the past 6 years the Board has sold in export approximately 69,000,000 pounds, an average of 11,500,000 pounds a year. During this period Pacific Coast walnuts have been quoted to practically every known consuming center in the world. Deliveries have been made to all of the important consuming centers and even to many out-of-the-way places.

Prior to the control period but few domestically produced merchantable walnuts were shelled. During the past 6 years approximately 66,000,000 pounds of surplus walnuts have been shelled, an average of 11,000,000 pounds annually. Surplus walnuts shelled have not replaced unshelled walnuts available to the domestic market, but rather have replaced shelled walnuts that statistics indicate would, under conditions previously existing, have been imported.

The records show that in 1931 this country was importing approximately 11,000,000 pounds of shelled walnuts. For the past 7 years, shelled imports have varied from approximately 4,000,000 to 5,500,000 pounds. This indicates

* The substance of this statement regarding the operations of the Walnut Control Board is furnished through the courtesy of W. E. Goodspeed, Manager of the Walnut Control Board, Los Angeles, California.

an annual reduction in imports of at least 5,000,000 pounds of kernels, which is the equivalent of 12,000,000 pounds of unshelled walnuts. The reduction in imports has been largely offset by the shelled walnuts from the domestic surplus stock. In other words, there has been a distinct gain in consumption of domestically produced walnuts, attributable in large part to the surplus-control program.

During this period the Federal Government has encouraged the diversion of walnuts from the unshelled to the shelled or export trade by the payment of a subsidy. The funds used by the government for this subsidy are derived from import duties collected on walnuts as provided by the Agricultural Marketing Act. The amount of the subsidy during the past 4 crop years has averaged 5 cents for each pound of surplus. The grower has therefore received for the 30 per cent of his production that was set aside as surplus, half of the current price for unshelled nuts plus a subsidy from the government of 5 cents a pound.

Although it is impossible to say just what the price of walnuts would have been without this program, it is obvious that the surplus-control program is a market factor of importance, and while no definite agreement exists for its continuation, it has so far been renewed from year to year.

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