

Cost of Producing
Strawberries for Processing
in the Willamette Valley, Oregon

By
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FOREWORD

Growers and processors alike will be interested in this study of the cost of producing strawberries in the Willamette Valley.

This bulletin presents a detailed analysis of the various factors of cost together with a discussion of the relative importance of each factor as it affects profit or loss in the enterprise.

Those growers who are interested in diseases and insect pests of strawberries in Oregon should refer to Oregon Agricultural Experiment Station Bulletin 419. Those interested in broad general questions about strawberry culture should refer to Station Bulletin 442.

The authors present a picture not of what might be true under ideal circumstances, but rather what is actually achieved by producers under existing conditions. The wide variation in results obtained by individual growers in this study suggests the opportunity for improvement on the part of many.

Wm. A. Schoenfeld

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Dean and Director



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Assisting with the field work were R. K. Nissen of Sheridan, Roy L. Davidson of Forest Grove, Ralph Bergstrom of McMinnville, O. B. Hardy and Russell M. Adams of Corvallis. Pictures were furnished by Curtis Reid, Extension Specialist in Visual Instruction, Oregon State College.

SUMMARY

The situation

OREGON ranked first in the United States in tonnage of strawberries, producing 16.4 per cent of the total crop reported, in 1948.

The bearing acreage in the state in 1948 was estimated as 15,000 acres.

Canning and freezing have been the principal outlets for Oregon's strawberries.

Size of planting

The 99 plantings in the cost study varied in size from 2 to 140 acres and averaged 11.8 acres per farm.

The estimated capital investment in the enterprise averaged \$6,777 per farm or \$574 per acre of strawberries, of which \$414 was for the land and planting exclusive of equipment.

Cost of production

The cost of producing strawberries (for processing) in Oregon in 1947 averaged \$537 per acre or 15.06¢ per pound with an average yield of 3,529 pounds per acre.

Cost of all labor averaged \$329.83 per acre or 62 per cent of total cost. Harvest labor comprised two-thirds of the entire labor cost or 40 per cent of all costs. This item is designated as a *variable cost* because it tends to vary with yield per acre.

Fixed costs, or costs which do not vary with the yield per acre, include depreciation, interest, and property taxes. These items averaged \$145.76 per acre or 27.3 per cent of the total cost of production.

Semifixed costs, or maintenance and miscellaneous costs, which to some extent vary with the yield per acre, in 1947 averaged \$170.38 per acre or 32.1 per cent of total costs.

The cost on 38 plantings in the Gresham area averaged 14.3¢ per pound, compared to 16.4¢ on 29 plantings studied in Washington County.

The cost on 33 plantings (one-third of the total studied) with the lowest costs of production averaged 11.79¢ while the 33 plantings with the *highest* costs averaged 24.19¢ per pound in 1947.

Plantings producing less than 2,000 pounds per acre had an average cost of 30.2¢ per pound, while those producing more than 6,000 pounds had an average cost of only 10.6¢.

The smallest plantings had high preharvest labor and machinery costs.

Valley-land plantings were more productive as a group than were the hill-soil plantings in 1947.

Costs of establishing strawberries in 1947 on 68 new plantings averaged \$326.50 per acre.

Labor and plants comprised two-thirds of the total cost.

Estimating current costs

It is impracticable to repeat a cost study every year, but if production methods are not materially changed, and if cost items are presented in physical as well as in money terms, cost data are useful beyond the period of the study. With the aid of index numbers relating to the major cost items, it is possible to make any necessary adjustments for a given year. In this way the estimated costs of producing strawberries in Oregon were computed for the 13-year period 1936-1948.

Cost of Producing Strawberries for Processing in the Willamette Valley, Oregon

By

Gustav W. Kuhlman and D. Curtis Mumford
(Agricultural Economists)

Introduction

This is a summary of the costs of strawberry production (for processing) in 1947 on 99 farms. Records also were obtained on the costs of establishing 68 new plantings.

The purpose of the study was to obtain basic facts on yields as well as on costs. This information, when adjusted for changes in yield and in the price level of costs, provides a basis for estimating the cost of production for any given year if no changes have occurred in production techniques. Another purpose of the study was to determine the major factors affecting yields and costs.

The Situation

United States strawberry production

Oregon, with 16.4 per cent of the total tonnage, was the leading state in strawberry production in 1948 (Table 1). The 10 major

Table 1. STRAWBERRIES: PRODUCTION IN THE 10 MAJOR PRODUCING STATES AND THE UNITED STATES¹

State	10-year average 1938-47	Production 1948	Percentage of 1948 production
	<i>Crates²</i>	<i>Crates²</i>	<i>Per cent</i>
Oregon	849,000	1,650,000	16.4
California	585,000	1,082,000	10.7
Washington	540,000	980,000	9.7
Louisiana	1,043,000	817,000	8.1
Michigan	671,000	750,000	7.5
Tennessee	616,000	680,000	6.8
Virginia	346,000	525,000	5.2
Arkansas	780,000	468,000	4.6
Kentucky	350,000	350,000	3.5
New York	323,000	315,000	3.1
10 states	6,103,000	7,617,000	75.6
All states	9,138,000	10,076,000	100.0

¹"Strawberry Acreage and April 1, 1949, Indicated Production," Bureau of Agricultural Economics, U. S. Department of Agriculture.

²Crate contains 36 pounds.

producing states accounted for three-fourths of the crop in the United States.

Oregon strawberry production

In 1948 the total area of bearing strawberries in Oregon was estimated to be 15,000 acres. Total production of 59,400,000 pounds was valued at \$12,128,000.

Strawberries comprised about 64 per cent of the tonnage and 74 per cent of the value of all "principal berries" produced in the state in 1948. They comprised nearly 10 per cent of the tonnage and 25 per cent of the value of all fruits and nuts produced in Oregon that year.

The three leading counties producing strawberries were Clackamas, Washington and Marion, together accounting for nearly 70 per cent of the state's total acreage of strawberries in 1948.

Utilization of strawberry production for freezing

About 78,059,000 pounds of frozen strawberries for marketing were reported in 1946. This comprised about 31 per cent of the 250,000,000-pound crop produced in the United States that year. Nearly half of the frozen strawberry output was from eight far western states.

Description of the Study

A detailed report of the production costs and practices for the 1947 crop was obtained by survey from 99 growers cooperating in the study (Table 2). Trained enumerators obtained a field survey schedule showing the investment, the man labor required, equipment

Table 2. STRAWBERRIES (FOR PROCESSING): NUMBER, ACREAGE, AND PRODUCTION OF BEARING PLANTINGS STUDIED; BY COUNTIES, OREGON, 1947.

County	Number of farms	Bearing straw-berries	Total produc-tion
		<i>Acres</i>	<i>Pounds</i>
Washington	29	369	1,212,060
Clackamas	27	337	1,283,214
Marion	19	238	796,849
Multnomah	11	111	513,000
Linn, Polk, Yamhill	13	115	321,541
Total	99	1,170	4,126,664

used, and all other costs incurred in the year's operations from those growers selected for the study.

The bearing acreage in the study totaled 1,170 acres, producing more than four million pounds of strawberries in 1947.

Description of Farms

Land use

The 99 farms included in this study averaged 92 acres of land per farm (Table 3). Nearly two-thirds of the acreage was cropland. About half of the cropland was in fruits and vegetables, and half was in general crops, cover crops, and fallow.

Table 3. STRAWBERRY FARMS: UTILIZATION OF THE LAND ON 99 FARMS STUDIED, WILLAMETTE VALLEY, OREGON, 1947.

Land use	Number of farms	Acreage per farm reporting	Average acreage per farm	Percentage of total farm area
		<i>Acres</i>	<i>Acres</i>	<i>Per cent</i>
Strawberries, bearing age	99	12.5 ¹	12.5 ¹	13.6
Strawberries, nonbearing	57	9.3	5.4	5.9
Boysenberries	15	6.3	1.0	1.0
Raspberries	13	4.7	.6	.7
Blackcaps	9	4.3	.4	.4
Loganberries	7	5.7	.4	.5
Gooseberries	3	3.8	.1	.1
Total berries, bearing age	99	.....	14.5	15.8
Total berries, nonbearing	58	10.0	5.9	6.4
Orchard	32	8.7	2.8	3.1
Vegetables	36	19.5	7.1	7.7
Other cropland	79	34.6	27.6	30.0
Total cropland	99	.....	57.9	63.0
Other land	95	35.5	34.1	37.0
TOTAL LAND	99	.....	92.0	100.0

¹This represents a total of 1,240 acres of bearing strawberries. Cost data in this study include those from 1,170 acres of the total 1,240.

Strawberry acreage

The strawberry enterprise generally was of major importance in the systems of farming followed by these operators. Bearing strawberries averaged 12.5 acres per farm. New plantings (in 1947) averaged 9.3 acres for the 57 growers who had planted that year.

Table 4. LIVESTOCK: NUMBER AND DISTRIBUTION OF ANIMALS AND POULTRY ON THE STRAWBERRY FARMS STUDIED, WILLAMETTE VALLEY, OREGON, 1947.

Kind of livestock	Number of farms reporting	Livestock per farm reporting	Animal units per farm (all farms)	
			Number	Per cent
Milk cows	70	2.1	1.89	40.1
Other cattle	41	3.0	.79	16.8
Sows	4	2.0	.02	.4
Other hogs	29	3.8	.14	3.0
Horses	44	1.6	.92	19.5
Sheep	3	66.7	.36	7.7
Goats	1	2.0	.01	.2
Hens	43	102.8	.57	12.1
Rabbits	1	12.0	.01	.2
Total	78	.....	4.71	100.0

¹An animal unit was computed as 1 cow or horse, 2 young cattle, 5 sows, 10 other hogs, 7 sheep or goats, 50 rabbits, and 100 chickens.

Livestock

About four out of every five strawberry growers in this study reported having some livestock (Table 4). Cattle (mostly dairy), horses, and chickens comprised nearly 90 per cent of the total livestock in terms of animal-unit equivalents.

Seventy of the 99 growers kept dairy cows, averaging two cows per farm. Horses were reported on 44 farms, averaging 1.6 head per farm reporting. Most of the horses were work stock. A few were riding horses. Chickens were kept on 43 farms, averaging about 100 hens per farm reporting them.

Capital investment in farms

The total capital investment in land and buildings, based on estimates made by each grower interviewed, averaged \$22,176 per farm or \$241 per acre (Table 5). Land comprised 69 per cent of the total value of this real estate, with buildings (and a small amount of irrigation equipment) comprising 31 per cent. These figures apply to the whole farm, regardless of how the property was used.

Capital investment in strawberry enterprises

The total amount of capital (present value) represented by the 99 strawberry plantings in the study averaged \$6,777 per planting (11.8 acres each) or \$574 per acre (Table 6). These amounts do not include cash required to operate.

Table 5. STRAWBERRY FARMS: SIZE AND DISTRIBUTION OF CAPITAL INVESTMENT IN LAND AND IMPROVEMENTS PER FARM AND PER ACRE; WILLAMETTE VALLEY, OREGON, 1947.

Item	Total acres per farm	Total value per farm	Average value per acre	Percentage of total value
				<i>Per cent</i>
Cropland	57.9	\$13,992	\$242	63.1
Nontillable land	34.1	1,288	38	5.8
All land	92.0	\$15,280	\$166	68.9
Buildings and irrigation equipment..	.....	\$ 6,896	\$ 75	31.1
TOTAL FARM	92.0	\$22,176	\$241	100.0

Table 6. BEARING STRAWBERRY ENTERPRISE INVESTMENT: AVERAGE VALUE OF CAPITAL INVESTED IN 99 PLANTINGS STUDIED, WILLAMETTE VALLEY, OREGON, 1947.

Item	Value per planting	Value per acre	Percentage of total value
			<i>Per cent</i>
Land	\$2,962	\$251	43.7
Planting	1,926	163	28.4
Buildings	1,160	98	17.1
Irrigation equipment	47	4	.7
Machinery	235	20	3.5
Tractor	118	10	1.7
Automobile and truck	329	28	4.9
Total	\$6,777	\$574	100.0

The value of the land producing the strawberries averaged \$251 per acre. This value of land was estimated by the growers from a conservative, long-term standpoint. The average capital represented by the plantings over the life of the stand was \$163 per acre, exclusive of the land value. The present (depreciated) values of buildings and other equipment used in production were allocated on each farm according to the extent used in the various enterprises, including strawberries.

The Cost of Strawberry Production

The cost of producing strawberries in 1947 on 1,170 acres, yielding 3,529 pounds per acre, averaged \$531.59 per acre, or 15¢ per pound (Table 7). The cost includes all items of expense incurred in producing and delivering the fruit to the cannery door excepting any cost for crates and hallocks. Canneries customarily furnish growers with the necessary crates and hallocks for harvesting.

Labor

The cost of labor per acre (except picking which was usually on a piece basis) was obtained by multiplying the average number of hours for each operation on the total acreage studied by the wage rate for the specific work done. Thus the data are applicable to the entire acreage of a crop within an area such as a county. They indicate the average amount of labor that may be required per area for all of the acreage of that crop even though each acre may not have been covered by every operation.

The cost of man labor was \$330 per acre or 62 per cent of the total cost. The average labor requirement per acre was 409 hours, of which 276 hours or about two-thirds of the total was for harvesting. (The number of hours shown for picking was computed by dividing the cost of picking by 75¢. The rate for all other labor averaged 88¢ per hour.) Hoeing was by far the largest preharvest task, averaging 95 hours per acre or 71 per cent of all preharvest labor.

Materials

The cost of commercial fertilizers applied on bearing strawberry plantings in 1947 averaged \$15.18 per acre. This cost amounted to less than $\frac{1}{2}$ ¢ per pound of berries produced. Dust (spittlebug control) and bait (weevil control) materials each averaged about \$5.00 cost per acre.

General expense

The charges for equipment operation and all miscellaneous expenses averaged \$33.51 per acre. This cost equaled nearly 1¢ per pound on the total berry production or about 6 per cent of the total cost of production.

Depreciation

The depreciation on machinery equipment chargeable to strawberries averaged \$9.11 per acre. Depreciation on buildings and irrigation equipment averaged \$6.49 per acre. The estimated cost of the

Table 7. STRAWBERRIES (FOR PROCESSING): ITEMIZED COSTS PER AVERAGE ACRE AND PER POUND, WILLAMETTE VALLEY, OREGON, 1947.
 FOR 1,170 ACRES ON 99 FARMS PRODUCING 4,126,664 POUNDS OF BERRIES, AN AVERAGE YIELD OF 3,529 POUNDS PER ACRE.

Item	Man hours per acre	Cost per acre	Cost per pound	Percentage of total
			<i>Cents</i>	<i>Per cent</i>
<i>Labor</i>				
Cultivating	10.9	\$ 10.21	.29	1.9
Hoeing	94.6	75.96	2.15	14.3
Fertilizing	1.8	1.74	.05	.3
Dusting .....	.9	.84	.02	.2
Baiting	4.5	3.79	.11	.7
Mowing .....	.9	.80	.02	.1
Supervision and miscellaneous	19.2	21.04	.60	4.0
Total preharvest	132.8	\$114.38	3.24	21.5
Picking	234.0	175.70	4.98	33.0
Other harvest	41.9	39.75	1.13	7.5
Total labor	408.7	\$329.83	9.35	62.0
<i>Materials</i>				
Fertilizer		\$ 15.18	.43	2.9
Dust		5.21	.15	1.0
Bait		5.41	.15	1.0
Total materials		\$ 25.80	.73	4.9
<i>General expense</i>				
Horse work		\$ 1.24	.04	.2
Building and irrigation upkeep		2.67	.08	.5
Machine repair		5.55	.16	1.1
Gas and oil		5.33	.15	1.0
Motor license and insurance		1.81	.05	.3
Liability and fire insurance		3.69	.10	.7
Electricity, water, wood		3.05	.09	.6
Office, procuring help		1.86	.05	.4
Property taxes		3.31	.09	.6
Interest on cash required to operate		5.00	.14	.9
Total general expense		\$ 33.51	.95	6.3
<i>Depreciation on equipment and planting</i>				
Machinery		\$ 9.11	.26	1.7
Buildings and irrigation		6.49	.18	1.2
Planting (cost amortized over 3 crop years)		108.83	3.08	20.5
Total depreciation		\$124.43	3.52	23.4
<i>Interest on investment</i>				
Machinery at 5 per cent		\$ 2.88	.08	.5
Buildings and irrigation at 5 per cent		5.11	.15	1.0
Land investment at 4 per cent		10.03	.28	1.9
Total interest		\$ 18.02	.51	3.4
TOTALS	408.7	\$531.59	15.06	100.0

planting, amortized over three crop years, was \$108.83 per year (see Table 22). This overhead item thus averaged 3¢ per pound of berries harvested in 1947. In other words, this one item of planting cost or depreciation of stand accounted for 20 per cent of the total cost of production.

Interest

Interest on the land investment (in lieu of rent) was computed as a cost at 4 per cent of the value of the land. A rate of 5 per cent interest was charged on the investment in buildings and machinery. Interest on the investment represented by the original planting was included in cost of the stand. Interest on the cash required to operate during the year was charged at 5 per cent and included under "General Expense." It amounted to \$5 per acre. The bulk of this cash is required at harvest time in May and June. Cooperatives then pay their growers by installments extending into the following season, for the strawberries delivered.

Low investment per acre for machinery and buildings generally is achieved by utilizing equipment for other farm enterprises, by operating large acreages, by renting out equipment, or by hiring custom work done.

Itemized cost on farm equipment

Costs on 76 trucks used on the farms studied, averaged 8.1¢ per mile for 4,360 miles driven in 1947. Costs on 41 pickups averaged 5.5¢ per hour for 5,842 miles. Costs on 205 tractors averaged 55.5¢ per hour for 648 hours of use per tractor during the year.

Table 8. BERRY FARM EQUIPMENT: COST OF USING, COMPUTED ON THE BASIS OF EACH \$1,000 PRESENT VALUATION, WILLAMETTE VALLEY, OREGON, 1947.
(DATA INCLUDE COSTS ON 117 TRUCKS AND PICKUP TRUCKS, 205 TRACTORS, AND ALL THE GENERAL EQUIPMENT.)

Item	Machinery				Irrigation equipment (11.4) ¹	Farm buildings (16.0) ¹
	Trucks (6.7) ¹	Tractor (8.5) ¹	Other (5.3) ¹	Total (6.3) ¹		
Depreciation	\$150	\$117	\$190	\$158	\$ 88	\$ 63
Interest	50	50	50	50	50	50
Repairs	100	91	93	96	19	26
Fuel and oil	135	158	.....	93	32	.....
License, insurance	65	.....	.....	31	.....	.....
Total	\$500	\$416	\$333	\$428	\$189	\$139

¹Years remaining in life.

The detailed costs of all the equipment used in strawberry production have been expressed as a ratio of the respective inventory values (Table 8). Thus the year's cost on all farm machinery equaled \$428 per \$1,000 worth (inventory value) of all machinery used, or about 43 per cent of the present (depreciated) valuation. The ratio for general machinery was only 33 per cent while that for trucks was 50 per cent of the present (depreciated) value. These results serve as a basis for estimating costs or rates when desired.

Fixed and Variable Costs

Some items of cost are quite fixed regardless of the production obtained. Other items vary somewhat with the size of the crop produced (Table 9). Any groupings of costs are, of course, somewhat arbitrary and therefore should be regarded only as rough approximations.

Table 9. STRAWBERRIES (FOR PROCESSING): FIXED AND VARIABLE COSTS, WILLAMETTE VALLEY, OREGON, 1947.
(AVERAGE YIELD, 3,529 POUNDS PER ACRE.)

Item	Cost per acre	Cost per pound	Percent- age of total cost
		<i>Cents</i>	<i>Per cent</i>
Fixed costs (Depreciation, interest, taxes)	\$145.76	4.12	27.3
Semifixed costs (Maintenance and miscellaneous)	170.38	4.83	32.1
Variable costs (Harvest labor)	215.45	6.11	40.6
Total cost	\$531.59	15.06	100.0

Fixed costs

As the planting, buildings, and machinery usually constitute an operating unit, such costs as depreciation, interest, and taxes cannot readily be shifted to some other enterprise in case of a crop failure. These items, designated as fixed costs, amounted to \$146 per acre or 4.12¢ per pound of strawberries produced in 1947.

Semifixed costs

Semifixed costs, including preharvest labor, fertilizers, farm motor fuels, repairs, and other miscellaneous items, amounted to \$170 per acre or 4.83¢ per pound of strawberries harvested in 1947. These

costs can be only partly postponed or shifted in case of crop failure. This is true either because they are incurred before crop prospects are known or because some maintenance seems advisable for the sake of future production.

Variable costs

Variable costs include labor and other costs connected only with harvesting the crop. Much of these costs, amounting to \$215 per acre or 40 per cent of all costs in 1947, would generally be eliminated during a year of crop failure.

How serious, then, are the fixed and semifixed costs in case of crop failure? It will be noted that in 1947 these costs totaled \$316 per acre or 9¢ per pound with a yield of 3,529 pounds per acre. If, however, a grower obtained only 3,000 pounds, his fixed and semifixed costs would increase correspondingly to 10.5¢ per pound. If the yield were only 2,500 pounds, these costs would increase to 12.6¢ per pound exclusive of harvesting expense (see Table 15).

Table 10. STRAWBERRIES (FOR PROCESSING): COST OF LABOR, MATERIALS, AND OTHER EXPENSE ITEMS PER ACRE; BY FIELD OPERATIONS, WILLAMETTE VALLEY, OREGON, 1947.

Item	Labor	Materials	Other expense	Total
Cultivating	\$ 10.21	.....	\$ 5.48	\$ 15.69
Hoeing	75.96	.....	.....	75.96
Fertilizing	1.74	\$15.18	.68	17.60
Dusting .....	.84	5.21	1.17	7.22
Baiting	3.79	5.41	.23	9.43
Mowing .....	.80	.....	.34	1.14
Picking	175.70	.....	.....	175.70
Other harvesting	39.75	.....	2.24	41.99
Supervision and miscellaneous	21.04	.....	6.77	27.81
Liability and fire insurance .....	.....	.....	3.69	3.69
Automobile and truck .....	.....	.....	13.92	13.92
Building expense .....	.....	.....	14.27	14.27
Property taxes .....	.....	.....	3.31	3.31
Interest on cash for operating ¹ .....	.....	.....	5.00	5.00
Interest on land investment at 4 per cent .....	.....	.....	10.03	10.03
Stand depreciation ² .....	.....	.....	108.83	108.83
Total cost per acre	\$329.83	\$25.80	\$175.96	\$531.59
Cost per pound	9.35¢	.73¢	4.98¢	15.06¢

¹Amount was estimated and applied uniformly over the entire acreage studied.

²Amount represents one-third of the average cost per acre of establishing 498 acres of strawberries in 1947 (total cost was prorated over three crop years).

Major Items of Cost by Operations

Sometimes the grower views his costs from the standpoint of each respective operation taken as a whole (Table 10). Thus the cost of cultivating was \$15.69 per acre in 1947. This cost was about one-fifth as much as the cost of hoeing during that year.

Some costs varied as a whole between the two major producing areas of Washington County and Clackamas County, or the Gresham area (Table 11). Growers in Washington County had higher costs for both cultivating and hoeing. Some of the difference may be due to the fact that growers in the Gresham area more commonly have practiced clean fallow and cover cropping for one or more years

Table 11. STRAWBERRIES (FOR PROCESSING): COSTS: BY MAJOR PRODUCING AREAS, WILLAMETTE VALLEY, OREGON, 1947.

Item	Total study	Washington County	Gresham area
Number of plantings	99	29	38
Average acres per planting studied	11.8	12.7	11.8
Pounds of berries per average acre	3,529	3,285	4,005
Estimated value of land per average acre	\$251	\$171	\$302
Cost per acre for:			
Cultivating	\$ 15.69	\$ 16.82	\$ 11.72
Hoeing	75.96	93.07	65.20
Fertilizing	17.61	18.71	19.86
Dusting	7.22	8.83	1.38
Baiting	9.42	10.12	8.77
Irrigating	1.11	.18	.77
Picking	175.69	165.14	209.53
Other harvest expense	38.75	41.96	42.49
Preparation and cleanup	4.08	4.82	4.56
Mowing	1.13	2.18	.22
Supervision and miscellaneous labor	20.69	17.75	28.36
Automobile and truck	13.92	12.30	17.44
Buildings, electricity, fire insurance	17.17	18.07	21.81
Miscellaneous equipment	1.78	1.56	2.24
Payroll insurance, office expense	4.20	2.48	6.42
Property taxes	3.31	2.93	4.12
Short-term interest at 5 per cent ¹	5.00	5.00	5.00
Interest on land investment at 4 per cent	10.03	6.84	12.06
Stand depreciation ²	108.83	108.83	108.83
Total cost per acre	\$531.59	\$537.59	\$570.78
Cost per pound	15.1¢	16.4¢	14.3¢

¹Amount was estimated and applied uniformly over the entire acreage studied.

²Amount represents one-third of the average cost per acre of establishing 498 acres of strawberries in 1947. (Total cost was prorated over three crop years.)

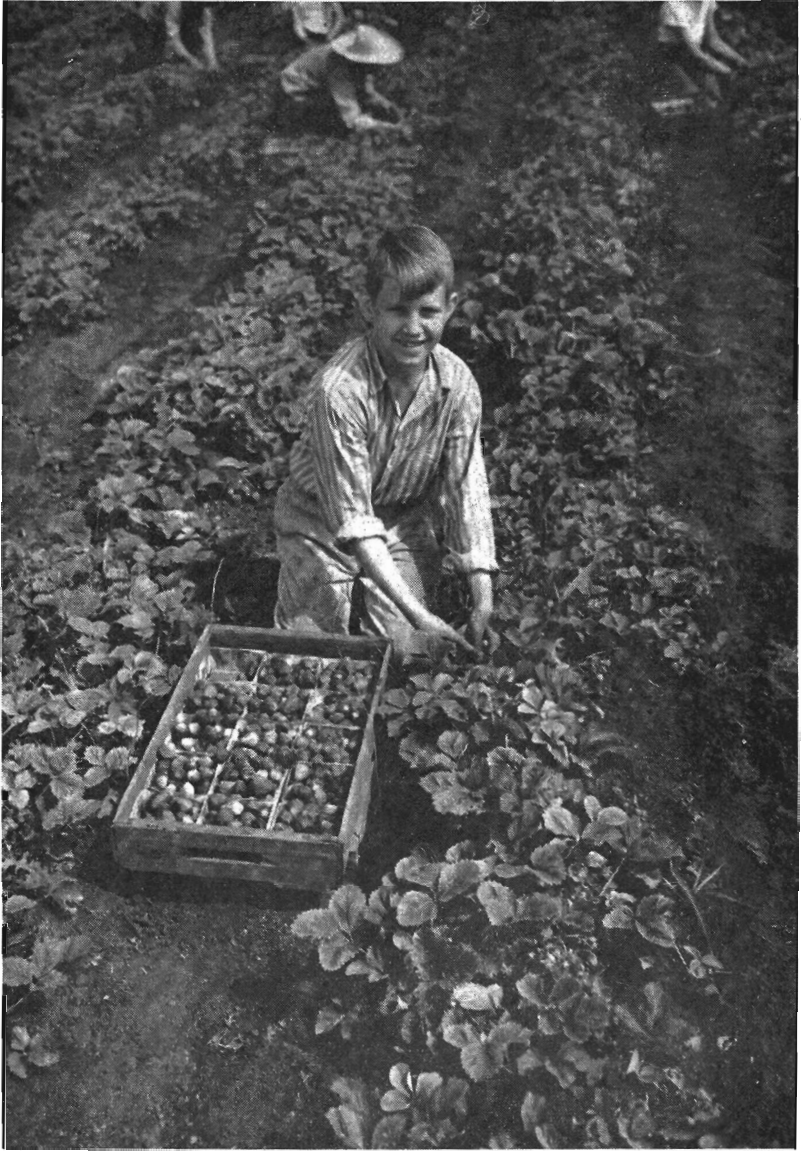


Figure 1. Pickers should be taught how to judge maturity and how to pick and handle the fruit without injuring it. Much of the success in harvesting operations depends on careful supervision of pickers.

Hours per
Month

LABOR PROGRAM
for 12 acres of strawberries
Willamette Valley 1947

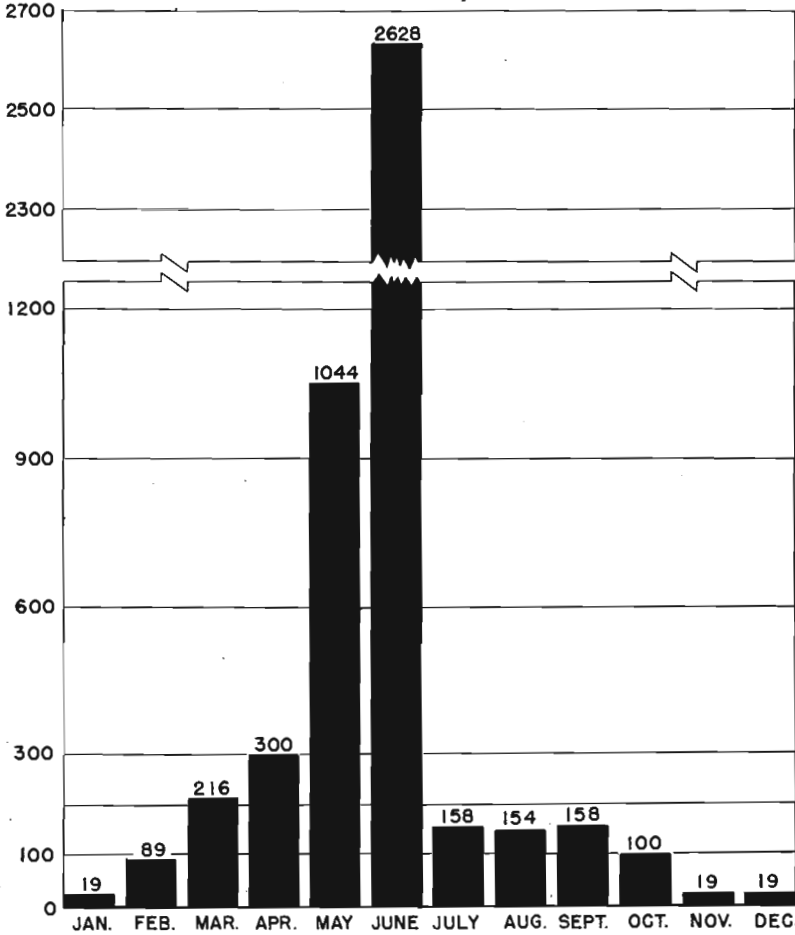


Figure 2. The man labor required in producing strawberries (for processing) in 1947 was recorded by type of work and its approximate distribution by months. On the basis of the average labor annually required per acre of bearing strawberries, the estimated total labor requirement for a 12-acre planting would be 4,904 hours. Assuming twenty-five 8-hour days (200 hours) per month as a full-time job for one man, a 12-acre strawberry planting would then provide full-time work for the operator during only a part of the year (see Table 12).

prior to planting the strawberries. This has reduced the amount of cultivation required thereafter.

Dusting for spittle bug was done more generally in Washington County. Likewise the practice of mowing the field after harvest was found quite commonly in Washington County. Very little of the acreage in the Gresham area was mowed in 1947. There was a marked difference in the amount of supervision and miscellaneous labor charged to the strawberry enterprise. Growers in the Gresham area had less diversified systems of farming. They therefore had more of their own indirect and miscellaneous labor during the year to figure against strawberries.

Seasonal Distribution of Man Labor

Three-fourths of the man labor for strawberry production in 1947 was used in May and June (Table 12). The bulk of this labor came in harvesting, and most of it was hired. Picking required 2.5 persons per acre (Figure 1).

During the other 10 months of the year, the man labor totaled about 100 hours per acre. The size of the 99 plantings in the study averaged nearly 12 acres each. Thus the man labor, exclusive of the harvest season, totaled about 1,200 hours on 12 acres. If a grower could distribute his work on 12 acres of strawberries uniformly he would have 15 eight-hour days of employment per month for 10 months in addition to full-time employment during May and June (Figure 2).

The weather, of course, plays an important role in determining if and when some of the jobs are done. Hoeing, for example, usually is hired in order to get it done at the right time.

While some degree of diversification was generally found on the farms studied, a number of the growers devoted full time to the strawberry enterprise. This included, however, a system of farming which embraced the growing of green manure crops and summer fallowing preparatory to planting, establishing of new plantings, and general farm maintenance. For the study as a whole, the 99 operators actually averaged only 47 hours of labor per acre on bearing strawberries. Unpaid family labor averaged an additional 22 hours per acre. Thus the operator and family labor together averaged 69 hours per acre as compared with 340 hours of hired labor.

The total man labor required for operations (such as cultivation and dusting per average acre) were also computed on the basis of the labor required per acre each time over the field (Table 13). Picking, although shown as one operation, obviously is repeated a number

Table 12. STRAWBERRIES (FOR PROCESSING): APPROXIMATE DISTRIBUTION OF MAN LABOR FOR 1,170 ACRES OF BEARING FIELDS; BY OPERATIONS AND MONTHS, WILLAMETTE VALLEY, OREGON, 1947.

Operation	Total hours per average acre	Monthly distribution of man hours per average acre											
		Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Cultivating	10.9	.....	.5	1.4	2.5	1.5	1.0	1.0	1.0	1.0	1.0	.....	.....
Hoing	94.6	.....	5.0	14.6	20.0	10.0	10.0	10.0	10.0	10.0	5.0	.....	.....
Fertilizing	1.8	.....	.3	.4	.....	.....	.....	.....	.....	.4	.7	.....	.....
Dusting .....	.9	.....	.....	.....	.3	.6	.....	.....	.....	.....	.....	.....	.....
Baiting	4.5	.....	.....	.....	.6	2.4	.9	.2	.2	.2	.....	.....	.....
Mowing .....	.9	.....	.....	.....	.....	.....	.5	.4	.....	.....	.....	.....	.....
Picking	234.0	.....	.....	.....	.....	60.0	174.0	.....	.....	.....	.....	.....	.....
Other harvest labor	41.9	.....	.....	.....	.....	10.9	31.0	.....	.....	.....	.....	.....	.....
Total direct labor	389.5	.....	5.8	16.4	23.4	85.4	217.4	11.6	11.2	11.6	6.7	.....	.....
Total indirect labor ¹	19.2	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
TOTAL LABOR PER ACRE	408.7	1.6	7.4	18.0	25.0	87.0	219.0	13.2	12.8	13.2	8.3	1.6	1.6
TOTAL LABOR PER PLANTING (12 acres) ²	4,904	19	89	216	300	1,044	2,628	158	154	158	100	19	19

¹Indirect labor of the operator is the share of his general farm upkeep and maintenance work which was charged to strawberries. This labor is arbitrarily distributed by months over the whole year.

²The average size of the 99 plantings in this study was 11.8 acres.

Table 13. STRAWBERRIES (FOR PROCESSING): AVERAGE NUMBER OF TIMES OVER AND THE MAN LABOR REQUIREMENTS OF DIFFERENT OPERATIONS USED IN PRODUCTION, WILLAMETTE VALLEY, OREGON, 1947.

Operation	Times over for acreage covered	Labor required per acre once over	Total labor required per acre	Percentage of total acres covered
		<i>Man hours</i>	<i>Man hours</i>	<i>Per cent</i>
Cultivating	7.3	1.5	10.9	100
Hoeing	3.2	30.0	95.0	100
Fertilizing	1.5	1.4	2.1	88
Dusting	1.5	1.0	1.5	64
Baiting	1.8	2.7	4.8	93
Irrigating	3.0	2.3	6.9	5
Mowing ¹	1.0	.9	.9	40
Picking	1.0	234.0	234.0	100
Other harvest labor	1.0	42.0	42.0	100

¹Exclusive of hand mowing.

of times during the harvest season which may extend over a month or more. Since there are many variations in the way jobs are handled, ranging from dusting by airplane to mowing with a hand sickle, these data are presented as indicative of the average rather than as standards of performance.

Variations in Costs of Production

The cost of strawberry production per pound in 1947 was more than twice as high on the group of 33 plantings (one-third of the total studied) with the highest costs as it was on the group of 33 plantings with the lowest costs (Table 14). The respective figures were 24.2¢ and 11.8¢ cost per pound.

Some preharvest items of cost varied quite widely on the acre-basis. Such variations were much greater on the pound-basis. The average size of the plantings in the two groups was quite similar. The big difference therefore lay in the average yield produced per acre. The yield averaged 1,868 pounds for the high-cost group, and 4,863 pounds for the low-cost group.

The data indicate that the high-cost operators had higher costs per acre for cultivating, hoeing, and dusting, yet they obtained much lower yields. The difference in equipment cost per acre is especially significant in years when receipts are low.

Table 14. STRAWBERRIES: VARIATIONS IN COST PER ACRE AND PER POUND ON THE ONE-THIRD LOW-COST AND THE ONE-THIRD HIGH-COST PLANTINGS, WILLAMETTE VALLEY, OREGON, 1947.

Item	Total study	Low-cost plantings	Your farm	High-cost plantings
Number of plantings	99	33	.....	33
Number of acres	11.8	10.6	.....	8.7
Pound of berries	3,529	4,863	.....	1,868
<i>Cost per acre</i>				
Cultivating	\$ 15.69	\$ 17.36	.....	\$ 19.71
Hoing	75.96	51.37	.....	98.24
Fertilizing	17.61	15.83	.....	16.50
Dusting	7.22	5.18	.....	12.13
Baiting	9.42	8.22	.....	9.41
Irrigating	1.11	1.30	.....	1.90
Mowing	1.13	.80	.....	.98
Supervision and miscellaneous labor	20.69	17.73	.....	13.56
Automobile and truck	13.92	10.81	.....	12.03
Building expense	17.17	18.06	.....	12.46
Liability insurance and office	4.20	5.34	.....	3.23
Miscellaneous equipment	1.78	1.44	.....	1.76
Property taxes	3.31	4.05	.....	2.93
Interest on land investment at 4 per cent	10.03	10.97	.....	9.73
Interest on cash for operating	5.00	5.00	.....	5.00
Stand amortization	108.83	108.83	.....	108.83
Total preharvest	\$313.07	\$282.29	.....	\$328.40
Picking	175.69	242.07	.....	92.72
Other harvest	42.83	49.09	.....	30.89
Total cost per acre	\$531.59	\$573.45	.....	\$452.01
<i>Cost per pound</i>				
Preharvest	8.87¢	5.80¢	.....	17.58¢
Picking	4.98	4.98	.....	4.96
Other harvest	1.22	1.01	.....	1.65
Total cost per pound	15.07¢	11.79¢	.....	24.19¢

What are the major factors responsible for these variations in cost and how can the individual grower improve his own situation? Analysis of conditions associated with low-cost production is presented in the following sections.

Some Major Factors Influencing Costs

Yield is usually dominant factor

The yield of strawberries per acre varied widely from farm to farm (Table 15). Fourteen farms had yields of less than 2,000 pounds averaging 1,200 pounds per acre in 1947. Eight farms had

Table 15. STRAWBERRIES (FOR PROCESSING): RELATION OF YIELD TO COST, WILLAMETTE VALLEY, OREGON, 1947.

Yield group	Average yield per acre	Number of farms	Costs excepting harvest labor		Total cost per pound
			Per acre	Per pound	
	<i>Pounds</i>			<i>Cents</i>	<i>Cents</i>
Less than 2,000 pounds per acre	1,200	14	\$286	23.8	30.2
2,000-3,000 pounds per acre	2,527	19	319	12.6	18.7
3,000-4,000 pounds per acre	3,276	20	300	9.1	15.2
4,000-5,000 pounds per acre	4,297	23	341	7.9	14.2
5,000-6,000 pounds per acre	5,219	15	324	6.2	12.2
6,000 or more pounds per acre	6,974	8	331	4.8	10.6
All plantings	3,529	99	\$316	9.0	15.1

yields of more than 6,000 pounds, averaging 6,974 pounds per acre. The cost on the low-yield plantings averaged 30.2¢ per pound, while the cost on the high-yield plantings averaged only 10.6¢ per pound. If the yield is small, each pound of berries must bear a proportionately larger share of the overhead or fixed costs than if the yield is large (Figure 3).

Many factors combine to affect the yield. Some of these factors appear in the following discussion of such items as size of the planting, the kind of soil, the use of irrigation, and the quality of plants.

One of the major factors affecting yield is the condition of the land when the berries are planted. Experienced growers usually turn under one or more green manure crops prior to the year they plant their berries. Growers who followed this practice had yields averaging 4,254 pounds per acre or 33 per cent greater than the average yield for all other growers in the study.

Size of the planting

Usually the smaller the enterprise the higher are the equipment and labor costs per acre. This was true of the very small operators in this study (Table 16). Extremely small operators either have a high investment per acre in equipment or they are dependent upon hand work or upon custom work, with accompanying high costs for such services. The small operator, on the other hand, may be able

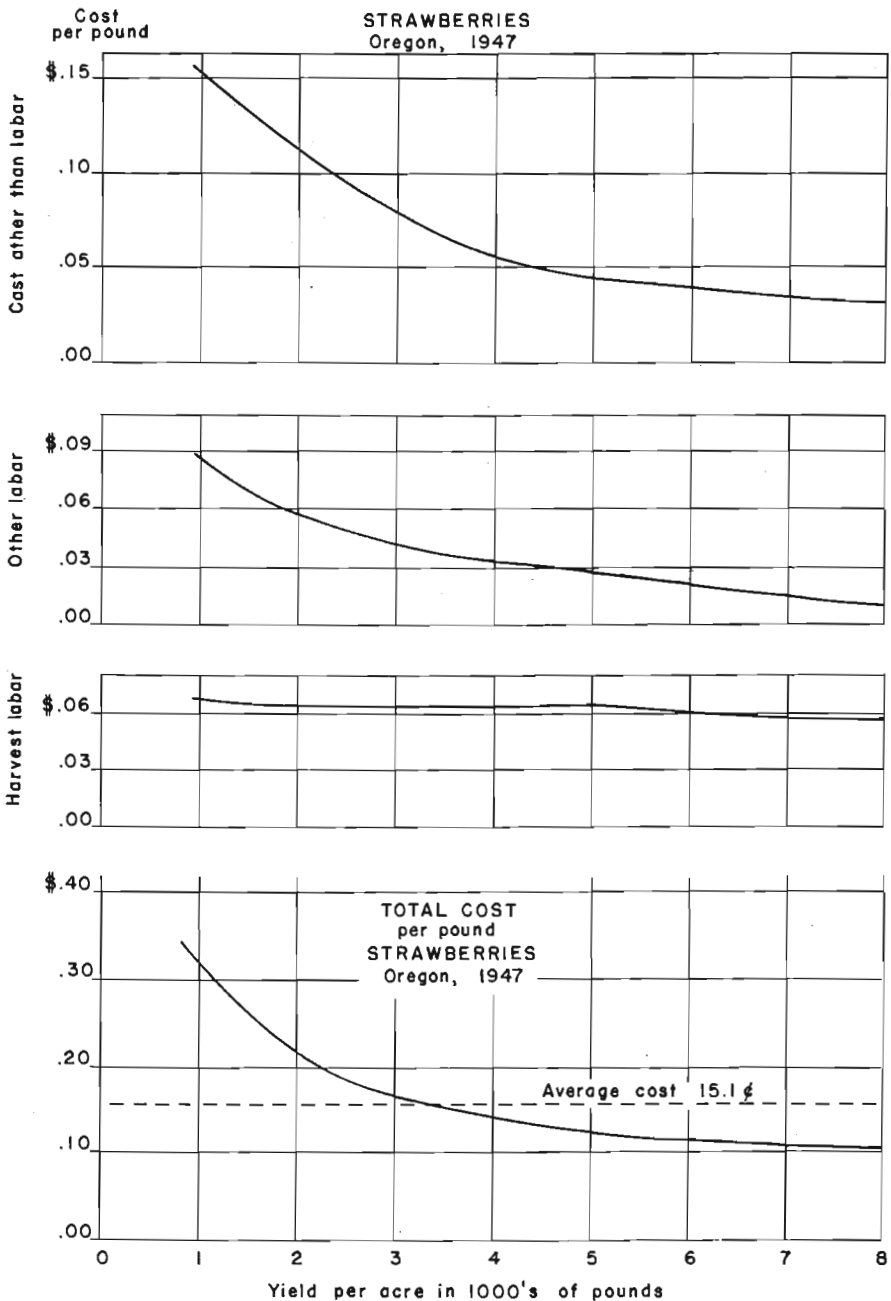


Figure 3. Cost of production per pound decreases as the yield per acre increases. Each group of costs per pound was affected by the size of the crop, but greatest effect was costs other than labor.

Table 16. STRAWBERRIES (FOR PROCESSING): RELATIONS BETWEEN SIZE OF PLANTINGS, YIELD, LABOR AND EQUIPMENT COST, AND TOTAL COST PER POUND, WILLAMETTE VALLEY, OREGON, 1947.

Planting group	Average planting	Number of plantings	Pre-harvest labor and equipment cost per acre	Yield per acre	Total cost per pound
	<i>Acres</i>			<i>Pounds</i>	<i>Cents</i>
Less than 4 acres	2.9	9	\$207	3,858	16.6
4 to 5.9 acres	4.8	25	154	3,351	15.8
6 to 9.9 acres	7.1	31	159	4,087	13.9
10 to 19.9 acres	12.6	18	155	3,338	15.6
20 to 29.9 acres	22.9	10	136	2,957	16.0
30 or more acres	57.5	6	160	3,711	14.7
All plantings	11.8	99	\$155	3,529	15.1

to weather unfavorable years more advantageously than the large operator because the work can be done largely by himself and his family.

Hill soils compared with valley soils

Approximately two-thirds of the plantings were on hill land (Table 17). About 11 per cent of the plantings were on bottom-

Table 17. STRAWBERRIES (FOR PROCESSING): COMPARISON OF HILL AND VALLEY-LAND PLANTINGS, WILLAMETTE VALLEY, OREGON, 1947.

Kind of soil	Number of plantings	Acres per planting	Yield per acre	Value of land per acre	Production cost per pound of berries
			<i>Pounds</i>		<i>Cents</i>
<i>Hill</i>					
Olympic	34	11.6	3,612	\$261	15.4
Melbourne	16	8.2	3,422	201	15.8
Other	14	10.4	3,064	160	16.0
All hill soils	64	10.5	3,456	\$228	15.6
<i>Valley</i>					
Bottomland (Class I)	11	10.3	3,757	\$349	13.9
Benchland (Class II)	15	11.7	4,200	337	13.2
Benchland (Class III)	8	8.9	2,818	298	15.9
All valley soils	34	10.6	3,786	\$333	13.8

land. Fifteen per cent were on good benchland (largely of the Willamette soil series). Only 8 per cent were on lower grades of benchland (mostly Amity soil series). The study indicates that the yield of strawberries is affected by the drainage. The best yields are usually produced on fairly level land that has depth and good drainage.

Irrigation not common in the Willamette Valley

Only 9 of the 99 growers in this study irrigated their strawberries in 1947 (Table 18). Usually this irrigation was rather minor in extent. In other words, it was possible for a few growers to apply a limited amount of water to their berries from a system used chiefly for vegetables or other crops rather than for their strawberries.

Table 18. STRAWBERRIES (FOR PROCESSING): EFFECT OF IRRIGATION ON YIELDS AND COST OF PRODUCTION, WILLAMETTE VALLEY, OREGON, 1947.

Item	Irrigated	Unirrigated
Number of records	9	90
Pounds of berries produced per acre	3,699	3,518
Cost per pound	15.6¢	15.0¢

Table 19. STRAWBERRIES: COST OF IRRIGATING PER ACRE ON 70 ACRES RECEIVING WATER, WILLAMETTE VALLEY, OREGON, 1947.

Item	Cost per acre	
		<i>Per cent</i>
Use of equipment	\$10.58	56.8
Man labor, 6.7 hours	5.84	31.4
Water and power	2.20	11.8
Total	\$18.62 ¹	100.0

¹ Equivalent to a $\frac{1}{3}$ ¢ cost per pound of berries.

The cost of labor, power, and use of equipment for irrigating 70 acres averaged \$18.62 per acre or $\frac{1}{3}$ ¢ per pound of strawberries produced (Table 19).

Age of stand

The records were grouped on the basis of the predominating age of the bearing strawberries on each farm (Table 20). The cost of hoeing the new (first crop) bearing acreage was \$101 per acre,

Table 20. STRAWBERRIES (FOR PROCESSING): VARIATIONS IN COST PER ACRE FOR SELECTED OPERATIONS, BY CROP YEAR, WILLAMETTE VALLEY, OREGON, 1947.

Item	Crop year			Average (99 records)
	First year (48 records)	Second year (40 records)	Third year ¹ (11 records)	
Cost per acre for:				
Hoeing	\$101	\$65	\$58	\$76
Cultivating	19	14	16	16
Fertilizing	18	17	18	18
Pest control	18	17	11	17

¹Includes two plantings (9 acres) of fourth year production.

compared to only \$65 per acre for the second year and \$58 for the third crop year. There was also slightly greater cost of cultivating the first crop year. The cost of pest control was lower on the third-year fields because usually the stand is plowed down right after harvesting.

Quality of plants

The use of certified plants has long been recommended in strawberry production. Grouping of the cost records according to this factor was possible on only a part of the farms studied (Table 21). The data indicate that 15 certified plantings produced 30 per cent more berries per acre and produced them at 17 per cent less cost per pound than was done on 23 noncertified plantings in 1947. Other factors, of course, may have caused part of the differences shown here.

Cost of Establishing Strawberry Plantings

The costs of establishing strawberries in 1947 on 68 new plantings averaged \$326.50 per acre (Table 22). On the usual basis of

Table 21. STRAWBERRIES (FOR PROCESSING): YIELD PER ACRE AND COST PER POUND; CERTIFIED AND NONCERTIFIED PLANTINGS, WILLAMETTE VALLEY, OREGON, 1947.

Item	Certified	Not certified
Number of farms reporting	15	23
Average age of plantings (years)	2.1	1.3
Pounds of berries produced per acre	3,617	2,762
Average cost per pound	14.1¢	17.0¢

Table 22. STRAWBERRY PLANTINGS: COST OF ESTABLISHING PER AVERAGE ACRE ON 68 FIELDS CONTAINING 498 ACRES, WILLAMETTE VALLEY, OREGON, 1947.

Item	Cost per acre	Percentage of cost
<i>Labor</i>		
Preparing ground (6.2 hours per acre)	\$ 6.06	1.9
Cover cropping (.5 hour per acre) .....	.48	.1
Fertilizing (1.9 hours per acre)	1.76	.5
Manuring (.3 hour per acre) .....	.28	.1
Planting (20.2 hours per acre)	17.06	5.2
Cultivating (13.7 hours per acre)	12.70	3.9
Hoeing (88.4 hours per acre)	73.16	22.4
Dusting (.3 hour per acre) .....	.23	.1
Baiting (3.4 hours per acre)	2.93	.9
Irrigating (.6 hour per acre) .....	.49	.2
Supervision and miscellaneous (13.6 hours per acre)	13.35	4.1
Total labor (149.1 hours per acre)	\$128.50	39.4
<i>Materials</i>		
Plants (5,575 per acre)	\$ 88.55	27.1
Cover crop seed	3.43	1.0
Fertilizer	12.28	3.8
Manure .....	.65	.2
Dust .....	.71	.2
Bait	3.27	1.0
Total materials	\$108.89	33.3
<i>General Expense</i>		
Horse work	\$ 1.84	.6
Building and irrigation upkeep	1.39	.4
Machinery repair	4.83	1.5
Gas and oil	5.64	1.7
Motor license and insurance	1.00	.3
Payroll insurance and office	1.47	.5
Electricity, fire insurance, water, wood	2.36	.7
Property taxes	4.95	1.5
Total general expense	\$ 23.48	7.2
<i>Depreciation on equipment</i>		
Machinery	\$ 7.60	2.4
Buildings and irrigation	4.01	1.2
Total depreciation	\$ 11.61	3.6
<i>Interest on investment</i>		
Machinery	\$ 3.13	.9
Buildings and irrigation	4.50	1.4
Land	13.37	4.1
Planting (cost amortized over three crop years)	33.02	10.1
Total interest	\$ 54.02	16.5
TOTAL COST	\$326.50	100.0
COST PER CROP YEAR (based on three-year life)	\$108.83	.....

keeping a planting for a period of three crop years, the cost including interest averaged \$108.83 per crop year. Labor and plants amounted to two-thirds of the total cost.

Labor

Man labor used per acre of strawberry plantings averaged 149 hours and \$128.50. This was nearly 40 per cent of the total costs. Hoeing represented about 60 per cent of the total hours of labor.

Materials

The cost of the strawberry plants was \$88.55 per acre or 27 per cent of the total cost of establishing. An average of 5,575 plants were set per acre and the prices paid for them averaged \$16.00 per thousand. Commercial fertilizers were used quite generally, averaging \$12.28 cost per acre for the entire acreage in the study.

General expense

Upkeep and miscellaneous items of cost amounted to \$23.48 per acre or 7.2 per cent of the total cost.

Depreciation

Depreciation on equipment averaged \$11.61 per acre or 3.6 per cent of the total cost.

Interest

Interest on the investment in the land was computed at 4 per cent over the period of time involved in establishing the planting. This always included the year the plants were set out, and in case of prior summer fallow practice where no cropping was done the extra year also was included.

Interest was charged at 5 per cent on the planting cost amortized over three crop years or a total period covering about 39 months from date of planting to the end of the third harvest season.

Variations in Cost of Establishing Strawberries

The cost of establishing strawberry plantings was 60 per cent higher on the group of 23 plantings (one-third of the total studied) with the highest cost than on the group of 23 plantings with the lowest costs (Table 23).

Which items of cost varied most? There was a difference of \$75 per acre in cost of hoeing; \$38 per acre in cost of plants; \$11 per acre in cost of preparing the ground and cultivating; and \$8 per acre in cost of fertilizing the land. Because of the higher input the high cost group also had more short-term interest cost than the low-cost group.

Table 23. STRAWBERRY PLANTINGS: VARIATIONS IN COST PER ACRE, BY OPERATIONS, ON THE LOW-COST AND THE HIGH-COST PLANTINGS, WILLAMETTE VALLEY, OREGON, 1947.

Item	Total study	Low-cost plantings	Your farm	High-cost plantings
Number of plantings studied	68	23	.....	23
Acres per planting	7.3	9.4	.....	6.3
Estimated value of land per acre	\$245	\$245	.....	\$272
<i>Cost per acre</i>				
Preparing ground	\$ 12.07	\$ 10.51	.....	\$ 15.33
Plants and planting	107.56	92.40	.....	130.77
Cultivating	18.31	16.16	.....	22.48
Hoing	73.15	41.55	.....	116.30
Cover cropping	4.30	5.24	.....	5.22
Fertilizing	15.96	13.32	.....	21.15
Dusting	1.02	.....	.....	1.13
Baiting	6.25	5.22	.....	5.25
Irrigating .....	.80	.....	.....	2.75
Miscellaneous equipment	1.29	1.35	.....	1.22
Supervision and miscellaneous labor	13.35	11.94	.....	15.28
Automobile and truck	7.70	7.22	.....	8.40
Buildings, electricity, fire insurance	11.93	11.20	.....	14.41
Pay roll insurance, office expense	1.47	1.05	.....	2.30
Property taxes	3.71	3.46	.....	4.10
Interest and taxes on summer-fallowed land	4.83	4.35	.....	6.59
Short-term interest (life of stand) at 5 per cent	33.02	26.42	.....	43.15
Interest on land investment at 4 per cent	9.78	9.81	.....	10.90
Total cost per acre	\$326.50	\$261.20	.....	\$426.73
Cost per crop year (3-year life) ¹ ..	\$108.83	\$ 87.07	.....	\$142.24

¹The cost of establishing strawberry plantings was prorated over three crop years, and interest was computed on the proportionate (annual) amounts to be recovered over a period of 39 months (approximately from date of planting to respective dates the berries would be sold).

Eight out of the 23 growers comprising the high-cost group had the extra cost of a summer-fallow year preceding the year of planting the strawberries, compared with only 4 out of the low-cost group.

Preparing the ground

Nineteen of the 68 growers in the study took the year prior to setting out the strawberry planting for growing a green-manure crop (Table 24).

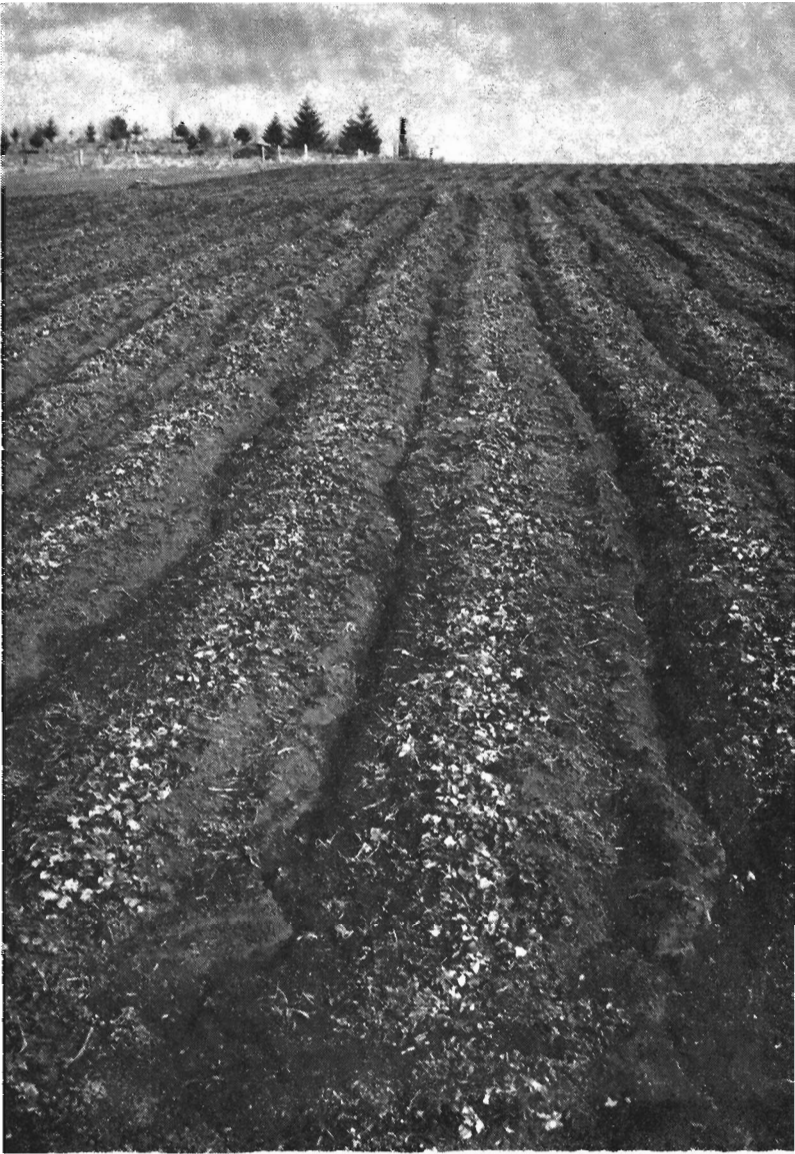
Table 24. STRAWBERRY PLANTINGS: EFFECT OF SUMMER FALLOWING BEFORE PLANTING ON THE COST OF SPECIFIED OPERATIONS, WILLAMETTE VALLEY, OREGON, 1947.

Item	Plantings with summer fallow	Plantings without summer fallow
Number of plantings	19	49
Cost per acre for:		
Preparing ground	\$ 15.25	\$ 10.58
Cover cropping	9.81	1.70
Hoeing	58.69	79.98
Interest and taxes on summer fallowed land	15.07	.....
Other expense items	246.28	225.47
Total cost per acre	\$345.10	\$317.73

On these 19 farms a seed mixture, such as vetch and oats, was sown in the fall on a well-prepared seedbed. This crop was plowed under late in the spring after attaining a heavy growth. Then the land was summer fallowed to kill weeds. Again in the fall a similar cover crop was sown. This cover crop, however, was turned under rather early in the spring in order to prepare the ground and set the berry plants as early as possible.

The latter cover-cropping practice was found also among growers who had not devoted an entire crop year to building up of soil productivity. Obviously the accumulation of organic matter under these circumstances is rather limited because of the necessity for turning the crop under early in the spring. Usually the best results are obtained if the cover crop is sown early in the fall on a well-prepared seedbed and liberally fertilized with suitable commercial fertilizers. County agents can recommend best procedures in the various areas.

Growers recognize the importance of the cover crop in reducing erosion (Figure 4) and leaching of soil fertility as well as its function of storing sufficient plant food and moisture to assure the profitable production of three or more successive crops of strawberries. Some growers have adopted a cropping plan in which they follow the last year of the strawberry stand with a hay or grain crop. Then they take *two* years for green manure crops, followed by a fall cover crop prior to the spring the berries are set. In some areas, because of the disease situation, authorities believe that a period not less than five years should elapse between successive plantings of strawberries.



—Photograph courtesy of U. S. Department of Agriculture Soil Conservation Service

Figure 4. Erosion loss was approximately 50 tons per acre in this strawberry field (Class IV land) cultivated up and down the slope. The soils of the Willamette Valley are quite erosion-resistant due to their heavy texture and cohesion qualities. In spite of these favorable soil characteristics, accelerated erosion will frequently occur where land-use practices are not consistent with the needs of the land.

Spacing

The width of rows varied from 30 inches in one planting to 60 inches in another instance. On about two-thirds of the strawberry plantings the rows were spaced 42 inches apart. Second in popularity was the 40-inch spacing, followed closely by the 36-inch width.

The spacing of plants in the row also varied greatly, ranging from 12 up to 42 inches. The plantings were grouped quite evenly, however, at 16 to 18 inches, 30, 36, and 42 inches apart, respectively. Practically all the growers in the study used the matted row system. Therefore those who had sufficient plants generally preferred to plant closely in order to develop the maximum growth during the first year. Others preferred to economize on the number of plants used, or they preferred to cultivate crossways for a time in order to reduce the expense of hand weeding.

Plants and planting

Nearly two-thirds of the 68 strawberry plantings in this study were planted by hand (Table 25). Machine planting effected a considerable saving in man labor required and some reduction in the total cost of planting. The combined difference, however, was more than offset by the cost for the larger number of plants set on the machine-planted fields.

Approximately 22 per cent more plants per acre were set by growers using mechanical planters. Part of this difference was due

Table 25. STRAWBERRY PLANTINGS: COSTS OF PLANTING BY HAND AND MACHINE METHODS, WILLAMETTE VALLEY, OREGON, 1947.

Item	Method of planting	
	Hand	Machine
Number of plantings	43	25
Acres per planting	6.1	9.3
Plants set per acre	4,852	5,935
Estimated percentage of plants which lived	90	89
<i>Planting time per acre</i>		
Tractor hours .....	.4 ¹	2.6
Man hours planting	24.8	10.4
Man hours replanting	2.5	1.8
<i>Cost of planting per acre</i>		
Labor and equipment use	\$ 23.29	\$ 14.15
Plants	80.22	97.98
Total cost of planting	\$103.51	\$112.13

¹ Marking the rows for planting. In addition to this tractor work, the horse work for marking averaged half an hour per acre.

to the fact that some growers either could not get sufficient plants or they deliberately spaced them farther apart as an economy measure. They expected to obtain the necessary stand from the subsequent growth of runners. According to the opinions expressed by the growers on the results obtained from using the respective methods of setting plants, there was practically no difference in the percentage of stand achieved.

The producer of strawberries for processing has, of course, practically no choice in the matter of varieties beyond that permitted by the processors. Nearly the entire acreage in this study was planted with the Marshall strawberry. Marshall is a superior variety in its fruit qualities but is susceptible to certain diseases. Information on best varieties and on other cultural problems may be found in Station Bulletin 442, *Strawberry Production in Oregon*.

Growers generally recognize the advisability of obtaining certified plants. Some growers were disappointed in the stock they received. Perhaps there had been severe deterioration in the shipment between the time of digging the plants and setting them. Some growers were intent on setting out the plants despite the fact that weather and soil conditions were unfavorable at the time.

One grower, who reset 12,000 plants in the fall on 7.5 acres of strawberries originally planted, estimated that poor plants cost him \$2,000 in labor and in loss of production the following year.

Bearing life of strawberry plantings

It was almost the universal practice among the growers in this study to plow up their strawberries after the third crop had been harvested. A few growers were planning to take off only two crops hereafter. Some growers have left plantings for the fourth crop, but generally have had disappointing results.

If berry diseases, injurious insects, weeds, and other pests could be eliminated or effectively controlled, and if adequate soil fertility could be maintained, then the productive life of a strawberry planting should extend beyond the usual three years, and thus the annual charge for cost of establishing would be reduced accordingly.

Estimated Costs and Returns Prior to 1947

During the eight-year period from 1936 to 1943, strawberries returned a profit only in 1937 (Table 26). During the following five-year period every year was profitable for strawberry growers in Oregon as a whole.

By applying official government indexes of Oregon farm wages and of "prices paid by farmers for commodities, interest and taxes"

Table 26. STRAWBERRIES: ESTIMATED COST, AND THE SEASONAL AVERAGE PRICE IN OREGON¹

Year	Yield per acre ²	Estimated cost per acre				Cost per pound	Price per pound ³	Per cent price is of cost
		Labor ³		Other costs ⁴	Total costs			
		Harvest	Other					
	<i>Pounds</i>					<i>Cents</i>	<i>Cents</i>	<i>Per cent</i>
1936	3,025	\$ 48	\$ 31	\$111	\$190	6.2	5.4	87
1937	2,700	49	33	117	199	7.3	10.3	141
1938	2,700	49	33	111	193	7.1	6.1	86
1939	2,880	52	33	109	194	6.7	5.3	79
1940	3,456	62	34	109	205	5.9	4.8	81
1941	3,600	76	40	115	231	6.4	5.6	88
1942	3,240	100	57	131	288	8.8	8.5	96
1943	2,016	93	87	141	321	15.9	13.9	87
1944	3,057	165	100	149	414	13.5	18.5	137
1945	2,880	164	107	151	422	14.6	18.4	126
1946	3,638	211	108	169	488	13.4	28.0	209
1947	3,529	215	114	202	531	15.1	17.6	116
1948	3,960	257	121	218	596	15.0	20.4	136
Average	3,129	.....	.....	.....	.....	10.5	12.5	119

¹The estimated costs of production for the period 1936-1948 are based on cost data for the year 1947 from 99 plantings in the Willamette Valley.

²The annual yields were computed from the estimates made by the Crop Reporting Service of the U. S. Department of Agriculture on the production and harvested acreages in Oregon over the 13-year period of 1936-48 excepting the yield in 1947 which was the average production obtained from the 99 plantings studied. The estimated production in Oregon for 1947 was 3,024 pounds per acre.

³The average cost of \$215 per acre (6.1¢ per pound) for harvesting the 1947 crop of 3,529 pounds per acre, and other labor costs of \$114 per acre were taken as 100 in computing the indexes used in estimating costs for other years. The cost of harvesting was calculated for each year on the basis of the average yield per acre. (The indexes of labor costs were computed from Oregon farm labor reports issued quarterly by the Bureau of Agricultural Economics, U. S. Department of Agriculture.)

"Other costs," which include all costs other than labor, averaged \$202 per acre for 1947. This figure was taken as 100 in computing the indexes used in calculating estimated cost for other years. (The indexes of cost for items other than labor are based on the indexes of "prices paid by farmers for commodities, interest, and taxes," with the index for 1947 taken as 100. Source: *The Agricultural Situation*, Bureau of Agricultural Economics, U. S. Department of Agriculture, June 1949.)

⁴Prepared cooperatively by the Oregon State College Extension Service, Agricultural Economics Section, and the Division of Agricultural Statistics, Bureau of Agricultural Economics, U. S. Department of Agriculture.

to the respective 1947 cost data adjusted for annual variations in yield, it is possible to estimate the probable costs of production during the entire period from 1936 to 1948.

The annual yields in Oregon for the 13-year period averaged 3,129 pounds per acre. The estimated costs averaged 10.5¢ per pound, varying from 5.9¢ in 1940 with a yield of 3,456 pounds per acre to 15.9¢ per pound in 1943 with a yield of only 2,016 pounds.

The price of strawberries averaged 12.5¢ during this entire period, or 19 per cent more than the estimated cost. In only six of the 13 years did the price exceed the estimated cost of production. These estimates indicate the extent to which the fluctuations in yield affected the cost and the price of strawberries over the period from 1936 to 1948, inclusive.

CONCLUSIONS

Do growers generally continue with the strawberry enterprise despite the unprofitable years? Many, of course, have had better-than-average results over a period of years. Others, obviously, have had little or no return from their investment, and only small returns for the use of their equipment and labor.

One grower underscored his convictions that *growers must produce quality products in order to enable packers to market them under their high-grade brands*. Quality is the result of having desirable varieties, favorable soil and climatic conditions, and proper management including the control of diseases and insect pests.

In order to reduce the risk of failure, a grower should select well-drained land as free as possible of pests, diseases, and weeds; improve the soil productivity by use of green manure crops and commercial fertilizers before berries are planted; set only high-quality plants adapted to his conditions; and follow approved practices in all phases of management.

When the berry enterprise is only part of a diversified farm business, the operator is less dependent on it for his total income. He looks forward hopefully to future prospects of good yields and satisfactory prices rather than to the prospect of changing to some other enterprise. Berry farming is a fairly long-term undertaking. The grower should strive for efficiency by improving the yield and quality of his product, thereby reducing his cost per pound and assuring himself the best price for his crop. Rigid adherence to this policy will enable him to compete advantageously with other growers.

Good farm-management practice suggests that specialization is not advisable for most farmers. The strawberry enterprise lends itself to a crop-rotation plan and thus fits into the livestock-production program on those farms with sufficient acreage and equipment to justify diversification. The farmer who has a diversified production

program is able to employ his farm machinery, power equipment, and his own and family labor more advantageously over the entire year than the specialized farmer with a one-crop system.

When adverse conditions arise in the strawberry enterprise, moreover, the diversified farmer with a relatively small acreage in strawberries along with some other enterprises may be able to re-trench more effectively with regard to cash expenditures. These include labor, because his family is able to substitute in a large part for the hired labor ordinarily employed.

The large-scale operator, on the other hand, is much more concerned about the necessity of obtaining good yields and high prices. He may be largely, if not entirely, dependent on his receipts from strawberries to pay 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. If he has no other resource to draw upon until the next crop is harvested, the financing of future operations following a disastrous year or two is often difficult for him and sometimes impossible.

The findings in this study, by pointing out the importance of good yields of high-quality berries 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. The chief variable in the cost of producing strawberries would be the labor factor. Any difference in the cost of production, therefore, would be due largely to changes in the wage rates for labor.

APPENDIX

METHODS USED IN OBTAINING, COMPILING, AND ANALYZING THE DATA

The data for this study were collected by the survey method. Each cooperating grower was visited at the end of the year for the purpose of obtaining a complete business record on the bearing strawberry 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. Sufficient time was spent with each grower to work out thoroughly all the facts pertaining to the year's operations. A comparable record was also obtained on the costs of establishing strawberries.

Joint costs

Those farm expenses that were incurred only in part for the strawberry enterprise were charged to the strawberries in proportion to the benefit received. The investment in machinery and buildings used jointly was likewise apportioned according to use.

Rent

A few growers rented land, buildings, or equipment. The renter was treated as an owner and was charged interest, taxes, and depreciation in lieu of rent, in order to make all farms comparable on an investment basis.

Labor

A very complete form was used to compile the various labor operations performed in strawberry production. Although the *total* yearly labor on an enterprise is an indefinite figure in the minds of many farmers, the grower can be quite definite about the labor required for each individual operation. The enumerator recorded for each operation the farmer's estimate of the work done by himself, members of his family, and by hired labor. As most of the estimates were on an hour basis, the wage rates were also expressed on the hourly basis, including the value of any board furnished. The wage rate for family labor was gauged by wages paid to hired labor for comparable work.

In addition to the time that the farmer spends at specified jobs, he generally puts in considerable time that should be charged as overhead against his enterprises. Each cooperator was asked to apportion his total year's time among his enterprises. From his esti-

mate for the strawberry enterprise, the actual time he had spent on the direct work was deducted, and the remainder was then entered as supervision and miscellaneous work.

Contract labor

Expenditures for contract work were divided between wages for the man labor involved and rental value of the equipment furnished.

Interest

The present investment or inventory value of plantings and equipment was estimated, and interest was charged uniformly at 5 per cent. Interest on the value of the land was 4 per cent.

Depreciation

Depreciation on buildings and equipment was obtained by dividing the present (depreciated) value by the remaining years of usefulness. Depreciation on the strawberry planting was prorated over three crop years.

Machinery operation cost

Interest and depreciation on machinery were computed separately from daily operation costs. Total machinery cost, therefore, may be obtained by adding the operating costs, interest, and depreciation.