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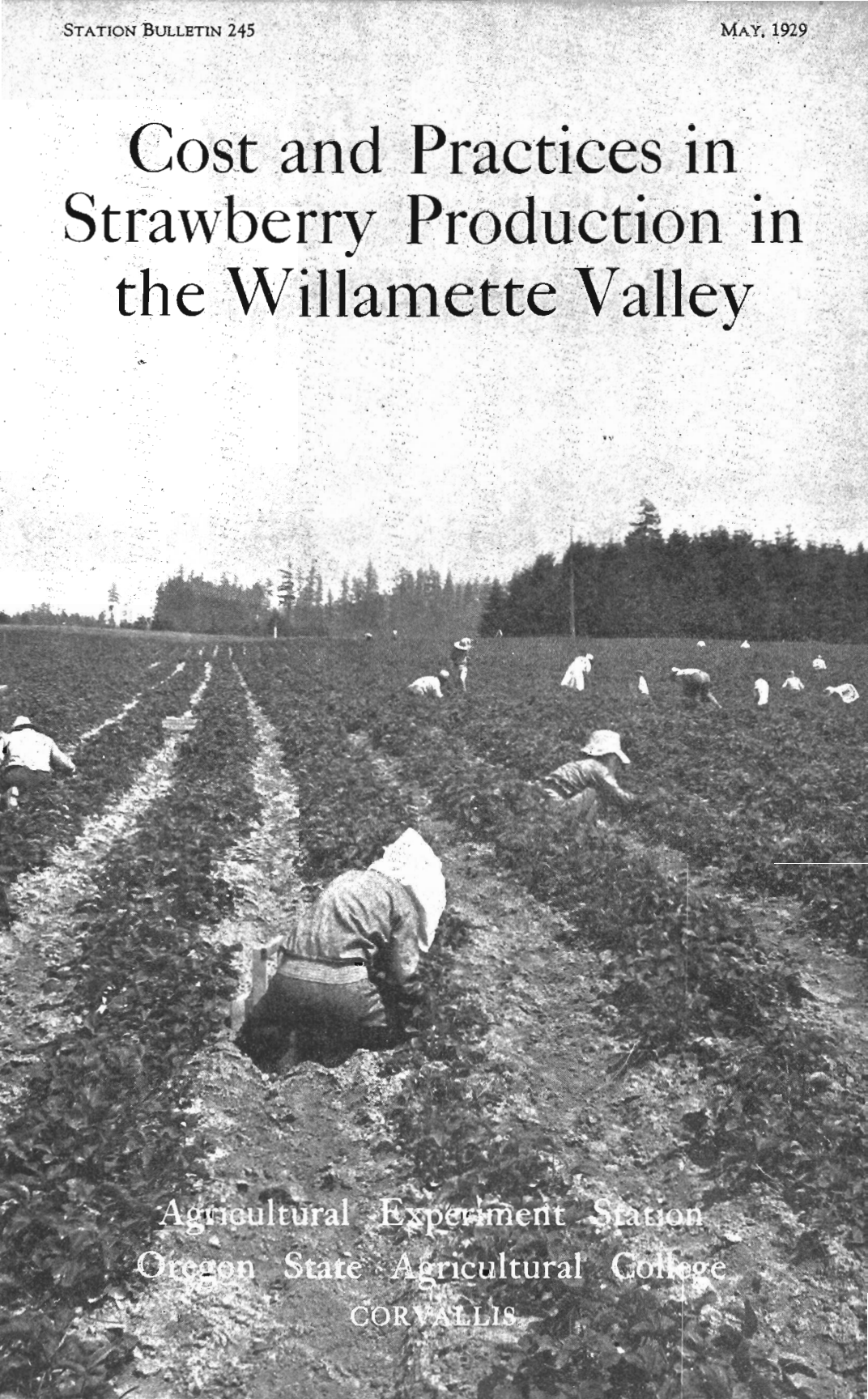
# Cost and Practices in Strawberry Production in the Willamette Valley



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**THE AVERAGE COST** of producing strawberries in the Willamette Valley is 5.87 cents per pound.

Heavy yields and the efficient use of labor are the most important factors affecting the cost of producing strawberries.

It costs $79.28 per acre to establish a strawberry planting.

Many strawberry farms appeared to need a larger volume or greater diversity of business.

Fig. 1. Flat land on which Ettersburg 121 thrives.

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## SUMMARY

### The situation and objective

1. The Willamette Valley has natural advantages for profitable strawberry production but competition with other states is keen.

2. The future of the enterprise depends largely on whether the Oregon grower can capitalize his natural advantages in a lower cost of production.

3. The purpose of this study is to determine the cost of production of strawberries in the Willamette Valley and the factors and practices permitting reduction of cost.

4. The results reported were obtained from 121 field survey records covering the costs and practices on 85 different farms, with a total of 633 acres of bearing crop producing 1,001 tons of fruit, during the two years 1925 and 1926.

### The cost of production

5. The capital investment required is small—$1,423 per farm for the average bearing patch of about 5 acres, or $273 per acre. The land investment of $247 per acre is 90 percent of the total investment in the enterprise.

6. The average cost of production for the two years, 1925 and 1926 combined, was $191 per acre, $117 per ton, or 5.87c per pound. Man labor constituted 71 percent of the total cost.
The operating cost (cost exclusive of interest on the investment) was $178 per acre or 5.4c per pound.

7. The cash cost was $95 per acre or 2.9c per pound, just 50 percent of the total cost. The chief item of cash cost was 1.8c per pound for picking.

8. There are wide variations in cost on the individual farms—
   27 percent of the acreage had an average cost of 4.4c per pound.
   32 percent of the acreage had an average cost of 5.6c per pound.
   31 percent of the acreage had an average cost of 7.0c per pound.
   10 percent of the acreage had an average cost of 10.6c per pound.
   At the average price received, 8c per pound, the first group made a handsome profit, the second a good profit, the third a fair profit, and the last did not receive even good wages for the operators' own labor. On a price basis of 6c only the first two groups would have made a profit above labor and investment costs.

### Factors influencing cost

9. Yield per acre is a dominant factor in cost, accounting for a difference of approximately 4c per pound between the low-yield and high-yield groups.

10. Soil fertility is a dominant factor in yield per acre. The effect of the use of fertilizers, however, was not clearly indicated.

11. The variety used had a marked effect on yields and profits. Ettersburg 121 as a canning berry and Marshall (or Oregon) as a barreling berry appeared the most profitable for common use at the present time. Ettersburg 121 is not successful, however, on sandy or hill soils.

12. Excessive cultivation is not warranted unless the price of berries is high. Clean ground for planting and timely cultivation, both early and late in the season, are more profitable than excessive cultivation. Horse cultivation materially reduces cost.

13. Increasing the size of the planting considerably reduced the man labor per acre required and the cost per pound.

14. About 5,000 plants per acre planted three feet by three feet seemed a satisfactory standard for planting.

15. Cost per pound was highest on the high-priced farm lands close to towns where location value of the land had a marked influence.

16. Labor requirements per acre and per operation are given in full. Marked variations in labor efficiency are shown.

    Cultivation uses 10 percent of all man labor.

    One hoeing requires as much man labor as seven horse cultivations.

    Harvesting requires 85 percent of all man labor, and of this 89 percent is for picking.

    Costs for hired hauling of berries to market are sometimes excessive.

17. Combating root-weevil and crown-borer is of vital importance. Poison bait has proved successful for the common or small root-weevil.

## Cost and factors in planting strawberries

18. The average cost of establishing a strawberry planting was found to be $79.28 per acre. Of this 58 percent was for labor and 22 percent for plants.

19. The cash cost of establishing a planting was $33 per acre, which is 42 percent of the total cost of planting.

20. The wide variation in cost of planting shown indicates opportunity for reduction of this cost by—

    More efficient use of man labor

    Larger size of plantings

    Less costly land.

21. Labor requirements per acre and for each operation are shown in full.

## Possible improvements in the farm organization

22. Marked improvements in the general organization of many of the farms studied seemed possible. The factors that appeared most frequently in need of attention and adjustment were: (1) diversity of business, (2) volume of business, (3) yield or quality of production, (4) crop rotation. Suggestions for better organization of the strawberry-producing farms, along these lines, are given.

# Costs and Practices in Strawberry Production in the Willamette Valley, Oregon

By

C. E. SCHUSTER and A. S. BURRIER

## THE SITUATION AND THE OBJECTIVE

The Willamette Valley has certain natural advantages for strawberry production—a long mild growing season, very little rain at picking time, and good berry soils at comparatively low prices per acre. The successful development and establishment of the cold pack or barreling method of processing the berries, together with the increasing availability of canneries, have opened nation-wide markets for the product.

For these reasons Oregon production has increased rapidly in recent years and the question has arisen as to how far the enterprise can safely be enlarged.

Since an adequate outlet for barreled and cannery berries is found only in national markets, Oregon processed berries must compete with those from many other states. Commercial strawberry production is common to many states and is increasing throughout the United States as well as in Oregon. Many of these states, also, are closer to the large markets.

The future success of the enterprise in Oregon and the extent to which it may be safely increased, therefore, seem dependent to a considerable degree on whether the Oregon grower can capitalize his natural advantages in a lower cost of production. In the long run, competition with other regions can be met only by a lower cost of production for goods of equal quality or by a product of superior quality at the same cost of production.

### PURPOSE OF THE STUDY

The purpose of the study reported herein, is therefore: (1) to determine the cost of producing strawberries in the area, and (2) to determine the effect of various factors and practices on cost and efficiency in strawberry production and the means of reducing cost thereby.

### STRAWBERRY GROWING IN THE UNITED STATES AND IN OREGON

Commercial strawberry growing is listed in Federal reports as important in twenty-seven states. In 1927 the United States had a total of 188,130 acres producing 342,284,000 quarts of strawberries, while Oregon had 8,420 acres producing 23,231,000 quarts, or 4.5 percent of the total United States acreage and 6.8 percent of the total production (see Table I).

TABLE I—STRAWBERRY ACREAGE AND PRODUCTION BY STATES FOR 1927* AND CANNERY PACK BY STATES FOR 1919†

| State | Acreage 1927 | Production 1927 | Percentage of total production | Cannery pack 1919 | Percentage of total cannery pack |
|---|---|---|---|---|---|
| | *acres* | *qts.* | *%* | *cases* | *%* |
| Washington | 7,670 | 29,829,000 | 8.7 | 25,426 | 6.8 |
| Maryland | 12,780 | 28,666,000 | 8.4 | 75,215 | 20.1 |
| Tennessee | 14,960 | 26,479,000 | 7.7 | not given | ..... |
| Missouri | 27,340 | 26,082,000 | 7.6 | not given | ..... |
| OREGON | 8,420 | 23,231,000 | 6.8 | 21,107 | 5.6 |
| Virginia | 9,420 | 22,796,000 | 6.7 | ..... | ..... |
| Arkansas | 17,590 | 20,651,000 | 6.0 | not given | ..... |
| California | 3,750 | 18,083,000 | 5.3 | 21,414 | 5.7 |
| Louisiana | 21,100 | 16,711,000 | 4.9 | 43,063 | 11.5 |
| North Carolina | 5,800 | 16,657,000 | 4.9 | not given | ..... |
| New Jersey | 6,600 | 14,784,000 | 4.3 | 19,717 | 5.3 |
| New York | 4,570 | 13,308,000 | 3.9 | 32,089 | 8.6 |
| Michigan | 6,480 | 12,843,000 | 3.7 | 87,892 | 23.5 |
| Kentucky | 6,740 | 10,932,000 | 3.2 | not given | ..... |
| Delaware | 4,000 | 9,600,000 | 2.8 | not given | ..... |
| Alabama | 4,520 | 7,924,000 | 2.3 | not given | ..... |
| Florida | 3,680 | 6,900,000 | 2.0 | not given | ..... |
| Ohio | 3,780 | 5,795,000 | 1.7 | not given | ..... |
| Illinois | 4,280 | 3,595,000 | 1.1 | not given | ..... |
| Other states | 14,650 | 27,418,000 | 8.0 | 48,174 | 12.9 |
| Total for the United States | 188,130 | 342,284,000 | 100.0 | 374,097 | 100.0 |

* From 1927 Year-book of Agriculture, p. 859.
† From 1920 United States Census, Volume X, p. 79.

Six states—Missouri, Louisiana, Arkansas, Tennessee, Maryland, and Virginia, the leaders in strawberry acreage—had 55 percent of the total United States acreage, while Washington, Maryland, Tennessee, Missouri, Oregon, and Virginia, in the order named, were the leaders in production.

Production increased in the United States from 145,060 acres in 1925 to 202,580 acres in 1928 and in Oregon from 5,930 acres to 10,000 acres.

**Fresh fruit.** The commercial acreage in the United States is largely devoted to strawberries for the fresh trade. In 1926, 13,528 car-loads of fresh strawberries were shipped, of which only 39 car-loads originated in Oregon, chiefly from the Hood River Valley. Excellent berries for fresh shipment can be produced in Oregon, but heavy transportation charges to distant markets justify only a limited acreage sufficient to supply the nearer western markets with the fresh fruit.

**The canned strawberry.** Commercial canning of strawberries is widely distributed throughout the United States (see Table I). Commercial canning in Oregon has greatly increased in recent years, from 21,107 cases in 1919 to 270,314 cases in 1927.

**The barreled strawberry.** The cold pack or freezing of fresh strawberries in barrels has developed rapidly in recent years, 30,000 barrels being processed in Oregon in 1927. In this process a different type or variety of berry is used from that grown for the canning or fresh ship-

ment. The fresh berries are put with sugar directly into barrels and in containers or cartons of smaller sizes, placed in cold storage and kept at low temperatures until used. This product is used by preserving plants, bakeries, confectioneries, soda fountains, etc., where the berry in as nearly a fresh state as possible is desired. The smaller cartons are being used in increasing amounts by the householder as the public becomes familiar with the frozen berry. Half a million one-pound cartons alone were packed in Oregon and Washington in 1928.

**Importance of the enterprise in Oregon.** As yet (1927) the whole commercial strawberry crop of Oregon constitutes but 5.6 percent of the total acreage of commercial fruit in the state and but 12.5 percent of the total value of such fruit. Because of its adaptability as an additional enterprise on many different types of farms, and the natural conditions favoring its success, the strawberry promises to become increasingly important in Oregon agriculture.

In 1925, 77 percent of the Oregon strawberry acreage was found in the Willamette Valley counties, the three leaders in acreage being Marion, Clackamas, and Washington counties.

## METHOD OF STUDY

The field-survey method of study was used to obtain the data reported herein. Cooperating growers were interviewed in person and a record of the year's operation on the strawberry enterprise was taken in considerable detail.

In selecting the farms to be studied, care was taken to obtain a fair sample of the whole enterprise. Records were obtained from farms of all degrees of success in the enterprise, representative of Willamette Valley strawberry growing as to locations, soils, varieties, size of acreage, etc. Only growers having several years of experience were included in the study.

For the 1925 crop, records were from 48 commercial growers having 198 acres of bearing strawberries producing 349 tons. For the 1926 crop, records were taken from 73 farms (including 36 of the 1925 farms) having a total of 435 acres of strawberries producing 652 tons. The two years combined supplied 121 records covering the cost of production on 85 different farms, or a total of 633 acres of strawberries producing 1,001 tons of fruit.

This constitutes a satisfactory preliminary study of the cost phase of the enterprise. A more complete combined farm organization and cost study may be required when the enterprise becomes more fully established and stabilized.

## TYPES AND LOCATION OF FARMS STUDIED

Table II is descriptive of the field crop and berry acreage of the farms studied. Farms of 20 to 40 acres and of 40 to 80 acres with an average of 4 acres of bearing strawberries per farm were the most common. Nearly all of the farms studied were diversified, having several other enterprises in addition to the strawberries.

The farms studied were located in the more important strawberry-growing sections of the Valley representative of commercial production. Table III indicates the approximate location of these farms.

TABLE II—SIZE OF FARM, ACRES OF CROP LAND, AND OF STRAWBERRIES
(Combined averages for 1925 and 1926)

| Size of farm | Number of records | Average size of farm | Crop land | Bearing strawberries | Non-bearing strawberries | Percentage of crop land in bearing strawberries |
|---|---|---|---|---|---|---|
| | | *acres* | *acres* | *acres* | *acres* | % |
| 10 acres and below | 12 | 8 | 7 | 2.2 | .8 | 30 |
| 10 to 20 acres | 16 | 16 | 12 | 3.4 | 2.0 | 28 |
| 20 to 40 acres | 38 | 30 | 24 | 4.0 | 2.0 | 16 |
| 40 to 80 acres | 33 | 59 | 40 | 3.9 | 3.2 | 10 |
| More than 80 acres | 22 | 159 | 85 | 12.3 | 8.4 | 14 |
| **Total and average** | ***121** | **58** | **36** | **5.1** | **3.3** | **14** |

* There were 85 farms in the study. Of these 36 were studied in both 1925 and 1926.

TABLE III—LOCATION OF FARMS COOPERATING, 1925 AND 1926

| Section | Number of records | Location |
|---|---|---|
| Hubbard, Woodburn | 45 | Northwest Marion county |
| Silverton | 11 | North Central Marion county |
| Gresham | 15 | Eastern Multnomah and Clackamas |
| Lacomb, Lebanon | 16 | Northeast Linn county |
| Falls City | 5 | Western Polk county |
| Salem, Macleay | 27 | Central Marion and East Polk |
| Hillsboro | 2 | Central Washington county |

## SOILS AND VARIETIES

The chief types of soil, both for upland and lowland plantings, were covered in this study, the elevation above sea-level ranging from about 200 feet on the Valley floor and bottom-lands to as high as 1,800 feet on the uplands.

Varieties of strawberries included in the study are indicated in Table IV. A sufficient number of plantings of each of the varieties most commonly grown, Ettersburg 121, Marshall, Oregon, and Wilson were included, in order to give satisfactory comparisons.

For further discussion of soils and of varieties see page 22.

TABLE IV—VARIETIES AND ACREAGE STUDIED, 1925 AND 1926

| Variety | Number of records | Total acreage bearing | Percentage of total bearing acreage |
|---|---|---|---|
| | | *acres* | % |
| Ettersburg 121 | 65 | 183.9 | 29.0 |
| Marshall or Oregon | 50 | 217.8 | 34.4 |
| Wilson | 23 | 108.5 | 17.1 |
| Trebla | 10 | 16.8 | 2.7 |
| Gold Dollar | 1 | 2.5 | .4 |
| Ettersburg 80 | 5 | 3.9 | .6 |
| Johnson | 2 | 2.5 | .4 |
| Unclassified * | 16 | 97.5 | 15.4 |

* Some growers (16) were unable to give the acreage of each variety of strawberry grown but were able to give the total acres in the bearing patch. These acreages were entered as unclassified.

## CAPITAL REQUIREMENTS FOR STRAWBERRY GROWING

Strawberries do not require a heavy outlay of capital. They are generally associated with other farm enterprises and usually the same equipment will serve all. On a general farm, an additional outlay of about $80 for each acre of berries will usually enable any one to begin the strawberry enterprise. (See page 35.) This outlay covers the costs of labor and other expense of establishing the planting and erection of picking or receiving sheds, pickers' camp accommodations, etc. Most of the equipment required for operating the enterprise is already found on the farm and a portion of its use is merely transferred to the strawberry enterprise. Since a considerable part of the outlay of $80 per acre mentioned will be for the cost of the operator's own labor the cash outlay will be usually only about half of this amount.

The entire capital investment represented in the strawberry enterprise is shown in Table V.

TABLE V—THE BEARING STRAWBERRY INVESTMENT, 1925 AND 1926

| Investment item (Against bearing berries only) | Average investment per farm | Average investment per acre | Percentage of total investment |
|---|---|---|---|
| | | | % |
| Bearing berry land (ave. 5.1 a.) | $1,302.23 | $ 247.19 | 90.4 |
| Buildings (exclusive of dwelling) | 8.79 | 1.80 | .7 |
| Work stock, and feed | 63.55 | 14.04 | 5.1 |
| Machinery and equipment | 48.56 | 10.52 | 3.8 |
| **Total investment** | **$1,423.13** | **$ 273.55** | **100.0** |

The land used represents 90 percent of the total investment per acre. The average value of this land was $247 per acre. Growers as a whole believe that bearing berry land is worth on the market about $100 per acre more than crop land of like value, while the investigation revealed that the actual cost of establishing a strawberry planting averaged approximately $79 per acre (see Table XIX).

The total investment per farm in the average strawberry enterprise of 5 acres in bearing was a little more than $1,400 (see Table V).

## THE COST OF PRODUCING STRAWBERRIES

The cost of producing strawberries in the Willamette Valley over a period of two years, the 1925 and 1926 seasons combined, averaged $191.37 per acre, $117.44 per ton, or 5.87c per pound. The costs for the two years were almost identical, $116.35 per ton in 1925 and $118.53 per ton in 1926; hence the combined cost for the two years, as shown in full in Table VI, is representative.

Since there are those who object to a charge for interest on investment being included in costs, this item has been kept separate so that operating costs alone may be used by those who prefer that figure. The operating cost (total cost exclusive of interest on investment) was $177.70 per acre, $108.89 per ton, or 5.4c per pound.

TABLE VI—STRAWBERRY COST SUMMARY, 1925 AND 1926

Combined average for two years' crops covering a total of 121 records, 633.33 acres of bearing berries producing 1,001.6 tons of berries, at an average yield of 3,262 pounds per acre.

| Items | Cost per acre | Cost per ton | Cost per pound | Percentage of total cost |
|---|---|---|---|---|
| LABOR | | | | % |
| Hired labor | $ 12.82 | $ 7.92 | ..... | 6.7 |
| Board of hired labor | .50 | .30 | ..... | .3 |
| Contract labor | 60.80 | 37.20 | ..... | 31.8 |
| Operator's direct labor † | 34.14 | 20.98 | ..... | 17.8 |
| Operator's indirect labor | 27.84 | 16.80 | ..... | 14.5 |
| Total man labor | 136.10 | 83.20 | ..... | 71.1 |
| Hired horse labor | .17 | .09 | ..... | .1 |
| Farm horse labor (feed cost) | 4.81 | 2.97 | ..... | 2.5 |
| Total horse labor | 4.98 | 3.06 | ..... | 2.6 |
| Total labor | 141.08 | 86.26 | 4.3c | 73.7 |
| MATERIALS | | | | |
| Fertilizer | 2.34 | 1.48 | ..... | 1.2 |
| Crates and hallocks | 2.17 | 1.32 | ..... | 1.1 |
| Weevil poison | .22 | .14 | ..... | .1 |
| Carriers | .10 | .06 | ..... | .1 |
| Total materials | 4.83 | 3.00 | ..... | 2.5 |
| MACHINERY ‡ | | | | |
| Truck | 1.96 | 1.18 | ..... | 1.0 |
| Auto | 1.56 | 1.00 | ..... | .8 |
| General machine repair | .14 | .09 | ..... | .1 |
| Machinery rent | .10 | .06 | ..... | .1 |
| Total machinery | 3.76 | 2.33 | ..... | 2.0 |
| GENERAL | | | | |
| Telephone | .28 | .17 | ..... | .2 |
| Miscellaneous | .24 | .15 | ..... | .1 |
| Taxes | 2.59 | 1.59 | ..... | 1.3 |
| Total general | 3.11 | 1.91 | ..... | 1.6 |
| DEPRECIATION | | | | |
| Buildings | .18 | .11 | ..... | .1 |
| Work stock | 1.09 | .65 | ..... | .6 |
| Machinery and equipment | 1.57 | .93 | ..... | .8 |
| Bearing berry stand | 22.08 | 13.70 | ..... | 11.5 |
| Total depreciation | 24.92 | 15.39 | ..... | 13.0 |
| Total operating expense | 177.70 | 108.89 | 5.4c | 92.8 |
| INTEREST ON INVESTMENT | | | | |
| Bearing berry land | 12.36 | 7.78 | ..... | 6.5 |
| Buildings | .08 | .05 | ..... | * ..... |
| Work stock | .36 | .21 | ..... | .2 |
| Machinery and equipment | .53 | .31 | ..... | .3 |
| Horse feed | .34 | .20 | ..... | .2 |
| Total interest | 13.67 | 8.55 | ..... | 7.2 |
| **Total cost** | **$191.37** | **$117.44** | **5.87c** | **100.0** |

* Less than .1 percent.
† Includes family labor.
‡ Exclusive of interest and depreciation.

NOTE: Many growers are accustomed to think of cost in terms of cash outlay only, and do not consider other items of cost. It is shown in the discussion on page 18 that only 50 percent of the total cost given above, is cash or out-of-pocket cost.

## EXPLANATION OF COST ITEMS IN TABLE VI

Hired labor includes all expenditure for labor hired on the day, hour, or month basis. Board was charged at cost to the farmer.

Contract labor is chiefly that hired for picking, but other services contracted at a set price per unit were also included in this item.

Operator's and family direct labor includes all unpaid labor performed by the operator or unpaid members of his family. The charge for this labor was made at current wages averaging 32½c per hour. The operator's wage is on a monthly basis for a 10-hour day and averaged 34c per hour. The family wage is on an hour basis and averaged 24c per hour.

Operator's overhead labor covers all time chargeable to the bearing strawberries that is not accounted for in the direct labor. Each operator made a careful estimate of the percentage of the year's time that should be charged to the bearing strawberries, as compared to the other income-producing farm enterprises. While this method may seem somewhat crude, there appears to be no other practical method of arriving at overhead time that will cover both idle time and legitimate overhead.

Hired horse labor includes all expenditure for hired horses.

Farm horse labor was charged at 15c per hour. This covers the feed cost only. This charge is based on a feed cost of $50 per horse per year, and an average of about 330 hours of work per year. It was considered that the horses on the farms studied were fed more cheaply than on the average Willamette Valley diversified farm, which, according to a study made by the Experiment Station, feed their horses at an annual cost of $62 per horse per year.* Interest and depreciation on the horse investment is covered under these heads.

All materials were charged at cost. Carriers lasting more than one season were not charged as carriers, but were entered in the machinery and equipment inventory and depreciated. Miscellaneous items include wood and electricity for the pickers' camps, rental of tents, tickets for pickers, and interest on borrowed working capital. Wood and tickets account for nearly the entire amount of this item.

Operation costs for the automobile and truck and general machinery repair costs were obtained in full, and then prorated to the strawberries according to the percentage of the total use. In several instances, 30 out of 85 records, automobile mileage was charged at 10c per mile; hence, in these cases, there is some interest and depreciation included in the operation costs. Machinery rented was charged for either on a day or an acreage basis.

Of the general expenses, insurance was a direct charge. This charge included only crop and labor liability insurance. The telephone charge was prorated to the strawberries in proportion to the amount of use for this enterprise. Taxes were computed by multiplying the per-acre tax by the number of acres of bearing strawberries.

The depreciation on buildings, which were chiefly picking or receiving sheds of light construction, was charged at 10 percent of the present estimated value. On work stock the charge was 15 percent of present value, which is the rate of depreciation as found in a separate Experiment Station study of the cost of horse labor on Willamette Valley diversified farms. The depreciation on machinery, with the exception of carriers, automobile, and truck, was charged at 12 percent of the present value. Carriers, automobile, and truck were depreciated on the basis of the remaining years of life. The bearing berry planting depreciation was computed by dividing the average cost of establishing a planting by the average life of a planting, as estimated by the producers.

Interest was charged at 5 percent. The actual market value of the bearing berry land was estimated by each producer. Building value was estimated at cost less a reasonable depreciation. Work stock value was estimated at market price for stock of like quality. Feed investment was charged at $25 per horse (one-half of a feed cost of $50 per horse). Machinery and equipment investment was based on present value. Stock and machinery used on farm enterprises, other than bearing strawberries, were charged to strawberries according to the amount of use and not in full. Horse feed was charged according to the percentage of use of horses on the bearing strawberries.

* Oregon Agricultural Experiment Station Bulletin 250, Cost of Horse Labor on Oregon Farms.

## ANALYSIS OF COST ITEMS

**Labor.** Man labor is the outstanding cost item in strawberry production, constituting 71 percent of the total cost.

Man labor is divided into direct operating labor and overhead labor. Direct labor consists of all hired and contract labor and the direct labor of the operator and his family, and totals $108.26 per acre or about 80 percent of the total man-labor charge. The hired labor amounted to 40 hours per acre at an average of 33c per hour. The direct labor put in by the operator and his family amounted to 105 hours per acre, valued at 32½c per hour. Contract labor, mostly picking, was $60.80 per acre. Picking averaged 1.8c per pound. The overhead labor of the operator averaged 84 hours per acre and was valued at 34c per hour.

The larger share of the overhead labor charge was found on those farms having but few enterprises. These operators did not consider their time so valuable. As contrasted to this, producers handling many enterprises and with but little waste time placed a higher value on their labor.

The division of all direct man labor between the various major operations is shown in Table VII. Cultivation accounts for 16 percent of the direct man-labor cost; harvest, for 73 percent; marketing, for 4.7 percent, and miscellaneous items such as topping, fertilizing, and other labor, for 5.8 percent. The total direct labor, aside from that contracted, amounted to 144½ hours per acre, which cost $47.46. In addition to this $60.80 was expended for contract labor, which was chiefly for picking.

TABLE VII—DIRECT MAN LABOR COST OF MAJOR OPERATIONS
(Combined averages for 1925 and 1926)

| Labor item | Hours per acre of labor other than contract | Cost per acre of labor other than contract | Cost of contract labor per acre | Total cost of labor per acre | Percentage of total man labor cost |
|---|---|---|---|---|---|
| | | | | | % |
| Cultivation | 53.02 | $ 17.42 | $ ..... | $ 17.42 | 16.1 |
| Harvest | 63.87 | 20.98 | 58.46 | 79.44 | 73.4 |
| Marketing | 8.73 | 2.87 | 2.34 | 5.21 | 4.7 |
| Miscellaneous | 18.88 | 6.19 | ..... | 6.19 | 5.8 |
| Total | 144.50 | $ 47.46 | $ 60.80 | $108.26 | 100.0 |

Cultivation and the miscellaneous labor operations must be carried on regardless of the size of crop expected. In this study the charge for cultivation and miscellaneous labor operations amounted to $23.61 per acre or 12.4 percent of the total production cost. Harvesting and marketing operations vary with the crop and cost here $84.65 per acre or 44.2 percent of the total production cost. Regardless of the size of crop, therefore, the producer will have a labor expenditure of about $23.61 per acre for care of the planting. This is largely a fixed charge, like interest, taxes, and depreciation.

**Materials, machinery operation, and general costs.** Materials, machinery operation costs, and general costs are minor factors in the cost of strawberry production. With the exception of taxes there was little uni-

formity of expenditure for items in these cost divisions, some farms having considerable expense for an item or group of items and others having no expense.

**Depreciation and interest.** Depreciation represents 13 percent of the total production cost and interest 7.2 percent. Though of considerable magnitude, these items are seldom thought of as costs by the farmer, for he buys machinery only at rare intervals and unless mortgaged he pays no interest.

**Value and use of the average cost.** The average cost figure of 5.87c per pound is an indication of what any individual cost may be. This figure is a mean or average of a number of costs that range both above and below this amount (see Variation in Costs, page 19). The value of such an average lies in the possibility it offers for comparison. It fairly represents in one figure the status of the whole enterprise. Any producer can compute his own costs and by comparison with the average can determine whether he is a high- or low-cost producer. Comparison is also possible with costs in competing regions.

Operators with a cost equal to or below average are on a fairly sound basis and will usually be able to make some profits even in seasons of serious depression. As contrasted to this, if an operator has costs that are very far above average the arrival of the first serious depression, in price or yield, will probably cause a considerable financial loss. In a period like the last few years where the selling price (average price 1925 and 1926, 8c) has been well above the cost of production, most of the high and all of the low-cost producers were able to make a profit. In 1928 the high-cost growers suffered serious losses.

The prospective producer can use the average cost quite advantageously as a basis for determining the practicability of the strawberry enterprise for his farm. Since profits are the ultimate aim of production, one of the soundest ways to make a test of an enterprise is on the basis of cost. By the use of a trial planting of the best-adapted variety or varieties a beginner can determine whether, with average yield, he can produce berries at a cost per acre comparable with the cost as given in Table VI.

## CASH AND NON-CASH COSTS

The total cost of producing strawberries is composed of both cash and non-cash costs. Classified as cash costs are the items of hired labor, contract labor, hired horse labor, materials, machinery operation, taxes, and general costs for which there is an actual money expenditure. In the non-cash group are found the items of operator's and family labor, farm horse labor, depreciation, and interest, for which no cash is paid out.

The importance of the non-cash items is as a rule not understood. In considering production costs many producers go no farther than the cash-cost items; the majority agree that any unpaid labor should be allowed a wage; a few consider production cost in its entirety. As a result of this lack of understanding many consider their strawberry business profitable when year after year they are producing at a real cost that is above any possible market price.

Commercial strawberry producers in the Willamette Valley were found to have 50 percent of their production cost, or 2.9c per pound, as cash items. If the selling price is equal to 50 percent of the production cost, or 2.9c, the average producer will lose no cash and any price above this will leave him with some cash return in payment for his own labor and investment.

The classification and importance of the various cash and non-cash costs are shown in Table VIII. Man labor is the outstanding cost in both classes.

TABLE VIII—CASH AND NON-CASH COSTS OF STRAWBERRY PRODUCTION

(Combined averages for 1925 and 1926)

| Items | Cash cost per acre | Per-centage of total | Non-cash cost per acre | Per-centage of total |
|---|---|---|---|---|
| | | % | | % |
| Hired labor | $13.32 | 7.0 | $ ..... | ..... |
| Contract labor | 60.80 | 31.8 | ..... | ..... |
| Operator's and family direct labor | ..... | ..... | 34.14 | 17.8 |
| Operator's overhead labor | ..... | ..... | 27.84 | 14.5 |
| Total man labor | 74.12 | 38.8 | 61.98 | 32.3 |
| Hired horse labor | .17 | .1 | ..... | ..... |
| Farm horse labor (feed cost) | ..... | ..... | 4.81 | 2.5 |
| Total horse labor | .17 | .1 | 4.81 | 2.5 |
| Materials | 4.83 | 2.5 | ..... | ..... |
| Machinery operation | 3.76 | 2.0 | ..... | ..... |
| General | 3.11 | 1.6 | ..... | ..... |
| Depreciation | *9.23 | 4.8 | 15.69 | 8.2 |
| Interest on investment | ..... | ..... | 13.67 | 7.2 |
| **Total** | $95.22† | 49.8 | $96.15 | 50.2 |

* Cash portion of planting replacement charge.
† This makes the cash cost per pound 2.9c.

Depreciation is ordinarily a non-cash cost, but, as previously stated, in this study the replacement cost of the bearing berries was included with depreciation. If the strawberry enterprise is being conducted on a permanent basis there will be some new planting every few years and part of the expense of this planting will be cash.

Interest is a non-cash cost except where the operator has a mortgage on his real estate. In this study no attempt was made to determine the mortgage debt, and all interest was charged as a non-cash cost.

## VARIATIONS IN COST

The cost per acre and per ton of producing the entire crops of 1925 and 1926 on all farms studied has been shown in Table VI. The average cost per pound for the whole crop was 5.87c. The variation in cost of production on the individual farms for the two years combined is depicted in Table IX. The story this table tells is illuminating and indicatve of the opportunity offered for the improvement of the enterprise on the part

of many growers. Thirty-two of the farm records taken, covering 27 percent of the entire bearing acreage, produced strawberries at a cost of less than 5c per pound, averaging about 4c per pound. At the average price received (8c) these growers had a clear profit above all costs (including wages for their own labor and interest on their berry investment) of 4c per pound—a profit of 100 percent on total cost.

Another group of 30 records covering 32 percent of the acreage had an average cost of 5.6c per pound and with the price at 8c had a clear profit of 43 percent on total cost.

Altogether more than half of the records covering 59 percent of the acreage were producing berries at less than the average cost of 5.87c and making profits.

The success of these growers surely indicates the opportunity for reduction of costs on the part of the growers whose costs are higher than the average. Almost half of the records and 40 percent of the acreage had higher than average costs and 10 percent of the acreage had costs above 9c per pound. Yet the natural conditions and the opportunity for successful berry growing are fairly uniform and common to the whole Valley. The factors which influence costs are therefore of the greatest importance, since these factors to a large extent are under the control of the grower. It is obvious that when prices drop to 5c or 6c, many of the high-cost growers cannot survive unless production methods are improved.

TABLE IX—VARIATION IN THE COST OF PRODUCING STRAWBERRIES
(Combined averages for 1925 and 1926)

| Cost per pound | Number of farms | Average cost per pound | Acres bearing | Percentage of total acreage | Cumulative percentage of acreage | Production | Percentage of total production | Cumulative percentage of total production | Average yield per acre |
|---|---|---|---|---|---|---|---|---|---|
| | | | *acres* | *%* | *%* | *lbs.* | *%* | *%* | *lbs.* |
| 2 to 4c | 5 | 3.6c | 17 | 5 | 5 | 78,971 | 8 | 8 | 4,803 |
| 4 to 5c | 27 | 4.6 | 69 | 22 | 27 | 269,411 | 27 | 35 | 4,399 |
| 5 to 6c | 30 | 5.6 | 101 | 32 | 59 | 322,785 | 32 | 67 | 3,309 |
| 6 to 7c | 27 | 6.5 | 63 | 20 | 79 | 183,152 | 18 | 85 | 2,955 |
| 7 to 9c | 17 | 8.1 | 35 | 11 | 90 | 90,471 | 9 | 94 | 2,535 |
| 9 to 11c | 10 | 10.0 | 23 | 7 | 97 | 46,204 | 5 | 99 | 2,255 |
| 11 to 17c | 5 | 13.2 | 9 | 3 | 100 | 10,646 | 1 | 100 | 1,404 |
| **Total and average** | 121 | 5.87c | 317 | 100 | ..... | 1,001,640 | 100 | ..... | 3,262 |

NOTE: In 1925 the extreme range in production cost was from 2.5c to 11.5c per pound. In 1926 the range was from 3.6c to 16.4c per pound.

## FACTORS INFLUENCING COSTS

Many factors influence production costs. Yield and labor efficiency are of major importance. Minor factors such as size of planting, land value, number of plants per acre, disease and pest control, selection of proper varieties for the soil, and fertilization, also influence cost. This influence is often exerted in an indirect fashion through altering the yield or labor efficiency. Each grower can analyze his own enterprise to determine and correct whatever factor or factors are causing him high costs.

### YIELD

**The influence of yield on production cost** is shown in Table X. As the yield increased from an average of 1,372 pounds per acre for the first group to an average of 6,960 pounds per acre for the fourth group, the production cost per pound decreased from 9.3c per pound to 5c per pound. While the cost per pound decreased, the cost per acre steadily increased, owing to greater harvest costs and also to more care being given the planting.

TABLE X—THE EFFECT OF YIELD ON COST OF PRODUCTION
(Combined averages for 1925 and 1926)

| Yield per acre | Number of records | Average yield per acre | Average cost per acre | Average cost per pound |
|---|---|---|---|---|
| *lbs.* | | *lbs.* | | *c* |
| Below 2,000 | 14 | 1,372 | $126.00 | 9.3 |
| 2,000 to 4,000 | 66 | 2,928 | 178.00 | 6.0 |
| 4,000 to 6,000 | 30 | 4,751 | 254.00 | 5.4 |
| 6,000 and over | 11 | 6,960 | 344.00 | 5.0 |
| Total and average | 121 | 3,262 | $191.00 | 5.87 |

Good yields and resultant low costs are definitely possible, and it is imperative that they be obtained if steady profits are to be assured. The high prices for several seasons may obscure the necessity for low production costs, but with expansion of the enterprise and lower prices many growers will find low yields no longer profitable. For example, the first group of farms shown in Table X had an average yield of 1,372 pounds per acre and an average production cost of 9.3c per pound.

Unless the yields of this group of fourteen farms can be increased economically so that the production costs will be lowered considerably, it is doubtful whether these growers can continue in the production of strawberries.

The next group of farms, 66 in number, had an average yield of 2,928 pounds per acre and an average cost of 6c per pound. Although not on an entirely sound basis these producers are not in danger of immediate failure. During the period of low prices, however, these growers will probably have very little or no profits to show for their work.

The third group of farms had an average yield of 4,751 pounds per acre and an average cost of 5.4c per pound, and the fourth group, 6,960

pounds per acre and a cost of 5c per pound. In both of these groups there are enough farms to prove conclusively that high yields and low costs are quite possible. Strawberry producers with yields as high and costs as low as these growers are practically assured of a steady profit.

**Improving yield.** There are two general methods of obtaining good yields. The first and most successful is to use fertile soil. The second is to increase yield by artificial means such as selection of the proper varieties for the soil, more intensive cultivation, and fertilization, and by pest and disease control. Increasing yield by the use of good production practices is equally applicable to both rich and poor soils, and is the only method a grower on the poorer soils has of obtaining maximum yields without moving to richer lands in a new location.

Some soils in the Willamette Valley naturally produce higher yields with certain varieties. Producers on newly cleared and richer lands have the natural advantage of greater fertility, and even with poor production methods can obtain better yields than many producers on the poorer lands can ever hope to obtain. It is important therefore that each producer understand fully the production capacity of his soil. Unless he is able to produce high yields at a low enough cost per pound to return a constant profit, some other enterprise may prove more profitable than strawberries.

## VARIETY

**The effect of variety on yield.** There is a considerable natural difference between varieties in yield and quality of fruit. The yield and the selling price determine to a large extent the profits returned to the grower. Table XI shows the average yield, selling price, and gross returns per acre for the major varieties covered in this study. Other varieties were handled only in small quantities, and on account of a good market demand for all strawberries their quality was not discriminated against. Since 1926 some of the inferior varieties are not finding a ready market, and it appears that future plantings must be limited to a few high quality varieties.

TABLE XI—YIELD AND VALUE OF STRAWBERRIES, MAJOR VARIETIES

(1925 and 1926)

| Variety | 1925 | | | | 1926 | | | |
|---|---|---|---|---|---|---|---|---|
| | No. of producers | Average yield per acre | Selling price per pound | Gross returns per acre | No. of producers | Average yield per acre | Selling price per pound | Gross returns per acre |
| | | *lbs.* | | | | *lbs.* | *c* | |
| Ettersburg 121 | 32 | 4,156 | 8.2c | $341 | 33 | 2,334 | 9.0 | $210 |
| Marshall or Oregon | 17 | 3,553 | 7.9 | 280 | 33 | 3,554 | 8.6 | 306 |
| Wilson | 9 | 2,501 | 6.7 | 168 | 14 | 2,818 | 7.1 | 200 |
| Trebla | 4 | 3,212 | 6.3 | 202 | 6 | 4,022 | 7.0 | 282 |
| All varieties | 48 | 3,525 | 7.8 | 275 | 73 | 2,999 | 8.4 | 252 |

Until better varieties are found, most of the strawberry acreage of the Willamette Valley will undoubtedly be planted to the Marshall (or Oregon) and Ettersburg 121. These varieties have separate markets and different soil requirements.

**Canning varieties.** The Ettersburg 121 is the main canning variety. It has a firm, dark-red fruit that holds its color and shape in the can. It is grown successfully only on the heavy clay loam soils of the Valley floor or the heavy alluvial soils. On the sandy soils or the hill soils it has been a failure as to fruit production, though the vegetative growth is satisfactory. This variety is so exacting in its demands that it cannot be widely grown and in many cases would not be grown at all were it not for the demand from the canners and the consequent good prices offered for it.

Other canning varieties are rapidly assuming minor importance. The Trebla produces well, but the fruit is very difficult to handle. Unless picked promptly and as promptly processed, the canned product may turn black. The 'Lnge is used in a small way in one section, but is not making headway as it is a second-rate berry when compared to Ettersburg 121. The Wilson, probably the oldest known variety still being grown, is rapidly going out of favor and cultivation. In the older strawberry-growing areas it has a very low production. Only in one or two sections of fairly recently cleared land and at a considerable elevation does this variety yield well.

**Barreling varieties.** The Marshall or the Oregon is the main berry used for barreling and is known as the "soft berry" to distinguish it from the solid, firm, canning berry. The fruit is too large and too soft for canning. This variety requires a light, well-drained soil and seems to do especially well in the rolling foot-hills. Marshall and Oregon are treated synonymously, as there is little or no distinction between them as they are now grown. With a few growers, there is another berry ripening a week to ten days later than the average run of Marshall and Oregon, that is always called Oregon. Otherwise the terms Marshall and Oregon are synonymous.

Ettersburg 80, while one of the heaviest-yielding varieties, is of such poor quality that only limited quantities can be used. The Johnson, once popular, is now practically out of cultivation. The Gold Dollar, supposedly an early variety, is early only in warm, light soils; in other cases it is no earlier than the Marshall. Its poor quality will limit its use.

**Mixtures.** Among the Marshall types of berry there has been in some localities a decided mixture of varieties. Instances have been noted where practically two years' work has been lost on a planting which, on coming into bearing, was found to be an inferior, worthless type of berry. Sufficient acreage of a superior type of Marshall is grown at the present time to enable any one to obtain good, clean stock, true to name and type.

With few exceptions there has been noted little mixture in the Ettersburg 121. The claim at times that there has been a poor strain of this berry put out has hardly been substantiated when study has been made of the soil on which these light-producing plantings were made. At times Ettersburg 80 has been distributed as Ettersburg 121. There may

be a possibility of confusing other Ettersburg varieties with Ettersburg 121, as too frequently it is the understanding that there is but one variety with the name Ettersburg. At the present time there are about a thousand numbered selections of berries with the Ettersburg name attached to them, though only a small number have been generally distributed.

## CULTIVATION

The destruction of weed growth and establishment of a soil mulch is the objective in cultivating strawberries. Dispensing with a soil mulch altogether, as practiced in the East in some sections, has not yet been thoroughly demonstrated for western conditions.

Conservation of both moisture and fertility is directly related to weed control, for weeds use large amounts of both. The cultivation needed for weed control is probably sufficient to meet practically all other functions of good tillage.

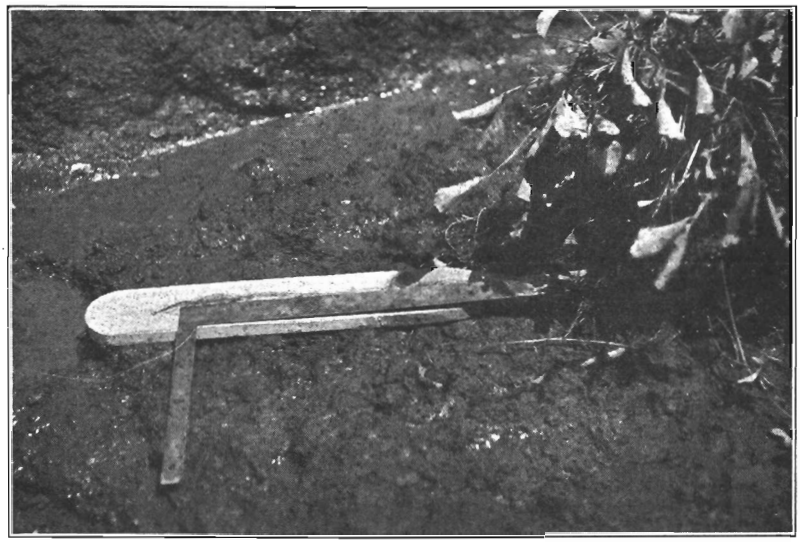
The number of man-hours used for cultivation of the bearing strawberries was found to vary widely. As little as five man-hours per acre and as much as two hundred and five man-hours per acre were reported. For the two-year period, 1925-1926, the average was fifty-three man-hours per acre. Table XII shows the effect of cultivation on yield and cost. The minimum number of cultivations for most effective results cannot be stated definitely and would vary with conditions. On most farms less than 70 man-hours per acre seems to be warranted if this tillage is given at the most effective times and in the most efficient way.

TABLE XII -THE EFFECT OF CULTIVATION ON YIELD AND COST
(Combined averages for 1925 and 1926)

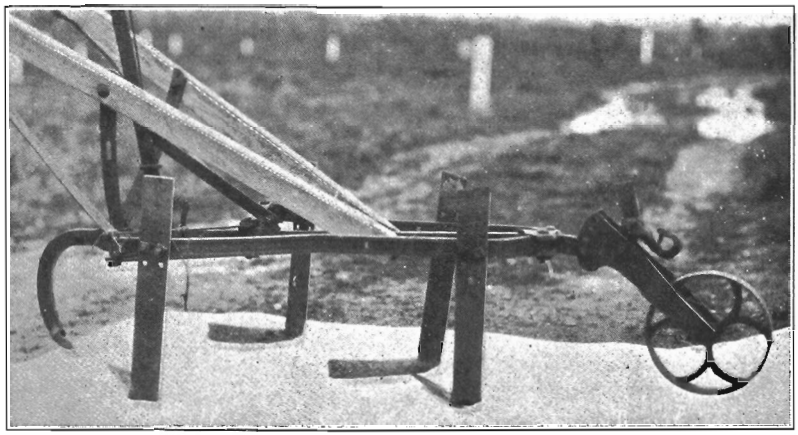
| Soils | Man hours per acre for cultivation | Number of records | Average man hours per acre | Average number of cultivations | Average yield per acre | Average cost per pound |
|---|---|---|---|---|---|---|
| | | | *hours* | | *lbs.* | *c* |
| Hill soils | 70 hours and less | 30 | 42.7 | 8.1 | 2,674 | 5.64 |
| | More than 70 hours | 11 | 93.6 | 12.6 | 3,577 | 5.93 |
| Bench and bottom soils | 70 hours and less | 54 | 41.2 | 9.8 | 3,460 | 5.84 |
| | More than 70 hours | 26 | 105.8 | 13.2 | 4,455 | 6.37 |
| All soils | 70 hours and less | 84 | 41.8 | 9.2 | 3,045 | 5.74 |
| | More than 70 hours | 37 | 101.0 | 13.0 | 4,104 | 6.22 |

Very intensive cultivation is evidently not an economical method of increasing yields. Large yields must be obtained in some other way than by intensive cultivation. Intensive cultivation will not make up for low fertility, inferior varieties, etc.

Large yields obtained at a greater cost per pound may be justified if the price is several cents above the production cost and the grower has a limited strawberry acreage. The high price prevailing during 1925 and 1926 paid the smaller producers for obtaining maximum yields by in-



Well-developed strawberry roots extend more than two feet out from the plant. They fill the space between the rows. Hence the need of wide spacing of plants and a type of cultivator designed for shallow, flat cultivation similar to that shown below.



tensive cultivation. Even then with sufficient land available the grower would have made larger total profits by handling more acres, cultivating less, and producing at a lower cost per pound.

The average price for the berries sold from the farms that were cooperating in this study was 8c per pound. This price was enough larger than the production cost so that the larger yields, as shown in Table XII, returned the larger net profit per acre although a less profit per pound. At a price of 7c per pound, however (which is above present prices), the smaller yields obtained by less cultivation and at a lower cost per pound are more profitable.

Berry plantings reporting the larger amount of cultivation per acre were usually on the smaller farms. These growers were attempting to obtain the largest yield possible so as to have a larger income, and evidently did not consider the cost of producing these large yields.

Bench and bottom soils apparently require more cultivation than the hill soils. In Table XII, it is shown that growers located on these soils averaged about one more cultivation per acre than the growers on hill soils. This would indicate that as a rule the bench and bottom soils are either more weedy or more difficult to mulch.

**Reducing cultivation.** There are two effective methods of reducing cultivation costs. The first and more important is to reduce the amount of cultivation needed, and the second is to substitute horse cultivation for hoeing. There are several ways of reducing the amount of cultivation necessary. The time of cultivation and the use of clean ground for the planting are two of the most important methods of accomplishing this.

Early spring cultivation and late fall cultivations are very effective means of weed eradication. There is probably no other practice that will give such good results in reducing the amount of necessary cultivation as cultivating at the proper time. Destruction of weeds when small is much easier than after they have well-developed roots and are firmly established. One cultivation at the proper time will often be as effective as several given at a later period.

The use of clean ground in which to set the planting is a very satisfactory way of reducing cultivation. The use of two clean-cultivated crops, preceding planting, will usually clear the ground of weeds so that ordinarily but little difficulty will be experienced in keeping down weed growth. Two years of cultivated crops are necessary also where a sod crop is infested with larvae of the June beetle.

The methods used in cultivating have much influence on the amount of labor needed for the operation. Table XII shows that the plantings using the larger amount of cultivation also performed this at a slower rate. This was chiefly because of the larger amount of hoeing done. Hoeing increased the total man-hours of cultivation much more rapidly than the horse cultivation. One hoeing will balance about seven horse cultivations in the amount of man labor required (see Table XXVII) so it appears that hoeing should be kept at a minimum. Clean ground and early and late cultivations will aid materially in reducing the need for hoeing. Another effective method is to cross-cultivate. Cross-cultivation destroys the weed growth between the hills and leaves only a few weeds near the hill to be removed with the hoe.

**Root damage.** Ideal cultivation consists of a maximum weed eradication with minimum injury to the berry plants. There is no object in removing weeds if the removal is more injurious to the berry plants than were the weeds. Cultivation with the usual one-horse cultivator equipped with large shovels is very likely to destroy some of the rootlets in the surface soils, and it is in that section of the soil that most of the roots and feeding rootlets are to be found. Additional work might not only fail to increase the crop, in proportion to the labor expended, but might tend to decrease the crop by destroying the feeding rootlets and in that way reduce the water and food supply.

The Ettersburg 121 seems to react more quickly to root injury than do many of the other berries. From observation made in the field apart from this study, it was frequently noted that the heaviest-yielding patches over a period of years were not always those that were the cleanest and most free from weeds. Total absence of weeds from the field or the maintenance of a deep mulch is no indication that such a patch will have a heavier yield per acre over one with a considerable amount of weeds in it. The heavy yields from the weedy patches probably are not due to the presence of weeds, but rather perhaps to the fact that excessive cutting of the feeding rootlets has been avoided.

The use of knives, or sweeps, in place of shovels on the cultivators tends to minimize the amount of root area destroyed, and in that way may avoid the possible damage from excessive cultivation where many cultivations need to be given.

## FERTILIZING

Definite findings on the value of fertilizing the soil were not obtainable in this study. Both commercial fertilizer and barnyard manure were being used, but only in a few cases on certain types of soil were growers able to determine that any fertilizer was profitable when applied to the bearing patch. Building up fertility of the soil before planting was generally conceded to be the best and most economical method.

There is no general fertilizer program that can be recommended that will be sure of giving a profit. The different soils vary so much in their requirements and in the past treatment by various forms of cropping that one fertilizer can hardly be expected to be satisfactory under all conditions. In some few localities fertilizers have proved practical according to the belief of the grower, but the same fertilizers used in other sections have proved unsatisfactory.

In only two localities in the Valley is there a consistent fertilizer program. In one the fertilizer is nitrate of soda, 125 pounds, and superphosphate, 250 pounds, to the acre. In the other section ground sheep-manure at the rate of about one ton to the acre is applied annually. In both districts growers believe that the fertilizer used is beneficial. The data as taken do not show conclusively the advisability or the lack of advisability of such a procedure. This would require a more detailed study over a period of years.

Low berry yields, in many cases, are owing to lack of moisture, rather than to lack of fertility. The addition of humus increases the moisture-holding capacity of the soil. Humus, as from green manure crops or barnyard manure, can be added effectively only before the planting is made.

## NUMBER OF PLANTS PER ACRE

The findings of the study as to the best number of plants per acre are not conclusive. The spacing of the rows and hills varies with the variety, the capacity of the soil for holding moisture, the method of tillage used, and the ideas of the individual producer.

No one spacing can be cited as an outstanding success or pattern. The moisture-holding capacity and fertility of the particular soil determines the number of plants that can be supported.

Large, vigorous plants like the Ettersburg 121 and Marshall, or Oregon, have root spreads of 40 to 60 inches. It is not necessary to set these plants close together in order that the roots may utilize the available plant food and moisture; to do so is likely to result in smaller berries and probably in smaller yields.

The optimum number of plants for the large-growing types of strawberries like the Ettersburg 121 and Marshall seems to be about 5,000 plants per acre. In practice this number is about 4,840 plants, allowing thirty-six inches each way between plants. This spacing allows for cross-cultivation with horses, which is an economical method of tillage.

## SELECTION OF PLANTING STOCK

Plants free from insects and diseases are a factor in profitable strawberry growing. There is a provision in this state for the inspection of all strawberry plants sold for planting, and this provision should be employed by those buying strawberry plants, in order to insure clean plants.

Ordinarily plants from one-year-old plantings are used; i. e., the plants set out in the spring are allowed to make runners and plants for use the next year. This practice is not followed solely because such plants from one-year-old stock are always superior or that plants from older plantings run out, but because the plants are apt to have a better chance to root well when the mother plants are allowed to set runners without interference. The plants from older plantings also are more apt to become infested by insects and diseases than are the plants taken from young, vigorous stock. Young plants from older plantings are equally good if they have the size and vigor and are free from diseases and pests.

## SIZE OF PLANTING

Small-sized plantings usually produced a better yield per acre than large plantings, but were doing so at a higher cost per pound of fruit.

Eighty-six records reported plantings ranging in size from 1 to 5 acres (see Table XIII). These plantings had an average yield of 3,893 pounds per acre and produced these strawberries for 6.2 cents per pound. Thirty-five records reported plantings larger than 5 acres. The average yield on these plantings was 2,850 pounds per acre and the production cost averaged 5.6 cents a pound.

The increased cost of production for the smaller plantings was chiefly due to the use of more direct labor, to a larger charge for overhead man labor, and to a higher land value. Usually the labor used in increasing

TABLE XIII—THE RELATION OF SIZE OF PLANTING TO YIELD, COST AND LABOR EFFICIENCY
(Combined averages for 1925 and 1926)

| Range in size | Number of records | Average size of planting | Average yield per acre | Average cost per pound | Direct man labor per acre | Indirect man labor per acre |
|---|---|---|---|---|---|---|
| | | *acres* | *lbs.* | *c* | *hours* | *hours* |
| 5 acres or less | 86 | 2.7 | 3,893 | 6.2 | 171 | 122 |
| More than 5 acres | 35 | 11.4 | 2,850 | 5.6 | 115 | 57 |
| Total and average | 121 | 5.1 | 3,262 | 5.87 | 136 | 85 |

production was supplied by the operator or unpaid members of his family. The large amount of both overhead and direct man labor on the small plantings is a result of the organization of many of the farms on which these plantings are located. (Overhead labor is largely idle time chargeable against the strawberry enterprise.)

The 86 records that reported from 1 to 5 acres of bearing strawberries had an average of only 24.6 acres of crop land per farm, including strawberries. Very few had livestock enterprises to supplement this crop acreage and to keep the operators profitably occupied. Part of their spare time was used in giving the strawberries greater care, but, even so, a large amount of idle time remained, much of which could be charged only to the bearing strawberries.

As long as the prices for berries are high these operators with limited acreage may be justified in increasing their per-pound production costs by the use of more labor. With lower prices for berries this higher cost per pound will wipe out all profits.

In this study small plantings were found to be less efficient units than large plantings. The large operators were able to handle several more acres with the same amount of labor and received almost one-third more income per hour of labor than the small operators.

If the small operators are to increase their efficiency they must organize their farms to do a larger volume of business. This will allow them to reduce their overhead or idle time chargeable to the strawberry enterprise. They must also use less direct labor per acre by means already explained, if they are to produce the maximum amount of berries per hour of labor.

## VALUE OF BEARING BERRY LAND

Many of the small plantings were located on high-valued small farms. This high value increased not only the interest charge but also the property tax. The difference in rate of interest and taxes on the small and large plantings is minor as compared to the difference in direct and overhead labor, but is quite important because these are fixed charges and cannot be reduced.

The price per acre of much of the land used for strawberry plantings in the Willamette Valley is determined by location, rather than by the productive value of the land. Some farmers prefer to live on a small

farm near a town rather than to invest the same capital in a larger farm located farther out. These small farms permit but a small acreage of strawberries, so the two factors of small size of planting and high land value were found to be very closely linked together.

Strawberries grown on high-priced land are produced at a higher cost than those grown on less valuable land (see Table XIV).

TABLE XIV—THE RELATION OF VALUE OF BEARING BERRY LAND TO YIELD AND COST
(Combined averages for 1925 and 1926)

| Value of bearing berry land | Number of records | Average size of farm | Average value per acre of bearing berry land | Average yield per acre | Average cost of production per acre | Average cost per pound | Average size of patch |
|---|---|---|---|---|---|---|---|
| | | *acres* | | *lbs.* | | *c* | *acres* |
| Below $300 per acre ..... | 65 | 75 | $180 | 3,154 | $174 | 5.53 | 6.0 |
| $300 per acre and up ..... | 56 | 32 | 386 | 3,336 | 224 | 6.68 | 3.8 |
| Total and average .... | 121 | 58 | $247 | 3,262 | $191 | 5.87 | 5.1 |

Increased cost of production on the more valuable land is chiefly due to three factors. First, the size of planting was smaller and the cost of man labor per acre was much greater, for reasons already given. Second, the higher land value raised the interest charge per acre. Third, the value caused a much heavier property tax per acre. These extra charges, together with some minor ones, served to raise the cost of production $50 per acre. To pay for this increase in production cost, there was an increase in yield of only 182 pounds per acre. The return from this increase was not sufficient to meet the additional production costs.

The Willamette Valley has an abundance of cheaper land suitable to strawberry production that will probably yield more heavily than much of the costly land now in strawberries. There are large areas of such land adjacent to good roads and within a reasonable distance of good markets. Not only will the production cost be less on such land but a given amount of capital will buy from two to five times the acreage that it will in the higher-priced sections. This larger acreage will allow for larger plantings of berries with sufficient land for properly rotating them and also for the larger volume of farm business needed to make farms more profitable.

## LABOR REQUIREMENTS

Since direct man labor represents, on the average, more than 56 percent of the total cost of strawberry production, importance of efficient labor management is easily apparent.

The difference in labor efficiency between producers is determined both by the methods used in performing the labor operations and by the rate of work. As a general rule there is more variation owing to methods used than to the rate of work, but there are quite a few exceptions to this.

**For cultivation.** The strawberry plantings in this study were cultivated on the average of 10.4 times per year. These cultivations included 8.4 horse cultivations and 2.2 hoeings per year. The horse cultivations required 3.2 man-hours and 3.8 horse-hours per acre per cultivation. The hoeing required 21.8 man-hours per acre per cultivation.

Hoeing is a costly labor operation. Since almost seven horse cultivations can be given with the same amount of man labor required for one hoeing it appears that the number of hoeings in many cases might be reduced by the use of clean ground for planting and by replacing hoeing with horse cultivation. Some idea of the possibilities for reducing the amount of hoeing may be seen from a study of Table XV.

TABLE XV—LABOR REQUIRED FOR CULTURAL OPERATIONS
(Combined averages for 1925 and 1926)

| Cultural operation | Number of records averaged | Percentage of total acreage covered | Average times over | Hours per acre | | Hours per acre per operation | |
|---|---|---|---|---|---|---|---|
| | | | | Man | Horse | Man | Horse |
| | | % | | | | | |
| Cultivating with horse | 120 | 99.1 | 8.4 | 24.8 | 34.6 | 3.2 | 3.8 |
| Hoeing | 110 | 93.7 | 2.2 | 40.8 | ..... | 21.8 | ..... |
| Total cultivation | 120 | 99.1 | 10.4 | 62.3 | 34.6 | 6.4 | 2.3 |

**For harvest.** Harvest alone requires more than five times as much labor as is used for all other operations in strawberry production. Approximately 89 percent of this labor is for picking, about 8 percent is for overseeing, and the other 3 percent is for the other harvest operations (see Table XVI).

TABLE XVI—LABOR REQUIREMENTS FOR HARVEST
(Combined averages for 1925 and 1926)

| Harvest operation | Number of records averaged | Percentage of total acreage covered | Hours per acre | |
|---|---|---|---|---|
| | | | Man | Truck* |
| | | % | | |
| Preparation for picking | 91 | 85.2 | 4.3 | ..... |
| Picking | 121 | 100.0 | 489.4 | ..... |
| Hauling pickers | 19 | 20.9 | 11.5 | 11.5 |
| Overseeing | 112 | 97.5 | 59.0 | ..... |
| Packing | 21 | 37.3 | 23.9 | ..... |
| Miscellaneous labor | 3 | 5.7 | 18.7 | ..... |
| Total harvest | 121 | 100.0 | 554.1 | 2.1 |

* Includes cars with and without trailers.

*Preparation for picking.* Labor in preparation for picking will vary considerably among different producers. Some operators with small plantings using but three or four pickers, will have almost no preparatory labor. Others with 30 or 40 pickers will spend several days in preparing the picking camp, assembling the crates, erecting temporary

receiving sheds, and other labor of similar character. On the average this preparation required 4.3 man-hours per acre. This is a rather small amount of labor and does not leave much room for improvement.

*Picking.* Time used in picking is of little importance as a factor in the cost of production, for all picking is done on a contract basis. Women and children do the greater part of the picking and there is a great variation in the amount picked per day. The average is less than 125 pounds per day, but good pickers will more than double that amount.

Three to six pickers per acre are estimated as needed to pick the ordinary berry patch for the season. This will not give steady labor at the beginning or at the end of the season, but it will in most cases keep the fruit well picked. It takes more pickers to the acre for Ettersburg 121 than with the Marshall or the other large, soft berries, at the same yield per acre.

There is opportunity for some districts to save money by changing the picking method where to do so is satisfactory to the buyer. The method most commonly used is to pick berries with the hulls or stems on and to have these removed at the processing plant by a crew of women. The cost of this hulling averages very close to a cent a pound. In a few districts it is the practice to pick the berries without the stems or hulls, this cost of stemming being added to the growers' price. There is usually no differential being paid to pickers for picking without stems.

*Hauling pickers.* Necessity for hauling pickers will vary with the conditions. Many operators of large plantings provide a camp or camp-site and try to hire families to come and stay through the picking season. Other producers hire local help and let them provide their own transportation. Some haul the pickers to and from town each day.

The average time used for hauling pickers was 11.5 man and 11.5 truck hours per acre. These averages apply only to the 19 records that reported hauling of pickers, as on the remaining farms no time was used for this operation.

*Overseeing picking.* Overseeing requires a large proportion of the operator's harvest time. An average of 112 records shows 59 man-hours per acre devoted to overseeing. On most of the smaller patches this includes giving out tickets and packing the berries as well as supervision of the picking. It is doubtful whether much reduction can be made in this item since careful supervision is necessary to get the best results.

*Packing.* A few of the larger plantings require an extra man for packing or putting the hallocks into crates to haul to the cannery or barreling plant. The average of 21 records shows 23.9 man-hours per acre required for this labor operation. For the larger plantings it is unlikely that this operation can be performed by the overseer, so there is little or no possibility of doing away with a separate packer.

*Miscellaneous harvest labor.* Miscellaneous harvest labor is found on a few of the larger plantings. Harvest labor classified as miscellaneous is chiefly for recording the amounts picked by each picker, computing wages due, running errands, and performing any emergency service that may arise. The three records reporting this item show a labor requirement of 18.7 man-hours per acre. Whether this item can

be dispensed with will depend on how it will affect the picking organization on those farms where an extra man is used for these miscellaneous operations.

**For marketing.** Strawberry producers in the Willamette Valley usually haul their berries to market with their own vehicles. Table XVII shows the average labor required for this operation.

TABLE XVII—LABOR REQUIREMENTS FOR MARKETING
(Combined averages for 1925 and 1926)

| Marketing | Number of records averaged* | Percentage of total acreage covered | Hours per acre | | |
|---|---|---|---|---|---|
| | | | Man | Horse | Truck† |
| Marketing (with horses) | 11 | 3.8 | 29.0 | 51.1 | ..... |
| Marketing (with truck) | 74 | 58.8 | 18.4 | ..... | 18.4 |

* A large number contracted their berries hauled. The labor for this is not included in the averages shown.
† Includes cars with and without trailers.

The average haul from all farms was five miles. The producers not owning a car or truck usually hire their berries hauled. An average of 32 records shows the average charge for hired hauling to be 80c per ton mile. There was very little uniformity in the charges, for rates as low as 11c per ton mile and as high as $6.52 per ton mile were found. Some opportunity for cost reduction may be found in this item.

**For miscellaneous operations.** There were very few farms that did not perform some miscellaneous operations. Topping was generally performed, and while cutting runners was equally common this was often combined in other operations. There was a labor charge for applying fertilizer on some places. Table XVIII shows the average labor expenditure for these miscellaneous operations.

TABLE XVIII—LABOR REQUIREMENTS FOR MISCELLANEOUS OPERATIONS
(Combined averages for 1925 and 1926)

| Operation | Number of records averaged | Percentage of total acreage covered | Hours per acre | |
|---|---|---|---|---|
| | | | Man | Horse |
| Cut runners (with horses) | 6 | 6.8 | 5.8 | 9.4 |
| Cut runners (by hand) | 52 | 40.2 | 23.4 | ..... |
| Topping (with horses) | 35 | 32.1 | 2.8 | 4.1 |
| Topping (by hand) | 39 | 23.4 | 25.2 | ..... |
| Fertilizing (with horses) | 15 | 14.0 | 4.4 | 6.6 |
| Fertilizing (by hand) | 25 | 7.5 | 7.2 | ..... |
| Other labor | 19 | 17.4 | 11.4 | 1.4 |
| Total miscellaneous | 98 | 74.4 | 26.1 | 2.2 |

*Cutting runners.* Runner cutting, as a separate operation, is usually performed by hand. Fifty-two reports on this operation, where the labor was performed by hand, show a labor requirement of 23.4 man hours per acre. Six reports where horses were used, in part or in full, for this operation show 5.8 man and 9.4 horse hours per acre.

On the farms not showing separate labor for runner cutting this was performed as a part of the cultivation. The more usual arrangement was to have rolling disks attached to the cultivator, but a few cut the runners as they hoed.

There is some question as to the desirability of cutting runners with a rolling disk. If the runners can be cut successfully without running deep enough to injure the roots, this method is a time saver. Hand cutting may be just as injurious as cutting with the rolling disk. Especially is this true where a circular cutter is used on loose soil.

*Topping.* Topping is an operation on which much labor may be used and is a general practice among strawberry growers. Probably not more than 5 percent omit this operation.

There were more omissions of this operation noted in 1926 than in 1925. In another study, the growers not topping the plants were obtaining as large a crop as those who were topping. This evidence, however, does not justify a claim either way.

In topping by hand thirty-nine records show that 25.2 man hours per acre were used for this operation. Shears, knives, and hoes were used and necessitated slow work.

Thirty-five farms using a mower needed but 2.8 man hours and 4.1 horse hours per acre for topping. The mowing machine will not cut off the low-lying leaves that are usually the oldest leaves on the hill, but merely takes off the newer leaves standing upright. Using a mower is a much cheaper method than the hand work, which takes off not only the new leaves that are functioning but the old leaves that have approximately ceased all functional work for the hill.

Early topping just after the crop is picked is the best time. The late topping is apt to remove the new crop of leaves and act as a secondary summer pruning. It may increase the number of leaves without any beneficial results to the plant and may reduce the crop the following season.

*Fertilizing.* Fertilization, as practiced on the commercial strawberry plantings of the Willamette Valley, is not a heavy user of labor. Manure requires a team or truck for hauling, but commercial fertilizer can be spread either by team or by hand. Fifteen reports on spreading fertilizer with a team show a labor requirement of 4.4 man and 6.6 horse hours per acre. Twenty-five reports where fertilizer was spread by hand show a labor requirement of 7.2 man hours per acre.

*Other miscellaneous labor.* A few farms have miscellaneous items of labor of no particular classification. Prominent among these items is the digging of plants infested with crown borers, and the spreading of poison bait for the strawberry root-weevil. The time required for items of this nature averaged 11.4 man hours and 1.4 horse hours per acre.

### INSECT AND DISEASE PESTS

Combating the strawberry root-weevil and crown-borer is of vital importance. Disease control is at present of lesser importance. Not all strawberry-growing districts are troubled by insects or diseases. Some of the newer plantings are still so clean that there is no need for this work. With the increase in acreage and particularly with the intensification of planting in some sections of small holdings, insect control has gradually become increasingly important.*

The use of poison bait against the strawberry root-weevil is a recent development. The first general poison program occurred during 1927, following the preliminary work of 1926. Evidence is available to show that the common or small strawberry root-weevil *(Brachyrhinus ovatus L.)* can be readily controlled by poison bait. Good farm practice such as the use of clean, vigorous plants, and systematic crop rotation, are helpful.

Control of the crown-borers can be had only by destroying the plant with the larvae in it. The loss of the plant involves either replanting or leaving a vacancy. In those sections where the plantings are close together and many old plantings are to be found, the control of the crown-borers is becoming more difficult, especially with the Ettersburg 121, where there is a multiplicity of crowns. In this variety the crown-borer can thrive for some time before its effects are noted. Where old plantings of such varieties are allowed to exist they serve as a breeding ground or the distributing point for this insect over the surrounding territory. The control of the crown-borer is a neighborhood as well as an individual problem.

Diseases affecting strawberries in this section of the country are at the present time of minor importance. Witches'-broom can be controlled easily by eliminating the affected plant from the nursery planting. The various root rots that occasionally cause heavy loss in many parts of the Valley are little known, and no method of control is available at the present time.

## COST OF ESTABLISHING THE STRAWBERRY PLANTING

To a considerable extent the success or failure of the strawberry enterprise is determined when the planting is set, rather than after it is in bearing. Factors such as eradication of weeds prior to planting, the rate and method of planting, and size and shape of fields, all have an important effect on the cost of producing strawberries. After the planting is in bearing, these factors are beyond the control of the operator.

The average cost of establishing a strawberry planting was found to be $79.28 per acre (see Table XIX). This was determined from a study of 98 records taken during 1925 and 1926, covering 466 acres of new planting. Of this total cost, $68.85 was operating expense and $10.43 was interest on investment. Of the entire cost 58 percent was for labor and 22 percent for plants. (The average value of plants used was $2.94 per thousand.)

This planting cost is an overhead charge against the whole enterprise and must be absorbed by the returns from the bearing plants.

* For discussion of strawberry insect pest control see Oregon Agricultural Experiment Station Circular 79, Strawberry Root-Weevils and Their Control in Oregon by D. C. Mote and Joseph Wilcox.

TABLE XIX—COST OF ESTABLISHING A STRAWBERRY PLANTING
(Combined averages for 1925 and 1926)
Based on 98 Records Covering 466 Acres of Non-bearing Strawberries

| Items | Average cost per acre | Percentage of total cost |
|---|---|---|
| | | % |
| Hired labor (33 hours per acre) | $10.89 | 13.7 |
| Operator's and family direct labor (79 hours per acre) | 26.89 | 33.9 |
| Total man labor | 37.78 | 47.6 |
| Hired horse labor | $ .16 | .2 |
| Farm horse labor | 8.41 | 10.6 |
| Total horse labor | 8.57 | 10.8 |
| Total labor | $46.35 | 58.4 |
| Plants (6,034 per acre) | $17.72 | 22.3 |
| Other materials | .57 | .7 |
| Machinery operation | 1.23 | 1.6 |
| Taxes | 2.50 | 3.2 |
| Depreciation (on equipment) | .48 | .6 |
| Total operating expense | $68.85 | 86.8 |
| Interest at 5 percent: | | |
| On land (average value, $205 per acre) | $10.23 | 12.9 |
| On equipment (average value, $4 per acre) | .20 | .3 |
| Total interest | $10.43 | 13.2 |
| **Total cost** | **$79.28** | **100.0** |

EXPLANATION OF COST ITEMS IN TABLE XIX

Items of hired labor, operator and family labor and hired horse labor, were derived in the same way as shown on page 15.

Farm horse labor covers feed cost, interest and depreciation.

Plants were charged at cost, except where bought untrimmed. In these cases, the cost of trimming was added to the plant charge. A few operators produced their own plants. These were valued at the market value for trimmed plants. This value was included in the plant charge.

A few farms had expense for fertilizer, and one operator purchased seed for a green-manure crop. These items were charged as other materials.

The machinery operation charge is for tractor operation and machinery hire. There were only four farms that reported machinery hire, and these charges were small.

With two exceptions, taxes, depreciation, and interest were computed in the same way as shown on page 15. The tractor depreciation was computed by dividing the cost by the remaining life. The investment in land was estimated at the present market value for land without crop.

## CASH AND NON-CASH COSTS OF PLANTING

About 42 percent of the cost of establishing a strawberry planting is cash or out-of-pocket cost. Distribution of the various items is shown in Table XX. The time required to bring a strawberry planting into production is not nearly so long as for other fruit enterprises. This fact and the low cash outlay make the strawberry enterprise rather easy to get into or out of without great expense or risk. Many farmers will grow strawberries when they would not invest capital in any other fruit

enterprise. There are enough of these in-and-out producers to cause quite a large fluctuation in acreage whenever the price for berries rises or falls.

Strawberry production should be on a permanent basis. Any grower who cannot produce berries cheaply enough to remain in the business on a fairly permanent basis cannot expect to make consistent profits and possibly is not justified in undertaking the enterprise. Too often growers who are not in the business permanently bring a planting into production after the price peak has passed.

TABLE XX—CASH AND NON-CASH COSTS OF ESTABLISHING A STRAWBERRY PLANTING
(Combined averages for 1925 and 1926)

| Items | Cash cost | | Non-cash cost | |
|---|---|---|---|---|
| | Cost per acre | Percentage of total cost | Cost per acre | Percentage of total cost |
| Hired labor | $10.89 | 13.7 | $ ..... | ..... |
| Operator's and family labor | ..... | ..... | 26.89 | 33.9 |
| Total man labor | 10.89 | 13.7 | 26.89 | 33.9 |
| Hired horse labor | .16 | .2 | ..... | ..... |
| Farm horse labor | ..... | ..... | 8.41 | 10.6 |
| Total horse labor | .16 | .2 | 8.41 | 10.6 |
| Plants | 17.72 | 22.4 | ..... | ..... |
| Other materials | .57 | .7 | ..... | ..... |
| Machinery operation | 1.23 | 1.6 | ..... | ..... |
| Taxes | 2.50 | 3.2 | ..... | ..... |
| Depreciation (on equipment) | ..... | ..... | .48 | .6 |
| Interest on investment | ..... | ..... | 10.43 | 13.1 |
| **Total** | **$33.07** | **41.8** | **$46.21** | **58.2** |

TABLE XXI—VARIATION IN COST OF ESTABLISHING A STRAWBERRY PLANTING
(A grouping of the costs of 48 producers in 1925 and 50 producers in 1926)

| Cost per acre | Number of records | Acres of non-bearing berries | Percentage of total non-bearing acreage | Cumulative percentage of non-bearing acreage | Percentage of total records |
|---|---|---|---|---|---|
| | | *acres* | % | % | % |
| $ 31 to 50 | 4 | 31.00 | 6.6 | 6.6 | 4.1 |
| 50 to 60 | 7 | 69.00 | 14.8 | 21.4 | 7.1 |
| 60 to 70 | 16 | 95.50 | 20.5 | 41.9 | 16.3 |
| 70 to 80 | 12 | 90.25 | 19.4 | 61.3 | 12.2 |
| 80 to 90 | 16 | 54.25 | 11.6 | 72.9 | 16.3 |
| 90 to 100 | 13 | 51.25 | 11.0 | 83.9 | 13.3 |
| 100 to 110 | 10 | 29.25 | 6.3 | 90.2 | 10.2 |
| 110 to 130 | 9 | 24.25 | 5.2 | 95.4 | 9.2 |
| 130 to 313 | 11 | 21.33 | 4.6 | 100.0 | 11.3 |

## VARIATIONS IN COST OF PLANTING

The variation in cost of establishing a planting of strawberries is wide. The lowest cost found in this study was $31 per acre and the highest was $313 per acre.

The range shown in Table XXI indicates that the cost of establishing a planting might be reduced considerably by some growers. About 30 percent of the growers (those with a cost of more than $100 per acre) appear to have excessive costs, but there are about 60 percent of the total number that have costs above the average of $80 per acre.

## FACTORS INFLUENCING COST OF PLANTING

**Distribution of man labor.** The total labor charge for establishing a planting (see Table XIX) averaged $46.35 per acre, which is 58 percent of the total cost of planting. Of this amount $37.78, or about four-fifths, was for man labor and $8.57, or about one-fifth, was for horse labor.

Of the man labor cost 71 percent was work by the operator or an unpaid member of the family; 29 percent was hired. The distribution and cost of planting labor is shown in Table XXII.

TABLE XXII—DISTRIBUTION OF MAN LABOR IN STRAWBERRY PLANTING

(Combined averages for 1925 and 1926)

| Labor Items | Hours of man labor per acre | Cost of man labor per acre | Percentage of total man labor used for operation |
|---|---|---|---|
| | *hours* | | % |
| Preparation of plant bed | 12.5 | $ 4.18 | 11.1 |
| Marking and setting | 30.1 | 10.18 | 27.0 |
| Cultivation | 59.0 | 19.94 | 52.7 |
| Miscellaneous labor | 10.4 | 3.48 | 9.2 |
| **Total** | **112.0** | **$37.78** | **100.0** |

Cultivation, which includes both horse cultivation and hoeing, required more than half of the total man labor needed to start a planting of strawberries. The miscellaneous labor shown consists of runner cutting and such fertilizing, green manuring, replanting, cutting blossoms, plowing to and from the berries with a breaking plow, and weevil poisoning, as is done on some of the farms.

**Variation in man labor per acre.** There was a wide variation in the amount of man labor used in planting. The range was from 46.6 hours per acre to 504.9 hours per acre, or a spread of 458.3 hours. A grouping of both the 1925 and 1926 records shows that 14 operators used less than 75 hours of man labor per acre for the establishment of the planting and that 63 producers used less than 150 hours of man labor per acre while 35 used much more than this. There is not enough variance in natural

conditions to necessitate so much difference in the amount of labor as is shown in Table XXIII. The cost of establishment steadily increased from $56.66 per acre to $147.23 per acre, as the man labor increased.

From the following discussion the operator should be able to discern methods of reducing his labor costs for planting.

TABLE XXIII—MAN LABOR AND TOTAL COST PER ACRE OF PLANTING

(Combined averages for 1925 and 1926)

| Hours of man labor per acre | Number of records | Average hours of man labor per acre | Average total cost of establishing the planting |
|---|---|---|---|
| *hours* | | *hours* | |
| 0 to 75 | 14 | 63.4 | $ 56.66 |
| 75 to 150 | 49 | 98.2 | 74.55 |
| 150 to 225 | 22 | 172.8 | 103.61 |
| 225 and over | 13 | 284.7 | 147.23 |
| All farms | 98 | 112.0 | $ 79.28 |

**Size of planting.** The size of the strawberry planting was found to have a strong influence on the cost. As the size of the planting increased from an average of 1.09 to 16.68 acres, the cost of establishment decreased from $109.14 per acre to $62.08 per acre (see Table XXIV).

TABLE XXIV—THE EFFECT OF SIZE ON COST OF PLANTING

(Combined averages for 1925 and 1926)

| | Number of records | Average size of planting | Average cost of planting per acre | Hours of man labor per acre* |
|---|---|---|---|---|
| | | *acres* | | *hours* |
| Below 2 acres | 17 | 1.09 | $109.14 | 166.7 |
| 2 to 6 acres | 58 | 3.01 | 94.03 | 146.5 |
| 6 to 10 acres | 12 | 7.46 | 78.62 | 98.2 |
| 10 acres and over | 11 | 16.68 | 62.08 | 76.8 |
| All farms | 98 | 4.74 | $ 79.28 | 112.0 |

* Exclusive of contract labor.

The decrease in the cost of establishment on the larger plantings is due chiefly to the use of less man labor per acre for runner cutting, planting, and cultivation.

The great saving of man labor on the larger plantings was due to the use of more rapid methods. In runner cutting the large operators used rolling cutters attached to a cultivator. A great many of these growers performed this operation as part of one of the cultivations, so that no extra labor was required. As contrasted to this, the smaller operators more often used hand methods for runner cutting, which of course required much more labor.

The saving in plant-setting labor on the larger patches was due both to the rate of setting and the number of plants set per acre. The larger operators tended to set fewer plants per acre and also were able to set these at a faster rate.

Cultivation and plant-bed preparation required less labor on the larger planting, chiefly because of the larger fields with longer rows and fewer turnings. Also, in cultivating the larger growers usually used two-horse cultivators and thus were able to cover the ground more rapidly.

**Value of land.** The value of the land on which the new planting is located has quite a marked effect on the cost of establishment. As the land increases in value, the interest charge also increases, and the property tax usually rises. In this study the interest on the land value plus the property tax on the land amounted to 16 percent of the total cost of establishing the planting.

## LABOR REQUIREMENTS FOR ESTABLISHING A STRAWBERRY PLANTING

As already shown man labor is the most elastic as well as the largest cost item in a strawberry planting. Increased labor efficiency is largely an individual problem, and the methods used to accomplish this will vary with the individual producers. The two general points of attack are, first to lessen the amount of work needed by use of a better-planned planting; second to increase the rate of work by use of more suitable equipment or improved methods.

Tables XXV, XXVI, XXVII, and XXVIII show the average labor requirements for each operation per acre and per operation and the extent to which each operation was used by growers in establishing a planting.

TABLE XXV—LABOR REQUIREMENTS FOR PLANT-BED PREPARATION
(Combined averages for 1925 and 1926)

| Labor operation | How performed | Number of records averaged | Percentage of total acreage | Average times over | Hours per acre | | | Hours per acre per operation | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Man | Horse | Tractor | Man | Horse | Tractor |
| Plowing | Horse | 90 | 85.9 | 1.2 | 8.0 | 16.4 | ..... | 6.5 | 13.4 | ..... |
| Plowing | Tractor | 6 | 10.4 | 1.4 | 3.4 | ..... | 3.4 | 2.6 | ..... | 2.6 |
| Disking | Horse | 49 | 37.6 | 2.3 | 4.4 | 8.9 | ..... | 1.9 | 4.0 | ..... |
| Disking | Tractor | 9 | 16.2 | 2.3 | 2.3 | ..... | 2.3 | 1.0 | ..... | 1.0 |
| Harrowing | Horse | 79 | 77.4 | 2.1 | 2.3 | 4.7 | ..... | 1.2 | 2.3 | ..... |
| Harrowing | Tractor | 6 | 12.4 | 3.2 | 2.0 | ..... | 2.0 | .7 | ..... | .7 |
| Floating | Horse | 24 | 17.1 | 1.2 | 1.6 | 3.3 | ..... | 1.4 | 2.7 | ..... |
| Floating | Tractor | 2 | 3.0 | 2.0 | 2.4 | ..... | 2.4 | 1.4 | ..... | 1.4 |
| Spring-toothing | Horse | 21 | 22.0 | 1.6 | 2.6 | 5.6 | ..... | 1.6 | 3.4 | ..... |
| Spring-toothing | Tractor | 2 | 1.8 | 3.0 | 2.7 | ..... | 2.7 | .8 | ..... | .8 |
| Other plant-bed preparation | Horse | 13 | 15.6 | 1.8 | 8.3 | 8.1 | ..... | 3.5 | 3.6 | ..... |
| **Total plant-bed preparation** | **Horse** | **88** | **83.1** | **5.2** | **14.6** | **28.7** | ..... | **2.8** | **5.6** | ..... |
| **Total plant-bed preparation** | **Tractor** | **6** | **12.0** | **7.8** | **8.6** | ..... | **8.6** | **1.2** | ..... | **1.2** |

TABLE XXVI—LABOR REQUIREMENTS FOR MARKING AND SETTING PLANTS

(Combined averages of 1925 and 1926)

| Labor operation | Number of records averaged | Percentage of total acreage | Hours per acre | | |
|---|---|---|---|---|---|
| | | | Man | Horse | Tractor |
| Marking (by hand) | 12 | 8.6 | 3.7 | ..... | ..... |
| Marking (with horse) | 50 | 60.9 | 1.4 | 2.5 | ..... |
| Setting (by hand) | 95 | 91.2 | 35.6 | ..... | ..... |
| Setting (with tractor) | 3 | 8.7 | 6.6 | ..... | 2.2 |
| Total planting* (by hand) | 47 | 35.9 | 39.9 | ..... | ..... |
| Total planting† (with horse) | 48 | 55.4 | 33.9 | 2.6 | ..... |

* Marked by hand and set by band or set by wire without marking.
† Marked by horses and set by hand.

(NOTE: Strawberries in the Willamette Valley are planted in hills. The matted row system is not satisfactory under limited summer rainfall unless irrigation is used.)

TABLE XXVII—LABOR REQUIREMENTS FOR CULTIVATION OF PLANTING

(Combined averages of 1925 and 1926)

| Labor operation | Number of records | Percentage of total acreage | Average times over | Hours per acre | | Hours per acre per operation | |
|---|---|---|---|---|---|---|---|
| | | | | Man | Horse | Man | Horse |
| | | % | | | | | |
| Cultivation (with horse) | 97 | 99.4 | 9.1 | 26.1 | 31.2 | 3.0 | 3.6 |
| Hoeing | 88 | 92.0 | 2.6 | 50.0 | ..... | 20.2 | ..... |
| Total cultivation | 97 | 99.5 | 11.6 | 70.8 | 31.2 | 7.0 | 3.6 |

TABLE XXVIII—LABOR REQUIREMENTS FOR MISCELLANEOUS OPERATIONS

(Combined averages of 1925 and 1926)

| Labor operation | Number of records | Percentage of total acreage | Hours per acre | |
|---|---|---|---|---|
| | | | Man | Horse |
| | | % | | |
| Cut runners (with horse) | 7 | 6.6 | 9.3 | 8.6 |
| Cut runners (by hand) | 52 | 33.8 | 32.0 | ..... |
| Other miscellaneous labor | 24 | 22.5 | 9.2 | 4.8 |
| Total miscellaneous | 63 | 51.7 | 30.9 | 3.9 |

The total man-labor requirement for establishing a planting is 112 hours per acre. Of this, 16 hours of man labor for preparing the seedbed and marking (where these operations are done with horses) and 35.6 man hours for setting (where done by hand) are the important items, since the season favorable to planting is limited and the labor for this work, except on small patches, must be hired.

Careful study of the average labor requirements should enable many growers, by comparison with their own expenditures of labor, either to eliminate or to materially reduce labor in certain operations.

For example, the savings made by marking the planting ground with horse labor instead of by hand, by cultivating with horses instead of by hoeing, by cutting runners with horse labor instead of by hand, and similar savings are made clear.

Many of the improvements indicated have already been discussed under the analysis of operations in the bearing berry patch, on earlier pages.

## POSSIBLE IMPROVEMENTS IN STRAWBERRY FARM ORGANIZATION

The primary purpose of this study was to determine the cost of producing strawberries and the major factors that influence this cost. Specific study of the entire farm organization was not undertaken. It seemed, however, that certain features in the organization of some of the cooperating farms could be improved. In some cases this improvement in organization might materially lower the strawberry production cost, and in other cases it appeared that it might return the operator a larger income for the operation of the farm as a whole. The factors in the organization of these farms apparently most frequently in need of adjustment were (1) diversity of business, (2) size or volume of business, (3) better yields or quality of business, and (4) crop rotation.

**Diversity.** Diversity allows the use of a better-balanced labor program and also provides several sources of income. By diversifying, peak labor periods can largely be eliminated, and the year's work can be spread out so that the operator can always have profitable work to occupy his time. Many cases were found where the lack of diversity placed too much dependence on the strawberry crop as a source of income. As long as prices for strawberries were high this was satisfactory enough, perhaps. A crop failure or a period of low prices, however, might prove serious to many growers with an organization of this type. The strawberry is not a very good enterprise of which to make an exclusive specialty unless the grower has sufficient cash reserve or outside employment available to tide him over years of failure or partial failure.

**Volume.** A large volume of business, which is essential to good profits, is directly related to diversity. With specialization in strawberries rather impractical, the only other way of developing a large volume of business is to add some other income-producing enterprise.

**Yields and rotation.** The effect of strawberry yields on costs and profits has previously been discussed. The same principle applies to other crops and to livestock production; namely, high yields and low costs are generally associated. One of the best methods of maintaining good crop yields is by crop rotation. This reduces weeds, allows the humus content of the soil to be rebuilt, and conserves and increases plant food. Rotation is considered of particular importance for good strawberry yields, yet in this study the use of a systematic rotation was not found in any instance.

**Organizing the strawberry farm.** There are two fairly distinct types of strawberry farms. Perhaps the most common is the small farm with

the small berry acreage. Usually this type is located near a town. The second type is the medium-to-large general farm which usually is located on cheaper land several miles from town. About equal numbers of these two types are included in this study.

Each type has a somewhat different set of conditions and needs as to its organization. The primary need of the small farm is greater diversity. This will allow additional sources of income, a larger volume of business, and better distribution of labor throughout the year. The larger farms are chiefly in need of better coordination of existing enterprises and better provision for maintaining good yields.

**Crop enterprises.** A number of cash crop and fruit enterprises fit well with strawberries. Permanent plantings such as the cane fruits, raspberries, blackberries, etc., tree fruit or nut crops, asparagus, etc., according as soil and other conditions favor them, enable the smaller farms to diversify and increase the volume of business. Many annual crops such as vegetables or truck crops, cannery crops, potatoes, market sweet corn, field corn for feed, etc., furnish cultivated row crops that work out well in the strawberry rotation.

**Crop rotation.** Regardless of the other enterprises selected a good rotation for the strawberry planting is very necessary. Approximately three times the area of the bearing berries is needed for such a rotation. This will allow five years between strawberry plantings on the same land.

A good strawberry rotation should include both legume and clean-cultivated crops. On most soils at least one legume used for a green manure crop will be very beneficial to fertility and humus building. For purposes of control of weed and insect damage it is desirable to have two years of clean cultivated crops preceding strawberry planting. A suggested rotation using clover or vetch as a legume and two years of clean cultivation preceding berry planting is shown in Table XXIX.

If a bearing patch of 5 acres was desired, for example, for this rotation three 5-acre fields would be needed, either one or other of which would be in bearing berries all the time.

TABLE XXIX—A SUGGESTED STRAWBERRY ROTATION

| Year | Field A | Field B | Field C |
|---|---|---|---|
| 1st | *Bearing berries* | Cultivated crop | Fall grain (sown to clover) |
| 2d | *Bearing berries* | Cultivated crop | Clover |
| 3d | *Bearing berries* | Nonbearing berries | Clover |
| 4th | Fall grain (sown to clover) | *Bearing berries* | Cultivated crop |
| 5th | Clover | *Bearing berries* | Cultivated crop |
| 6th | Clover | *Bearing berries* | Nonbearing berries |
| 7th | Cultivated crop | Fall grain (sown to clover) | *Bearing berries* |
| 8th | Cultivated crop | Clover | *Bearing berries* |
| 9th | Nonbearing berries | Clover | *Bearing berries* |

The soil will determine to a large extent what crops can be used in the strawberry rotation. On some soils clover may not be a satisfactory legume and in these cases vetch can be substituted. Where vetch is

used the fall grain crop shown might be omitted and vetch could be grown for three years instead of two, one of the crops being plowed under as green manure. Where clover is grown the second crop, or the whole crop in the second year, can be used for green manure.

Suggestions for cultivated crops have been given. If manure is to be used on the soil it would be better to use it on the cultivated crop as this will allow most of the live weed seeds to germinate and be destroyed before the strawberries are set.

**Livestock enterprises.** The number and size of the livestock enterprises will depend on the land available and the crops grown. The purposes of these enterprises should be: First, to utilize as nearly as possible all of the idle time of the operator, and second, to increase further the farm income to the desired size. As a rough rule an operator should aim toward a minimum gross income of $3,000 but many will be able so to organize their farms that they can surpass this sum.

There are two livestock enterprises well adapted to the small farm. Both, like strawberries, require close attention to detail. These enterprises are: Chickens for egg production, and cows. Either, or a combination of the two, added to strawberry growing will give a well-balanced labor program. A minimum unit of 400 hens will allow efficient production for the poultry enterprise, although 600 hens are a more desirable minimum for many farms.

On the smaller farms 600 hens and 3 to 4 acres of strawberries will make a combination capable of producing a gross income of $3,000 or better. With reasonably good management, normal prices, and an average production of 180 eggs per hen, a gross income of $4.50 per hen can be expected. Strawberries, based on normal prices and an average yield of 3,500 pounds, return a gross income of about $200 per acre.

On medium-sized or large farms where acreage for hay and succulent feeds are available, a dairy enterprise can be used. A minimum of 10 cows and 8 to 10 acres of strawberries will return a very satisfactory gross income. With reasonably good care a gross income of $120 per cow may be expected from cows of standard quality. Some of the larger farms may find it desirable to have other livestock enterprises such as sheep, goats, or a combination of sheep, cows, and chickens.

The acreage and crop possibilities of the farm and the experience and abilities of the operator determine the enterprises that are desirable. Satisfactory combinations of profitable crop and livestock enterprises can be worked out for any type of farm. The incorporation of some of these enterprises into the farming program along with the strawberries is suggested as offering opportunity for improvement of the organization and income of many of the strawberry farms.

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