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# GROWING CELERY ON THE ISLAND OF HAWAII-- PRODUCTION PRACTICES, COSTS AND FIGURES

*William L. Collier, Jack R. Davidson, and Samuel G. Camp*

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# GROWING CELERY ON THE ISLAND OF HAWAII-- PRODUCTION PRACTICES, COSTS, AND RETURNS

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## INTRODUCTION

The Waimea (Kamuela) area on the Island of Hawaii produces all the celery grown commercially in the State. Between the first of August and the middle of September, 1965, detailed physical and economic information was obtained on 13 of the 17 known celery operations through personal interviews of the farm operators. This was part of a general survey of productions costs and practices for vegetable operations on the Island of Hawaii.

The following report on the costs and practices used in growing celery is based on this survey. The survey findings have been checked against and supplemented with information from published research and the experience of staff members of the Hawaii Agricultural Experiment Station and the Hawaii Cooperative Extension Service.

## CHARACTERISTICS OF THE AREA AND FARMS

The Waimea area is a cool, relatively dry plateau between the Mauna Kea and Kohala mountains. Production is concentrated in two locations: Puukapu, several miles east of the Kamuela Post Office on State Highway 19, and Lalamilo, a state irrigation project, located a few miles southwest of the Post Office on Highway 19.

The farmers interviewed grew approximately 78 percent of the celery produced in the State. The four growers who produced the remainding 22 percent could not be interviewed at the time of the survey, although some information about their operations was gathered from other reporting sources and has been included below.

The average farm size of the 17 celery growers was 37½ acres. Although two or more vegetable crops per year are grown on most of these farms, the average annual production of vegetables is only about 35 acres. Of the 17 growers, one grew only celery while the other 16 diversified their production. Fifteen of these farmers produced lettuce, 7 grew head cabbage, 7 Chinese cabbage, and 3 daikon. Celery made up an average of 23 percent of the total vegetable acreage grown by these farmers in a normal year. Of the 13 farmers included in the survey only one rented all of his land (from the Hawaiian Homes Commission), while four rented part of their land.

Figure 1. A view of the Lalamilo farming area, Waimea (Kamuela), Hawaii.

Figure 2. A view of the Puukapu farming area, Waimea, (Kamuela), Hawaii.

## PRODUCTION PRACTICES OF THE INTERVIEWED FARMERS

Analysis of the practices of the interviewed farmers indicate that they may be classed into two groups on the basis of the intensity with which they applied productive resources. Eight farmers fell into a group using relatively high applications of productive inputs per acre of celery grown. This group consequently incurred much higher per-acre production costs than did the remaining five operators. In the following description of production practices these groups are referred to as the representative "high-cost" and "low-cost" producers. However, it must be recognized that this is a classification based on per-acre cost and not per unit of product. The typical high-cost producer in the survey realized much higher yields per acre than did the low-cost producer, as will be shown later.

Normally, a representative producer in each classification would grow the following crops and acreages:[1]

| | LOW-COST PRODUCER (acres/year) | HIGH-COST PRODUCER (acres/year) |
|---|---|---|
| Celery | 11.0 | 6.0 |
| Lettuce | 16.0 | 8.0 |
| Head cabbage or Chinese cabbage | 0.0 | 7.0 |
| Other crops | 10.0 | 0.0 |
| Total | 37.0 | 21.0 |

A crop of celery requires, on the average, 167 days in the summer and 175 days in the winter to mature enough for harvesting. This length of time is separated into two periods: the seedbed and the field. Typically, celery seedlings remain in the seedbeds for an average of 73 days before transplanting. After being in the fields for an average of 94 days (summer) or 102 days (winter) the crop is harvested. A number of the farmers interviewed estimated a difference of two weeks in length of the growing time between the summer and winter.

Seedbed. All of the growers prepared a small plot for starting their plants. These seedlings were fertilized, sprayed, irrigated, and weeded. Most of the island's celery growers planned to set out from 1/6 of an acre (high-cost producer) to 1/4 of an acre (low-cost producer) of seedlings every week. They were not always able to maintain this schedule because of weather conditions.

Field Preparation. The fields were usually first plowed and then disked, though five farmers relied only on disking the field a number of times. Most of the farmers fumigated their soil.

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[1] These two totals are representative acreages and not averages. Consequently, several large acreages of daikon are not included.

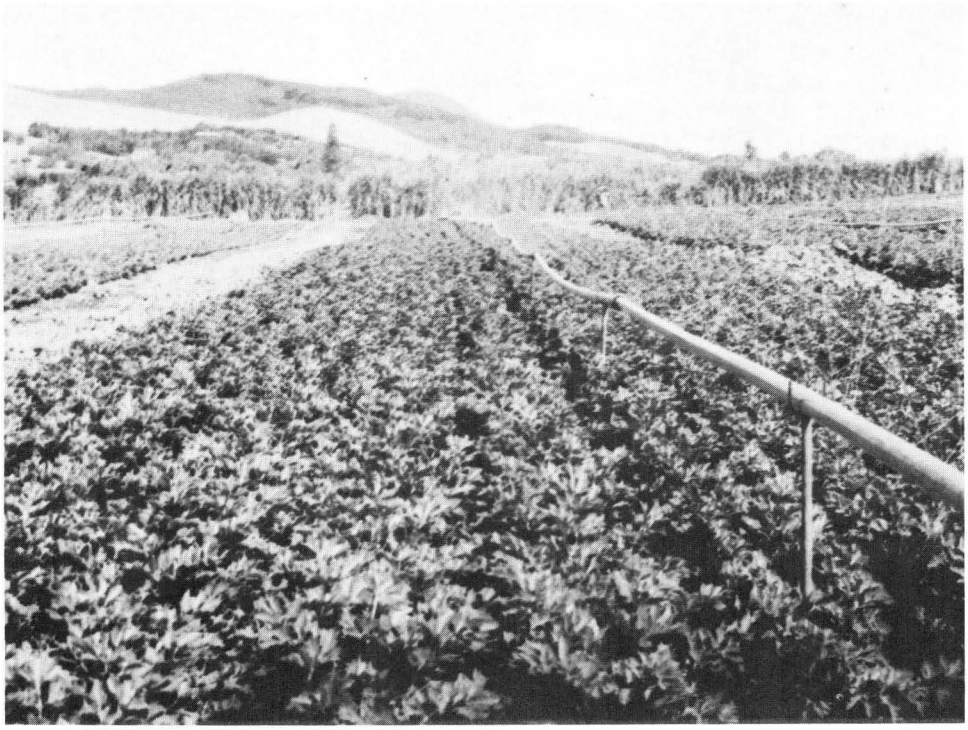

Figure 3. An irrigation system in the Lalamilo area, Waimea (Kamuela), Hawaii.

Figure 4. An irrigation system in the Puukapu area, Waimea (Kamuela), Hawaii.

Transplanting. Pulling up the seedlings and setting them into the field required between 14 and 16 percent of the total hours of labor. Transplanting was done entirely by hand. The representative high-cost grower used twice as much labor, on the average, as did the representative low-cost grower (Table 1).

Fertilizing. Only chemical fertilizers were used. None of the farmers interviewed used manure for this crop. Three-fourths of the growers applied some fertilizer to the fields before transplanting. All sidedressed their plantings, though the representative low-cost operator performed this operation twice and the high-cost, three times per crop.

Irrigating. Celery must be irrigated. In the summer the growers irrigated their fields about once every two or three days. In the winter they irrigated approximately every five days. The low-cost producer used less than one-half the labor hours for each irrigation; therefore, his total labor for irrigating was much less (Table 1).

Spraying. Usually the growers sprayed their celery one time per week.

Weeding. This operation required more labor than any of the other operations except harvesting. Most of the farmers (eight) relied on hand weeding and herbicides. Over three-fourths of them applied herbicides at least once. About one-third used some kind of machinery to help eliminate weeds. Although each cost group weeded approximately two times per crop, the farmers represented by the high-cost producer used an average of 112 hours per acre per weeding operation as compared with 35 hours per acre for the low-cost producer (Table 2 and 3).

Harvesting. Due to the much greater yield per acre of the high-cost producer, his harvesting time was about 100 hours more than the low-cost grower's. The low-cost grower averaged two harvests per crop, while the high-cost harvested three times (Table 1).

## CALENDAR OF OPERATIONS

An important task for a farm manager is to select his crops and to organize his planting schedule so that he effectively utilizes his available labor and other resources. Tables 2 and 3 show calendars of operations for the representative low-cost and high-cost celery producers; the tables give a breakdown of this crop's demand on productive resources by months. This can be used as a guide in planning labor use and in scheduling the various operations (e.g., spraying and fertilizing) that must be done each month. The amounts of fertilizer, spray materials, and seed that are normally used in producing the crop on Hawaii are listed in the last column.

Labor requirements are usually very low for the first two months. They rise rapidly in the third month with transplanting and then decrease and level off for the final two months of the maturing process. Finally, the labor use reaches a peak in the sixth month during the harvest operation (see Figures 1 and 2).

Table 1. Summer labor use per acre of celery, representative low-cost and high-cost producers, Waimea area, Island of Hawaii, Hawaii vegetable crop survey, 1965.

| Labor-using activity | Low-cost producers Hrs/Ac | Percent | High-cost producers Hrs/Ac | Percent |
|---|---|---|---|---|
| Establishing the stand | (106.1) | (24.1) | (166.8) | (19.6) |
| Seedbed | 39.1 | 8.9 | 34.4 | 4.0 |
| Field preparation | 2.7 | .6 | 6.4 | .8 |
| Transplanting | 64.3 | 14.6 | 126.0 | 14.8 |
| Cultural operations | (158.3) | (35.9) | (409.6) | (48.1) |
| Fertilizing | 12.5 | 2.8 | 39.3 | 4.6 |
| Weeding | 70.2 | 15.9 | 219.4 | 25.8 |
| Spraying | 27.7 | 6.3 | 32.3 | 3.8 |
| Irrigating | 47.9 | 10.9 | 118.6 | 13.9 |
| Havesting and handling | 176.4 | 40.0 | 275.3 | 32.3 |
| Representative total hours | 440.8 | 100.0 | 851.7 | 100.0 |

Winter labor use per acre of celery, representative low-cost and high-cost producers, Waimea area, Island of Hawaii, Hawaii vegetable crop survey, 1965.

| Labor-using activity | Low-cost producers Hrs/Ac | Percent | High-cost producers Hrs/Ac | Percent |
|---|---|---|---|---|
| Establishing the stand | (99.9) | (23.6) | (174.1) | (20.8) |
| Seedbed | 30.1 | 7.1 | 32.1 | 3.8 |
| Field preparation | 3.0 | .7 | 6.6 | .8 |
| Transplanting | 66.8 | 15.8 | 135.4 | 16.2 |
| Cultural operations | (145.5) | (34.3) | (382.0) | (45.5) |
| Fertilizing | 12.5 | 2.9 | 36.4 | 4.3 |
| Weeding | 70.2 | 16.6 | 226.7 | 27.1 |
| Spraying | 29.8 | 7.0 | 37.3 | 4.4 |
| Irrigating | 33.0 | 7.8 | 81.6 | 9.7 |
| Harvesting and handling | 178.5 | 42.1 | 282.2 | 33.7 |
| Representative total hours | 423.9 | 100.0 | 838.3 | 100.0 |

## COSTS OF PRODUCING CELERY

In this report the cost of producing celery is based on practices and use of materials reported by the interviewed farmers in the Waimea area on the Island of Hawaii. When the farmers were interviewed, they were asked about their usual practices in the summer and in the winter under normal conditions. Under conditions of severe storms or unusual insect and disease problems, the estimates of the amounts of materials used, the techniques practiced, and the yield achieved in this report must be adjusted to the changed conditions.

None of the information in this report reveals the costs and practices of any of these individual farmers.

Costs of producing celery have been grouped into direct and indirect costs. Direct costs of production are those that can be related to the actual growing and harvesting of the crop. Mainly this includes labor and materials. Indirect costs are related to the entire farm operation. Examples are the depreciation costs of machinery and buildings, rent, etc.

### Indirect Costs

The representative investment in the various kinds of machinery and buildings is presented in Table 4. Depreciation of this investment is the primary indirect cost for these producers.

Since the growers produced other crops besides celery, this indirect cost was prorated among all the crops on the basis of usage. Celery production required about 50 percent of the total equipment usage, varying from 25 to 100 percent among the farmers interviewed. After being adjusted to a per-acre basis, this cost was $73.00 for the low-cost growers and $99.50 for the high0cost growers (see Table 4).

Representative low- and high-cost farmers had the following equipment:

| Low-Cost | High-Cost |
|---|---|
| Irrigation pipes | Irrigation pipes |
| 2 - Disc harrows | 1-- Disc harrow |
| 1 - Disc plow | 1 - Disc plow |
| 1 - Fertilizer applicator | 1 - Fertilizer applicator |
| 1 - Cultivator | 1 - Seeder |
| 1 - Seeder | 1 - Boom-type or hose-type power sprayer |
| 1 - Boom-type or hose-type power sprayer | 1 - Knapsack sprayer |
| 1 - Knapsack sprayer | 1 - Tractor, 1949, crawler |
| 1 - Tractor, 1957, crawler | 1 - Tractor, 1957, wheel |
| 1 - Tractor, 1955, wheel | 1 - Tractor, 1960, wheel |
| 1 - Tractor, 1962, wheel | 1 - Pickup truck, ½ ton, 1960 |
| 1 - Pickup truck, ½ ton, 1958 | 1 - Truck, 1½ ton, 1952 |
| 1 - Farm building, 4,000 sq. ft. | 1 - Farm building, 700 sq. ft. |

From the survey it appeared that the major differences between these two groups were that the representative high-cost producer had a truck while the low-cost did

Table 2. Calendar of farm operations for a representative low-cost producer who has yields of 25,700 pounds (Summer) and 37,200 pounds (Winter) of celery per acre per crop, Waimea (Kamuela) area, Island of Hawaii.

| Month | Operation | Man hours per acre | No. of men | Acres | Power hrs. per acre | Type of power and equipment | Materials and notes |
|---|---|---|---|---|---|---|---|
| 1 | Seedbed:[a] | | | | | | |
| | Soil preparation | 1.0 | 1 | - | 1.0 | | |
| | Planting(1X) | 2.0 | 1 | - | - | By hand | 8 oz of seed per seedbed for 1 ac |
| | Spraying(4X) | 1.0 | 1 | - | - | Power sprayer | A nominal amount of fertilizer |
| | Irrigating(9X) | 7.5 | 1 | - | - | | |
| | Fertilizing(1X) | .5 | 1 | - | - | By hand | A nominal amount of fertilizer |
| | Weeding(1X) | 5.0 | 1 | - | - | By hand | |
| Total | 1st month | 17.0 | | | 1.0 | | |
| 2 | Seedbed:[a] | | | | | | |
| | Spraying(4X) | 1.0 | 1 | - | - | Power sprayer | A nominal amount of spray |
| | Irrigating(10X) | 7.5 | 1 | - | - | | |
| | Weeding(1X) | 5.0 | 1 | - | - | By hand | |
| Total | 2nd month | 13.5 | | | | | |

Table 2 (cont.)

| Month | Operation | Man hours per acre | No. of men | Acres[c] | Power hrs. Per acre | Type of power and equipment | Materials and notes |
|---|---|---|---|---|---|---|---|
| | Seedbed[a] (12 days):[b] | | | | | | |
| | Spraying(2X) | .5 | 1 | - | - | Power sprayer | A nominal amount of spray |
| | Irrigating | 1.9 | 1 | - | - | | |
| | Plowing(1X) | 2.5 | 1 | 1 | 2.5 | Tractor and disk plow | |
| | Disking(2X) | 4.0 | 1 | 1 | 10.5 | Tractor and disk harrow | |
| 3 | Fumigating(1X) | 8.0 | 1 | .25 | - | | 70 lbs/ac of Nemagon |
| | Preplant Fertilizing (1X) | 1.3 | 1 | .25 | - | By hand | 660 lbs/ac of 10-10-5+20, 340 lbs/ac of other ratios |
| | Transplanting(1X) | 65.6 | 4 | .25 | - | By hand | |
| | Spraying(3X) | 3.9 | 1 | 1 | 3.9 | Tractor and boom sprayer or power spra sprayer | Parathion ½ lb (actual)/ac/spray DDT 2 lbs wettable/ac/spray Manzate 2 lbs/ac/spray |
| | Irrigating(8X summer) | (9.6) | 1 | ½ | - | | |
| | (5X winter) | (6.0) | 1 | ½ | - | | |
| | Applying herbicide(1X) | 3.7 | 11 | .25 | - | Knapsack sprayer | Vegadex 4½ qts/ac/application |
| Total | 3rd month Summer | 101.0 | | | 16.9 | | |
| | Winter | 97.4 | | | 16.9 | | |

Table 2 (cont.)

| Month | Operation | Man hours per acre | No. of men | Acres[c] | Power hrs per acre | Type of power and equipment | Materials and notes |
|---|---|---|---|---|---|---|---|
| | Sidedressing(1X) | 6.0 | 1 | .25 | - | Hand applicator | 660 lbs/ac of 10-10-5+20 340 lbs/ac of others |
| | Irrigating(13X summer) | (15.6) | 1 | ½ | - | | |
| | 7X winter) | ( 8.4) | 1 | ½ | - | | |
| 4 | Spraying(4X) | 5.2 | 1 | 1 | 5.2 | Tractor and boom sprayer or power sprayer | Parathion ½ lb (actual)/ac/spray DDT 2 lbs wettable/ ac/spray Manzate 2 lbs/ac/ application |
| | Weeding(1X) | 35.0 | 2 | .25 | - | By hand | |
| Total | 4th month Summer | 61.8 | | | 7.6 | | |
| | Winter | 54.6 | | | 7.6 | | |
| | Sidedressing(1X) | 6.0 | 1 | .25 | - | Hand applicator | 660 lbs/ac of 10-10-5+20 340 lbs/ac of other ratios |
| | Irrigating(13X summer) | (15.6) | 1 | ½ | - | | |
| | ( 7X winter) | ( 8.4) | 1 | ½ | - | | |
| 5 | Spraying(4X) | 7 6 | 1 | 1 | 7.6 | Tractor and boom sprayer | Phosdrin ½ lb (actual)/ac/spray Manzate 2 lbs/ac/ spray |
| | Weeding(4X) | 35.0 | 2 | .25 | - | By hand | |
| Total | 5th month Summer | 61.8 | | | 7.6 | | |
| | Winter | 54.6 | | | 7.6 | | |

Table 2 (cont.)

| Month | Operation | Man hours per acre | No. of men | Acres[c] | Power hrs per acre | Type of power and equipment | Materials and notes |
|---|---|---|---|---|---|---|---|
| | (20 days)[d] | | | | | | |
| | Irrigating(8X summer) | (9.6) | 1 | ½ | - | | |
| | (5X winter) | (6.0) | 1 | ½ | - | | |
| 6 | Spraying(3X) | 3.9 | 1 | 1 | 3.9 | Tractor and boom sprayer or power sprayer | Phosdrin ½ lb (actual)/ac/spray Manzate 2 lbs/ac/ spray |
| | Harvesting(2X) | 180.0 | 4 | .25 | - | By hand | |
| Total | 6th month Summer | 193.5 | | | 3.9 | | |
| | Winter | 189.9 | | | 3.9 | | |
| Total | for crop Summer | 448.6 | | | 34.6 | | |
| | Winter | 427.0 | | | 34.6 | | |

[a]The inputs for the seedbed are the amounts which will produce enough seedlings to transplant into a one acre field.

[b]The seedlings are in the seedbed for an average of 12 days in the third month.

[c]This column indicates the actual land size in acres of each operation. However, the man hours per acre and the power hours per acre columns are in terms of hours per acre in order to facilitate summation of the hours for each month.

[d]An average of 20 days in the sixth month are required for this crop.

Table 3. Calendar of farm operations for a representative high-cost producer who has yields of 48,800 pounds (Summer) and 54,600 pounds (Winter) of celery per acre per crop, Waimea (Kamuela) area, Island of Hawaii.

| Month | Operation | Man hours per acre | No. of men | Acres | Power hrs per acre | Type of power and equipment | Materials and notes |
|---|---|---|---|---|---|---|---|
| 1 | Seedbed:[a] | | | | | | |
| | Soil preparation | 1.0 | 1 | - | 1.0 | | |
| | Planting(1X) | 2.0 | 1 | - | - | By hand | 8 oz of seed per seedbed for 1 ac |
| | Spraying(4X) | 1.0 | 1 | - | - | Power sprayer | A nominal amount of spray |
| | Irrigating(10X) | 7.5 | 1 | - | - | | |
| | Fertilizing(1X) | .5 | 1 | - | - | By hand | A nominal amount of fertilizer |
| | Weeding(1X) | 5.0 | 1 | - | - | By hand | |
| Total | 1st month | 17.0 | | | 1.0 | | |
| 2 | Seedbed:[a] | | | | | | |
| | Spraying(4X) | 1.0 | 1 | - | - | Power sprayer | A nominal amount of spray |
| | Irrigating(10X) | 7.5 | 1 | - | - | | |
| | Weeding(1X) | 5.0 | 1 | - | - | By hand | |
| Total | 2nd month | 13.5 | | | - | | |

Table 3 (cont.)

| Month | Operation | Man hours per acre | No. of men | Acres[c] | Power hrs. per acre | Type of power and equipment | Materials and notes |
|---|---|---|---|---|---|---|---|
| | Seedbed[a] (10 days):[b] | | | | | | |
| | Spraying(2X) | .5 | 1 | - | - | Power sprayer | A nominal amount of spray |
| | Irrigating(3X) | 1.9 | 1 | - | - | | |
| | Plowing(1X) | 2.5 | 1 | 1 | 2.5 | Tractor and disk plow | |
| 3 | Fumigating(1X) | 8.0 | 1 | 1/6 | - | | 70 lbs/ac of Nemagon |
| | Preplant Fertilizing (1X) | 5.3 | 1 | 1/6 | - | By hand | 1,000 lbs/ac of 10-10-5+20<br>500 lbs/ac of other ratios |
| | Transplanting(1X) | 130.0 | 3 | 1/6 | - | By hand | |
| | Spraying(3X) | 5.1 | 1 | 1 | 5.1 | Tractor and boom sprayer or power sprayer | Parathion ½ lb (actual)/ ac/spray<br>DDT 2 lbs wettable/ ac/spray<br>Manzate 2 lbs/ac/ spray |
| | Irrigating(10X summer) | (23.0) | 1 | ½ | - | | |
| | ( 5X winter) | (15.0) | 1 | ½ | - | | |
| | Applying herbicide(1X) | 3.7 | 1 | 1/6 | - | Knapsack sprayer | Vegadex 4½ qts/ac/ application |
| Total | 3rd month Summer | 184.0 | | | 11.6 | | |
| | Winter | 176.0 | | | 11.6 | | |

Table 3 (cont.)

| Month | Operation | Man hours per acre | No. of men | Acres[c] | Power hrs. per acre | Type of power and equipment | Materials and notes |
|---|---|---|---|---|---|---|---|
| | Sidedressing(1X) | 10.0 | 1 | 1/6 | - | Hand applicator | Parathion ½ lb (actual)/ac/spray DDT 2 lbs wettable/ ac/spray |
| 4 | Irrigating(15X summer) | (34.5) | 1 | 1/2 | - | | Manzate 2 lbs/ac/ application |
| | ( 7X winter) | (21.0) | 1 | 1/2 | - | | |
| | Spraying(4X) | 6.8 | 1 | 1 | 6.8 | Tractor and boom sprayer or power sprayer | 1,000 lbs/ac of 10-10-5+20 500 lbs/ac of other ratios |
| | Weeding(1X) | 112.0 | 2 | 1/6 | - | By hand | |
| Total | 4th month (Summer | 163.3 | | | 5.2 | | |
| | Winter | 149.8 | | | 5.2 | | |
| | Sidedressing(1X) | 10.0 | 1 | 1/6 | - | Hand applicator | 1,000 lbs/ac of 10-10-5+20 500 lbs/ac of other ratios |
| | Spraying(4X) | 6.8 | 1 | 1 | 6.8 | Tractor and boom sprayer or power sprayer | Phosdrin ½ lb (actual)/ac/spray Manzate 2 lbs/ac/ spray |
| 5 | Weeding(1X) | 112.0 | 2 | 1/6 | - | By hand | |
| | Irrigating(15X summer) | (34.5) | 1 | 1/2 | - | | |
| | ( 7X winter) | (21.0) | 1 | 1/2 | - | | |
| Total | 5th month Summer | 163.3 | | | 6.8 | | |
| | Winter | 149.8 | | | 6.8 | | |

Table 3 (cont.)

| Month | Operation | Man hours per acre | No. of men | Acres[c] | Power hrs. per acre | Type of power and equipment | Materials and notes |
|---|---|---|---|---|---|---|---|
| | (20 days)[d] | | | | | | |
| | Sidedressing(1X) | 10.0 | 1 | 1/6 | - | Hand applicator | 1,000 lbs/ac of 10-10-5+20 1/2 500 lbs/ac of other ratios |
| 6 | Irrigating(10X summer) | (23.0) | 1 | 1/2 | - | | |
| | ( 5X winter) | (15.0) | 1 | 1/2 | - | | |
| | Spraying(3X) | 5.1 | 1 | 1 | 5.1 | Tractor and boom sprayer or power sprayer | Phosdrin ½ lb (actual)/ac/spray Manzate 2 lbs/ac/ spray |
| | Harvesting(3X) | 279.0 | 4 | 1/6 | - | By hand | |
| Total | 6th month Summer | 317.1 | | | 5.1 | | |
| | Winter | 309.1 | | | 5.1 | | |
| Total | for crop Summer | 858.2 | | | 29.7 | | |
| | Winter | 815.2 | | | 29.7 | | |

[a]The inputs for the seedbed are the amounts which will produce enough seedlings to transplant into a one acre field.

[b]The seedlings are in the seedbed for an average of 10 days in the third month.

[c]This column indicates the actual land size in acres of each operation. However, the man hours per acre and the power hours per acre columns are in terms of hours per acre in order to facilitate summation of the hours for each month.

[d]Twenty days in the sixth month are required for this crop.

Table 4. Machinery and building investment, representative low-cost and high-cost celery producers Waimea (Kamuela) area, Island of Hawaii, Hawaii vegetable crop survey, 1965

| Item | 1965 value of investment[a] | | Depreciation per year[b] | | Cost per acre to the celery enterprise[c] | |
|---|---|---|---|---|---|---|
| | Low cost | High cost | Low cost | High Cost | Low cost | High cost |
| Irrigation Equipment | $33,290.00 | $3,960.00 | $ 335.00 | $ 283.00 | $15.00 | $27.00 |
| Implements | 990.00 | 950.00 | 172.00 | 137.00 | 6.50 | 10.00 |
| Sprayers | 430.00 | 280.00 | 93.00 | 51.00 | 4.50 | 4.00 |
| Tractors | 4,600.00 | 3,640.00 | 636.00 | 418.00 | 27.00 | 29.00 |
| Trucks and pickups | 240.00 | 3,200.00 | 97.00 | 425.00 | 9.00 | 28.00 |
| Buildings | 3,700.00 | 300.00 | 232.00 | 18.00 | 11.00 | 1.50 |
| Total | $13,250.00 | $12,330.00 | | | $73.00 | $99.50 |

[a]Value of investment was calculated by first depreciating the original price of each piece of equipment to determine the 1965 value. Next these values for each category were added and divided by the number of farmers interviewed.

[b]Depreciation per year was determined by dividing the purchase price of each piece of equipment by the number of years it could be used. These amounts were then added for each category and divided by the number of farmers interviewed. This also covers the cost of repairs and maintenance which is a relatively minor cost since the farmers do not extensively use their equipment.

[c]Per acre cost to the celery enterprise was calculated by adding the depreciation per year for each item and reducing this to a per acre basis. This was multiplied by the percentage of use of each item by the representative celery crop.

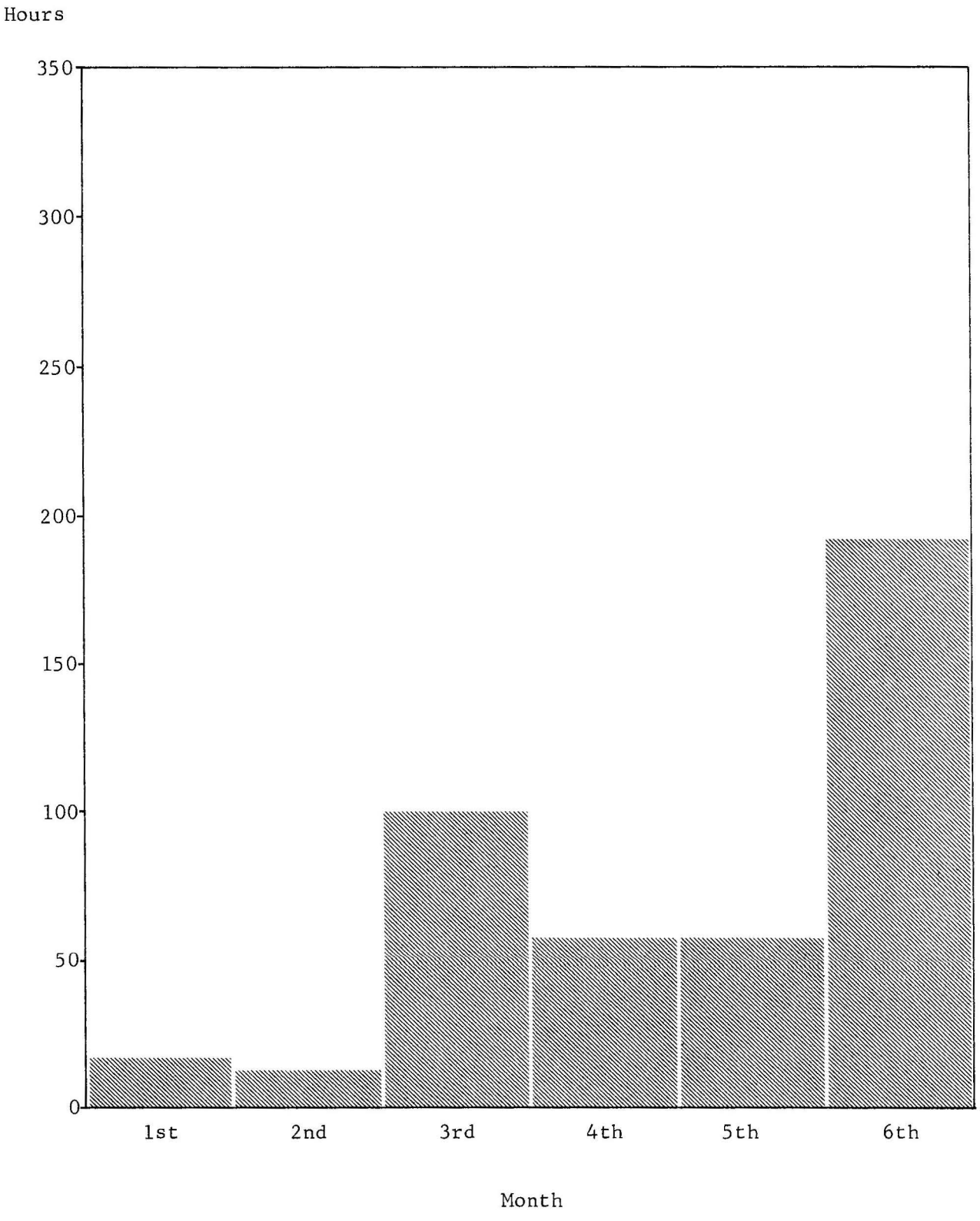


Figure 5. Schedule of labor use per acre per crop by month for a representative low-cost celery producer in the Waimea (Kamuela) area, Island of Hawaii, (an average of summer and winter)

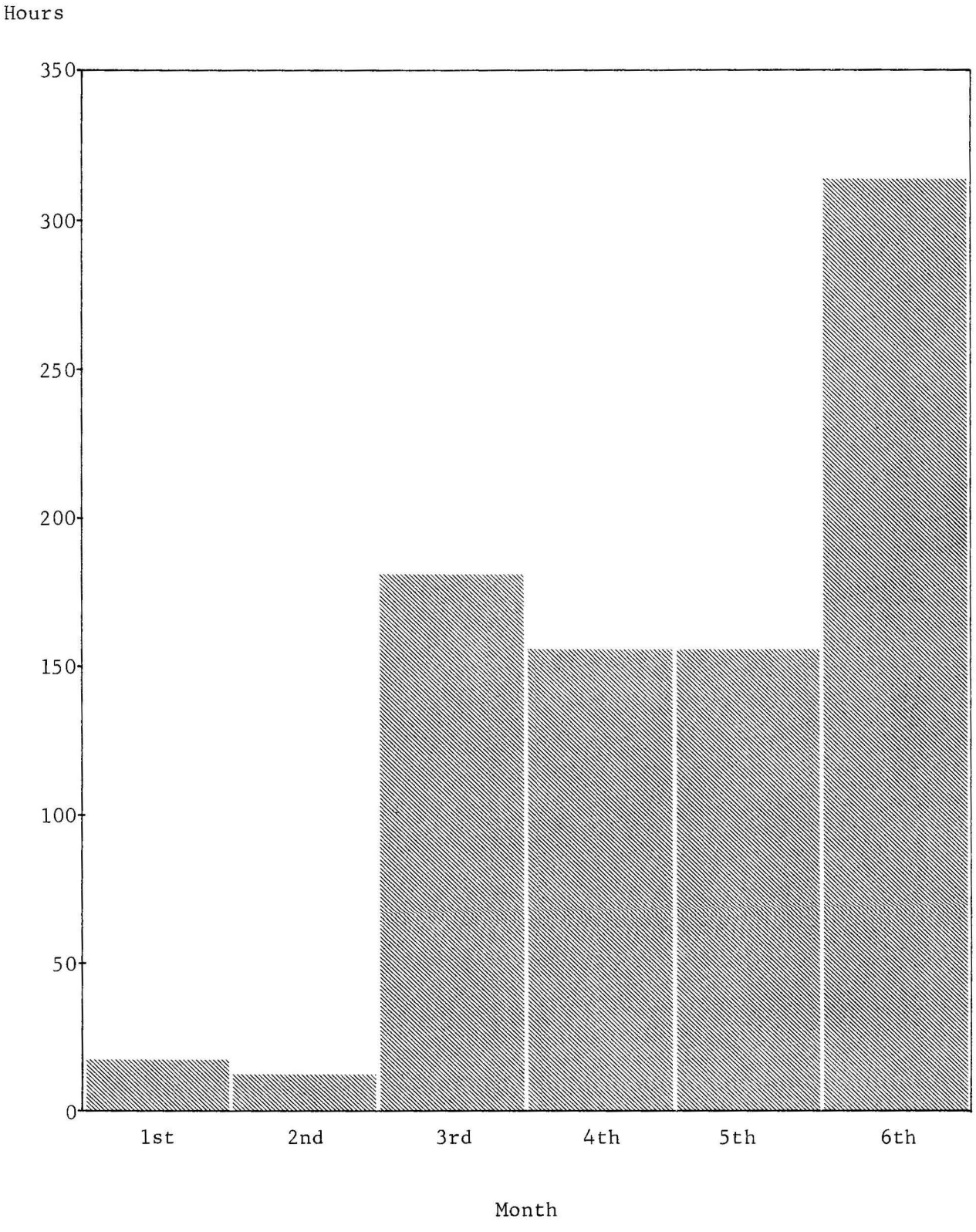


Figure 6. Schedule of labor use per acre per crop by month for a representative high-cost celery producer in the Waimea (Kamuela) area, Island of Hawaii, (an average of summer and winter)

not, and the low-cost grower had more invested in his farm building. Table 4 gives the values of these investments for representative operations.

Another indirect cost to the farmers is a charge for their land. Some rented and some owned their farm land. For this analysis a charge of $15.00 rent per acre per crop was made to each grower.

**Direct Costs**

Consisting of labor costs, materials expenditure, and a gross income tax, direct costs were the predominant expense of the celery producers. In Waimea the prevailing wage was $1.25 per hour for hired truck crop workers. Charging this rate for both family and hired labor, the representative labor costs per acre, based on requirements in Table 1, would be $551.00 (summer) and $530.00 (winter) for low-cost producers and $1,065.00 (summer) and $1,048.00 (winter) for high-cost producers.

The material costs for representative operations are given in Table 5. These costs include:

Seed, Each of the cost groups used about 8 ounces of seed in order to plant a one acre field of celery.

Fertilizer. The low-cost producer used 3,000 pounds per acre of fertilizer for a crop of celery. Doubling this amount, the high-cost producer used almost 6,000 pounds per acre. Most of it was 10-10-5+20, supplemented with other ratios. The +20 stands for minor elements.

Spray materials. A wide variety of fumigants, herbicides, insecticides, and fungicides were used by the farmers. Because of the difficulty in determining the amounts used, these costs are only rough estimates.

Crates. Each crate holds 55 pounds of celery and costs 80 cents new. All of the growers used new crates, except one who had 10 percent used crates. By far, this was the growers' highest material cost, and from 26 to 35 percent of the total cost per acre of production of celery. Understandably, this is a cost that the farmers feel is too high and should somehow be lowered.

Gas and Oil. The growers were asked how much gas and oil they used per month. Then this was converted to the cost per acre of celery. Consequently, it is an approximation of this expense per year.

Irrigation water. Each farmer was questioned about the cost of water per month in the summer and winter. Based on the estimates of their water bills, the cost was allocated to each crop depending on the share applied to each. Therefore, the cost of irrigation water per acre has been derived from overall monthly or yearly figures and must be considered as only a rough indication of the cost.

Total representative material costs amount to $765.00 per acre (summer) and $927.00 per acre (winter) for the low-cost producer; $1,323.00 per acre (summer) and $1,345.00 per acre (winter) for the high-cost producer (see Table 5). The latter one is higher because of the cost of fertilizer and crates.

Finally, the remaining direct cost is the gross income tax. This was calculated by taking one-half of one percent of the gross return from an acre of celery as the amount of the tax per acre.

Table 5. Costs of materials for the representative low-cost and high-cost producers, Waimea (Kamuela) area, Island of Hawaii, Hawaii vegetable crop survey, 1963.

| | Low-cost Producers | | High-cost Producers | |
|---|---|---|---|---|
| | Summer | Winter | Summer | Winter |
| Seed | $100.00 | $ 10.00 | $ 15.00 | $ 15.00 |
| Fertilizer | 170.00 | 170.00 | 300.00 | 300.00 |
| Spray materials | 121.00 | 121.00 | 145.00 | 135.00 |
| Crates | 370.00 | 540.00 | 730.00 | 815.00 |
| Gas and oil | 36.00 | 33.00 | 33.00 | 30.00 |
| Irrigation water | 58.00 | 53.00 | 100.00 | 50.00 |
| Total | $765.00 | $927.00 | $1,323.00 | $1,345.00 |

**Total Costs and Net Returns**

A combination of the direct and indirect costs, the total cost of production of celery is given in Tables 6 and 7 for the low-cost and high-cost producers.

The total costs for the representative low-cost producer were $1,412.22 per acre (summer) and $1,558.39 per acre (winter). For the high-cost producer, the total costs of production were $3,123.20 per acre (summer)pand $3,932.65 per acre (winter). Due primarily to the difference in labor hours, cost of crates, and fertilizer expense, the high-cost producer had a much higher cost of production. However, this was compensated for by increased yields.

Under representative conditions, the low-cost grower had yields of 25,700 pounds per acre in the summer and 37,200 pounds per acre in the winter. On the other hand, the high-cost grower had yields of 48,800 pounds per acre in the summer and 54,600 pounds per acre in the winter. Because of this variation in cost and yields between the two groups, the important basis for comparison is the cost per pound, which was calculated by dividing the total cost of production by yield. The low-cost producer of this study had total costs of production of 5.5 cents a pound (summer) and 4.2 cents per pound (winter). In comparison, the high-cost producer realized costs of 5.2 cents a pound (summer) and 4.6 cents a pound (winter), while the high-cost grower had the advantage in the summer.

Table 6. Cost of and net return from producing celery by a representative low-cost producer in the Waimea (Kamuela) area, Island of Hawaii

| Item | Cost per acre | | Cost per pound | |
|---|---|---|---|---|
| | Summer | Winter | Summer | Winter |
| Direct costs: | Dollars | Dollars | Cents | Cents |
| Labor ($1,25/hr.)[a] | 551.00 | 530.00 | 2.1 | 1.4 |
| Materials | 765.00 | 927.00 | 3.0 | 2.5 |
| Gross income tax[b] | 8.22 | 13.39 | - | - |
| Total direct costs | 1,324.22 | 1,470.39 | 5.1 | 4.0 |
| Indirect costs: | | | | |
| Machinery and buildings | 73.00 | 73.00 | .3 | .2 |
| Rent | 15.00 | 15.00 | .1 | - |
| Total indirect costs | 88.00 | 88.00 | .4 | .2 |
| Total cost of production | 1,412.22 | 1,558.39 | 5.5 | 4.2 |
| Total gross return (Summer 25,700 lbs/ac @ 6.4¢/lb) (Winter 37,200 lbs/ac @ 7.2¢/lb) | 1,644.80 | 2,678.40 | | |
| Net farm earnings | 232.58 | 1,120.01 | .9 | 3.0 |
| Interest on investment[c] | 32.00 | 32.00 | .1 | .1 |
| Net return to management | 200.58 | 1,088.01 | .8 | 2.9 |

[a]The prevailing wage rate in the Kamuela area was $1.25 per hour for hired labor.

[b]This is based on one-half of one percent of the farmers' gross sales.

[c]Interest was set at 6% per year on the average investment.

Table 7. Cost of and net return from producing celery by a representative high-cost producer in the Waimea (Kamuela) area, Island of Hawaii

| Item | Cost per acre | | Cost per pound | |
|---|---|---|---|---|
| | Summer | Winter | Summer | Winter |
| | Dollars | Dollars | Cents | Cents |
| Direct costs: | | | | |
| Labor ($1.25/hr.)[a] | 1,065.00 | 1,048.00 | 2.2 | 1.9 |
| Materials | 1,323.00 | 1,345.00 | 2.7 | 2.5 |
| Gross income tax[b] | 15.62 | 19.66 | - | - |
| Total direct costs | 2,403.62 | 2,412.66 | 5.0 | 4.4 |
| Indirect costs: | | | | |
| Machinery and buildings | 99.50 | 99.50 | .2 | .2 |
| Rent | 15.00 | 15.00 | - | - |
| Total indirect costs | 114.50 | 114.50 | .2 | .2 |
| Total cost of production | 2,518.12 | 2,527.16 | 5.2 | 4.6 |
| Total gross return (Summer 48,800 lbs/ac @ 6.4¢/lb) (Winter 54,600 lbs/ac @ 7.2¢/lb) | 3,123.20 | 3,932.65 | | |
| Net farm earnings | 605.08 | 1,405.49 | 1.2 | 2.6 |
| Interest on investment[c] | 60.00 | 60.00 | .1 | .1 |
| Net return to management | 545.08 | 1,345.49 | 1.1 | 2.5 |

[a]The prevailing wage rate in the Kamuela area was $1.25 per hour for hired labor.
[b]This is based on one-half of the percent of the farmers' gross sales.
[c]Interest was set at 6% per year on the average investment.

As reported, the price of celery per pound received by the farmers fluctuated about one cent from summer (8 cents) to winter (9 cents).[2] The Hawaii Crop and Livestock Reporting Service estimated that in 1965 the farmers were paid 6.8 cents a pound.[3] Based on the more conservative figure adjusted for price fluctuations, the price per pound in this report was assumed to be 6.4 cents a pound in the summer and 7.2 cents a pound in the winter. The gross returns per acre are shown in Tables 6 and 7. Minus the costs of production, the net farm earnings were $232.58 per acre (summer) and $1,120.01 per acre (winter) for the low-cost producer and $605.08 per acre (summer) and $1,405.49 per acre (winter) for the high-cost producer. Or, in other terms, the net farm earnings for the low-cost one were .9 cent a pound (summer) and 3.0 cents a pound (winter), and for the high-cost were 1.2 cents a pound (summer) and 2.6 cents a pound (winter). With some allowance for variation this suggests the two groups actually achieved similar results.

Even though the high-cost grower's return was about $300.00 per acre more, the low-cost grower's return for a year's production of celery was greater. He grew 11 acres per year while the high-cost producer grew only 6 acres per year. Using less labor per acre, he was able to handle more total acres of the crop. Each representative producer owned or rented about the same size of farm.

## COMPARISON WITH A PREVIOUS STUDY

In order to compare this study with a 1963 study on the cost of producing celery in Hawaii, the marketing cost must be added to the cost of production in Tables 6 and 7.[4] To determine this marketing cost, the assumption of a 20-percent wholesaler's commission was used in this study as was done in the 1963 study by Mollett. The other expense incurred in shipping the celery from the Island of Hawaii at a cost of 1¼ cents a pound, a cost similar to the 1.2-cents-a-pound charge found in the Mollett study. A comparison of these marketing costs is presented in Table 8, along with the costs of production, yields and total costs.

Yields and costs of the typical producer in the 1963 study fall between the low- and high-cost producers of this study. However, in 1963, this typical producer had the highest cost per pound, indicating that since 1961 and 1962 the farmers have increased their efficiency in growing celery by improving their yield per acre and/or lowering their costs per acre. This is a trend that must continue.

## MARKETING AND SHIPPING COSTS

Almost all the celery growers belong to marketing cooperatives. There are at least three cooperatives handling the grower's celery. The interviewed farmers

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[2]The farmers reported the price as 8 cents a pound (summer) and 9 cents a pound (winter).

[3]Statistics of Hawaiian Agriculture, 1965, Hawaii Crop and Livestock Reporting Service, June 1966, p. 42.

[4]J.A. Mollett, Cost of Producing Celery in Hawaii, Agricultural Economics Report No. 62, Hawaii Agricultural Experiment Station, University of Hawaii, June, 1963, p. 10.

Table 8. A comparison of costs and yields for the representative low-cost and high-cost producers and a typical producer

| | Cost of production | | Yield | Marketing cost | | Total cost | |
|---|---|---|---|---|---|---|---|
| | $/Ac | ¢/Lb. | Lbs/Ac | $/Ac | ¢/Lb | $/Ac | ¢/Lb. |
| Low-cost producer: | | | | | | | |
| Summer | 1,412.22 | 5.5 | 25,700 | 910.25 | 3.3 | 2,322.47 | 9.0 |
| Winter | 1,558.39 | 4.2 | 37,200 | 1,335.48 | 3.6 | 2,893.87 | 7.8 |
| High-cost producer: | | | | | | | |
| Summer | 2,518.12 | 5.2 | 48,800 | 1,615.28 | 3.3 | 4,133.40 | 8.5 |
| Winter | 2,527.16 | 4.6 | 54,600 | 1,960.14 | 3.6 | 4,487.30 | 8.2 |
| 1963 Typical Producer | | | | | | | |
| Mollett study | 2,227.60 | 5.6 | 40,000 | 1,521.80 | 3.8 | 3,749.40 | 9.4 |

took their celery to nearby cooperative loading points. Most of this crop was sent to Honolulu although some was sent to Hilo and Maui.

According to the farmers the cost of shipping the celery to Honolulu by refrigerated vans (chill box) was approximately 1¼ cents a pound.[5] Several growers sent part of their celery by plane to Honolulu. They estimated the cost of air freight a 2-3/4 cents a pound. Some of the celery was also shipped by non-refrigerated vans. This cost about ½ cents a pound.

## LABOR AND MANAGEMENT EARNINGS FROM CELERY PRODUCTION

In this study the growers represented by the low-cost producer used an average of 53 percent family labor, while the high-cost used 72 percent (Table 8). Since the net farm earnings in Tables 6 and 7 do not include the return to family labor, the cost of family labor was added to the net farm earnings in Table 9 to show the labor and management earnings gained by the operator from an acre of celery production. Thus, the representative net returns to the low-cost growers were $524.61 per acre (summer) and $1,400.91 per acre (winter), and $1,371.88 per acre (summer) and $2,160.05 per acre (winter) to the high-cost growers. Consequently, the family income per acre to the two types of operations was larger than that indicated earlier as net return. This was especially true for the high-cost growers using family labor extensively. However, the return from a year's production of celery under the assumed prices and yields was almost the same for the two groups because of the larger acreage of the low-cost growers (p. 3). Although this level of income can be achieved under the special conditions found in the Waimea area, there can be great variation because of fluctuations in yields and prices.

From the above analysis it would appear that since the representative low- and high-cost growers received about the same earnings per year, the choice of which method to use depends on the available land, family labor, hired labor, and the other crops that can be grown in Waimea. If an operator has a large farm or a small family, he would probably choose the low-cost method. If he has a smaller farm or large family, he might choose the high-cost method. Another factor that would affect the decision is the possibility of growing other crops.

## SUMMARY

There appears to be opportunities for expansion of the celery industry on the Island of Hawaii. In 1965 the Waimea (Kamuela) growers supplied only 66 percent of the total amount of celery bought in the state.[6] In order to replace the mainland celery on the local market, it is necessary to produce an additional 27 to 44 acres of celery per year depending on which method of production is used. If all the celery were grown by high-cost producers, then 27 acres more would about

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[5]Young Brothers charges $82.50 per chill van with a load limit of 7,000 pounds, a cost of $.0118 per pound. Interisland Freight Tariff and Classification Naming Class and Commodity Rates Between Ports of Call; Young Brothers, Limited, of Honolulu, Hawaii, April 13, 1965, p. 25.

[6]Statistics of Hawaiian Agriculture 1965, pp. 21 and 50.

Table 9. The effect of the percentage of family and hired labor on family income, Waimea (Kamuela), Hawaii vegetable crop survey, 1965

| Range and average percentage of family labor | | Range and average percentage of hired labor | | Income to family per acre of head cabbage | |
|---|---|---|---|---|---|
| Low-cost[a] | High-cost[d] | Low-cost[b] | High-cost[e] | Low-cost[c] | High-cost[f] |
| 39% (lowest) | 45% (lowest) | 61% (highest) | 55% (highest) | $ 447.49 (summer) $1,326.71 (winter) | $1,084.33 (summer) $1,877.09 (winter) |
| 53% (average) | 72% (average) | 47% (average) | 28% (average) | $ 524.61 (summer) $1,400.91 (winter) | $1,371.88 (summer) $2,160.05 (winter) |
| 66% (highest) | 100% | 34% | 0% | $ 596.24 (summer) $1,469.81 (winter) | $1,670.08 (winter) $2,453.49 (winter) |

[a]Column 1 presents the lowest, average, and highest percentages of family labor for the interviewed growers represented by the low-cost producer.

[b]Column 3 is the reverse of column 1, showing the highest, average, and lowest percentages of hired labor for the interviewed growers represented by the low-cost producer. Columns 1 and 3 sum horizontally to 100%.

[c]Column 5 shows the income per acre from celery to the farm family. The first block in this column gives the income per acre for the summer and winter if the operator used 39% family labor and 61% hired labor in both seasons. The second block in this column presents the income per acre for the summer and the winter if the operator use used 53% family labor and 47% hired labor in both seasons. The third block in this column presents the income per acre for the summer and the winter if the operator used 66% family labor and 34% hired labor.

[d]Column 2 gives the same information as column 1 (see a.) except that it is for the growers represented by the high-cost producer.

[e]Column 4 provides the same information as column 3 (see b.) except that it is for the growers represented by the high-cost producer.

[f]Column 6 gives the same information as column 5 (see c.) except that it is for the growers represented by the high-cost producer.

would about fulfill the state's demand. If all were grown by low-cost producers, then approximately 44 acres more is necessary.

At present, celery not only accounts for a large portion of the Waimea (Kamuela) farm income, but appears to rank first among the major crops grown in terms of net returns per acre (see Table 10). However, this crop also makes the highest demand on available labor resources. Table 10 shows even the low-cost celery growers using at least twice as much labor per acre than required for the alternative crops. Lettuce and Chinese cabbage, the two major crops of the area not shown in the table, have lower net returns and labor use than celery. However, as a labor user lettuce approaches the low-cost method. These observations are based on preliminary analysis of data gathered in the general vegetable survey being prepared for publication.

Present trends indicate that in the next few years the cost of hired labor in Waimea will increase as labor becomes scarcer.[7] As costs increase and as the farmers' children grow up and move away, most grower will probably find it necessary to make changes in organization and operation of their farms. One alternative is for the high-cost producers to cut down on their yearly acreage of celery. Another would be to shift to the low-cost method of producing celery or to other crops. It is apparent also that for celery growers as a group to increase or maintain their income they must be alert for still other methods to increase celery yields and lower costs. For example, analysis of the results of this survey indicates that those presently using low-cost practices could probably increase net farm earnings with little increase in cost by using the heavier fertilizer applications of the high-cost group. This seems to be an important factor in the high yields obtained by these producers.

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[7]Economic Indicators, First National Bank of Hawaii, September, 1965; June, 1966, and December, 1966.

Table 10. Representative labor use and net returns for three crops grown in Waimea (Kamuela), Island of Hawaii, Hawaii vegetable crop survey, 1965

| Crops | Labor use (hrs/ac) | | Net returns ($/ac) | |
|---|---|---|---|---|
| | Summer | Winter | Summer | Winter |
| Daikon[a] | 143.5 | 143.5 | $120.31 | $ 120.31 |
| Head cabbage[b] | 223.2 | 220.9 | 61.28 | 625.23 |
| Celery (low-cost) | 440.8 | 423.9 | 232.58 | 1,120.01 |
| Celery (high-cost) | 851.7 | 838.3 | 605.08 | 1,405.49 |

[a]William L. Collier, Jack R. Davidson, and Teck-Yeu Pee, Analysis of Daikon Proeuction on the Island of Hawaii, Agricultural Economics Report No. 75, Hawaii Agricultural Experiment Station, University of Hawaii, 1967.

[b]William L. Collier and Jack R. Davidson, Economic Analysis of Head Cabbage and Dry Onion Production in the State of Hawaii.

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