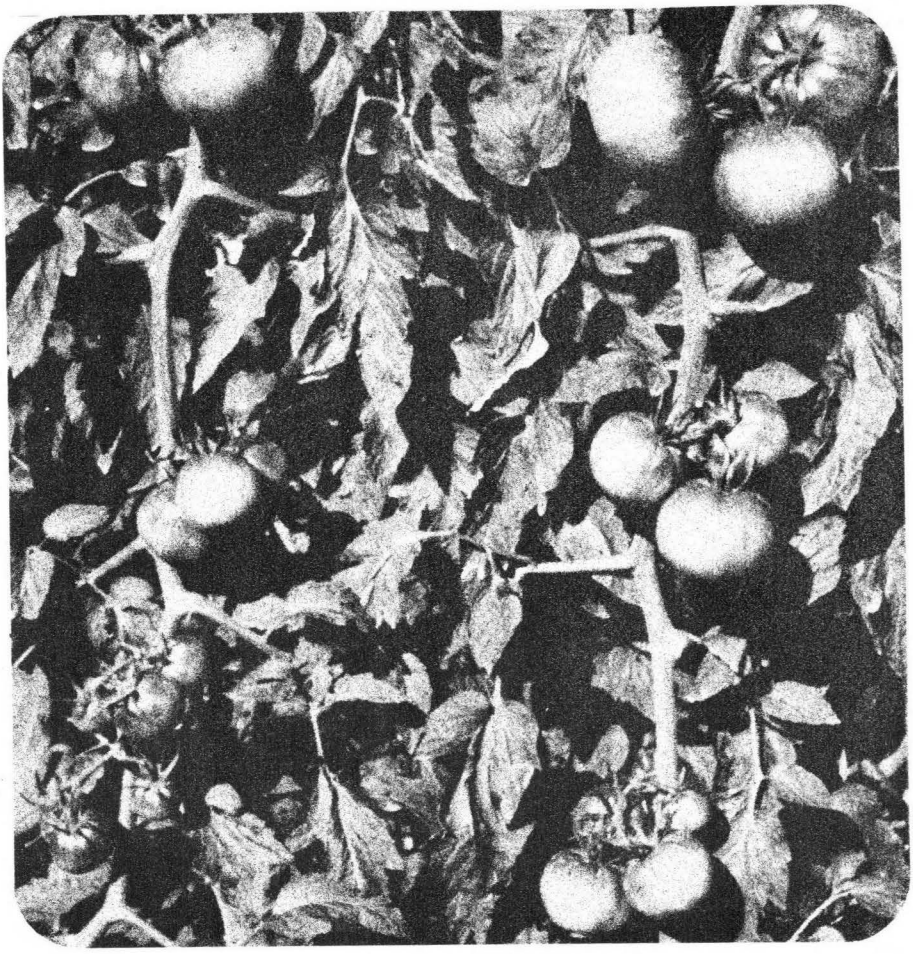

EXPORT POTENTIALS OF MOLOKAI PRODUCED TOMATOES

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EXPORT POTENTIALS OF MOLOKAI PRODUCED TOMATOES

Lloyd B. Rankine[1]
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Arnold B. Larson[2]

INTRODUCTION

The purpose of this study is to make a comprehensive evaluation of the winter export potential for Hawaiian tomatoes on the U.S. Mainland, particularly on the West Coast. Presented here are estimates of production costs, marketing costs, and net returns and an evaluation of Hawaii's ability to produce tomatoes in sufficiently large quantities for commercial export. The demand for fresh tomatoes in selected West Coast markets is examined from the standpoint of the 1952–1963 wholesale prices, the effect of variation in quantities supplied on these prices, and a trend factor. From the analysis of historical data, we have determined the ability of selected markets to absorb added quantities as well as the levels to which the wholesale prices might be depressed. These price levels are of extreme importance since they must be higher than local production and marketing costs if they are to provide local exporters with net profits.

The effect of extra quantities on prices was estimated from wholesale demand curves. From these demand curves estimates were made of the average monthly wholesale prices in the West Coast markets which in turn were used to measure gross returns from sales. Net returns were computed by subtracting the total production and marketing costs for an assumed quantity of fresh tomatoes from the gross returns. Since additional quantities of fresh tomatoes are contemplated for selected West Coast markets, levels of market price are expected to be lower than those presently experienced. In analyzing the West Coast market potential it was assumed that (1) supplies coming from Mexico and other areas would remain unchanged, (2) Hawaiian tomatoes would meet standards for market quality, and (3) the three wholesale markets of Los Angeles, San Francisco, and Seattle can be considered independently. If tomatoes are exported to the mainland from Hawaii, local prices would tend to fall below mainland prices. Hawaiian tomato producers would have alternative markets in which to sell their produce, and surplus or overripe fruits could be channelled into

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the local market. The economies that may be achieved during the winter months could equally apply during the other seasons and this would enable local producers to supplant some of the imports of tomatoes into the state.

During the winter months, December through May, the bulk of the fresh tomatoes sold in the wholesale markets of Los Angeles, San Francisco, and Seattle are imported from Mexico. In 1963, for example, 32.4 percent of the San Francisco wholesale market supply came from Mexico while the remainder was supplied by the warmer areas of California, Texas, and Florida. This amounted to a 12.4-percent increase over the amount supplied in 1952. Similar conditions prevailed in the Seattle and the Los Angeles wholesale markets.

Wholesale tomato prices in West Coast markets are higher in the winter than at any other time of the year. This is due to the scarcity of supplies from the major producing areas in California and the high cost of production and marketing that exist in the warmer areas during the winter. The average monthly prices paid for fresh Mexican tomatoes in West Coast markets are often 5 cents lower than prices paid for tomatoes supplied from other sources. Two probable reasons for this are (1) higher quality of the domestic supply that commands premium prices and (2) differences in the time of day supplies are delivered to the market. A third reason is that the supply of Mexican tomatoes is larger, tending to depress the market price. However, the prices for Mexican tomatoes showed more stability than prices for fresh tomatoes from other areas.

Source of Data and Justification

Two main sources of data were used in this study. The 1963–1965 operations of the Hawaii Agricultural Experiment Station's Molokai Demonstration Farm provided most of the data on which cost estimates were based. Price and quantity data were obtained from the Federal-State Market News Service for Los Angeles, San Francisco, and Seattle. Additional market information was supplied by Sea View Farms, Ltd., in Honolulu, Safeway Stores in Los Angeles and San Francisco, and Pacific Fruit Company, Seattle. Only the data on costs will be discussed in this section. Price and quantity data will be discussed in the section on market analysis.

The Molokai Demonstration Farm was established in 1960 to explore the economic feasibility of producing and exporting winter vegetables to the U.S. Mainland and as such was designed primarily to provide data for several economic feasibility studies on vegetables. Since that time valuable data have been generated on this farm. Many crops have successfully been grown. Of these, tomatoes appear the most promising.

Arriving at a cost of production estimate was perhaps the most difficult of the problems involved in the study. One aspect of the problem was to decide whether to use prevailing practices and results obtained elsewhere

in the state and apply them to the Hoolehua area in which the farm is located or to use only the results of the Demonstration Farm. The results of the Molokai Demonstration Farm operations were used in preference to costs and returns under prevailing practices elsewhere in the state since it was felt that conditions might be different at Hoolehua. This introduced considerable scope for variation due to random causes. In the first place, very few plantings were made of any one crop, so exceptional weather, insect and disease conditions may have affected yields greatly. Differences in time of planting, cultural practices such as timing of fertilizer and spray applications, and the inherent variability in performance of the crop could not be adequately controlled. In addition, plot sizes were small, so experimental errors would be magnified when the data were applied to larger acreages.

The original data were obtained from plots that varied from one-twelfth to two-fifths of an acre. These data were first extended to 1 acre and then to 5 acres, after some adjustments were made for increased scale of operation. These adjustments were made after interviews with specialists at the Hawaii Agricultural Experiment Station and the Cooperative Extension Service, review of previous studies, and on-the-spot observations.

Method of Analysis

A relatively simple model was used in evaluating export potential for tomatoes. First, wholesale demand curves were estimated statistically for San Francisco, Los Angeles, and Seattle. A single equation regression model was used in the analysis of price and quantity data that had been collected for these markets for the period 1952 to 1963. In this model, the average monthly winter prices in these markets were assumed to be largely determined by monthly quantities supplied and a trend factor. Each relationship established for these markets was adjusted for trend to 1963, the year for which the most recent data were available. These results were used to estimate (a) the gross returns per pound of tomatoes as shown in table 1 and (b) the estimated additional quantities that these markets can absorb and their likely effect on the wholesale price levels (see table 8).

A least squares regression model using price as the dependent variable helps to provide estimates such as those we are concerned with in this study. The model can also provide a basis for estimating a retail demand curve for fresh tomatoes in the different markets, or demand at the farm level. Retail and wholesale mark-ups can be added or subtracted to get the desired relationship. Further, the model is easy to interpret and does not require very rigid assumptions. Often the rigid assumptions of more complicated models present difficulties in locating statistical weaknesses in the results. The overall model is such that any change that occurs in costs or market price can easily be substituted to get new results.

Table 1. Summary of projected winter production costs and expected returns for tomatoes produced on 5 acres at Hoolehua, Molokai, at average wholesale prices in selected West Coast markets, 1963

Costs and returns	Percent of total	Dollars 5 acres	Dollars per acre	Cents per pound
Costs				
Labor operations	17.92	11,462.50	2,292.50	2.49
Materials, equipment, and others	9.43	6,031.45	1,206.29	1.31
Fixed costs of building and equipment	1.07	687.50	137.50	.15
Marketing charges	69.62	44,523.00	8,904.60	9.70
Sundries	1.96	1,254.34	250.87	.27
Total costs	100.00	63,958.79	12,791.76	13.92
Returns				
Returns in San Francisco				
Gross		75,735.00	15,147.00	16.50
Net		11,763.81	2,352.76	
Returns in Los Angeles				
Gross		69,309.00	13,861.80	15.10
Net		5,337.81	1,067.56	
Returns in Seattle				
Gross		89,964.00	17,992.80	19.60
Net		25,992.81	5,198.56	
Yield per acre (saleable)		459,000	91,800	

COST AND RETURN ESTIMATES FOR A FIVE-ACRE TOMATO FARM

In the development of the cost and return estimates that appear in the tables below, numerous assumptions were made. Of these the major ones were:

1. The level of management is similar to that used on the Molokai Demonstration Farm and may be superior to that found on an average tomato farm in the state.
2. Five acres of tomatoes can be produced with the same management and cultural practices used in the smaller test plots.
3. Each acre will yield an average of 108,000 pounds over the entire production period, that is, a single crop produced during the winter months.
4. The farmer's prices that are associated with each input will not show any significant increases in the near future.

Table 1 summarizes the estimated costs for production and marketing, also the net returns from estimated sales in San Francisco, Los Angeles, and Seattle. The gross returns per pound that are shown for these markets were obtained from the 1963 demand curves, assuming a low level of sales from Hawaii, so there was no depression of wholesale prices. Costs per pound were distributed over labor, materials, and equipment costs and charges for marketing. Net returns in the Seattle market exceeded returns in Los Angeles by more than $4,000 per acre and in San Francisco by approximately $3,000. A net saleable yield of 91,800 pounds (mature greens) per acre was assumed to allow for spoilage.

Table 2. Estimated amounts and costs of labor required on a 5-acre unit of tomatoes at Hoolehua, Molokai

Operations	Five acres		One acre	
	Hours	Dollar value	Hours	Dollar value
Land preparation	75	93.75	15	18.75
Planting out	175	218.75	35	43.75
Cultivation	385	481.25	77	96.25
Setting up trellises	350	437.50	70	87.50
Pruning and training	2,100	2,625.00	420	525.00
Fertilizing	485	606.25	97	121.25
Spraying (herbicide, fungicide, insecticide)	1,145	1,431.25	229	286.25
Irrigation	530	662.50	106	132.50
Harvesting	3,000	3,750.00	600	750.00
Selecting, packing and shipping	740	925.00	148	185.00
Others	185	231.25	37	46.25
Total	9,170	11,462.50	1,834	2,292.50

Labor requirements for each operation are shown in table 2. All labor was charged at $1.25 per hour. Harvesting operations accounted for the major portion of the labor costs. They cannot be mechanized easily because of the trellised method of cultivation. Harvesting cost per acre increases as yield levels increase but amount picked per hour should increase. Of the other operations for which labor estimates were made, those for selecting, packing, and shipping were the highest. It was estimated that approximately 9,200 hours of labor valued at $11,500 would be required to produce and market 5 acres of fresh tomatoes. Labor operations cost slightly over two cents per pound of saleable produce.

Estimates of both quantity and costs for materials and equipment use are shown in table 3. Listed under materials and equipment use are:

Sprays. These include materials used such as fungicides, herbicides, and insecticides. DDT was charged at 32 cents per pound while Diathene and tribasic copper solution were valued at 87 and 57 cents, respectively. Diazinon was charged at $2.15 per pound and parathion at 54 cents per pound.

Fertilizer. Fertilizer estimates were based on recommendations for the area and were valued at the prices available to farmers at local stores. Potassium chloride was valued at $78 per ton, treble superphosphate at $100 per ton, and urea at $56 per ton. Total fertilizer costs can be expected to stay within $800 or approximately $156 per acre.

Irrigation. The estimates for irrigation charges include amount of water used during packing, spraying, and actual irrigation. Total water charges were estimated at approximately $502 for 6 million gallons and were based on 8 cents per 1,000 gallons and $1.10 per acre per month.

Miscellaneous. Those miscellaneous items for which estimates were made include string, seed, flats, and frames for trellises. Together, they total approximately $1,073 per acre.

Equipment Use. Only charges for truck and tractor use have been included in these estimates and were based on 90 cents per hour for tractor and 80 cents per hour for truck. These are variable expenses and do not relate to the fixed expenses for equipment that are shown in table 5. These estimates represent the average expenditures that can be expected to cover normal operations of the farm.

Others. Items included in this category of costs were charges for land use, land tax, gross income tax, and incidentals. Taxes for land have been assessed at approximately $9.50 per acre, land use cost at $45 per acre,[3] and average gross income tax at one-half of one percent of the gross returns from each market. Together these items were estimated at $149 per acre.

[3]This is an arbitrary figure but is thought to be representative under present conditions. New uses for the land at Hoolehua, including potatoes for potato chip manufacture and hybird seed corn propagation, may raise the value of land.

Table 3. Estimated amounts and costs for materials and equipment use on a 5-acre tomato farm at Hoolehua, Molokai

Materials	Five acres		One acre	
	Units	Dollar value	Units	Dollar value
Sprays (insecticides, fungicides, herbicides)				
Diazinon 50W	195 lbs.	419.25	39 lbs.	83.85
DDT	200 lbs.	64.00	40 lbs.	12.80
Parathion 25W	40 lbs.	21.60	8 lbs.	4.32
Dithane Z78, 75W	260 lbs.	226.80	52 lbs.	45.36
Tribasic copper sulphate	520 lbs	296.40	104 lbs.	59.28
Vegadex	20 qts.	55.00	4 qts.	11.00
Spray total		1,083.05		216.61
Fertilizer				
Treble superphosphate	10,000 lbs.	502.25	2,000 lbs.	100.45
Potassium chloride	2,000 lbs.	77.50	400 lbs.	15.50
Urea	3,625 lbs.	203.00	725 lbs.	40.60
Fertilizer total		782.75		156.55
Irrigation water	60,000 thous. gals.	480.00	1,200 thous. gals.	96.00
Assessment fee		22.00		4.40
Irrigation water cost total		502.00		100.40
Miscellaneous				
Seeds	6¼ oz.	93.75	1¼ oz.	18.75
Flats	225	225.00	45	45.00
String	60 rolls	93.75	12 rolls	18.75
Trellis frames		625.00		125.00
Miscellaneous Total		1,037.50		207.50
Equipment use				
Tractor	860 hrs.	774.00	172 hrs.	154.80
Truck	1,485 hrs.	1,188.00	297 hrs.	237.60
Equipment use total		1,962.00		392.40
Others				
Land use cost		225.00		45.00
Taxes (land)[1]		47.50		9.50
Average gross income tax		391.65		78.33
Others total		664.15		132.83
Total materials and equipment		6,031.45		1,206.29

[1]Assessed value is 70 percent of the market value, estimated at $1,000 per acre. The assessed value per acre amounted to $700 and the tax rate was based on $13.80 per $1,000.

Table 4. Estimates of marketing charges, assuming yield of 91,800 pounds of mature green tomatoes per acre

	Dollars per 5 acres	Dollars per acre	Cents per pound
Shipping crates	8,032.50	1,606.50	1.75
Transportation to Honolulu at $7.00 per ton	1,606.50	321.30	.35
Ocean freight, Honolulu to West Coast at $5.04 per cwt.	23,133.60	4,626.72	5.04
Average wholesale commission at 15% of average wholesale West Coast prices[1]	11,750.40	2,350.08	2.56
	44,523.00	8,904.60	9.70

[1]Only one commission rate was used. It reflects a weighted average of the returns in all three markets—San Francisco, Seattle, and Los Angeles.

Table 4 shows estimates for marketing charges. These estimates include wholesale commission costs, costs for transport from Molokai to Honolulu and from Honolulu to the West Coast. Two freight rates were used: $7.00 per ton from Molokai and $5.04 per cwt. from Honolulu to any of the three markets. Fumigation costs are a very minor item and are included in wholesale commission, 15 percent of the gross returns in each market. These average marketing charges assume that freight passes through one wholesale distributor from Molokai to Honolulu and the West Coast. Ocean freight appears to be the only economically feasible means of transportation under present conditions. Air freight tends to be too expensive to justify its use. Should there be ample supplies this means may be preferred over ocean freight if costs of air and ocean freight are approximately the same or if market prices are substantially higher than they are at the present time. Jumbo jets, which are due in a very few years, may have significantly lower air freight rates. Marketing costs account for approximately 70 percent of the total costs of the entire operation.

Table 5 shows in detail estimates of fixed costs of building and equipment for a typical 5-acre vegetable farm. These estimates were originally prepared by McConnell[4] and revised by Hogg[5]. Costs for each item were based on salvage value, depreciation, interest, and insurance charges. Buildings to accommodate all equipment and provide storage facilities for

[4]McConnell, Douglas J., *Preliminary Studies on the Feasibility of Producing Vegetables on Molokai,* Nos. 1, 2, 3, Hawaii Agricultural Experiment Station, College of Tropical Agriculture, University of Hawaii, 1962.

[5]Hogg, Howard C., *The Feasibility of Diversified Crop Production at Hoolehua,* Department of Land and Natural Resources, State of Hawaii, 1965.

Table 5. Annual fixed costs of buildings and equipment for a 5-acre farm

Items	Initial value	Life	Salvage value	Depreciation	Interest	Insurance	Total	Cost per acre
	Dollars	Years	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
Buildings	2,640	20	264	118.80	79.20	13.00	211.00	42.50
Irrigation	2,660	20	133	126.35	79.80	—	206.15	41.23
Tractor	3,500	12	100	283.33	105.00	—	388.33	77.66
Garden tiller	715	10	35	68.00	21.45	—	89.45	17.89
Bottom plough	530	12	15	42.92	15.90	—	58.82	11.76
Disc harrow	460	12	20	36.67	13.80	—	50.47	10.09
Spike harrow	40	12	—	3.33	1.20	—	4.53	.90
Sprayer	310	10	16	29.40	9.30	—	38.70	7.74
Farm truck	1,000	7	100	128.00	30.00	16.50	332.00[1]	66.40

[1]Includes truck operating costs for 10,000 miles.

SOURCE: Howard C. Hogg, *The Feasibility of Diversified Crop Production at Hoolehua,* Department of Land and Natural Resources, State of Hawaii, 1965.

unshipped produce are expected to last 20 years. Salvage value was estimated at 10 percent of the initial cost. This was subtracted from the original cost and the remainder was divided by the total life expectancy (20 years) to get the annual depreciation value—that is, the straight line method of depreciation was used. To these annual depreciation costs were added interest and insurance charges. The original costs for the equipment listed were based on commercial prices and include transportation to Molokai. If all equipment is purchased outright an outlay of approximately $11,855 would be required. However, annual costs were estimated to be $275 per acre, and since a two-crop year was anticipated, the actual charges were reduced to $137.50 per acre per crop.

These costs and returns estimates are intended to provide basic information on production and marketing potentials for fresh tomatoes in the Hoolehua area. It should be remembered that the data given are based on the results of the operations of the Molokai Demonstration Farm during two seasons, 1963–1965, although efforts have been made to adjust these data to be more in line with expectations on a commercial operation of equal size. Very little adjustment for economies of scale of operation was made. Besides these, other important qualifications are:

1. The yields were obtained from the N55 variety of tomato grown on trellises. Further, they reflect the level of technology that was employed on the Molokai Demonstration Farm. The harvesting season is approximately 4 months.
2. The levels of inputs used are similar to those recommended for the area by the Cooperative Extension Service.
3. Production requirements vary from farm to farm, so the budgets are presented in a manner that permits easy adjustments to a particular situation.
4. Many small overhead costs are not included explicitly but are subsumed in sundry costs.
5. Returns per pound shown in table 6 are subject to a number of important qualifications. First, tomato wholesale prices on which these returns were predicted were derived from the market demand curves for 1963. Statistical evidence shows a negative price trend in Los Angeles as well as San Francisco. Only Seattle showed a positive trend in prices. If the trend in Los Angeles and San Francisco continues, we can expect prices to become lower each year, particularly if there are significant increases in the market supplies.
6. All estimated costs are based on 1963 prices. Obviously, different prices will alter these results.
7. No charges for management have been included in these estimates.

Table 6. Summary of tomato production cost and returns per pound from sales in selected West Coast markets at 1963 wholesale prices

Items	Cents per lb.
Costs	
Labor operations	2.49
Materials and equipment	1.31
Fixed cost of buildings, land and equipment	.15
Marketing charges	9.70
Sundries	.27
Total costs	13.92
Returns	
Los Angeles	
Gross returns[1]	15.10
Net returns	1.18
San Francisco	
Gross returns[1]	16.50
Net returns	2.58
Seattle	
Gross returns[1]	19.60
Net returns	5.68

[1]Gross returns per pound are average monthly 1963 wholesale prices determined from the price-quantity analysis.

8. The data presented here are different from those shown in a previous study,[6] and reflect additional information acquired later.

TOMATO PRICE-QUANTITY RELATIONSHIP IN SELECTED WEST COAST MARKETS

Three wholesale markets, Los Angeles, San Francisco, and Seattle, were selected as sample areas for this study. Each market was considered separately. These are important markets in which much of the winter consumption of fresh tomatoes on the West Coast is centered. The population of these cities is increasing as is also the amount of tomatoes consumed each year. The costs of transporting tomatoes from Hawaii to these markets are similar and supplies can be shifted among the markets as the need arises.

Price and quantity data for the three markets cover only the metropolitan and surrounding wholesale distribution areas. Fresh tomatoes delivered directly to government agencies and those which passed through the cities directly to other markets were not included. Wholesale prices were based on supplies that were generally of good quality and on Wednesday's prices for each week. Prices are quoted in dollars per lug. In the

[6]Lloyd B. Rankine, Arnold B. Larson, and Richard E. Green, *Economic Evaluation of Winter Vegetable Production on Molokai: Molokai Demonstration Farm, Results for 1964–65*, Agricultural Economics Report No. 71, Hawaii Agricultural Experiment Station, University of Hawaii, December 1966.

analysis the following weights were used: Los Angeles and San Francisco, 26 pounds per lug; Seattle, 33 pounds per lug. Quantity data are reported in carlot and carlot equivalents. Each carlot was estimated to contain approximately 30,000 pounds of fresh tomatoes. The data covered the period 1952 to 1963 for Los Angeles and San Francisco. Only six years of complete data were available for Seattle. Wholesale price-quantity relationships were estimated for each market with the aid of multiple regression. In addition to these price-quantity relationships trend equations were estimated for the respective markets.

Results Obtained

The wholesale price-quantity relations obtained took the general form,

$$X_1 = a + b_2X_2 + b_3X_3$$

where X_1 = estimated average monthly wholesale price of fresh tomato from December through May in dollars per lug of varying weights (Los Angeles and San Francisco, 26 pounds each; Seattle, 33 pounds).

X_2 = monthly wholesale quantity of tomato in carlots and carlot equivalents.

X_3 = time in years, (used as substitute variable to account for the effect of income and population changes).

a = intercept

b_2 = quantity coefficient

b_3 = time coefficient

The specific net regressions of X_1, average monthly wholesale winter price on X_2, monthly wholesale quantity, and X_3, time in years (with 1952 = 1), were obtained as follows:

Los Angeles $\quad X_1 = 5.6056 - .00166\,X_2 - .06058\,X_3$
$\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad (3.06)^{*} \quad (1.88)^{**}$

San Francisco $\quad X_1 = 6.5115 - .00939\,X_2 - .03634\,X_3$
$\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad (3.18)^{*} \quad (.662)$

Seattle $\quad X_1 = 6.7673 - .02450\,X_2 + .26170\,X_3$
$\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad (1.74)^{**} \quad (2.01)^{*}$

These are also shown in figure 1.

The following historical trends in supplies available in each market were also obtained:

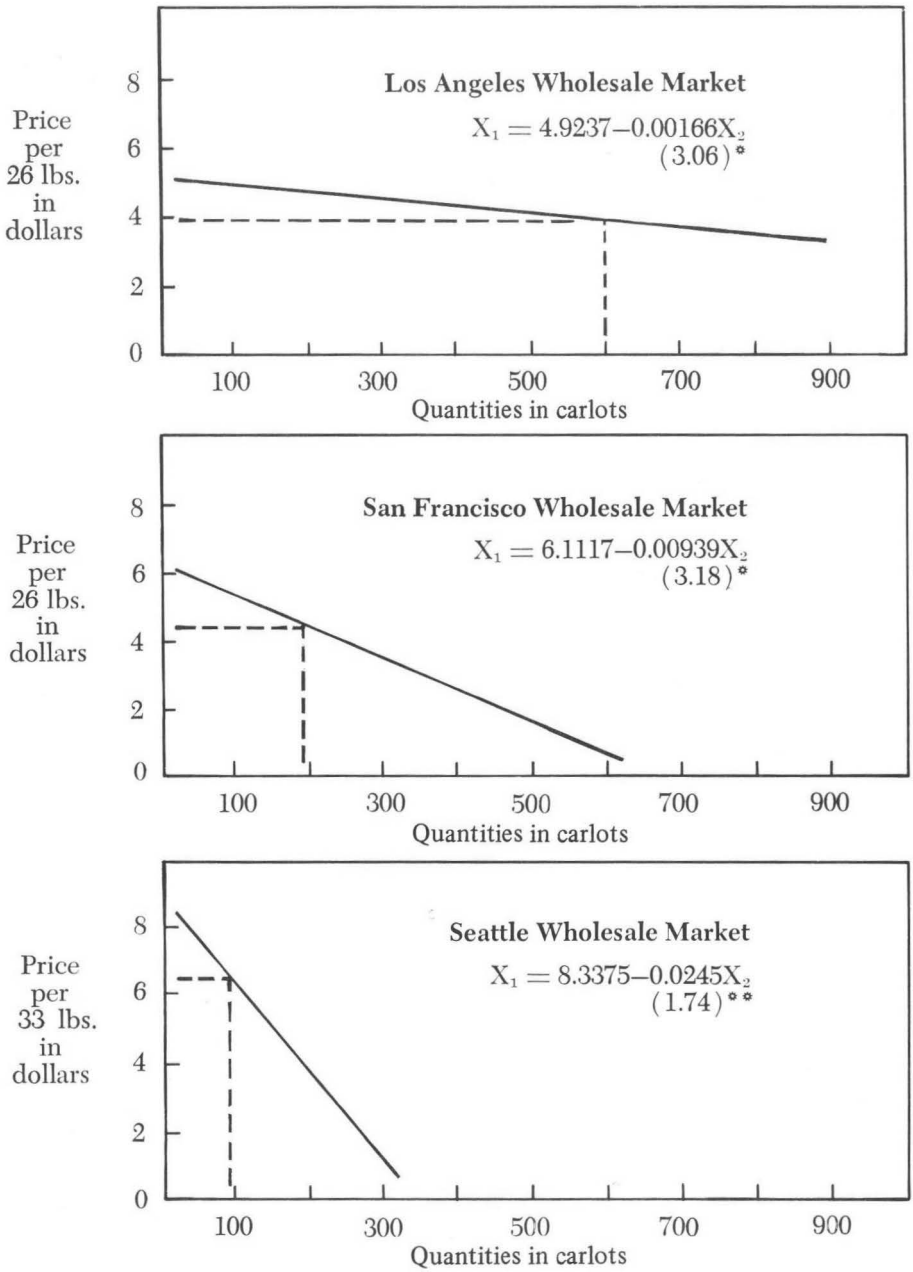
Los Angeles $\quad X_2 = 49.75 + 4.324\,X_3$
$\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad (.324)$

Seattle $\quad X_2 = 57.512 + 12.351\,X_3$
$\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad (7.08)^{*}$

San Francisco $\quad X_2 = 633.227 - 2.285\,X_3$
$\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad (3.11)^{*}$

* t ratios significant at 5-percent level

** t ratios significant at 10-percent level



* t ratios significant at 5-percent level
** t ratios significant at 10-percent level

Figure 1. Price-quantity relationships showing estimated prices and quantities for 1963 in selected markets.

Price and Quantity Determination

Based on the wholesale market information shown above, the 1963 (winter) monthly prices for tomatoes in the various markets were estimated as follows:

Los Angeles $X_1 = 5.6506 - .00166 X_2 - .0606 X_3$

For 1963, $X_3 = 12$, and X_2 is found by solving the trend equation:

$X_2 = 633.227 - 2.285 X_3$

which yields

$X_2 = 605.8$ carlots

therefore

$X_1 = 5.6506 - .00166 (605.8) - .0606 (12)$

or

$X_1 = \$3.92$ per 26-pound lug.

This means that the expected quantity of tomatoes in the Los Angeles market is 606 carlots per month, and this amount can be sold at an average price of $3.92 per 26-pound lug, or 15 cents per pound. Actual figures for that year were 510 carlots per month, sold at $3.88 per lug. These results, together with the results for San Francisco and Seattle, are shown in table 7.

From the above equations and the original data the following information was obtained.

1. Fresh tomatoes from Hawaii face a declining price trend in the California markets studied.
2. During 1952–1963, Seattle was the highest priced wholesale market for fresh tomatoes of the three markets studied. Based on the estimates for 1963, fresh tomato prices in this market averaged approximately 20 cents per pound and were 4 cents higher than prices in both the San Francisco and the Los Angeles markets. The average monthly wholesale price in San Francisco differed from that in Los Angeles by only one cent per pound.

Table 7. Expected and actual average monthly wholesale prices and quantities of fresh tomatoes in selected West Coast markets, winter 1963

Market	Quantities (carlots)		Prices (per 26-lb. lug)	
	Expected	Actual	Expected	Actual
Los Angeles	606	510	3.92	3.88
San Francisco	206	184	4.14	4.28
Seattle[1]	76	68	6.48	7.20

[1]The expected and actual prices for Seattle wholesale market are quoted in dollars per 33 pounds.

3. For every carlot of fresh tomatoes (estimated at 30,000 pounds) supplied to these markets, the average monthly wholesale price decreased by $.0016 in Los Angeles, $.0093 in San Francisco, and $.024 in the Seattle market.
4. Occasionally, there were price differences within these markets. The prices paid for fresh tomatoes from Mexico were often slightly less than those paid for tomatoes from other areas. While this is thought to be due in part to a difference in arrival time on the market, it may also reflect temporary price reductions caused by the arrival of the relatively large shipments from Mexico.
5. Mexico was the largest supplier of fresh tomatoes in these markets, supplying approximately 25 percent from December through May (see table 8 for Mexico's supply). Los Angeles was by far the heaviest consumer of fresh tomatoes from Mexico. In 1963 over 2,000 carlots were supplied to Los Angeles compared with 850 and 269 carlots to San Francisco and Seattle respectively. A similar pattern existed in previous years. While Los Angeles imported Mexican tomatoes the year around, the amounts imported from June to November were relatively small. At no time did these amounts exceed 90 carlots for a particular month. This is because local production is heavy and fresh tomatoes can be obtained at lower prices. Heavy importation from Mexico begins in late December and continues until May with peaks during February, March, and April.
6. Over 814 carlots of fresh tomatoes were handled monthly in the three markets, with the largest amount (about 618 carlots) in Los Angeles. Seattle and San Francisco averaged 65 and 131 carlots per month, respectively. Fresh tomato supplies to Seattle and San Francisco showed increasing trends while those for Los Angeles showed a decreasing trend.
7. A large percentage of the fresh tomato supplies was obtained directly from the shipping point rather than through the wholesale markets. This was particularly true in Los Angeles, especially for the larger supermarkets and chain store distributors located in the area. This trend has been noticeable since 1959. Since some supplies bypass the terminal market, the estimated price effects of reported supplies may be exaggerated somewhat.
8. Table 9 shows the estimated monthly quantities of fresh tomatoes that the three markets can absorb at the price levels indicated. These quantities are based on the price-quantity relationships adjusted for 1963 and computed for each city. The tables shows the amounts of fresh tomatoes in carlot quantities that would be required monthly to depress wholesale prices from their present levels (1963) to the levels indicated in column one.

Table 8. Monthly receipts of fresh tomatoes from Mexico into Seattle, Los Angeles, and San Francisco wholesale markets in carlots and carlot equivalents

Years	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Total	Percent of total receipts
Seattle														
1963	49	67	71	57	13	1	—	—	—	—	—	11	269	25.5
1962	62	52	86	72	30	3	—	—	—	—	—	11	316	27.9
1961	48	27	63	52	6	—	—	—	—	—	2	6	204	19.1
1960	57	57	46	71	40	1	—	—	—	—	—	40	312	29.6
1956	16	20	12	4	1	—	—	—	—	—	—	13	66	6.4
1955	17	14	19	17	7	—	—	—	—	—	—	1	75	7.8
Los Angeles														
1963	182	451	549	509	221	8	3	3	1	—	4	67	1,998	27.7
1962	214	327	429	498	256	30	10	2	—	1	4	18	1,789	23.9
1961	256	287	367	310	75	2	22	23	1	3	11	29	1,386	18.6
1960	205	312	382	387	133	5	21	13	—	—	10	104	1,572	19.5
1959	134	206	492	425	61	—	48	7	1	8	39	55	1,476	12.5
1958	185	300	375	409	67	—	40	1	—	—	22	62	1,461	12.8
1957	246	259	442	394	19	2	62	34	—	2	5	97	1,562	14.0
1956	60	112	97	139	97	—	23	35	—	2	15	242	822	7.4
1955	182	157	276	384	81	2	31	42	—	—	9	19	1,183	11.4
1954	131	255	432	249	43	3	88	28	1	2	25	88	1,345	12.5
1953	228	170	375	301	65	—	47	49	1	—	11	58	1,305	12.8
1952	296	269	372	363	66	—	19	28	1	4	25	88	1,531	16.5

Table 8 (Continued).

Years	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Total	Percent of total receipts
						San Francisco								
1963	81	150	224	223	137	3	—	—	—	—	—	36	854	32.8
1962	91	111	151	186	120	21	—	—	—	—	—	7	687	28.6
1961	108	80	119	113	26	1	—	—	—	—	—	18	465	19.7
1960	59	71	134	108	37	—	2	1	—	—	—	36	448	20.3
1959	41	63	135	145	22	—	—	—	—	—	—	4	410	12.4
1958	35	53	93	53	3	—	—	—	—	—	—	5	242	8.2
1957	44	33	37	24	1	—	2	—	—	—	1	14	156	10.8
1956	22	32	10	31	12	—	—	—	—	—	—	19	126	9.1
1955	32	31	34	45	15	—	—	—	—	—	—	1	158	11.2
1954	29	38	77	51	5	—	7	—	—	—	—	10	217	14.7
1953	50	36	76	59	11	1	—	—	—	—	—	8	241	15.6
1952	61	57	65	66	23	—	—	—	—	—	—	24	296	20.4

SOURCE: Federal-State Market News, Los Angeles, San Francisco and Seattle, *Unloads of Fresh Fruit and Vegetables,* (1952–1963) Only six years of complete data were available for Seattle.

9. Figures 2 and 3 show variations in the total market supply and the average monthly wholesale prices for fresh tomatoes in Los Angeles, San Francisco, and Seattle.

EXPORT POTENTIALS

There seems to exist a potentially large winter export market for fresh tomatoes in the selected markets that were studied, particularly if production and marketing costs can be held at about 14 cents per pound as appears possible from Table 1. Hawaiian tomatoes would bring between one cent and five cents per pound net returns in these wholesale markets assuming that only small amounts were sold. Seattle and San Francisco seem to offer the best prospects for Hawaiian tomatoes mainly because prices are higher than in Los Angeles. However, both are smaller markets so the amount of sales is correspondingly lower. Average monthly sales of 450,000 pounds or 15 carlots of fresh tomatoes[7] valued at existing prices would net approximately $5,300 in Los Angeles. Similar sales in San Francisco and Seattle would yield net returns of $11,000 and $25,000, respectively. If we consider the effect on the existing prices, the net returns would fall to approximately $4,000, $8,000, and $20,000 in Los Angeles, San Francisco, and Seattle, respectively. Table 9 indicates that in the Los Angeles market, with present prices estimated at 15.1 cents per pound, 72 carlots would be required to bring the prices down to 14.6 cents per pound. To bring prices down to 14 cents, at which no net returns would

Table 9. Estimated additional quantities of fresh tomatoes that can be sold in San Francisco, Los Angeles, and Seattle at specified levels of market prices

Average wholesale price per pound (cents)	Number of additional carlots			Total additional carlots[1]
	Los Angeles	San Francisco	Seattle	
10.0	795.20	180.00	129.90	1,105.10
10.3	734.90	169.30	125.80	1,030.00
10.7	674.70	158.70	121.80	955.20
11.5	554.20	137.40	109.50	801.10
11.9	493.80	126.70	104.40	724.90
12.3	433.70	116.10	98.90	648.70
12.6	373.50	105.40	94.90	573.80
13.0	313.20	94.80	89.50	497.50
13.4	253.00	84.10	84.10	421.20
13.8	192.80	73.50	78.70	345.00
14.2	132.50	62.80	73.30	268.60
14.6	72.30	52.20	68.00	192.50
15.0	12.00	41.50	62.60	116.10
15.3	—	30.90	58.50	89.40

[1]1 carlot has been estimated at 30,000 pounds.

[7]This amount represents saleable yield from 5 acres of tomatoes (Table 1).

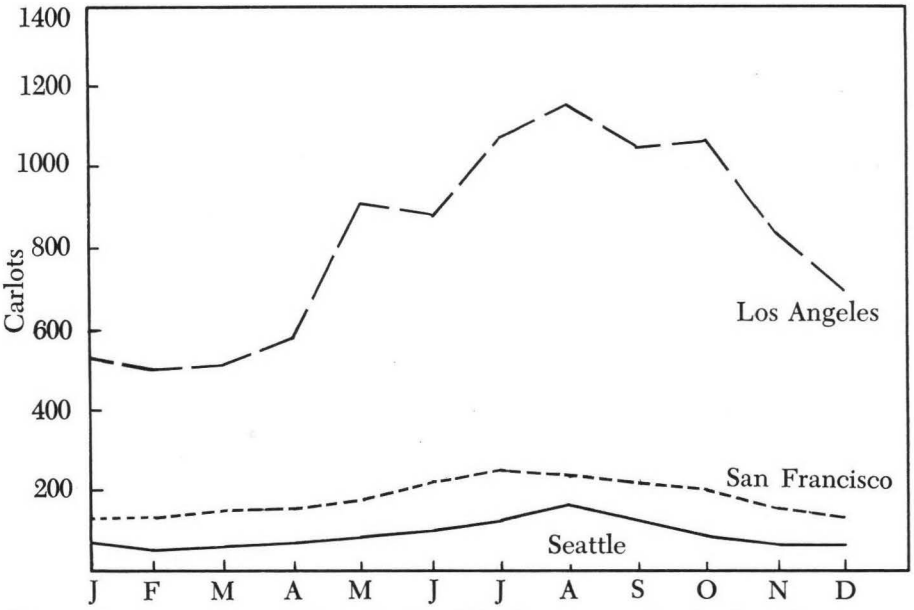


Figure 2. Average monthly unloads of fresh tomatoes in the San Francisco, Los Angeles, and Seattle wholesale markets, 1952-1963[1].

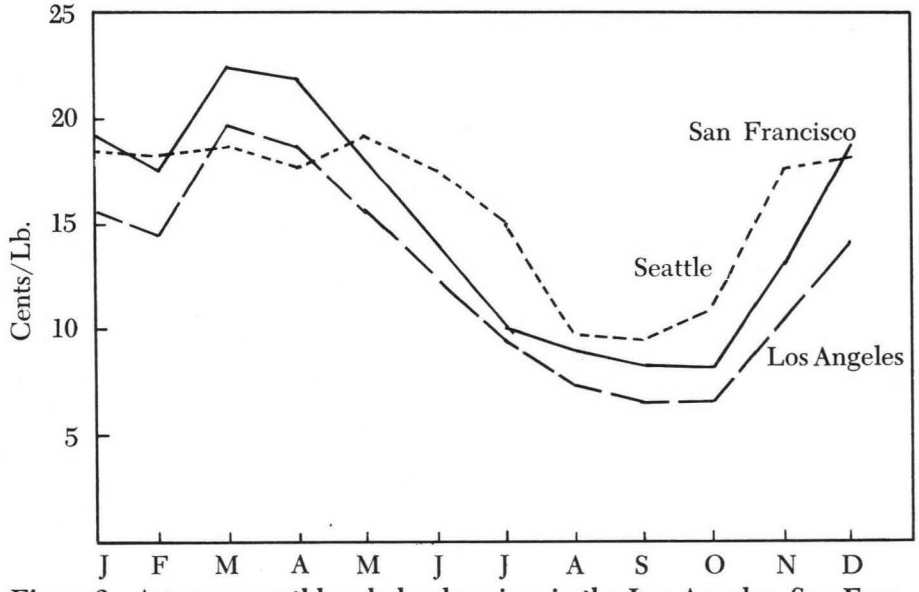


Figure 3. Average monthly wholesale prices in the Los Angeles, San Francisco, and Seattle wholesale markets, 1952-1963[1].

[1]Only six years of complete data were available for Seattle (1955–1956, 1960–1963).

Table 10. Monthly trend equations for Mexican imports of fresh tomatoes into selected markets for specified years, in carlots.

Months	a[1]	X_3[2]	R^2	Level of Significance	
				t ratio	F ratio
Los Angeles (1952-1963)					
January	195.121	42	.005	ns[3]	ns
February	145.636	19.70	.40	5%	5%
March	299.924	12.78	.16	ns	ns
April	257.318	16.41	.32	5%	5%
May	11.212	13.45	.46	2%	5%
San Francisco (1952-1963, 1953 ommitted)					
January	19.163	5.79	.44	5%	5%
February	9.8000	9.11	.65	1%	1%
March	5.818	15.36	.66	1%	1%
April	-3.400	16.40	.74	1%	1%
May	.25.400	10.30	.53	1%	5%
Seattle (1955, 1956, 1960-1963)					
January	12.600	8.25	.59	ns	ns
February	6.400	9.45	.65	5%	ns
March	.0.400	14.25	.82	2%	1%
April	7.000	11.00	.52	ns	ns
May	7.866	2.37	.08	ns	ns

[1]a represents number of carlots.
[2]X represents time in years, with 1952 = 1.
[3]nonsignificant.

exist, would require a little less than 132 carlots of fresh tomatoes. Similar price movements would occur in San Francisco and Seattle with lesser quantities being supplied.

Such price movements have been considered under the assumption that present supplies in these markets would remain unchanged. Monthly trend equations derived from data on Mexican imports in the three markets (see table 10), for the most part, show a generally significant upward trend in tomato supplies for the years studied. Robert Gehring, in a recent study on the United States demand for fresh winter vegetables from Mexico, obtained similar results for the U. S. as a whole.[8] Gehring found that the major factor contributing to this rise in Mexican exports was the development and introduction of adequate and efficient marketing facilities. Improvements in transportation facilities as well as the introduction of mechanical grading equipment caused most farmers to switch from growing

[8]Robert Gehring, *The United States Demand for Fresh Winter Vegetable Imports from Mexico and Some Economic Implications for the State of Sinaloa,* Unpublished M.S. thesis, Department of Agricultural Economics, University of Arizona, August 28, 1967.

tomatoes on the ground to growing them on stakes, a practice that is common in Hawaii. Staked tomatoes are usually harvested at the pink stage whereas ground tomatoes are picked as mature greens. With improved transportation facilities, pink tomatoes can be harvested in most of North Mexico and trucked to markets within a 200-mile range in 18 hours. Mexican tomatoes are also shipped by rail, but trucking seems to be favored. The mechanical grader has eliminated most of the hand labor and besides speeding up the grading operation, it has also reduced mechanical damage to the tomatoes. Speedier handling favors the shipment of vine-ripened tomatoes (pinks).

Gehring also found that the price and income elasticities of demand for tomatoes imported from West Mexico into the Nogales market (Arizona) were both highly elastic.[9] These results were based on wholesale prices of tomatoes in Nogales and shipments of tomatoes from West Mexico and all other sources expressed on a per-capita basis. The data covered a six-year period (1961–1966). Elasticity coefficients for the total U.S. market approached 3.6, again implying highly elastic conditions. Other important findings in this study were:

1. Quantities of shipments from other sources varied inversely with tomato shipments from West Mexico. The variables used in the analysis accounted for a relatively small proportion of the variation in the wholesale price.
2. The U. S. can absorb approximately 7 percent more fresh tomatoes annually through 1976 without adversely affecting wholesale prices. This result was obtained by adding to the rate of population increase, the rate of income growth multiplied by income elasticity.
3. Even though West Mexican exports have been increasing over the years, their share of the total market has been relatively stable.
4. Tomato yields are expected to increase at a less dramatic pace in the 1970's than the early years of the 1960's. Much of the increase in yield has occurred because of change from ground to staked tomatoes. By 1970 ground production of tomatoes will be discontinued completely.
5. Between 1958 and 1963 tomato earnings approached 50 percent of the total export value of Mexican fresh winter vegetables.

These findings bring to light some of the hurdles that Hawaii producers of tomatoes for the winter market on the West Coast must clear. It is evident that Mexican producers will continue to be the largest suppliers in most West Coast markets and, therefore, will remain strong competitors. A factor favoring Mexican producers is their proximity to the market. Even though we have no correct estimates on their overall costs, it is safe to

[9]The concept of elasticity refers to responsiveness of quantity to price or income changes.

assume that their per-unit costs will either be similar to or lower than the costs in Hawaii. Under present conditions Hawaiian tomatoes must be transported by ocean freight, which takes approximately five to six days. Air freight is too expensive at its present rates. So Mexican vine-ripened tomatoes, even after being taxed an additional 2 cents per pound for import duty, are likely to bring higher returns than Hawaiian mature green tomatoes.

Besides the competitive strength of Mexican suppliers, other problems, mainly of local nature, must be attacked before Hawaiian tomatoes can be exported to these wholesale markets in sufficiently large amounts to be profitable. Problems in the marketing channels are probably the most important. Marketing functions include standardization, fumigation, packing, and transportation. Transportation has been discussed briefly above but will be discussed from another viewpoint below. Our estimates of the overall costs of producing fresh tomatoes in Hawaii and marketing them on the West Coast showed that marketing charges accounted for almost 70 percent of these costs (see table 1). These relatively high estimates reflect the complex nature of the marketing operations that exist under present conditions. For example, presently, fresh tomatoes produced on Molokai must pass through Honolulu where they can be fumigated according to state and federal specifications. This necessarily increases the handling costs. It would seem feasible that if export of fresh tomatoes became a reality other physical arrangements could be made to ensure greater efficiencies in marketing.

To get a firsthand knowledge of the effects of fumigation and to identify more specifically some of the problems that would occur, several shipments of fresh tomatoes produced on Molokai were exported to the West Coast during the 1965–1966 winter. These shipments were necessary so that a comparsion could be made with the results obtained from similated shipments made previously (1963–1964). The results of the test shipments are presented in the following section.

RESULTS OF TEST SHIPMENTS OF MOLOKAI PRODUCED TOMATOES

Between February and May 1966, four shipments of fresh tomatoes were made to the West Coast, one each to Seattle and Los Angeles and two to San Francisco. Three were sent by refrigerated ocean freight and one by air freight.

The main objectives of these shipments were:

1. To identify some of the problems that were involved in shipping tomatoes.
2. To compare results with those of simulated shipments made earlier in the project history.
3. To evaluate the performance of the produce under the stress of fumigation and refrigerated ocean transportation.

Simultaneously with these shipments, comparable amounts of fresh tomatoes were sold in the local market, particularly where California and Mexican tomatoes were being handled. These sales were made to compare locally the quality of Molokai-produced tomatoes with the imported ones and to isolate the effects of transportation on tomatoes under actual market conditions. We relied heavily on the experience of large-scale produce handlers locally as well as on the West Coast for market evaluation of the produce.

General Procedure

Specified amounts of mature green tomatoes were harvested and graded on Molokai and then flown or barged to Honolulu for processing[10] prior to shipment to the West Coast. Fumigation with methyl bromide was done at the State of Hawaii Plant Quarantine Station and lasted for approximately 3½ hours. Temperatures were held at 70°F. during fumigation.

Consigned Shipments to the West Coast

Of the four shipments to the West Coast, two went to Richmond, California, one to Los Angeles, and the other to Seattle, Washington. These shipments were made in accordance with the Federal Quarantine Regulations. A summary of the West Coast shipments and the results are presented in table 11.

These test shipments provided valuable information. They showed that a high degree of quality control is necessary before Molokai tomatoes can be sold in West Coast markets and that more extensive market research is required.

Losses were severe mainly because of a rapid breakdown in the quality of tomatoes upon arrival on the West Coast. These losses cannot at the

[10]Processing refers to all the preshipping treatments.

Table 11. Summary of tomato test shipments to selected West

Shipment no. and destination	Date and amount harvested	Date arrived in Honolulu and mode of transport	Date and duration of methyl bromide treatment	Preshipping Storage		Date and amount shipped
				Duration	Temperature	
1. Seattle	14/2/66 600 lbs.	15/2/66 Barge	16/2/66 a.m. 3½ hours	12 hours before fumigation 18 hours after fumigation	Room temperature 45-50°F	17/2/66 600 lbs.
2. Richmond	28/3/66 450 lbs.	29/3/66 Barge	1/4/66 a.m. 3½ hours	48 hours before fumigation	Room temperature 45°F.	1/4/66 340 lbs.
3. Los Angeles	8/4/66 300 lbs.	9/4/66 Air freight	11/4/66 a.m. 3½ hours	48 hours before fumigation 46 hours after fumigation	Room temperature 45°F.	13/4/66 220 lbs.
4. Richmond	15/4/66 360 lbs.	15/4/66 Air freight	16/4/66 a.m. 3½ hours	57 hours	45°F.	18/4/66 304 lbs.

Note: A total of seven test shipments were planned but only four were actually made.

° In the opinion of the tomato handler in Seattle, the fruits were not handled carefully enough at picking and packing.

Coast markets from the Molokai Demonstration Farm, 1966

Refrigeration temperature and length of shipment	General description and comments	Results in West Coast markets General remarks
45°F. 7 days Ocean Freight	Mature greens, U.S. No. 1; 30 two-layer, 5x6, 20-lb. boxes (wooden boxes). Produce was shipped in standard L.A. lugs, but had to be encased in plastic bags to satisfy fumigation requirements.	154 lbs. discarded due to breakdown. 210 lbs. sorted out at No. 2's due to scarring and small decay. 354 lbs. failed to ripen properly and broke down very rapidly.*
45°F. 6 days Ocean Freight	Mature greens, U.S. No. 1; 17 two-layer, 5x6, 20-lb. boxes (fiberboard cartons).	Upon arrival the following defects were noticeable: puffiness, rough shoulders, some indentations but no decay. Tomatoes were put through normal ripening process and colored up unevenly. Defects became more pronounced and progressed rapidly into decay. The whole shipment was unfit to sell at retail and had to be discarded.
chill 38-44°F. 6 days Ocean Freight	Mature greens, U.S. No. 1; 11 two-layer, 20-lb. boxes (fiberboard cartons). Produce was originally intended for ocean freight on 11/4/66 but due to change in shipping schedule, produce had to be shipped on 13/4/66.	Similar to results of shipment No. 2 above.
Air Freight	Mature greens, U.S. No. 1; 12 two-layer, 5x6 boxes (cartons); 3 three-layer, 5x6 boxes (cartons); 1 three-layer mixed box (carton). Produce was originally intended for ocean transport, but had to be sent by air freight due to changes in shipping schedule.	Similar to results of shipment No. 2 above.

present time be traced to a particular factor. Any number or a combination of factors may have been responsible. However, comparing the results of the shipment to Seattle with those made to San Francisco and Los Angeles suggest that the type of container may have had a strong influence on the results.[11] Another factor is fumigation. Fumigation with methyl bromide is known to cause serious physiological damage to tomatoes, particularly when the tomatoes are in sealed containers and free circulation of air is not possible. In addition, it is known to cause burns on the surface of the fruits, which leaves them prone to bacterial decay. Efforts were made to reduce the incidence of the side effects of fumigation. Perhaps another factor contributing to the loss in tomato quality was the method and the number of times the produce was handled. As noted earlier, tomatoes had to be shipped to Honolulu because proper fumigation facilities are lacking on Molokai. Despite many precautionary measures adopted, scope for mechanical damage remained.

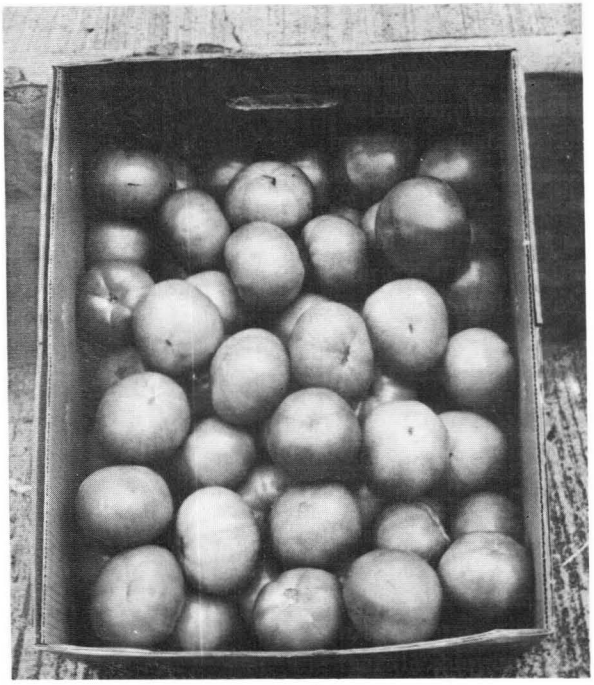
Inadequate temperature control, both before and during shipping, appeared to have had significant effect on the tomatoes. Three shipments were transported at temperatures ranging from 38° to 45°F. It is the opinion of one of the produce handlers on the West Coast that 55°F. would have produced better results. Since the volume of tomatoes per shipment was small, they had to be shipped with other produce that largely dictated the chill temperature of the refrigerated container. It was difficult to control the preshipping temperatures except after fumigation and packing, because of lack of proper facilities and because of fumigation requirements.

Molokai-produced tomatoes were compared with tomatoes from Mexico both in Honolulu and California. Figure 4 shows samples of fresh tomatoes from Mexico and Hawaii in California, and Figure 5 shows similar samples in Honolulu. The marked difference in quality between Mexican tomatoes (figure 4, right) and Hawaii tomatoes (figure 4, left) upon arrival on the West Coast is apparent. Most noticeable are varietal difference, irregular ripening, and a number of decayed fruits among the more beefy mature greens. Clear evidences of decay at the blossom ends and other areas of the mature greens are shown at the bottom of Figure 4b. It can readily be seen that the quality of the vine-ripened tomatoes justifies the preference that may be shown for handling Mexican tomatoes on the West Coast at this time.

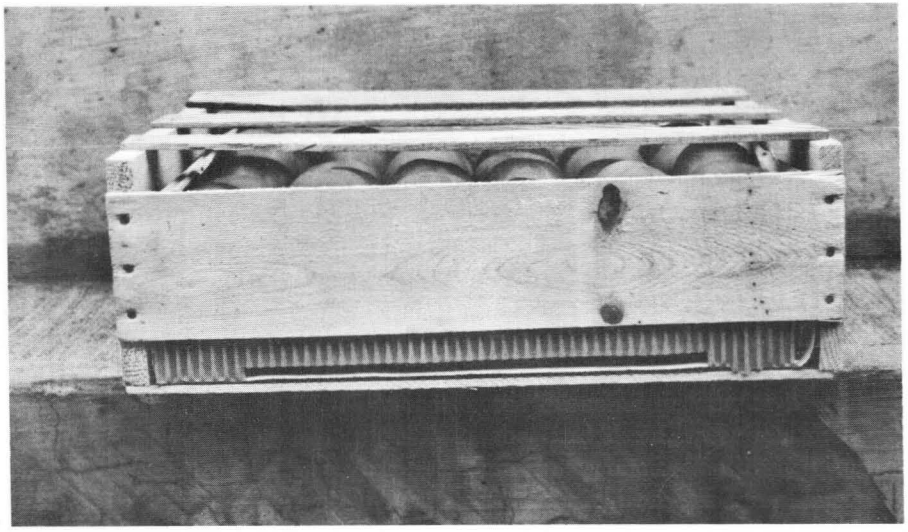
Mature greens from Hawaii are on the left side of pictures (a) and (b) while Mexican vine-ripes are on the right side.

Figure 5 shows the differences in crates and in methods of packing. Quite noticeable is the marked difference between the two types of crates. Mature tomatoes from Molokai (figure 5a) were transported over relatively

[11]See table 11 for these results.



(a)



(b)

Figure 5. Methods of packing tomatoes

short distances (Molokai to Honolulu) and so were loosely packed and shipped in less expensive and less sturdy crates. On the other hand, Mexican tomato shipments (figure 5b) required sturdier crates for the longer travel distance. As previously mentioned, the cheaper crates were used in shipping mature greens to Seattle. Mexican crates cost approximately one dollar each while local fiberboard crates cost approximately thirty-five cents each.

Vine-ripened tomatoes from the Molokai Demonstration Farm sold in the Honolulu market were not in sufficient quantity to cause any lowering of wholesale prices. By and large, their quality compared favorably with, and at times was superior to, the quality of other tomatoes offered in the market. This comparison was made since the local market could become a secondary outlet for tomatoes that would be too ripe for export, assuming that only mature greens and very early pinks would be exported. But the comments received from West Coast produce handlers suggest that the market for mature greens may eventually be lost to vine-ripened tomatoes. This is supported by Gehring's study[12] as well as a study made in Florida in 1963[13], which suggests that mature greens are gradually losing ground to vine-ripened tomatoes. The reasons for this are that vine-ripened tomatoes enable more direct handling, eliminate storage, ripening and repacking expenses. Another reason advanced, but which remains unproven, is that consumers feel that vine-ripened tomatoes are superior to mature greens. The impact of vine-ripened tomatoes on the market is such that significant changes are taking place in the structure of the winter market for fresh tomatoes. The extent to which vine ripes are popular in California or Washington is not known at this time but appears to be a very important consideration in decisions to produce tomatoes for export to the West Coast.

Another problem Molokai tomato producers must face is the impact on the local market. This local market could become a regular outlet for tomatoes that are too ripe to export. There could be a substantial amount of such produce, especially if a large number of acres is planted in tomatoes. Local production is likely to increase to the point where all imports are supplanted. This would not require large acreages, assuming that the present yields hold. It is also possible that local production could extend into the summer months, too. But it will be difficult to exclude imports entirely since California tomato farmers can produce and market tomatoes in Honolulu during summer and fall at prices that are about equal to Hawaiian production costs.

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[12]Robert Gehring, *op. cit.*

[13]Manley, William T. and Marshall R. Godwin, *Marketing Florida Vine Ripened Tomatoes,* Florida Agricultural Experiment Station, University of Florida, Gainesville, Florida, November 1963.

SUMMARY AND CONCLUSIONS

In this study an attempt was made to evaluate the export potentials for fresh tomatoes grown in Hawaii. Production and marketing costs were estimated and considered together with measurement of the demand for fresh tomatoes in Los Angeles, San Francisco, and Seattle. These markets are the most important on the West Coast but other areas, such as Sacramento or Portland, represent potential markets of considerable importance too.

The underlying assumption in the study was that the market potentials for these fresh tomatoes can be estimated from wholesale demand curves. From these curves, prices can be estimated and used to estimate the potential net returns in each market given a particular cost and the total quantities that are likely to be sold. To do this it was necessary to hold some market factors constant.

Production of fresh tomatoes for export to the West Coast seems unlikely if farm units are less than 5 acres. With this size, costs can be approximated at 14 cents per pound. Though relatively high compared with costs in other areas, it is low enough to bring profitable returns in the markets studied.. Returns would be higher in Seattle and San Francisco, where winter prices are higher, until supplies from Hawaii become large enough to equalize all prices. Over the years market prices have shown downtrends while the supply of fresh tomatoes during the winter months has increased significantly. The increase in demand has been met with increased supplies from Mexico and other areas such as Florida and Texas.

Hawaii can make a successful entry into the export market for tomatoes during the winter months, but under the present conditions only a limited scale of operation would be possible. The adventurous farmer should proceed with caution. Decisions to produce or not to produce tomatoes for the winter export market cannot be based on the findings of this study alone. In the first place, these production estimates were based on highly efficient levels of management as reflected in yields and overall requirements. While the study does not imply that there exists a major breakthrough in technology in tomato production on Molokai, high yields, which enabled low per-unit cost estimates, were consistent over the period of the study. Studies conducted on tomatoes on a statewide basis at a much later date showed that other areas can do as well under lower levels of management and on a much larger scale.[14] So while Molokai has been used as the basis for the study, it is apparent that statewide applications are possible. Does this mean that continuous year round production of tomatoes on a scale that would reverse the flow of this commodity is possible? Such

[14]William L. Collier, *Opportunities for Adjusting Farming in Hawaii to Prospective Markets.* Unpublished Ph.D. dissertation, Department of Agricultural Economics, University of Hawaii, 1969.

a far-reaching conclusion is not warranted at this time. Furthermore, one cannot ignore the impact of present competitive uses for land in the State. Recently, large-scale commercial production of Irish potatoes for potato chip manufacturing began on Molokai despite the fact that Irish potatoes were not considered a profitable crop earlier. Such factors would no doubt increase the rental values of land to a higher level than the one adopted in this study. What this means is that other commodities could bid land away from tomato production, particularly those commodities requiring less labor-intensive operations and those that yield larger profits.

A close examination of the results of this exploratory study shows that several adjustments will be required in the present method of production and marketing of fresh tomatoes before limited export sales to the West Coast can become a reality. Present methods of handling are very inefficient. It is highly important that the produce exported be of high quality if it is to compete with vine-ripened tomatoes. As noted earlier, the West Coast market is changing toward a preference for vine-ripened tomatoes so that producers contemplating selling in this market would be advised to think in these terms. This strengthens the argument for a closer look at the problems due to fumigation since this is one of the major requirements for export. The results of our investigations on the effects of fumigation are not conclusive, and further research is required. Very little consideration was given to the possibilities of air shipment. Its marketing aspect could be significant, especially with increased air traffic between Hawaii and the West Coast.

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