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Progress Report on the Molokai Demonstration Farm of the University of Hawaii for the 1963-64 Fiscal Year

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INTRODUCTION

This report summarizes preliminary estimates of cost of production, yield, and marketing cost for a number of vegetables produced on the Molokai Demonstration Farm during 1963-64. These studies continue the analysis of the feasibility of production of vegetables on Molokai for export to the Mainland, and build on the work of Douglas J. McConnell,[5] as reported in previous progress reports. Not all aspects of the problem are dealt with in the present report, and the results presented here should be viewed in relation to previous findings. In addition to the cost and returns analysis, there is a discussion of the cultural practices used during the year, and

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[5] Douglas J. McConnell, *Preliminary Studies of the Feasibility of Producing Vegetables on Molokai, Progress Reports No. 1, 2, and 3.* Hawaii Agricultural Experiment Station, College of Tropical Agriculture, University of Hawaii, March 1962.

reports on fumigation and simulated shipment of tomatoes to the Mainland by surface freight, and herbicide tests on tomatoes, peppers, and eggplant.

The scale of operations of the Molokai Demonstration Farm was drastically curtailed for the 1963-64 season. Acreage planted to vegetables was reduced from 45 acres to little more than an acre, and efforts at perfecting commercially feasible mechanization of field operations, applicable to large-scale farms, were dropped. Work on fumigation of produce at the Farm, and on improvements in packing shed equipment and operation, also at the Farm, was also abandoned for the time being. Instead, efforts were concentrated on obtaining cost of production and yield data from small plots of five vegetables; eggplant, tomatoes, bell peppers, cucumbers, and zucchini squash. The results of these field trials will be presented and evaluated in this report. Some Farm produce was sold on the Honolulu market, where it found ready acceptance, but no shipments were made to the Mainland. Actual field operations were supervised by Mr. Richard P. Hanchett, Farm Manager of the Molokai Demonstration Farm.

Perhaps the most interesting results were achieved with tomatoes grown on trellises. Yield far exceeded that of the block of prone tomatoes which was given the same program of fertilization, herbicide, insecticide, and fungicide sprays, and harvesting frequency. The increased yield appears to be far in excess of that required to pay for the added labor required. As a result of the encouraging performance of trellis tomatoes, Farm operations during the 1964-65 season will be directed primarily toward further study of this crop.

Eggplant and zucchini squash also appeared to be profitable crops. Bell peppers barely covered expense while cucumbers show a net loss, but this may be due in part to the fact that plant density was low in the test plots. The net returns of each crop must be interpreted with great care, and some of the qualifying factors will be discussed in the body of this report. For the present, we wish merely to note that these other vegetables do not appear to be as promising as tomatoes as potential export crops, whether because there is no satisfactory fumigation method, the crop has relatively low volume of sales in mainland markets, or there is some question of acceptability of the particular variety grown in the trials.

COSTS AND RETURNS OF SELECTED VEGETABLES

During the year, seven 1/5th-acre blocks of vegetables were produced on the Molokai Demonstration Farm; one each of eggplant, cucumbers, and

zucchini squash, and two each of bell peppers and tomatoes. These crops were among those shown to have promise in previous studies. In general very high yields were obtained for the season, probably attributable in part to unusually favorable weather. Data obtained on the test plots were used to calculate costs and returns for the several crops, and the results are expressed on an acre basis in the tables which follow.

Table 1 presents a summary of costs and returns. Several items are synthetic and most are not necessarily equivalent to corresponding costs as they would be incurred on a commercial farm. Labor costs, presented in more detail in Table 2, are charged at a rate of $1.25 per hour. This may be an appropriate rate for family labor, but it is slightly less than the modal rate of $1.40 currently being paid by the pineapple producers on Molokai for temporary labor brought in from other islands for summer employment. Since some hired labor would be needed at harvest time on even the smaller commercial farms, the budgeted wage rate may be a little too low. A greater potential source of error might be the lower labor efficiency on the Demonstration Farm compared to a commercial farm, especially one with a larger scale of operations. The detailed data in Table 2 nevertheless probably give a fairly accurate picture of the relative labor requirements of the various crops and of the operations required for each crop.

The data in Table 3, relating to cost of materials and equipment use, are probably such that they can be almost directly translated to the commercial farm situation. The spray, irrigation, and fertilizer programs may be better than those which would be achieved under average management on a commercial farm. The truck and tractor equipment used on the Molokai Demonstration Farm was not particularly well suited to the scale of operation, and costs may accordingly be somewhat out of line. But by and large, the costs are fairly representative of those needed to achieve the reported yields.

Marketing charges as shown in Table 4 are predicated on current rates for barge service from Molokai to Honolulu and refrigerated ocean freight from Honolulu to San Francisco, and on wholesale commission charges of 15% for the mainland market, the percentage being taken of the average wholesale price during the 6 months December through May of the 1962 and 1963 winter seasons. We have based commission charges on only one reported rate, and they may not be representative of the average. Indeed, consignment sales to mainland markets, at least in large volume, may require development of new or greatly expanded trade channels for which costs are not presently known. The possible development of a farmers' cooperative shipping association further clouds the question of the appropri-

TABLE 1. Net Returns Assuming Export Sales to Mainland (San Francisco)

	Eggplant (One Acre)	Tomatoes (One Acre)	Bell Peppers (One Acre)	Cucumbers (One Acre)	Zucchini Squash (One Acre)	Total
	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
Costs:						
Labor Operations	1,468.75	2,531.25	1,181.88	1,478.12	1,090.62	7,750.62
Materials and Equipment	609.61	778.01	505.37	582.24	406.89	2,882.12
Marketing Charges	6,328.78	6,087.97	1,583.04	2,681.75	2,883.11	19,564.65
Fixed Cost of Equipment, Land and Buildings	125.00	125.00	125.00	125.00	125.00	625.00
Others	177.70	198.24	76.12	99.18	95.48	646.72
Total Costs	8,709.84	9,720.47	3,471.41	4,966.29	4,601.10	31,469.11
Cost Per Pound	13.3¢	13.5¢	22.7¢	16.9¢	16.2¢	
Gross Returns (based on 1962 and 1963 San Francisco prices)	12,341.70	12,528.00	3,583.75	4,439.40	6,282.60	39,175.45
Gross Returns Per Pound	18.9¢	17.4¢	23.5¢	15.1¢	22.2¢	
Net Returns	3,631.86	2,807.53	112.34	–526.89	1,681.50	7,706.34
Yield Per Acre	65,300 lb	72,000 lb*	15,250 lb	29,400 lb	28,300 lb	

*Amounts are for marketable trellised tomatoes and are estimated at two-thirds of the yield per acre (108,000 lb).

TABLE 2. Labor Utilization

Crop	Eggplant (One Acre)		Tomatoes (One Acre)		Bell Peppers (One Acre)		Cucumbers (One Acre)		Zucchini Squash (One Acre)		Total	
Operations	Hours	Percent of total for crop	Hours	Percent of total for crop	Hours	Percent of total for crop	Hours	Percent of total for crop	Hours	Percent of total for crop	Hours	Average % of total
Land Preparation	80	6.8	10	0.5	20	2.1	22.5	1.9	12.5	1.4	145	1.9
Planting	60	5.1	35	1.7	85	9.0	50	4.2	60	6.9	290	4.5
Cultivation	75	6.4	77.5	3.8	68	7.2	45	3.8	15	1.7	280.5	4.6
Setting Up Trellis	–	–	35	1.7	–	–	–	–	–	–	35	.8
Pruning and Trimming	–	–	422.5	20.9	–	–	–	–	–	–	422.5	9.2
Fertilizing	60	5.1	97.5	4.8	40	4.2	20	1.7	30	3.5	247.5	4.2
Spraying	225	19.2	405	20.0	265	28.0	135	11.4	115	13.2	1,145	19.8
Irrigation	195	16.6	157.5	7.8	165	17.5	120	10.2	105	12.0	742.5	11.6
Harvesting	270	23.0	600	29.6	175	18.5	455	38.5	330	37.8	1,830	28.4
Selecting, Packaging, and Shipping	180	15.3	147.5	7.3	87.5	9.3	305	25.8	165	18.9	885	12.2
Other	30	2.5	37.5	1.9	40	4.2	30	2.5	40	4.6	177.5	2.8
Total	1,175	100.0	2,025.0	100.0	945.5	100.0	1,182.5	100.0	872.5	100.0	6,200.5	100.0
Cost @ $1.25/hour	$1,468.75		$2,531.25		$1,181.88		$1,478.12		$1,090.62		$7,750.62	

TABLE 3. Materials and Equipment Use

Crops	Eggplant (One Acre)		Tomatoes (One Acre)		Bell Peppers (One Acre)		Cucumbers (One Acre)		Zucchini Squash (One Acre)		Total	
	Units	$ Value	Units	$ Value	Units	$ Value	Units	$ Value	Units	$ Value	Units	$ Value
Sprays (Insecticides, Fungicides, Herbicides)[1]												
Diazinon	–	–	39 lb	83.85	18 lb	38.70	24 lb	51.60	24 lb	51.60	105 lb	225.75
DDT	–	–	40 lb	12.80	12 lb	3.84	–	–	–	–	52 lb	16.64
Parathion	–	–	8 lb	4.32	4 lb	2.16	–	–	–	–	12 lb	6.48
Sevin	50 lb	65.00	–	–	8 lb	10.40	24 lb	31.20	24 lb	31.20	106 lb	137.80
Dithane	52 lb	45.36	52 lb	45.36	50 lb	42.00	24 lb	20.16	24 lb	20.16	202 lb	173.04
Tribasic Copper Sulfate	100 lb	57.00	104 lb	59.28	92 lb	52.44	24 lb	13.68	24 lb	13.68	344 lb	196.08
Vegadex			4 qt	11.00			4 qt	11.00			8 qt	22.00
Spray Total		167.36		216.61		149.54		127.64		116.64		777.79
Fertilizer												
Treble Superphosphate	2,000 lb	100.45	2,000 lb	100.45	2,000 lb	100.45	2,000 lb	100.45	2,000 lb	100.45	10,000 lb	502.25
Potassium Chloride	400 lb	15.50	400 lb	15.50	400 lb	15.50	400 lb	15.50	400 lb	15.50	2,000 lb	77.50
Urea	600 lb	33.60	725 lb	40.60	725 lb	40.60	425 lb	23.80	525 lb	29.40	3,000 lb	168.00
Fertilizer Total		149.55		156.55		156.55		139.75		145.35		747.75
Irrigation Water (Includes Water Used in Sprays)	(1,000 gal) 1,440	115.20	(1,000 gal) 1,195	95.60	(1,000 gal) 1,105	88.40	(1,000 gal) 795	63.60	(1,000 gal) 705	56.40	(1,000 gal) 5,240	419.20
Miscellaneous												
Seeds	2½ oz	9.00	1¼ oz	18.75	2½ lb	12.50	5 lb	170.00	2½ lb	5.00		215.25
Flats	120	60.00	45	22.50	52	26.00	–	–	–	–	217	108.50
Strings			12	18.75							12	18.75
Boxes		50.00		50.00		37.50		25.00		25.00		187.50
Trellis Frames				125.00								125.00
Miscellaneous Total		119.00		235.00		76.00		195.00		30.00		655.00

Equipment Use												
Tractor	20 hr	18.00	20 hr	18.00	16.25 hr	14.63	17.5 hr	15.75	15 hr	13.50	88.75 hr	79.88
Truck	45 hr	40.50	62.5 hr	56.25	22.50 hr	20.25	45 hr	40.50	50 hr	45.00	225.50 hr	202.50
Equipment Use Total		58.50		74.25		34.88		56.25		58.50		282.38
Total Materials and Equipment		609.61		778.01		505.37		582.24		406.89		2,882.12

[1]See Table 5 for composition of spray materials.

TABLE 4. Marketing Costs
(If produce were sold on San Francisco, California market)

	Eggplant (One Acre)	Tomatoes (One Acre)	Bell Peppers (One Acre)	Cucumbers (One Acre)	Zucchini Squash (One Acre)	Total
	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
Transportation (to Honolulu)	228.55	197.05	53.37	102.90	99.05	680.92
Ocean Freight, Honolulu to San Francisco (at $5.04 per cwt)	3,291.10	2,837.50	768.60	1,481.75	1,426.30	9,805.25
Wholesale Commission (at 15% of average wholesale price in San Francisco 1962-63)	1,851.25	1,469.42	537.55	665.90	942.40	5,466.52
Shipping Crates	957.88	1,584.00	223.52	431.20	415.36	3,611.96
Total	6,328.78	6,087.97	1,583.04	2,681.75	2,883.11	19,564.65

ate marketing costs in the long-term situation. It may be possible to obtain higher average prices than those shown by predicting the higher price periods within the winter season, but it does not seem advisable to assume that such a high degree of market coordination will be achieved for some time. The probable impact of Hawaiian exports on mainland market prices has not as yet been evaluated, and this too would affect commission rates computed as a percentage.

Fixed costs of land and capital cannot be based on conditions as they exist on the Molokai Demonstration Farm, as these are clearly unrepresentative of a commercial farm regardless of size. The charge of $125 per acre which was used is about equal to that shown by McConnell in previous studies for a 30-acre farm,[6] with all fixed costs borne by a single winter vegetable crop. No charge has been made for management in this study.

The net returns figures shown in Table 1 are subject to a number of very important qualifications, and should be interpreted as no more than indicative of crops showing promise. Yields are from small plots for a single, perhaps unusually favorable, crop season. Prices are for 2 years only. As has been previously noted, some costs are synthetic and others are based on the possibly unrepresentative conditions of the Molokai Demonstration Farm. Some crops, notably eggplant and peppers, have not been cleared for fumigation by satisfactory means, and approved methods are not suited to subsequent shipment of the treated produce by surface freight as assumed.

Should production for export become established on Molokai, there would undoubtedly be some sales to the Honolulu market. In the first place, whenever net returns from the sale of first quality produce in the Honolulu market exceed those from the sale of similar produce in the mainland markets, produce will be diverted to the local market. Honolulu wholesale prices will be lower than West Coast prices by the additional amount that it costs to ship to these markets. In addition, there might usually be some high-quality produce which has become too ripe to tolerate fumigation and shipment and which consequently must be disposed of locally. This would be especially true in initial stages of development, before more frequent barge service, prompt cooling of harvested produce, and efficient handling and harvesting methods have been achieved. Since the net revenues will be determined by the larger West Coast markets, prices on these markets form the basis for the present study.

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[6] op. cit.

The reported yields are much higher than those shown by McConnell in previous studies.[7] Net returns are also much higher in most cases. Eggplant, squash, and tomatoes all appear to be quite promising as export crops, based on computed net returns, but eggplant does not as yet have an approved satisfactory fumigation method available. Zucchini squash has a somewhat limited market, even on the West Coast. Thus tomatoes appear to offer the greatest promise at the present time. If the reported yields could be maintained, all the crops except cucumbers could also be marketed successfully, at least in limited amounts, on the Honolulu market.

Tomatoes were grown in two blocks of 1/5th acre each, and the two blocks were treated the same except that on one the vines were pinched and trained on trellises, and on the other the vines were allowed to lie prone. Almost six times as much yield was achieved on the trellised block, where yield was almost 50 tons per acre. The net returns figure shown in Table 1 understates considerably the returns from the trellised block, but cost figures were not kept separately for the two blocks of tomatoes, so net returns to each block cannot be exactly shown. Cost per pound might be several cents less than the amount shown here. Much of the increased

[7] op. cit.

FIGURE I. PATTERN OF HARVEST OF TRELLISED TOMATOES (N-55 VARIETY)

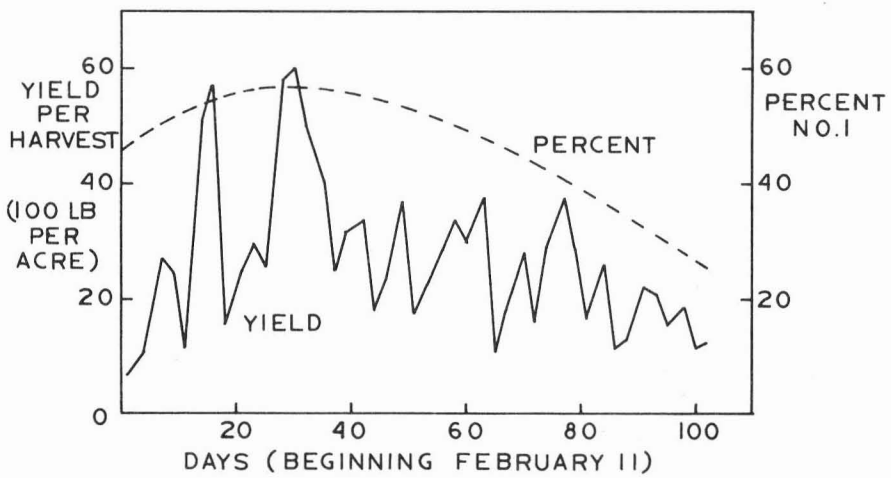
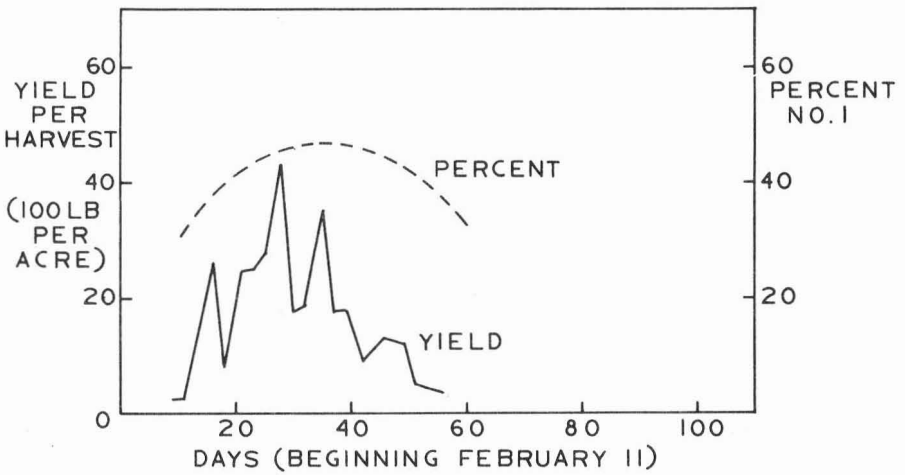


FIGURE 2. PATTERN OF HARVEST OF PRONE TOMATOES (N-55 VARIETY)



yield of the trellised tomatoes appears to be associated with increased length of harvesting period and improved quality of produce, as shown in Figures 1 and 2, which show amounts picked at each harvest, frequency of harvest, and percent No. 1 grade tomatoes harvested from the trellised and the prone plots during the year.

The yield of the trellised tomatoes, and indeed all cost and returns information relative to this crop, need to be established with greater certainty before firm recommendations regarding this crop can be made. Accordingly, during the 1964-65 season three staggered crops of tomatoes, all trellised, will be grown, and records similar to those for this year will be kept. If yields can be maintained at or near the level achieved in 1963-64, the crop will merit more extended investigation.

Concurrently with the field trials, we are making a study of the price levels of tomatoes in West Coast markets, including estimation of the ability of these markets to absorb increased supplies without severe depression of market prices. The question of elasticity of supply in present supply centers of Florida and Mexico will not be studied at this time. The tolerance of Hawaiian tomatoes to fumigation and shipment, especially by ocean freight, and consumer acceptance in West Coast markets will be studied by observing results of test shipments in 1965-66.

CULTURAL PRACTICES

Cultural practices used on vegetable crops grown during the 1963-64 season are summarized in Table 5.

Fertilizer

All crops received the same pre-plant fertilizer application which was broadcast and disked in. The rates per acre for each element and carrier were as follows:

100 lb. N (220 lb. Urea)
400 lb. P (2000 lb. treble superphosphate)
200 lb. K (400 lb. muriate of potash)

The above rates, especially for P and K, are far in excess of rates used in previous years on the Farm. The initially high rate of phosphorus will not be repeated in subsequent years, but will be reduced to 100–200 lb. P per acre per year.

A single-replicate test with five rates of phosphorus was conducted to estimate the yield response of squash and corn to applied phosphorus fertilizer. The results indicated that a phosphorus application of 200 lb. P per acre should be adequate for squash, while field corn may require considerably more for maximum yield. It was observed that the corn plot receiving 800 lb. P per acre produced stalks with two ears each, while plants on plots receiving lower rates generally had only one ear per stalk.

Weed control

Vegadex was applied at 4 quarts/acre as a pre-emergence spray on cucumbers and as a directed spray after transplanting on tomatoes. In general, the effectiveness of the herbicide treatment was only fair. Cucumber plants were retarded somewhat by the Vegadex pre-emergence treatment. On tomatoes Vegadex was used in lieu of the recommended herbicide, Dymid, which was not currently available.

The number of cultivations necessary for effective weed control for each crop are shown in Table 5.

Insect and Disease Control

Despite a fairly intensive spray program, it was difficult to control all insects. There was some damage to tomato fruit by the Southern Green

TABLE 5. Cultural Practices Used for Vegetable Crops Grown on the Molokai Demonstration Farm, 1963-64 Season

Crop and variety	Plant spacing	Field planting date	First harvest date	Last harvest date	Frequency of harvest	Number of cultivations	Supplemental nitrogen side-dressed Date, lb N/Acre	Insecticides Kind[1], frequency	Fungicides Kind[1], frequency
Tomato, N-55 (trellised)	3 ft x 5 ft	11/18/63	2/11/64	5/22/64	3 x weekly	7	1/23; 2/18; 4/7 80 lb each time	Diazinon–weekly Parathion–semi-monthly before harvesting	Copper Sulfate–weekly; Dithane Z-78–semimonthly
Tomato, N-55 (untrellised)	3 ft x 6 ft	11/25/63	2/19/64	4/6/64	3 x weekly	1	1/23; 2/18 80 lb each time	DDT–2 times only	Same as above
Eggplant, Florida market	2 ft x 4 ft	11/16/63	1/17/64	5/11/64	Weekly	2	1/23–90 lb	Sevin–weekly	Same as above
Bell pepper, Keystone Giant	2 ft x 4 ft	12/10/63	2/4/64	5/11/64	Weekly	6	3/4–46 lb 4/14–58 lb	Diazinon–semi-monthly DDT–3 times only Sevin–weekly for 1 month	Same as above
Cucumber, Burpee hybrid	2 ft x 6 ft (2/hill)	2/6/64	3/30/64	5/6/64	Daily	3	3/4–46 lb 4/14–58 lb	Diazinon–weekly Sevin–weekly	Copper Sulfate–semimonthly; Dithane Z-78–semimonthly
Zucchini squash, Harris hybrid	18 inches x 4 ft	2/13/64	3/25/64	5/4/64	Daily	1	3/2–90 lb 4/14–58 lb	Diazinon–weekly Sevin–weekly	Copper Sulfate–Dithane Z-78–semimonthly

[1]Active ingredients of chemical formulations: Wettable powders–Diazinon, 50%; Parathion, 25%; Sevin, 50%; DDT, 50%; Dithane Z-78, 75%.

Stink Bug which was populous in the area surrounding the cropped fields. Pepper weevils caused severe pepper fruit drop until controlled by DDT and Sevin. Some fruit fly damage to squash could not be prevented when fruit was being harvested daily, necessitating the cessation of regular spraying. Corn borders were sprayed with protein bait and parathion in an effort to reduce insect damage during the harvest period.

The first planting of cucumber was severely damaged by powdery mildew and wind, and was replanted. Little trouble was encountered with the second cucumber planting. There was considerable blight damage to the untrellised tomatoes but no evidence of blight in the trellised crop. Soil rot was a problem for cucumbers, eggplant, and untrellised tomatoes.

Windbreaks

Protection from the wind was provided by a trellised passion fruit crop and by field corn planted between the 40-foot-wide blocks of vegetable crops. Cucumber and squash plantings suffered some wind damage when the corn windbreak was not planted early enough to give protection to the vegetable crops.

Irrigation

Crops were irrigated by a sprinkler system utilizing Rainbird 70B circular sprinklers with 7/32-inch nozzles. The sprinklers were spaced 30 feet apart. Water was applied at 5- to 7-day intervals when there was inadequate rainfall. About 1½ hours were required to apply 1¼ inches of water. Crop appearance and tensiometer readings indicated that irrigation rates and frequencies were adequate.

TESTS OF FUMIGATION TOLERANCE WITH SIMULATED SHIPMENTS OF TOMATOES

The purpose of these tests was to determine how well the N-55 variety of tomatoes grown on the Molokai Demonstration Farm would tolerate fumigation and subsequent shipment to mainland markets by refrigerated ocean freight. Mr. Ernest K. Akamine of the Plant Physiology Department advised on procedures and provided facilities for refrigeration and storage.

General Procedure

The tomatoes were harvested and selected on Molokai and flown to Honolulu prior to the fumigation treatment, which was done by the Entomology Research Branch, Fruit Fly Investigations Section, of the Agricultural Research Service, USDA, at the University of Hawaii. The treatment consisted of methyl bromide at a dosage of 2 pounds per 1000 cubic feet for 3½ hours at 70° F. The tomatoes were removed and transferred to the Plant Physiology Laboratory where they were again sorted and placed in groups according to degree of ripeness, presence of growth cracks, or evidence of mechanical damage in handling. The numbers in each group varied with the tests. The criteria used in selection were based on USDA standards.

The fruits were stored for varying numbers of days under simulated shipping conditions, that is, at a temperature of 55° F., at the conclusion of which they were removed and placed in storage at room temperature for observation. There were four separate tests, beginning on March 24, 1964 and ending on May 31, 1964.

The results of this series of tests (see Table 6) agree well with previous fumigation tolerance tests performed by Mr. Akamine of the Plant Physiology Department. Mature green is the best stage of maturity for shipping, but breakers or very early pinks will do about as well. Tomatoes must be free of mechanical damage. If tomatoes are picked at the proper stage of maturity, cooled promptly, and sorted, packed, and shipped with care they should arrive in West Coast markets in good condition. Furthermore, ripening should occur after the fruit reaches the retail store so the produce clerks can watch the ripening process and get the fruit on the shelf at peak condition.

While the time lapse from shipping does not in itself appear to present a problem, there are a number of unresolved questions. First, there is the question of what percentage of production could be harvested, barged to Oahu, and prepared for containerized shipment under present conditions of barge service, cooling facilities, harvest labor availability, and shipping schedules. As a side issue, we need to know what volume of actual or potential business will call forth improved shipping and handling facilities. A second major problem area is the possible effect of mechanical damage sustained by even well-packed fruit during the long shipping process. Finally, we should get some indication of the consumer acceptance of the tomatoes at their final destination. We hope to obtain reasonably good answers to all these questions by making some trial shipments of tomatoes to West Coast markets during the 1965-66 season.

TABLE 6. Summary of Fumigation Trials on Tomatoes, Molokai Demonstration Farm 1963-64

Test No.	Date harvested	Group	Number in each group	Description	Treatment			Results	
					Fumigant	Refrigeration	Stored at room temperature	Spoilage %	General description
1	March 24, 1964	1	25	Mature greens, some pinks, good quality, small. Could qualify as U.S. No. 1.	Methyl Bromide	Six days 55° F.	Four days	36% 2nd day 36% 3rd day in store	Spoilage was due to fungus growth at stem end. Remainder soft and sweet.
		2	15	Mostly same as above, but slightly damaged.	"	"	Five days	13.3% 3rd day 6.6% 4th day	Spoilage due mainly to softness and over-ripening.
		3	45	Almost perfect for export market.	"	"	Six days	6.6% 4th day	Although signs of stink bug attack were identified from 2nd day (60%) in store, there was no appreciable effect on quality except discoloration.
		4	15	Unsuited for export but salable locally within a short time.	"	"	Three days	100% 3rd day	Complete spoilage at the end of 3rd day.
2	March 31, 1964	1	35	Considered ideal for local market requirements, pinks too ripe for shipping.	"	Five days 55° F.	Four days	Ripening increased 2nd day	Fruits maintained quality up until the end of the 3rd day.
		2	35	Slightly damaged, good size and quality, free from cracks.	"	"	"	Increased ripening at end of 2nd day	At end of 4th day, fruits became over-ripe–discarded.

TABLE 6. Summary of Fumigation Trials on Tomatoes, Molokai Demonstration Farm 1963-64 (Continued)

Test No.	Date harvested	Group	Number in each group	Description	Treatment			Results	
					Fumigant	Refrigeration	Stored at room temperature	Spoilage %	General description
3	April 4, 1964	1	25	Early pinks, salable but slightly mishandled, firm and of good quality.	Methyl Bromide	Eight days 55° F.	No storage	–	50% of fruits were completely ripe on removal from refrigeration.
		2	25	"	"	No refrigeration	Four days	100% 4th day	Fruits were completely ripened after three days.
		3	20	"	No fumigation	"	"	8% at the end of the 4th day 100% on 5th day	Fruits displayed vertical splitting from which emerged fluids.
4	April 4, 1964	1	40	Pinks, free from scars, of good size and quality.	Methyl Bromide	Eight days 55° F.	Six days	100% 6th day	Fruits stood up well. Some displayed spottiness and turned soft. Later identified as virus infection.
		2	30	Mature greens, free from scars, of good size and quality.	"	Eight days 55° F.	Seven days	After the 5th day the fruits could be considered spoiled	After five days, there was no ripening in two fruits, eight showed signs, six were completely ripe, and 14 were ripened with irregular spottiness. Some fruits were evidently not fully mature and did not ripen well.

One device to help assure that only mature green or breaker tomatoes are shipped would be to dispose of fully pink and more mature fruit on the local market. The availability of this market greatly reduces the precision otherwise required in harvesting schedules.

HERBICIDE TRIALS

For the most part, cultural practices used on the Molokai Demonstration Farm are those recommended for general use, but there was some experimentation, usually directed toward determining practices best suited to Molokai conditions. A series of herbicide trials was conducted in the fall of 1963, the results of which are applicable to Hawaiian vegetable production generally. Herbicides were applied to transplanted tomatoes (N-55), peppers (Keystone Giant), eggplant (Black Beauty), direct-seeded cucumbers (Burpee Hybrid), and squash (Zucchini) on September 24, 1963. All treatment areas were cultivated 2 days before the herbicide applications. A subjective rating system was used on October 24 to evaluate the plant response to the herbicides.

The results show that all of the herbicides were safe on the tomatoes, peppers, and eggplant (Table 7). It is suggested that Dymid be considered for initial large-scale testing for tomatoes and peppers. Experiments at other locations showed Dymid to be relatively safe when sprayed over the transplanted crop. If the weed control is not satisfactory with Dymid, directed sprays of Dacthal should be tried on tomatoes. Both Dymid and Dacthal will give longer residual weed control than Vegadex. However, the latter should be considered if either of the other herbicides does not control certain weed species. Unfortunately, none of the above chemicals are cleared for use by FDA on eggplants.

Vegadex showed no injury on squash and cucumbers, but Alanap was slightly injurious to the cucumbers and very toxic to the squash (Table 8). The granular Alanap application did not injure the cucumbers when applied at the vining stage. Either herbicide could be used to control weeds in cucumbers on the Molokai Farm. Vegadex is not cleared for use on squash, hence treatment is not recommended for commercial production of this crop.

Dymid 80-W is recommended at 6 to 7.5 pounds per acre as an over-the-plant spray on peppers and tomatoes. Dacthal W-75 is suggested as a directed spray on peppers and tomatoes at the rate of 8 to 14 lb/acre.

TABLE 7. Subjective Ratings of Tomato, Pepper, and Eggplant Tolerance to the Herbicides 4 Weeks After Treatment

Treatment	Rating[1]		
	Tomatoes	Peppers	Eggplant
1. Check, no spray	1.0[2]	1.0	1.0
2. Vegadex 6 lb active/acre[3]	1.0	1.0	1.0
3. Dacthal 10.5 lb active/acre	2.3	2.3	1.3
4. Dymid 6 lb active/acre	1.0	2.0	1.7
5. Tillam 4 lb active/acre	1.0	1.0	1.3

[1] Rating scale: 1–no injury; 2–slight; 3–moderate; 4–severe injury; 5–dead.

[2] Each value an average of 3 replicates.

[3] Treatments 2 to 4 were directed to the base of the plants and treatment No. 5 was "soil incorporated" immediately after spraying.

TABLE 8. Subjective Ratings for Cucumber and Squash Tolerance to the Herbicides 4 Weeks After Treatment

Treatment	Rating[1]	
	Cucumbers	Squash
1. Check, no spray	1.3[2]	1.3
2. Alanap 4 lb active/acre	2.3	4.0
3. Vegadex 4 lb active/acre	1.0	1.0
4. Alanap 4 lb + Alanap 4 lb[3]	2.0	4.0

[1] Rating scale: 1–no injury; 2–slight; 3–moderate; 4–severe injury; 5–dead.

[2] Each value an average of 3 replicates.

[3] Alanap 4 lb/acre applied as liquid spray at sowing and again as a granular application at vining (4 weeks after sowing).

Alanap at 3 to 4 lb active/acre may be applied on cucumbers at sowing and again as a granular formulation at vining. Vegadex may be used on cucumbers at the rate of 4 lb/acre at sowing. No herbicides are presently recommended for squash for commercial production.

Additional information pertaining to methods of application is contained in University of Hawaii Cooperative Extension Service Circular 402.

SUMMARY AND CONCLUSIONS

This report covers only those facets of the question of the feasibility of vegetable production on Molokai for export to the Mainland, on which work was actually performed during the year. Several factors previously treated to some extent by McConnell, such as large-scale mechanization, fumigation at the farm, prospects for and probable benefits of cooperative organization of production and/or marketing, and economics of scale of farm size, have not been considered. It should perhaps also be noted that the Demonstration Farm is intended to test recommended varieties and recommended cultural practices under Molokai conditions, and the amount of controlled experimentation is limited.

Very high yields were obtained for a number of vegetable crops, and they are being grown again in continuing trials to test whether this high level can be sustained. Tomatoes were found to be the most promising crop for export, and attention will be concentrated upon, but not restricted to, this crop in subsequent trials. We are shipping small shipments to West Coast markets to test consumer acceptance of the N-55 variety in these markets. We are also conducting a statistical analysis of prices of tomatoes in the West Coast markets to estimate the capacity of the markets to absorb added supplies from Hawaii should they be forthcoming.

Hawaii currently imports tomatoes during much of the year, with the heaviest volume during the summer and fall months of heavy production in California. Even during winter months we import smaller quantities, from Florida and Mexico, so prices in Hawaii must always be higher than those on the Mainland. If Hawaii should begin to export tomatoes to the Mainland during the winter months, the local prices would have to become lower than the mainland prices by approximately the cost of transportation. The farmers who produce for export will have the alternative of selling on the local market, and they will do so whenever their net revenue is higher on this

market. So if production for export becomes feasible and is practiced, the price of tomatoes on the local market will surely decline, and by a considerable amount. Local production which merely supplants imports would have a considerably smaller effect on prices on the Honolulu market, since the local price is largely determined by mainland prices so long as any produce is being imported. Local price would be especially unresponsive to increased local production during the summer months of high production in California, when we import large quantities. While all trials and test shipments are being made with reference to Molokai, the results will in all probability apply with equal force to all existing production areas in the State. Indeed the other areas presently in tomato production in the State may be able to out-compete with Molokai in supplying both the local and export markets. Especially is this so if, as we now surmise, the land and labor intensive trellis method is to be preferred over the mechanized land extensive methods which were tested on Molokai previously.