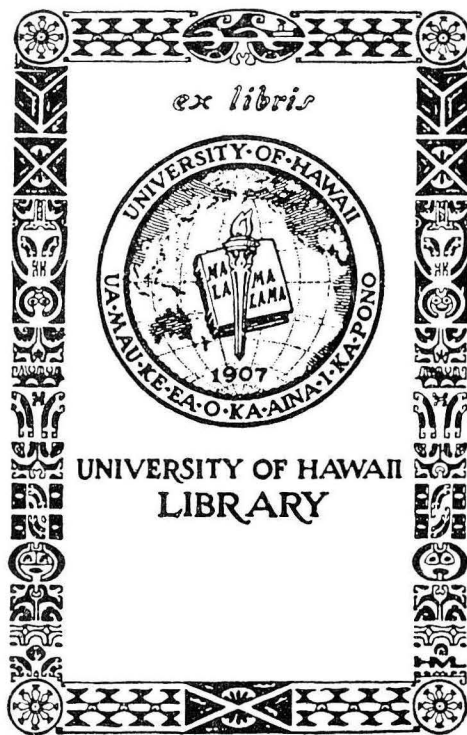DP 37

The Economics of
Growing Dendrobium on Oahu for Mainland Export

S. G. Camp III
and P. F. Philipp

HIGHLIGHTS

An Oahu dendrobium grower producing sprays for mainland export has an estimated original investment of $127,000 per acre of shade house. Of this total, $73,000, or 57 percent, is investment in plants (*see* Table 1). Figures in these highlights are calculated for a shade house a full acre (43,560 square feet) in size compared to one of 42,000 square feet in the main part of this study.

The annual cost of operation of this grower per acre of shade house amounts to $54,000, including a $10,000 charge for interest on his current investment.

His annual gross returns at a mainland wholesale price of $12 per dozen sprays during the winter and $6 during the summer totals $95,000 per acre of shade house. His net returns per acre at these prices, after deduction of his operating costs and his $10,000 interest charge, is $41,000, or 32 percent, on his original investment.

At an average mainland wholesale price per dozen sprays of $5.90 throughout the year he just breaks even, if he uses a paid manager.

If he himself is the full-time working manager, he still earns $15,000 per acre of shade house for his management and labor but gets no profit for his risks of being in business.

Per square foot of shade house, his original investment is $2.92; his cost of operation, including interest, is $1.23; and his gross and net returns at the higher mainland wholesale prices are $2.17 and $0.94, respectively. At the lower average price of $5.90 per dozen sprays, his gross return of $1.23 equals his costs and interest charges, and he has no net return.

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INTRODUCTION

The 1974 Legislature of the State of Hawaii made an appropriation to the College of Tropical Agriculture of the University of Hawaii to study the market potential for dendrobium orchids and ornamental foliage on the U.S. Mainland and in Japan. Orchid growers on Oahu requested the Department of Agricultural and Resource Economics to conduct a study of the economics of growing dendrobium orchids on Oahu for export to the Mainland as cut flower sprays. At that time, no dendrobium producers were exporting sprays on a truly commercial scale. Also, too few dendrobium sprays were sold on the Mainland to establish a meaningful wholesale market price. This study is thus based on production and market estimates of some of the dendrobium growers who have been producing for the Honolulu market and on the experience of University orchid researchers. Supply prices are those that existed in October 1974 and freight rates are those that were in force in May 1975.

Table 1. Summary of estimated investment, returns, and
costs of an Oahu dendrobium grower

Item	Per square foot of shade house 1/	Per acre of shade house 2/
Cost of plants	$ 1.67	$ 72,860
Investment other than plants	1.25	54,290
Total original investment	$ 2.92	$127,150
Annual gross returns, high prices	$ 2.17	$ 94,510
Annual gross returns, break even prices	1.23	53,730
Annual cost of operation, including interest	1.23	53,650
Annual net returns, high prices	0.94	40,860
Annual net returns, break even prices	0	80

1/ Calculated by dividing relevant shade house figures in the following tables by 42,000 square feet.
2/ Calculated by multiplying relevant shade house figures by the factor 1.03714, which is the fraction $\frac{43,560 \text{ square feet } (= 1 \text{ acre})}{42,000 \text{ square feet}}$.

CAPITAL INVESTMENT

The grower in this study is assumed to use one and one-half acres for the raising of dendrobium orchids. Site improvement costs him $3000 and fencing $2000 (see Table 2). The shade house measures 200 x 210 feet and thus has 42,000 square feet of usable room, or slightly less than one acre (one acre = 43,560 square feet). It is of cable and pipe construction; the ceiling and sides are covered with polypropolene shade screen; and it is 10 feet high. Prices used are:

$30.00 per post
$3.50 per anchor
$0.50 per cable clamp
$0.02 per foot for 9-gauge wire in 100-pound coils
$0.25 per foot of cable
$0.15 per square foot of 30 percent shade cloth including hooks, grommets, and edging
$150.00 for ready-mixed cement to construct the anchors.

Two men at $4 per hour are needed for one week to construct the shade house. Construction of the house costs $12,000 (see Table 2).

The 58 benches, each measuring 92 x 4 feet, are arranged in 29 rows, leaving 4 feet at each end and allowing for an 8-foot wide aisle in the middle. A 3-foot space is allowed at each side of the house as well as 3-foot aisles between benches and a 7-foot aisle in the center. The benches are built with 2-x-4-foot rough redwood on each side, with a center reinforcement and cross braces every 4 feet. This wooden construction is covered by a 4-x-2-inch 12-1/2 gauge wire mesh and stands on 8-x-8-inch cement blocks. Seven hours of labor, valued at $4 per hour, are required to build each bench. The cost of the 58 benches is $12,250.

Table 2. Original capital investment

Site improvement, including fencing 1-1/2 acre	$ 5,000
Shade house 200' x 210', or 42,000 square feet	12,000
Multipurpose building, 1000 square feet, to include packing room, office, garage, and storage room	8,500
Benches (58 benches 92' x 4' constructed with 2' x 4' rough redwood and 4" x 2" wire mesh, standing on cement blocks)	12,250
Irrigation system, automatic, PVC	6,600
Truck	5,000
Tools, small equipment, and machinery	1,000
Plants (21,516, of which 14,776 are 'Louis Bleriot' @ $3.50 per plant and 6,740 are 'Jacqueline Thomas UH 44' @ $2.75 per plant)	70,250
Miscellaneous, including cash	2,000
Total investment	$122,600

An automatic irrigation system, using PVC pipe, costs $6600. This system, controlled by a 10-station automatic timer, operates spray mist nozzles, mounted on 4-foot risers, spaced at 9-foot intervals in the center of the benches.

A multipurpose building of 1000 square feet, to include packing and storage room, office, and garage, costs $8.50 per square foot, or $8500. This building is equipped with a garage door, a side door, a cement floor, and electricity installed and connected. Other capital investment items are a truck, priced at $5000; tools, small equipment and machinery worth $1000; and miscellaneous supplies and cash amounting to $2000.

We assume that this grower buys his plants when they are ready to bloom in commercial amounts and that he keeps them for 4 years. Thereafter, he breaks them up, repots the younger parts of the plant, and uses them for another 4 years, and so on.

The grower has 4 x 92 feet, or 368 square feet, of space per bench. With 58 benches at 368 square feet each, he has a total of 21,344 square feet of bench space in his shade house. We assume that he gives half his total bench space to each of the two varieties, 'Louis Bleriot' and University of Hawaii selection 'Jacqueline Thomas UH 44'. 'Louis Bleriot' is selected because it has dark lavender flowers and 80 percent of its total flower production is expected during the winter months. 'Jacqueline Thomas UH 44' is chosen to round out the product mix because it has white flowers and is a prolific flower producer, although almost two-thirds of its flower spikes are produced during the summer months.

'Louis Bleriot' is a comparatively upright and small dendrobium plant, which will remain in 6-inch plastic pots during its whole 4 years in the shade house. During the first 2 years, the pots are placed next to each other at a distance of 8 inches from pot center to pot center. During the last 2 years, the distance from pot center to pot center is increased to 12 inches. This spacing allows the grower to keep a total of 14,776 'Louis Bleriot' plants in his shade house, or 3694 in each of the four yearly age classes (see Table 3).

The 'Jacqueline Thomas UH 44' is a more spreading plant which requires 12-inch spacing from center to center of the 8-inch pots during the first year and 16 inches during the last 3 years. Thus, the producer has a total of 6740 'Jacqueline Thomas' plants, or 1685 of each age class.

With 'Louis Bleriot' plants in great demand, the purchase price, including the 6-inch plastic pot, is estimated at $3.50 per 3-year-old plant. The market price for 'Jacqueline

Table 3. Total number of plants and flower spikes per year in shade house

Year in shade house	'Louis Bleriot'			'Jacqueline Thomas UH 44'		
	Number of plants	Number of flower spikes per plant per year	Total number of flower spikes per year	Number of plants	Number of flower spikes per plant per year	Total number of flower spikes per year
1	3,694	5.0	18,470	1,685	6	10,110
2	3,694	7.5	27,705	1,685	18	30,330
3	3,694	15.0	55,410	1,685	24	40,440
4	3,694	15.0	55,410	1,685	24	40,440
Total	14,776		156,994	6,740		121,320

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Thomas' is estimated at $2.75 per plant. The total cost of the 21,516 plants is $70,250, and the total investment in the dendrobium enterprise amounts to $122,600 (see Table 2).

COST OF OPERATION PER YEAR

Rent on 1-1/2 acres, at $1200 per acre, is $1800, and property tax is $50 for a total of $1850 (see Table 4).

Two workers receive wages of $3 per hour, to which is added a labor overhead of 25 percent. One of these works full time, 8 hours per day, 5 days per week, or 260 days per year; the other is a half-time employee. Thus, annual hired labor cost is $11,700. In addition, a working manager, at a salary of $1000 per month plus 25 percent overhead, costs $15,000 per year. Total labor and management cost is thus $26,700 per year.

Water and chemicals, including fertilizer, fungicides, insecticides, and herbicides, cost $1000 each. Six-inch plastic pots at $0.27 apiece, used for the 14,776 'Louis Bleriot' plants, cost $3900, and the 8-inch pots, at $0.50 per pot, needed for the 6740 'Jacqueline Thomas', cost $3370. After 4 years of use, these pots are discarded. Thus, every year one-fourth of these pots, worth $1840, are replaced. Annually, 55 tons of cinders, worth $715 at $13 per ton, are used as planting media. The total cost of replacement pots and planting media, including state sales tax, amounts to $2657.

The calculation of annual depreciation and maintenance is shown in Table 5. The straight-line method of depreciation is used. Salvage values are disregarded, and conservative estimates are used for the expected life of the items. This is done to include a margin for maintenance and repair in addition to depreciation in the last column of Table 4. Total annual charges for depreciation, maintenance, and repair amount to $6128. All the above costs total $39,335. A miscellaneous cost item, amounting to 7 percent of $39,335, is added to take care of all other unspecified costs, such as gas and oil, utilities other than water, insurance, and accounting and legal fees. Total costs of operation excluding interest are estimated at $42,085 per year (see Table 4).

Table 4. Cost of operation per year

Rent and property tax on 1-1/2 acres	$ 1,850
Labor and management (labor at $3.75 per hour and manager at $1250 per month, overhead included)	26,700
Water	1,000
Chemicals, including fertilizer, fungicides, insecticides, and herbicides	1,000
Other supplies, including replacement of 1/4 of all plastic pots and planting media	2,657
Depreciation	6,128
Miscellaneous (7% of $39,335, which is cost of operation excluding miscellaneous cost)	2,750
Total cost of operation per year	$42,085

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Table 5. Calculation of annual depreciation, maintenance, and repair

Item	Original cost	Years of expected life	Annual depreciation, maintenance, and repair
Shade house	$ 12,000	10	$ 1,200
Multipurpose building	8,500	10	850
Benches	12,250	10	1,225
Irrigation system	6,600	5	1,320
Fencing	2,000	10	200
Truck	5,000	5	1,000
Tools	1,000	3	333
Total			$ 6,128

CALCULATION OF NUMBER OF SPRAYS USABLE FOR MAINLAND SHIPMENT

The total number of flower sprays per year per shade house of both 'Louis Bleriot' and 'Jacqueline Thomas UH 44' are calculated in Table 3. The 'Louis Bleriot' section of the shade house is expected to produce 156,994 flower spikes per year, based on an output per plant ranging from five spikes in the first year to 15 each in the third and fourth years. 'Jacqueline Thomas UH 44' plants are estimated to produce six spikes in the first year and up to 24 spikes in the fourth year, for a total shade house production of 121,320 spikes.

As shown in Table 6, the total number of sprays of both varieties, which are usable for export, amounts to 11,365 dozen during the winter and to 7188 dozen during the summer for the shade house. In arriving at these estimates, it was assumed that 80 percent of the 'Louis Bleriot' sprays are produced during the winter, compared to 37 percent for the 'Jacqueline Thomas UH 44'. If the spray production of the two varieties is added together, winter sprays make up 61 percent and summer sprays 39 percent of total annual production. Twenty percent of all produced flower sprays are expected to be rejected for mainland spray export, but the flowers can be sold locally for leis.

COST OF SHIPPING BOX, PACKING, AIR FREIGHT, AND INSURANCE

The cost of the shipping box and packing materials and of assembling and packing a box is estimated at $0.75. Of this total, the cost of the knocked down box at $0.455 apiece is the most expensive item, even if the boxes are bought at container volume prices. The costs of other packing materials and of assembling and packing amount to an estimated $0.295 per box.

We estimate the average cost of air freight of a shipping box holding 4 dozen sprays to a mainland receiver to amount to $3.355 (see Table 7). We expect that about half of the dendrobium shipments will be made to the West Coast and half to inland destinations, such as Chicago. We are thus using an average of the Honolulu-San Francisco and the Honolulu-Chicago air freight rates for floral shipments of at least 100 pounds, which amounts to $27.35 per 100 pounds, according to May 1975 rate schedules.

Table 6. Calculation of number of dozen sprays for mainland export

Item	Winter	Summer
'Louis Bleriot':		
Percent of total 156,994 sprays	80%	20%
Number of sprays	125,595	31,399
'Jacqueline Thomas':		
Percent of total 121,320 sprays	37%	63%
Number of sprays	44,888	76,432
Total sprays of both varieties	170,483	107,831
Percent of both varieties	61%	39%
Twenty percent of all sprays export rejects	34,097	21,556
Eighty percent of all sprays usable for mainland shipment	136,386	86,265
Dozen sprays for mainland export	11,365	7,188

A shipping box 30 x 10 x 7 inches has a volume of 2380 cubic inches. For air shipments of low-density products, such as flowers, rates are paid by pound equivalents rather than volume. One pound is equivalent to 194 cubic inches in these rate calculations. The volume of the shipping box of 2380 cubic inches is equivalent to 12.268 pounds, which cost $3.555 to ship.

Table 7. Calculation of air freight cost per shipping box

Air freight rate for flower shipment of 100 pounds:

Honolulu to San Francisco $21.95

Honolulu to Chicago 32.75

Honolulu to average of San Francisco
and Chicago $27.35

Size of shipping box 34" x 10" x 7" .... 2380 cubic inches

For flower shipments by air,
194 cubic inches .... 1 pound equivalent

A box of 2380 cubic inches/
194 cubic inches .... 12.268 pound equivalents

Freight per box: 12.268 pounds x $0.2735 per pound = $3.355

Shipping insurance is paid at a rate of $0.40 per $100 value of the flowers shipped. As shown in Table 8, the value of a shipping box filled with 4 dozen dendrobium sprays f.o.b. mainland wholesale receiver depends on the mainland wholesale price.

In Case I, at a wholesale price of $1 per spray, or $12 per dozen, during the winter, 4 dozen dendrobium sprays are valued at $48 on the wholesale market. This wholesale value less the mainland wholesaler's commission of 25 percent represents the value of the box with 4 dozen sprays f.o.b. mainland receiver. Similarly, at a wholesale price of $0.50 per spray or $6 per dozen during the summer, the value of the box at the receiver level is $18. At a wholesale value of $0.75 per spray, or $9 per dozen, throughout the year (Case II), the box value is $27 to the receiver. The insurance per box thus amounts to $0.144 per box in Case I, winter; $0.072 in Case I, summer; and $0.108 in Case II.

Table 8. Calculation of value of shipping box f.o.b. mainland wholesale receiver

Item	Case I		Case II
	Winter	Summer	
Selling price of mainland wholesale receiver per dozen sprays	$12.00	$ 6.00	$ 9.00
Selling price of shipping box holding 4 dozen sprays	48.00	24.00	36.00
Mainland wholesaler's commission: 25% of his selling price	-12.00	-6.00	-9.00
Value of 4 dozen sprays f.o.b. mainland wholesale receiver	$36.00	$18.00	$27.00

CALCULATION OF GROSS RETURN TO GROWER PER BOX SHIPPED TO MAINLAND

As shown in Table 9, the grower's gross return per dozen sprays shipped to the Mainland ranges from $5.95 when the mainland wholesale price is $12 per dozen (Case I, winter) to $2.59 at a mainland wholesale price of $6 per dozen (Case I, summer). It is $4.28 when the mainland wholesale price is assumed to be $9 per dozen all year round (Case II). In arriving at these gross returns to the grower, the costs of the box, packing, freight, and insurance were deducted from the value of the box f.o.b. mainland receiver. From the remainder, another 25 percent were deducted for losses during marketing and to cover the costs of operation of a dendrobium marketing cooperative in Honolulu. It was assumed that all Hawaiian shippers of dendrobiums to the Mainland would join together in a marketing cooperative. This cooperative would be in charge of all marketing aspects of dendrobium sprays destined for the Mainland, including the development of the mainland market for the product.

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Table 9. Calculation of gross return to grower
per box shipped to Mainland

| Item | Case I | | Case II |
	Winter	Summer	
Value of box f.o.b. mainland receiver	$36.00	$18.00	$27.00
Freight and insurance	-3.50	-3.43	-3.46
Cost of box and packing	-0.75	-0.75	-0.75
Gross return per box to grower before deduction by cooperative	$31.75	$13.82	$22.79
Gross return per dozen to grower before deduction by cooperative (box value/4)	$ 7.94	$ 3.45	$ 5.70
Deduct 25% for operational cost of Honolulu marketing cooperative and for marketing loss	-1.99	-0.86	-1.42
Grower gross return per dozen sprays shipped to Mainland	$ 5.95	$ 2.59	$ 4.28

CALCULATION OF VALUE OF EXPORT REJECTS

The flowers from the sprays that are rejected for mainland export can still be sold on the local market at the minimum price of $0.01 per flower (see Table 10). The 'Louis Bleriot' is currently in demand locally as a lei flower; however, the 'Jacqueline Thomas' may not be equally acceptable for this purpose because of its white color. At a rejection rate of 20 percent for both varieties and at a rate of 7 and 11 usable flowers per rejected spray for the 'Louis Bleriot' and the 'Jacqueline Thomas UH 44' varieties, respectively, a total of 486,697 flowers are estimated to be sold at a value of $4867 per year.

CALCULATION OF NET RETURN TO GROWER

The net return to the grower per year from his shade house of 42,000 square feet depends first of all on the price he gets for his dendrobium sprays on the Mainland. In Case I, where we assume a mainland wholesale price of $12 per dozen sprays during the winter and of $6 during the summer, his net return excluding interest amounts to $39,378 per year, or a 32 percent annual return on his original investment (see Table 11). In Case II, at an average mainland wholesale price of $9 per dozen sprays all year round, the grower has a net return

Table 10. Calculation of the value of export rejects

'Louis Bleriot'

    Number of sprays rejected (20% of total production) ... 31,399

    Average number of flowers per rejected spray   7

        Total number of rejected 'Louis Bleriot'
           flowers (31,399 x 7)   219,793

'Jacqueline Thomas UH 44'

    Number of sprays rejected (20% of total production) ... 24,264

    Average number of flowers per spray   11

        Total rejected 'Jacqueline Thomas'
           flowers (24,264 x 11)   266,904

Total number of rejected flowers, both varieties   486,697

Rejects sold locally at $0.01 per flower $4,867

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of $32,546 per year after interest payment, or a 27 percent annual return on his original investment.

The break-even point of this operation is at an average mainland wholesale price of $5.90 per dozen sprays throughout the year. This will result in a gross return to the grower of $2.53 per dozen sprays. After deducting his costs of production and an interest charge of 10 percent per year on his average invested capital, he is just breaking even. That means, if he himself is the working manager of the operation, he earns a gross management and labor salary of $15,000 per year, but he gets no profit for taking the risks of being in business.

CONCLUSIONS

This analysis is based upon certain assumptions about type of shade house structure, equipment, management practices, and product mix, as well as marketability of product. These assumptions may not be applicable to all dendrobium operations. Individual growers may want to calculate their own estimated returns and costs by applying the methods used here, but by substituting their own data for those assumed in this study.

We have assumed a high level of management and efficiency, and a favorable location that is conducive to use of low-cost structures and minimal transportation costs. There is, however, a need for the development of management methods and cultural practices through additional research that will enable commercial growers to meet these high-level criteria. Land with the proper service facilities has to be made available in those areas which are optimal for the growing and marketing of dendrobiums. The appropriate environment for producing dendrobiums is an area with low rainfall, low elevation, low wind velocity, an adequate water supply, and good transportation facilities.

Table 11. Calculation of annual net return to grower per shade house of 42,000 square feet

Period	Use	Price to grower	Number of units	Case I 1/	Case II 2/	Case III 3/
Winter	Export	$5.95/dozen	11,365 dozen sprays	$67,621.75		
Summer	Export	2.59/dozen	7,188 dozen sprays	18,616.92		
All year	Export	4.28/dozen	18,553 dozen sprays		$79,406.84	
All year	Export	2.53/dozen	18,553 dozen sprays			$46,939.09
All year	Leis	0.01/flower	486,697 flowers	4,866.97	4,866.97	4,866.97

	Case I	Case II	Case III
Total gross return	$91,123.00	$84,274.00	$51,806.00
Total cost of growing	-42,085.00	-42,085.00	-42,085.00
Net return before deducting interest	$49,021.00	$42,189.00	$ 9,721.00

Interest at 10% on plants at original costs: $7025

Interest at 10% on all other capital
investment on 1/2 of the original cost: $2618

	Case I	Case II	Case III
Total annual interest	-9,643.00	-9,643.00	-9,643.00
Net return after deducting interest	$39,378.00	$32,546.00	$ 78.00
Net return after interest as percent of total original capital investment	32%	27%	0%

1/ Mainland wholesale price per dozen sprays $12 during the winter and $6 during the summer.
2/ Average mainland wholesale price per dozen sprays $9 throughout the year.
3/ Average mainland wholesale price per dozen sprays $5.90 throughout the year.

Various options are available to the grower that can alter his cost/return relationship. He should consider the effects of these variables on his net returns as compared to the example given in this report. Following is a list of some of these factors that can affect costs and gross revenues.

Cost-increasing Factors

1. A less favorable location.

2. Higher costs of rented or fee simple land.

3. Higher incidence of insects and diseases.

4. Construction of more expensive structures, such as fiberglass houses, to protect plants from adverse climatic conditions.

5. Use of more sophisticated irrigation and fertilization systems.

6. Use of more expensive materials for bench construction.

7. Higher costs of plant replacements, supplies, and labor.

8. Lower quality of labor.

9. More direct marketing to mainland retailers.

10. Increased efforts to develop the mainland market for dendrobiums.

Cost-decreasing Factors

1. Use of cheaper benches, such as gravel beds.

2. Use of cheaper or longer-lasting containers, such as plastic bags or cement pots.

3. Greater economies of large scale through increasing size of the operation.

4. Own production of dendrobium plants. This will substitute investment in labor and time for capital investment. Ownership of valuable plants can serve as security for additional financing.

5. Lower costs of plant replacement, supplies, and labor.

6. Higher quality of labor.

Gross Revenue-increasing Factors

1. Increased density of planting through reduced space between plants. This may decrease yield per plant but increase yield per square foot of bench space.

2. Decreased aisle space to increase number of benches in the shade house. This is limited by the size of equipment used in the aisles.

3. Increased bench width. This is limited by a decrease in the efficiency of labor use, particularly in picking flower spikes.

4. Increased price of flower sprays on the Mainland.

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5. Increased lei flower price.

6. Direct sales to mainland retailers.

7. Decreased percentage of cull spikes.

8. Plant sales as a sideline.

Gross Revenue-decreasing Factors

1. Increased transportation costs.

2. Reduced mainland price for flower sprays.

3. Decreased lei flower price.

4. Competition from other growing areas.

5. Decline in consumer preference for the grower's particular varieties or for dendrobiums in general.

ACKNOWLEDGMENTS

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