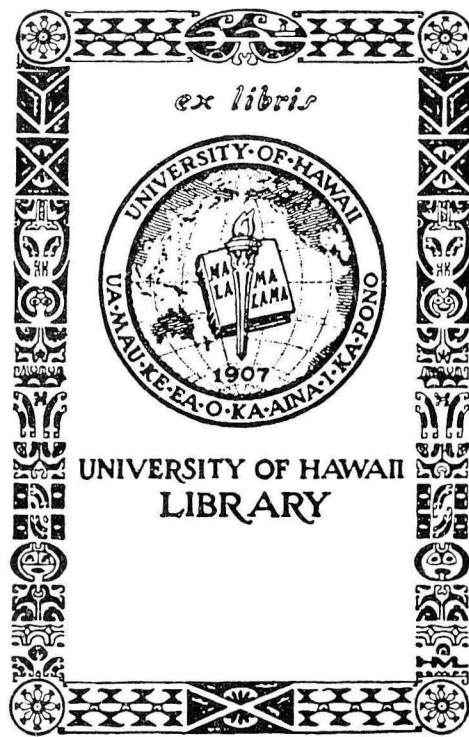


**Feasibility of Growing Pineapple
Forage on Molokai
for Sale to Oahu Cattle Producers**

P. F. Philipp, W. G. Sanford, and R. W. Stanley



Hawaii Agricultural Experiment Station • College of Tropical Agriculture
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THE AUTHORS

Perry F. Philipp is Agricultural Economist, Hawaii Agricultural Experiment Station, and Professor of Agricultural Economics, College of Tropical Agriculture, University of Hawaii.

Wallace G. Sanford is Agronomist, Hawaii Agricultural Experiment Station, and Chairman, Department of Agronomy and Soil Science, College of Tropical Agriculture, University of Hawaii.

Richard W. Stanley is Animal Scientist, Hawaii Agricultural Experiment Station, and Professor, Department of Animal Sciences, College of Tropical Agriculture, University of Hawaii.

PREFACE

In preparing the 1973 monograph form of this work for publication as Departmental Paper 33, we have kept the cost and return calculations at 1973 conditions and prices but updated the rest of the study to the mid-1975 situation.

Feasibility of Growing Pineapple Forage on Molokai for Sale to Oahu Cattle Producers

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Since Dole Company disclosed its planned discontinuation of pineapple production on the Island of Molokai, other agricultural uses have to be found for the land planted to that crop. The dry, windy climate and the scarcity and high cost of irrigation water limit the choice of crops; hence this study of the feasibility of growing pineapple forage as the main crop in the Hoolehua Homesteads of Molokai for sale as pineapple green chop or hay for cattle producers on the Island of Oahu was undertaken.

In 1974, Oahu dairymen bought an estimated 50,000 tons of pineapple green chop, a by-product of pineapple fruit-growing operations on Oahu. In addition, the two pineapple companies operating canneries on Oahu sold an estimated 15,000 tons of pineapple bran and some pineapple stump meal to dairy and beef producers in the same year. Furthermore, about 25,000 tons of alfalfa meal and pellets were imported annually into Hawaii during the last 3 years of record. ^{1/}

With a decline in pineapple acreage and pineapple canning planned on Oahu, less Oahu-produced pineapple bran and green chop may be available in the future, while demand for these products is expected to increase. Assuming that no other locally produced roughage feed becomes available, there should be a market on Oahu for pineapple-leaf products from Molokai, if they can be produced at prices competitive with imported alfalfa hay.

YIELDS OF GREEN CHOP AND HAY

Since pineapple has never been grown for forage production as the main crop, many data used in this report are estimates. In particular, the figures for total yield of chopped forage for the whole plant cycle and for the annual yields during the cycle are only "informed guesses." Pineapple is planted at the rate of 31,500 plants per 9/10 acre (Table 1), and 1/10 acre is used as roadways. This plant population is higher than normally used for fruit production. It is assumed that 9000 tons of pineapple hay equal to 55,800 tons of pineapple green chop are produced per year on a 900-acre farm.

One planting cycle is assumed to last 4 1/2 years. Leaves are cut for the first time after 1 year of plant growth. At every cutting during the entire cycle, 2 pounds of leaves per plant will be harvested. Four cuttings will be made in the second year, three in the third, and two in the fourth. The number of cuttings is assumed to decline over the cycle

^{1/} Average annual import figure during the last 3 years of record (1971-74), Statistics of Hawaiian Agriculture, 1974, Hawaii Crop and Livestock Reporting Service, Honolulu, 1975, p. 75.

because the plants become less vigorous with age due to increased nematode damage. After the last cutting at the end of the fourth year, a half-year of field use is scheduled to dispose of the old plants and to prepare the field for the new planting. The total yield of fresh pineapple green chop is estimated at 283.5 tons per cycle, or 63 tons per year of land use (Table 1).

It is estimated that the dry matter content of the freshly cut pineapple leaves increases from 10 percent for the first cut to 20 percent for the ninth, or last, cut in the cycle.

Table 1. Estimated yield of fresh pineapple green chop and pineapple hay from 1 acre with 4 1/2-year replanting cycle ^{1/}

Item	No. of leaf cuttings	Fresh leaf weight per cutting ^{2/}	Pineapple green chop per acre per year	Leaf dry matter content		Pineapple hay per acre per year ^{3/}
		Tons	Tons	Percent	Tons	Tons
Second year	4	31.5	126.0	12.5	15.7	17.5
Third year	3	31.5	94.5	15.0	14.2	15.8
Fourth year	2	31.5	63.0	18.0	11.3	12.6
Total (per acre per 4 1/2-year cycle)	9		283.5		41.2	45.9
Average production (tons per acre per year)			63.0			10.2
Average percent dry matter				14.5		
Drying ratio of fresh green chop to hay						6.2:1

^{1/} 31,500 plants planted per acre.

^{2/} Each plant yields 2 pounds of fresh leaves per cutting.

^{3/} Pineapple hay includes 10 percent moisture and amounts to an average of 16.2 percent by weight of the fresh weight of pineapple green chop over the crop cycle.

Average dry matter content thus increases from 12.5 percent in the second year to 15 percent in the third and 18 percent in the fourth. If we assume a moisture content of 10 percent in the final product, total production of pineapple hay amounts to 45.9 tons per acre per 4 1/2-year cycle, or 10.2 tons per acre per year (Table 1). Pineapple hay amounts to an average of 16.2 percent by weight of fresh pineapple green chop over the crop cycle. The drying ratio is 6.2 tons green chop to 1 ton hay (Table 1).

COST ANALYSES

Field Preparation and Planting

Operational cost estimates are based on January 1973 prices, costs, and wages of organized labor on Molokai. Since a pineapple farm of 900 acres cannot by itself fully utilize some of the larger pieces of equipment - such as boomsprayer or mulch layer - it is assumed that equipment is made available by an adjoining pineapple plantation at its regular hourly service rates based on capacity utilization of the machines. No management charges and no

Table 2. Estimated cost of field preparation and planting of pineapple raised for leaf production on Molokai

Item	Cost per operation per acre	Cost per ton of green chop ^{1/}
	<u>Dollars</u>	<u>Dollars</u>
Field preparation	55.00	0.19
Laying mulch, including plastic mulch; fertilizer and fumigant application, including fumigant	139.00	0.49
Fertilizer ^{2/}	166.50	0.59
Plants ^{3/}	273.00	0.96
Planting ^{4/}	168.00	0.59
Miscellaneous ^{5/}	16.50	0.06
Subtotal	818.00	2.88
Interest ^{6/}	114.52	0.40
Total field preparation and planting	932.52	3.28

^{1/} Cost per acre divided by 283.5 tons, which is the total green chop production per 4 1/2-year cycle (see Table 1).

^{2/} N - \$37.63; K - \$40.16; P - \$78.80; miscellaneous - \$10 per acre.

^{3/} 31,500 plants per acre @ \$8.66 per 1000 plants.

^{4/} 31,500 plants per acre @ \$5.32 per 1000 plants planted.

^{5/} Road maintenance.

^{6/} At 7 percent per year on 1/2 of \$818 for 4 years.

Note: No management and no interest charges on equipment included as a cost.

interest on equipment are included in field cost estimates. It is assumed that contemporary Hawaii plantation methods of growing pineapple are used. For example, a mulch laying machine applies fertilizer and inserts fumigants into the soil while laying a sheet of plastic mulch at the same time. Much more potassium fertilizer is applied than for fruit production to enhance vegetative growth. Planting materials of the Cayenne variety (both crowns and slips) are used, since more suitable varieties for forage production are not available in large amounts. Planting is done by hand.

The investment in field preparation is \$818 per acre, or \$2.88 per ton of green chop. Since the field preparation and planting investment is used over a period of 4 years, interest is charged at 7 percent per year for 4 years on half of the \$818 investment. This interest amounts to \$114.52 per acre, or \$0.40 per ton green chop. Total costs of field preparation and planting are thus \$932.52 per acre, or \$3.28 per ton of green chop (Table 2).

Growing

Much of the growing costs consists of spraying of fertilizers, herbicides, and pesticides with a boomsprayer. Because of iron deficiency, the boomsprayer will go over every field once every 10 days on the average. About 300,000 gallons of irrigation water will be applied per acre per year at a cost of \$0.08 per 1000 gallons and \$1.10 per acre per month. Growing costs including a small interest charge on growing costs per cutting amount to \$456.27 per acre per cycle, or \$1.62 per ton of green chop (Table 3).

Table 3. Estimated cost of growing pineapple raised for leaf production on Molokai 1/

Item	Cost per acre	Cost per ton of
	per cycle	green chop <u>2/</u>
	<u>Dollars</u>	<u>Dollars</u>
Fertilizer <u>3/</u>	166.84	0.59
Spraying, weed control, and insect control <u>4/</u>	130.00	0.46
Irrigation <u>5/</u>	148.80	0.53
Miscellaneous	5.00	0.02
----- Subtotal	450.64	1.59
----- Interest <u>6/</u>	5.63	0.02
Total cost	456.27	1.62

1/ Costs of land preparation and planting not included (see Table 2).

2/ Cost per acre per cycle divided by the green chop yield per cycle of 283.5 tons (see Table 1).

3/ N - \$81.63; K - \$51.84, Fe - \$33.37 per cycle. Does not include fertilizer applied at planting.

4/ Spraying - \$50/cycle; weed control - \$60/cycle; insect control - \$20/cycle.

5/ At \$0.08 per 1000 gallons for 300,000 gallons per acre per year + \$1.10 per month per acre.

6/ At 7 percent for 4 1/3 months on 1/2 of \$450.64.

Note: No management and no interest charges on equipment included in costs.

Table 4. Summary of estimated cost of production of pineapple green chop on Molokai

Item	Cost per ton of green chop
	<u>Dollars</u>
Cost of field preparation and planting	3.28
Cost of growing	<u>1.62</u>
Total cost of field preparation, planting, and growing	4.90
Leaf cutting and chopping	1.82
Hauling green chop from field to central station	2.28
Loading and weighing green chop on cattleman's truck	<u>0.30</u>
Total cost of green chopping, hauling, and loading	4.40
Land costs ^{1/}	0.55
Office and miscellaneous costs	<u>0.12</u>
Total land cost and miscellaneous	<u>0.67</u>
Total cost of green chop per ton loaded on cattleman's truck in Molokai	<u><u>9.97</u></u>

^{1/} Land rental at \$30 per acre per year and real property tax at \$5 per acre per year for 4 1/2 years.

Note: No management and no interest charges on equipment included in cost.

Total Molokai Production

Field preparation, planting, and growing of pineapple forage cost \$4.90 per ton of green chop (Table 4). Cutting and chopping the pineapple leaves, hauling the green chop to a central station, and loading it on a customer's truck cost another \$4.40 per ton of green chop. Land rental, land tax, and miscellaneous charges add another \$0.67 to cost per ton of green chop. Thus, the total cost of green chop loaded on a cattleman's truck in Molokai amounts to \$9.97 per ton (Table 4). In comparison, dairymen at Whitmore Village in Central Oahu pay \$9.50 per ton of pineapple green chop loaded on their trucks - that is, \$0.47 per ton less.

Molokai Green Chop Delivered in Honolulu

In shipping pineapple feed from the Molokai farm to Honolulu, the following additional cost items are incurred: hauling to Kaunakakai Harbor on Molokai, loading on the barge, ocean freight and insurance, state wharfage tolls, unloading in Honolulu Harbor on Oahu, and returning the empty container to Molokai. These costs total \$7.20 per ton (Table 5). A ton of pineapple green chop from Molokai delivered in Honolulu Harbor costs \$16.87. This is \$7.37 more than the price of the Oahu-produced pineapple green chop. But, in this comparison, it

Table 5. Estimated cost of Molokai-produced pineapple green chop delivered to Honolulu

Item	Cost per ton of green chop
	<u>Dollars</u>
Cost of pineapple green chop at Molokai farm	9.67 ^{1/}
Hauling to Kaunakakai Harbor, loading on barge, and unloading at Honolulu Harbor	1.20
Ocean freight and insurance ^{2/}	5.20
State wharfage tolls ^{3/}	<u>0.80</u>
Total cost of transportation from Molokai farm to Honolulu Harbor	<u>7.20</u>
Total cost of pineapple green chop from Molokai delivered in Honolulu Harbor	<u><u>16.87</u></u>

^{1/} This is the total cost of green chop of \$9.97 per ton at the farm (Table 4) less the loading cost onto a cattleman's truck of \$0.30 per ton.

^{2/} Ocean freight charge by Young Brothers barge from Kaunakakai, Molokai, to Honolulu Harbor @ \$4.39 per ton, insurance at \$0.32 per ton, and return charge for empty container @ \$0.39 per 40 cubic feet.

^{3/} State wharfage tolls for the loaded feed container are \$0.27 per ton both in Kaunakakai and Honolulu Harbors. Tolls for the empty returned containers are \$0.13 in both harbors.

is important to remember that the Oahu product is from mature plants, which would be lower in feed value than those grown specifically for feed on Molokai.

Molokai Hay Delivered in Honolulu

Instead of shipping pineapple green chop, which contains 85.5 percent water, it seems reasonable to dry it first to pineapple hay with a 10 percent moisture content before shipping. It takes 6.2 tons of fresh pineapple green chop to produce 1 ton of pineapple hay. At \$9.67 per ton, 6.2 tons green chop cost \$59.95 (Table 6). Drying and pelletizing costs \$23.79 per ton of hay, of which \$20.29 goes for drying and \$3.50 for pelletizing. Thus, 1 ton of pineapple hay costs \$83.74 to produce at the Molokai farm. If we add a transportation cost of \$7.20 per ton, Molokai-produced pineapple hay delivered in Honolulu costs \$90.94 (Table 6).

COMPETITIVE POSITION OF MOLOKAI-PRODUCED PINEAPPLE HAY

Pineapple hay on the Honolulu market would be in direct competition with alfalfa hay imported from the Mainland. While pineapple hay may be equal to alfalfa hay in total digestible nutrients, it is much poorer than alfalfa hay in digestible crude protein (Table 7).

Table 6. Estimated cost of producing pineapple hay on Molokai and transporting it to Honolulu

Item	Cost per ton of pineapple hay
	<u>Dollars</u>
Cost of pineapple green chop <u>1/</u>	59.95
Cost of heating oil <u>2/</u>	11.99
Drier and storage costs other than heating oil <u>3/</u>	8.30
Total drying and storage costs	20.29
Cost of pelletizing	<u>3.50</u>
Total cost of drying and pelletizing	23.79
Cost of one ton of pineapple hay at Molokai farm	83.74
Cost of transportation to Honolulu <u>4/</u>	<u>7.20</u>
Total cost of Molokai-produced pineapple hay delivered at Honolulu Harbor	<u><u>90.94</u></u>

1/ It takes 6.2 tons of fresh green chop with 14.5 percent dry matter content to produce 1 ton of hay with 10 percent moisture content (see Table 1). The cost per ton of green chop is \$9.67 per ton (see Table 5).

2/ If it is assumed that the drier works at 80 percent efficiency, which is considered normal, it takes 97.5 gallons of heating oil to dry 1 ton of hay to a moisture content of 10 percent. Heating oil costs \$0.123 per gallon.

3/ Includes labor, electric power, depreciation, interest, and maintenance.

4/ See Table 5 for details on transportation costs to Honolulu Harbor of \$7.20 per ton.

At a January 1973 price of alfalfa hay pellets in Honolulu of \$83.60 per ton, the comparative value of pineapple hay pellets would be \$54.80 per ton (Table 7). The cost of Molokai pineapple hay of \$90.94 per ton (Table 6) thus greatly exceeds its market value in Honolulu under present market conditions.

WHAT ABOUT THE FUTURE?

Improved Production Technology

Production of both pineapple green chop and pineapple hay in Molokai for the Honolulu feed market is unprofitable under the production assumptions we have made. It must be emphasized, however, that the assumed growing methods were developed for the production of pineapple fruit. Pineapple forage as the main product requires a different technology of production. If such a new technology is developed - resulting in larger output, higher value

Table 7. Comparison of Honolulu market value of alfalfa hay and pineapple hay in January, 1973

Product	Nutrient content in 100 pounds		Price per pound		Value per 100 pounds		Value of product	
	DCP <u>1/</u>	NPTDN <u>2/</u>	DCP	NPTDN	DCP	NPTDN	Per 100 pounds	Per ton
	<u>Pounds</u>	<u>Pounds</u>	<u>Cents</u>	<u>Cents</u>	<u>Dollars</u>	<u>Dollars</u>	<u>Dollars</u>	<u>Dollars</u>
Alfalfa hay pellets	10.0	40	22.6	4.8	2.26	1.92	4.18	83.60
Pineapple hay pellets	1.5	50	22.6	4.8	0.34	2.40	2.74	54.80

1/ Digestible crude protein.

2/ Nonprotein total digestible nutrients.

of product, lower cost, or a combination of these - the economic results might be different. Some areas in which substantial improvements in producing pineapple green chop and hay seem indicated are the following:

1. Pineapple varieties other than the presently grown Cayenne may be much more suited for the production of pineapple forage.
 - a. Varieties are known which are more vigorous vegetative growers and thus could produce a greater tonnage.

- b. The Cayenne variety is susceptible to nematodes, which is the reason why we assumed a rapid decline in forage yield after the second year after planting and why we specified replanting after 4 years. Pineapple varieties with much greater nematode resistance are known, which, if otherwise suitable, would produce more consistent yields and would have a much longer productive life span. This would make it possible to spread the high replanting costs over a longer period of productive life. It would also reduce the proportion of time during which the land would lie fallow to dispose of the plant refuse of the previous crop.
 - c. A big item of the replanting cost is the expense of planting material (Table 2). Varieties exist and methods could be developed to greatly increase the amount of planting material that could be produced per plant and thus decrease this item of cost.
2. It has been assumed in this study that no additional nematode treatment would be given during the crop cycle after soil fumigation at planting time. New chemicals such as Nematicur have been developed, however, which can be sprayed on the growing plant in the field to reduce nematode damage. Nematicur is presently expensive and has not yet been cleared for use on pineapples. In our case where the forage is sold as animal feed, tests have to be made whether residues of the chemical remain on the leaves at harvest time. If the above obstacles to the use of nematode repressants can be overcome, forage production could be increased and the life span of the plant lengthened.
 3. Methods of green chopping which were used in 1973 are now being improved. For example, during harvesting by the old method the green chop is blown by the harvester into a truck driving alongside. Much labor and hauling time is now saved by blowing the green chop instead into a trailer being pulled behind the harvester. When the trailer is full, its contents are unloaded into a big truck trailer. A harvester of different design is currently being field tested which is expected to further reduce costs.
 4. A major cost item in making pineapple hay is the cost of drying. On the Mainland, forage drying operations are made more efficient by first pressing some of the water out of the fresh forage by mechanical presses, thus doubling the amount of forage dry matter which is eventually run through the drier.
 5. The quality of pineapple hay which was produced in Hawaii in the past has been questioned. It is expected that with additional research, this quality can be improved upon, thus resulting in a more valuable product than previously produced.
 6. Other cost reductions in producing pineapple green chop and hay might be brought about by developing better methods of applying various fertilizers, water, insecticides, and herbicides, and by finding the optimum number of plants per acre.
 7. It was assumed here that 2 pounds per plant were to be harvested per cutting. Research as to whether a much larger portion of the plant could profitably be marketed, particularly during the last harvesting of the cycle, is now underway. If this last cut could not be dried successfully, that forage could possibly be ensiled. This leads into the important issue whether production of pineapple forage on Molokai could not best be used as cattle feed in an integrated cattle operation of either beef or dairy, or both, on Molokai.
 8. This study assumed the use of a highly mechanized plantation methodology. Under conditions existing in the Hoolehua Homesteads, it might be worthwhile to investigate a less mechanized, more labor-intensive and more land-extensive production technology. This was not done for lack of time.

These changes in production technology would improve the economic results of growing pineapple forage in Molokai. Perhaps some of our assumptions, though, were a little optimistic. For example, we assumed a yield of 2 pounds of green chop per plant per cutting; the condition of pineapple fields on Oahu, which have just been green chopped, show many

plants that have been uprooted or severely damaged by the harvester or the tractor. Such a condition of the pineapple plants does not matter on Oahu where the plants will be disposed of after green chopping. In the case of the Molokai forage operation, however, where a new harvestable leaf crop is expected within 3 months, equipment has to be operated in such a way that the wheels run between the plant rows thus minimizing plant damage.

Potential Market

Some final thought should be given to the size of the market for Molokai-produced pineapple green chop or hay on Oahu and to the potential competition that a Molokai producer might face. The Oahu market for pineapple forage products is largely limited to Oahu cattle, both dairy and beef. A total of 35,500 head of cattle of all ages and types were on Oahu on January 1, 1975. ^{2/}

Corn is now being grown in Kahuku, Oahu, and used as a roughage feed by Oahu dairymen. Recent test plantings of alfalfa have been successful on the islands of Molokai and Hawaii. Substantial expansion of alfalfa production is being contemplated on these islands for marketing on Oahu.

Cane strippings from Oahu's sugarcane plantations are another potential cattle feed. So far the amount of sugarcane strippings used for feed by Oahu cattle raisers has been limited because of the rather poor quality of the product. However, with public pressure to reduce the burning of sugarcane fields, cane harvesting methods might be changed and a better cane stripping product may reach the market. The potentially large and low-priced supply of such a feed might become competitive to a pineapple forage producer on Molokai.

Castle and Cooke Corporation has made a study of producing pineapple hay on the Island of Lanai. Since pineapple hay on Lanai would be a by-product rather than the main product as postulated in our Molokai feasibility study, Castle and Cooke Corporation on Lanai would be able to outbid the price of a Molokai pineapple-forage producer on the Oahu feed market. Any agricultural entrepreneur who is contemplating whether or not to go into pineapple leaf production as his major product on Molokai, will have to take a good look at all the actual and potential competition.

While numerous alternatives thus appear feasible for producing forage, it also appears that forage is presently in short supply and that its price is high in the State of Hawaii. This situation should not exist in a State with a year-round growing season and a potential for producing its own forage supply.

^{2/} Statistics of Hawaiian Agriculture, 1974, p. 56.

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