

Milk Production with All-Grass Rations from Steep, Intensively Managed Tropical Pastures¹

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INTRODUCTION

Feeding of dairy cows in Puerto Rico is generally based on fairly well-managed pastures, mostly of Pangola grass, supplemented by 1 pound of 20- to 24-percent protein concentrate per liter (2.2 pounds) of milk produced. About \$15 million worth (180,000 tons) of concentrated dairy feeds are imported yearly. Most dairies are located on expensive, level, or rolling lands in the Coastal Region, many of which are suited to mechanized crop production.

About 500,000 acres of land in the humid Mountain Region are suited only to pastures since they are too steep for mechanized crop production and require the protection that grass provides against erosion. Livestock production in this area can be "mechanized" by applying fertilizer and lime with broad base crawler-type tractors or aerially, while grazing cattle harvest the forage.

Numerous long-term grazing experiments conducted in the humid Mountain Region by Vicente-Chandler *et al.*³ show that intensively managed pastures of improved grasses on steep slopes can carry over 2 head of growing cattle per acre and produce over 1,000 pounds of beef per acre yearly. The grazing cattle consumed about 14,000 pounds of dry matter per acre yearly containing 16 to 18 percent of crude protein. Productivity of these pastures on 50-percent slopes was only 20 percent lower than that of similarly treated pastures on level, irrigated lands. Cattle on such high-yielding pastures obtain their feed requirements in a small area and expend little energy in walking.

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² Agronomist, cooperative between the Soil and Water Conservation Research Division, Agricultural Research Service, USDA, and the Agricultural Experiment Station, Mayagüez Campus, University of Puerto Rico, and the Project Leader and Soil Scientist, Soil and Water Conservation Research Division, ARS, USDA, Río Piedras, P.R.

³ Vicente-Chandler, J., Caro-Costas, R., Pearson, R. W., Abruña, F., Figarella, J., and Silva, S., *The Intensive Management of Tropical Forages in Puerto Rico*, Bull. 187, Agr. Expt. Sta., Mayagüez Campus, Univ. P.R., 152 pp., 1964.

Little has been done to determine the productive capacity of intensively managed, heavily fertilized tropical grass pastures in terms of milk production.

The present study determined the capacity for milk production of steep, intensively managed pastures of three major tropical grasses grazed by Holstein cows receiving no concentrate feed over an 8-month lactation period.

MATERIALS AND METHODS

The experiment was carried out near Orocovis, about 2,000 feet above sea level. Average monthly temperatures range from 70° to 80° F., with

TABLE 1.—*Past performance of 8 Holstein cows when fed the standard ration currently used in Puerto Rican dairies*

Cow No.	Age	Previous lactations	Data for previous lactation		
			Total milk production	Length of lactation	Average daily production
	<i>Years</i>	<i>Number</i>	<i>Pounds</i>	<i>Days</i>	<i>Pounds</i>
503	8	5	4,850	240	20.2
109	5	3	6,500	270	24.1
767	5	2	5,320	210	25.3
422	10	5	5,600	240	25.0
263	5	3	6,040	270	22.4
761	5	3	5,870	240	24.5
822	5	3	5,970	300	19.9
11	5	3	4,360	240	18.1
Average	6.8	3.4	5,564	251	22.2 (10 liters)

highest daily temperatures rarely exceeding 90° F. Rainfall of about 65 inches is fairly well distributed here throughout the year. The soil is deep, red, acid, well-drained Cialitos clay on 50-percent slopes.

Three 1-acre, 8-year-old pastures each of Pangola, Napier, and Guinea grasses, were used in this experiment. The Napier and Guinea grass pastures were cut back with machetes, to a height of about 6 inches, 2 months before starting the experiment. All pastures were provided with drinking water, shade, salt, and steamed bonemeal and received 500 pounds of 14-4-10 fertilizer per acre every 3 months. Soil pH was maintained at about 5.5 by periodic liming.

Information available on the experimental cows taken from a dairy herd on the South Coast of Puerto Rico, is shown in table 1. These data show that the cows were rather poor producers.

Over previous lactations the cows had been fed a free choice ration of good quality fresh cut grass, 4 pounds of molasses daily, and 1 pound of 24-percent protein concentrate feed per liter of milk produced.

The cows were grazed on the experimental pastures as dry cows for approximately 2 months before calving so that they would become accustomed to the new environment. Three cows were assigned at random to graze the pastures of each grass. One cow on Pangola grass developed a hoof problem with which she had been previously troubled and was removed from the experiment. Data for this cow are not included in the discussion, although she produced satisfactory yields over the first 3 months.

The three 1-acre pastures of each grass were grazed in rotation for 1-week periods followed by 2 weeks of rest. The cows were on the pastures at all times and could graze at will day and night.

The cows were milked twice daily by hand and the amount of milk produced by each cow recorded. Samples for butterfat determinations were taken periodically from both the morning and evening milkings. The cows were weighed monthly.

RESULTS AND DISCUSSION

The 8 cows on an all-tropical-grass ration from steep pastures (fig. 1) averaged 25.2 pounds or 11.5 liters of milk daily (table 2) during an 8-month lactation period, at the end of which the cows were still averaging 6.4 liters daily and were 4 to 6 months pregnant. The previous lactation of these cows also averaged about 8 months. The average of 11.5 liters of milk produced daily by these cows on an all-grass ration compares favorably with an average of 9 quarts per cow for class A dairies with standard feeding practices in Puerto Rico.

Butterfat content of the milk ranged from 3.0 to 4.6 percent, averaging about 3.8 percent, slightly above average for Holsteins (table 2).

The cows produced an average of 6,064 pounds of milk on the full grass ration from steep pastures (table 2), compared to 5,564 pounds over their previous lactation on the standard ration described above.

Projections from these data show that, on a yearly basis, these pastures produced about 6,000 pounds of T.D.N. (Totally Digestible Nutrients) actually consumed by the cows. A similar projection shows that milk yields would total about 9,000 pounds per acre yearly.

The period of experimentation covers all but the two (January–February) coolest months of the year, and includes all the hot months of generally low milk production. Excess forage was available at all times in the pastures.

The cows on Guinea grass averaged 7,133 pounds of milk compared to 5,538 pounds for Napier grass and 5,123 pounds for Pangola grass (table 1).

The following tabulation shows protein content of these forages, harvested by plucking to simulate grazing, as affected by season of the year. Values are averages of 36 samples taken during each 2-month period.

Month	Pangola	Guinea	Napier
March-April	16.4	17.5	18.6
May-June	14.9	16.8	16.8
July-August	16.7	16.6	18.7
September-October	18.3	18.9	20.0
November-December	17.3	19.5	20.9
January-February	18.1	19.8	20.7
Average	16.8	18.2	19.3

Crude-protein content of the forage was similar for all grasses, averaging 18.1 percent, and varied little with season of the year.



FIG. 1.—Cows fed exclusively on an all-grass ration from well fertilized, steep, tropical grass pastures at Orocovis. Eight cows in this pasture averaged 11.5 liters of milk daily over an entire lactation period while gaining slightly in weight.

Table 2 shows how milk production of the cows on an all-grass ration decreased gradually over the lactation periods from an average of 33.4 pounds the first month to 14.2 pounds during the 8th month. The trend was similar to that of previous lactations on standard rations (fig. 2).

TABLE 2.—Monthly milk production in pounds of 8 cows on full tropical grass rations from steep pastures, over an 8-month lactation period (approximately April–December 1968)

Month of lactation	Guinea grass pastures			Pangola grass pastures		Napier grass pastures			Average
	Cow 503	Cow 767	Cow 109	Cow 422	Cow 263	Cow 761	Cow 822	Cow 11	
	<i>Lb.</i>	<i>Lb.</i>	<i>Lb.</i>	<i>Lb.</i>	<i>Lb.</i>	<i>Lb.</i>	<i>Lb.</i>	<i>Lb.</i>	
1	1,042	1,171	1,110	890	944	946	1,059	843	1,000
2	1,073	1,021	1,104	771	849	790	980	794	923
3	967	1,040	1,054	684	813	753	938	747	875
4	941	1,106	1,058	650	711	619	883	781	844
	(4.5)*	(3.7)	(3.6)	(4.2)	(4.3)	(4.4)	(3.1)	(3.7)	
5	879	982	919	575	623	565	791	717	756
	(3.3)	(3.0)	(3.6)	(3.0)	(4.1)	(4.5)	(3.8)	(3.9)	
6	834	795	739	513	490	540	746	614	658
	(3.7)	(4.4)	(3.4)	(3.5)	(4.6)	(4.6)	(3.6)	(4.4)	
7	698	685	620	549	433	425	589	522	565
	(3.8)	(3.1)	(3.2)	(3.6)	(4.0)	(4.5)	(3.4)	(3.9)	
8	676	643	344	435	316	226	428	328	425
Total	7,110	7,443	6,948	5,067	5,179	4,864	6,404	5,346	6,064
Average daily production (pounds)	29.6	31.0	29.0	21.1	21.6	20.3	26.7	22.3	25.2
(Liters)	13.5	14.1	13.2	9.6	9.8	9.2	12.2	10.1	11.5
Production during previous** lactation (pounds)	4,850	5,320	6,500	5,600	6,040	5,870	5,970	4,360	5,564

* Numbers in parentheses show percent butter-fat content on one day of the month.

** Cows fed a ration of 4 pounds molasses daily, 1 pound of 24-percent protein concentrate per liter of milk and free choice of good quality chopped grass.

All eight cows maintained rather constant body weights throughout the lactation period (table 3), averaging about 1,150 pounds, which is normal for Holsteins in Puerto Rico. These data show that the cows were obtaining sufficient nutrients from the all-tropical grass ration for both milk production and maintenance.

The data suggest that cows producing up to 15 liters (33 pounds) of milk daily may obtain all their nutritional requirements from all-grass rations.

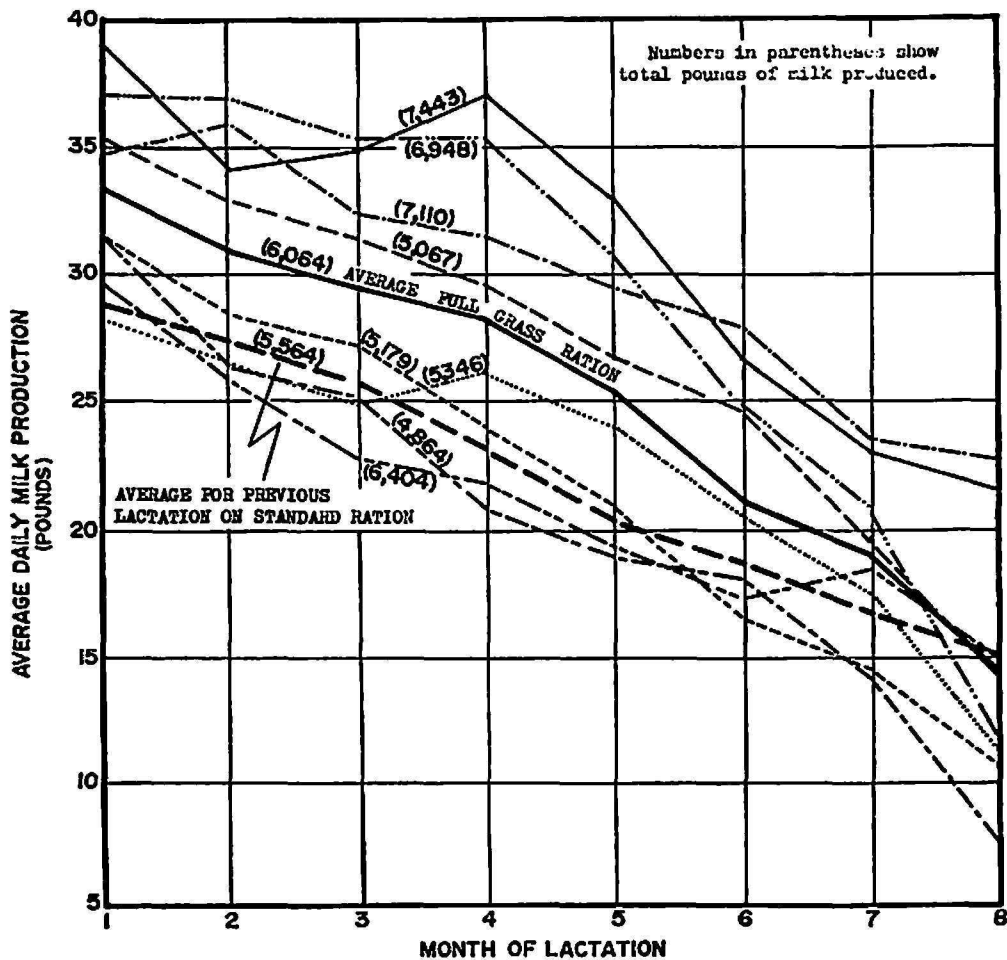


FIG. 2.—Monthly milk production of 8 cows on an all-grass ration from steep, well fertilized pastures, over an 8-month lactation period (1968).

TABLE 3.—Monthly body weights (in pounds) of 8 cows on a full tropical grass ration from steep pastures over an 8-month lactation period

Cow No.	Body weight for month of lactation period							
	1st	2nd	3rd	4th	5th	6th	7th	8th
503	1,135	1,090	1,195	1,175	1,235	1,205	1,165	1,210
109	1,155	1,080	1,210	1,140	1,250	1,245	1,215	1,220
767	985	950	1,010	1,010	1,085	1,055	1,060	1,030
422	1,035	995	960	1,040	1,040	1,065	1,055	1,040
263	1,225	1,205	1,255	1,185	1,235	1,235	1,250	1,265
761	1,050	1,045	1,055	1,025	1,120	1,140	1,120	1,120
822	1,020	1,095	1,095	1,065	1,125	1,110	1,135	1,104
11	1,145	1,126	1,155	1,130	1,180	1,190	1,210	1,230
Average	1,094	1,072	1,117	1,096	1,160	1,156	1,151	1,152

Cows No. 503, 109, 822, and 767, for example, averaged 14.9, 15.8, 14.1, and 16.1 liters of milk daily, respectively, during the first 5 months of lactation (table 2) without losing weight (table 3).

Daily cost of the forage consumed by the cows on a full-grass ration was about 30 cents (Vicente-Chandler, *et al.*).³ This contrasts with feed costs of 75 cents daily for similar cows fed the standard ration of 12 pounds of 24-percent concentrate which cost 57 cents and 18 pounds of dry forage (about 90 pounds of green forage) which cost 18 cents.

The following tabulation shows estimated costs and profits for a 120-acre dairy farm based exclusively on intensively-managed tropical pastures in the humid mountain region of Puerto Rico. Such a farm should yield a net income for management of \$20,525 yearly, or over \$170 per acre.

1. 2 milkers at \$50 per week ¹	\$ 5,200
2. 2 laborers for managing pastures at \$40 per week (fertilizing, liming, fence repairs, etc.).....	4,160
3. Fertilizer (120 T) and lime (40 T).....	7,400
4. Medicines and salt.....	1,300
5. Light, water, transportation.....	1,600
6. Social Security, taxes and insurance.....	1,500
7. Veterinary and artificial insemination service.....	1,800
8. Interest on land (120 acres at 600 and 8 percent).....	5,760
9. Interest on building and equipment (\$30,000 at 8 percent).....	2,400
10. Interest on cattle (\$40,000 at 8 percent).....	3,200
11. Depreciation of building (20 years) and equipment (10 years)....	2,000
12. Purchase of 6-month-old heifers.....	3,000
TOTAL EXPENSES	\$39,320
Income—900 liters per day at 17¢ × 365 days.....	\$55,845
Sale of cattle (20 cows, 50 calves).....	4,000
TOTAL INCOME	59,845
NET PROFIT FOR MANAGEMENT	20,525

¹ Owner helps in milking operation on milker's free day.

The data presented in this paper suggests that there is great waste in feeding concentrates at the 1-pound per liter of milk ratio used almost universally in Puerto Rico. With good pastures, only cows producing over 10 liters of milk daily should require concentrate feeds, although this must be confirmed by critical experimentation now underway.

This study also shows the vast potential for profitable milk production, which exists on thousands of acres of steep mountain lands. If each acre yields 2,000 liters of milk yearly, all the Island's present fresh-milk consumption (380 million liters yearly) can be produced on less than 200,000 acres of steep mountain lands.

Some benefits of a milk industry based largely on intensively managed pastures in the Mountain Region are: 1, Reduced importations of dairy concentrate feeds which now drain \$15 million yearly from the economy; 2, reduced imports of milk and milk products which now total \$30 million yearly; 3, reduced costs of milk production; and 4, realized potential of thousands of acres of steep mountain lands which would also be protected from erosion by the pastures.

SUMMARY

Eight cows in Puerto Rico produced an average of 6,064 pounds of milk (25.2 pounds or 11.5 liters daily) over an 8-month lactation period on an all-grass ration from steep pastures of tropical grasses. Butterfat content of the milk averaged 3.8 percent, about average for Holsteins. All cows maintained normal body weights throughout the lactation.

A 120-acre farm with all cows fed exclusively on well-fertilized and managed pastures could yield a profit of about \$170 per acre yearly.

The data suggest that the use of concentrate feeds, now almost universally fed at the rate of 1 pound per liter of milk, can be sharply reduced by using well fertilized pastures. On good pastures little or no concentrate feed should be required for the first 10 liters or so of milk produced.

RESUMEN

Ocho vacas produjeron un promedio de 6,064 libras de leche (25.2 libras u 11.5 litros diarios) durante un período de lactancia de 8 meses, alimentadas exclusivamente a base de una ración de yerbas tropicales en pastos inclinados. El contenido de grasa de la leche promedió 3.8 por ciento, que se considera normal para la raza Holstein. Durante la lactancia todas las vacas mantuvieron su peso normal.

Una finca de 120 cuerdas con vacas alimentadas exclusivamente de pastos, bien abonados y manejados podría producir una ganancia de alrededor de \$170 por cuerda al año.

Los datos sugieren que el uso del alimento concentrado, el cual se suministra generalmente a razón de 1 libra por cada litro de leche puede reducirse drásticamente si se utilizan pastos bien abonados. Cuando los pastos son buenos, no debe necesitarse alimento concentrado para los primeros 10 litros de leche que una vaca produzca.