MINIMUM NUTRITIVE REQUIREMENTS OF DAIRY CATTLE UNDER TROPICAL CONDITIONS

J. I. Cabrera[1]

Introduction

The literature on the minimum requirements of dairy cattle under tropical conditions is very scarce. This is because tropical agricultural workers have relied considerably on the research findings of their fellow workers of the Temperate Zone. For a long time the animal husbandman in the Tropics has relied on Morrison's Standards for nutritional requirements, but practical findings have demonstrated that these are not appropriate for the conditions prevailing in this region.

With this in mind, a series of feeding and digestion trials were conducted to determine the minimum requirements in therms, for growing heifers, dry dairy cows, and producing dairy cows.

The report that follows is a preliminary one. More research is needed and is under way, to provide final answers.

Method of Procedure

The method used in determining the minimum requirements for dairy cattle is the one suggested by Dr. R. W. Swift of the Institute of Animal Nutrition at the Pennsylvania State College, in a personal interview with the author in September 1950.

Experimental Results

GROWTH REQUIREMENTS

The heifers used weighed an average of 611 pounds with a range from 495 to 712 pounds. The group of 10 heifers were grade Holsteins and Native animals. These heifers were placed on a ration consisting of Merker grass about 70 days old. The heifers received all the grass they could eat. Daily weighings were taken. A balance between the grass intake and body weight was obtained in about 10 days. After the animals reached this point the ration was left unchanged and feces and grass samples were taken for 7 days in succession. The heifers were weighed daily during this collection period.

After the feces and roughage samples were taken they were dried and burned in the bomb calorimeter to determine their energy value. From these values the following equation was determined (see fig. 1):

$$Y = 29.023\ X - 3{,}547$$

[1] Assistant Animal Husbandman, Agricultural Experiment Station, University of Puerto Rico, Río Piedras, P. R.

The analysis of variance to show the fitness of the equation is shown below:

Source of variation	*DF*	*SS*	*V*	*F*
Total	9	60,532,709		
Regression	1	33,640,356	33,640,356	10.00*
Error	8	26,892,353	3,361,544	

The regression on the equation is significant at the 5-percent point. From this equation the requirements for heifers weighing from 495 to 712 pounds

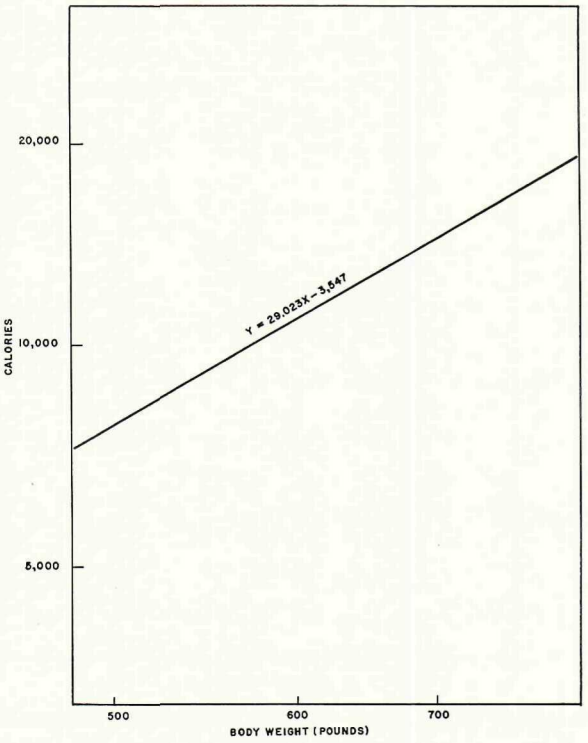

FIG. 1.—Growth requirements of heifers at different body weights.

which varied from 10.82 to 17.12 therms can be determined. These requirements are about 1.5 or 2 times the requirements reported by Morrison.

MAINTENANCE REQUIREMENTS

In determining the minimum requirements of dry dairy cows the same procedure used with heifers was followed. The cows weighed an average of 860 pounds with a range from 701 to 1,018 pounds. The equation determined was as follows (see fig. 2):

$$Y = 38.76\ X - 20{,}576.60$$

The following analysis of variance to determine the fitness of the equation shows that the regression was highly significant at the 1-percent point:

Source of variation	*DF*	*SS*	*V*	*F*
Total	13	287,786,624		
Regression	1	136,847,955	136,847,955	10.88**
Error	12	150,938,669	12,576,222	

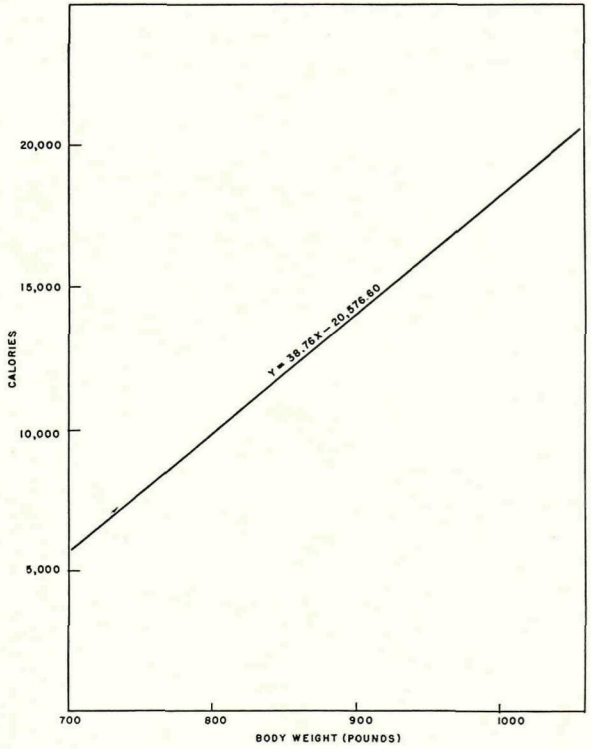

FIG. 2.—Maintenance requirements of mature dairy cows of different body weights.

From this equation the requirements of dry dairy cows weighing from 701 to 1,018 pounds can be determined as follows: 6.594 therms for 701 pounds and 18.9198 therms for 1,018 pounds. These findings are about 1.5 and 2 times the requirements reported by Morrison.

PRODUCTION REQUIREMENTS

In determining the requirements of dairy cows producing from 16 to 33 pounds of FCM milk the requirements for maintenance determined previously were used. The roughage fed was Merker grass which was hand-fed in quantities weighed daily. All forage and concentrate consumption was

recorded. Forage and concentrate samples were taken for calorimetric determinations.

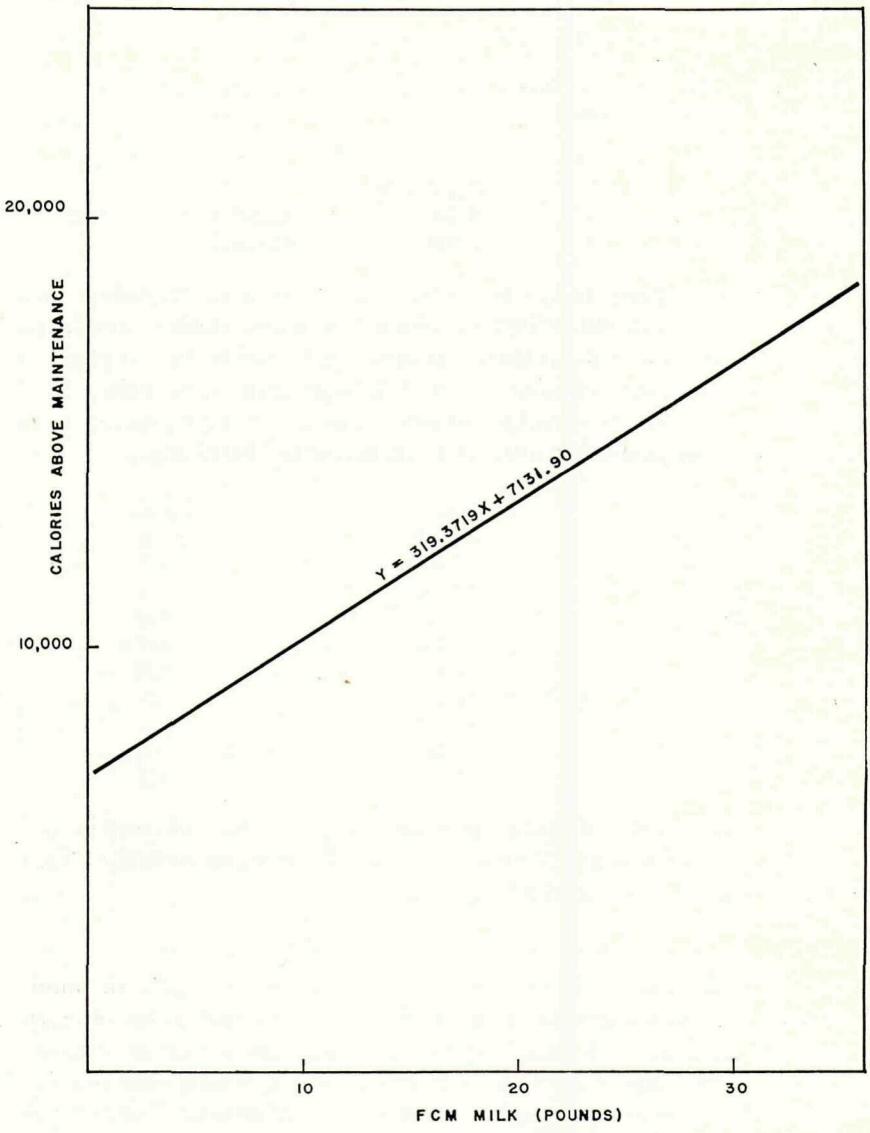

FIG. 3.—Requirements of milking cows of different body weights.

The caloric value of the feed used was 2,004.15 calories per pounds with a coefficient of digestibility of 0.7840.

Exactly the rame procedure reported previously was followed with this group of cows.

The equation obtained was as follows (see fig. 2):

$$Y = 319.3719 + 7{,}131.90$$

The analysis of variance shown below indicates that the regression of the equation is not significant:

Source of variation	*DF*	*SS*	*V*	*F*
Total.....	5	67,145,475		
Regression..	1	16,240,841	16,240,641	1.28
Error.....	4	50,894,833	12,723,708	

Although the regression was not significant, there is an indication that the nutritional requirements for milk production under tropical conditions are again about 1.5 to 2 times those reported by Morrison. In this phase of the problem more research is needed with a larger number of cows.

The following results showing requirements above maintenance were obtained for cows producing from 16 to 33 pounds of FCM milk:

FCM milk Pounds	*Therms*	*Therms per pound*
16	12.242	0.765
18	12.881	.716
20	13.519	.676
22	14.158	.644
24	14.797	.617
26	15.435	.594
28	16.074	.574
30	16.713	.557
32	17.352	.542
34	17.991	.529

There is an indication that the higher producers are more efficient in feed utilization. It was found also that the addition of concentrates to the ration educed its digestibility about 9.58 percent.

Summary and Conclusions

A series of digestion trials was conducted in order to determine the minimum requirements for growth, maintenance, and milk production of dairy cattle under tropical conditions. The growth requirements were determined by using the following equation: $Y = 29.023\ X - 3{,}547$. This equation was determined by using heifers weighing from 495 to 712 pounds. The requirement varied from 10.82 to 17.12 therms.

The maintenance requirements can be determined by solving the equation: $Y = 38.76\ X - 20{,}576.60$. The cows used to determine this equation weighed from 701 to 1,018 pounds. The therm requirements varied from

6.594 to 18.92. The production requirements above maintenance were studied also and the equation: $Y = 319.3719\ X + 7{,}131.90$ was worked out, but the regression was not significant.

This preliminary report on minimum requirements indicates that the energy required for growth and maintenance is about 1.5 to 2 times the requirements reported by Morrison. The addition of concentrates to the ration reduced its digestibility 9.58 percent.

In all cases the X of the equations above represents the live weight of the animals used. Y represents the total calories needed.

Resumen

Se hizo una serie de pruebas de digestibilidad con el propósito de determinar los requisitos mínimos para crecimiento, mantenimiento y producción de leche de ganado vacuno bajo condiciones tropicales. Los requisitos mínimos para crecimiento se pueden determinar usando la fórmula: $Y = 29.023\ X - 3{,}547$. Esta ecuación fué determinada usando novillas que pesaron entre 495 y 712 libras. Los requisitos de mantenimiento se pueden determinar resolviendo la equación de: $Y = 38.76\ X - 28{,}576.60$. Las vacas usadas para determinar esta equación pesaron entre 701 y 1,018 libras. Los requisitos térmicos variaron entre 6.594 y 18.92. Se estudiaron también los requisitos para producción por encima de los requisitos de mantenimiento. Se trabajó la fórmula siguiente: $Y = 319.3719\ X + 7131.90$ pero la regresión no fué significativa. Este informe preliminar de los requisitos mínimos de energía necesaria para crecimiento y mantenimiento es de 1.5 a 2 veces la cantidad informada por Morrison.

La presencia de concentrados redujo la digestibilidad de la ración en 9.58 por ciento.

En todos los casos, en las ecuaciones arriba indicadas X representa el peso de los animales y Y representa el número total de calorías.