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Evaluation of Different Feeding Systems for Dairy Heifers[1]

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ABSTRACT

Two trials were performed at the Corozal Substation with Holstein heifers subjected to one of five feeding regimes to determine possible effects of feeding practices on development of heifers bred to calve at 28 to 29 months with minimum body weight of 472.5 kg.

Pasture supplemented with a bulky feed at either 1.80, 1.35, or 1.35 to 2.70 kg/head/day when pastures were poor did not result in a significant difference in net gains of the animals at 24 mo of age, age at calving, or services per conception when compared to pasture alone. A significant difference was determined in net gains of the heifers in the first trial when consuming 1.8 kg of ground corn/head/day through the duration of the experiment, as compared to other groups in the first trial. The former calved about 2 mo earlier than heifers in other groups. However, the use of any kind of supplement to grazing increases so much the cost of production that if future milk production is not sufficiently increased, which was not measured in those trials, use of the supplement may not be justified.

All feeding regimes used in both trials, including grazing alone, showed that heifers can be brought to calving at an average age of 29 to 30 months with an average body weight above 450 kg.

INTRODUCTION

The rearing of animal replacements is a vital part of an efficient dairy operation. In well-managed herds, 7 to 10% of the cow herd is lost each year due to health problems or sterility. It is generally recommended that an additional 10% of the herd be culled for low production; thus farmers should rear heifers equivalent to 20 or 25% of their herds each year. Puerto Rico dairymen have become interested in producing larger heifers that will calve at about 30 mo of age.

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Some milk producers raise their own replacements, but in the majority of cases, these heifers are not well developed at their first freshening. Also, their first calf is born when the heifers are more than 3 years old. The first factor curtails the production potential of the future cow, and the second delays production. Both of them entail money losses that can be eliminated if sound feeding and management practices are observed in the rearing of dairy replacements. As a rule, dairymen plan to have their well-grown heifers calve when they are about 2 years of age. Delay in calving beyond 2 years may lead to a slight increase in milk production in the first lactation, but the cost is increased due to a longer feeding period before freshening.[3]

Because the period between birth and first lactation is unproductive, the advantage of early calving is evident. Age alone does not necessarily determine the proper time for breeding, since growth rate can be materially influenced by feed intake. It is estimated that Holstein heifers 18 to 20 mo old should weigh from 382.50 to 405 kg at the time when they should be bred.[4]

In 1971 the Agricultural Experiment Station, Mayagüez Campus, of the University of Puerto Rico, initiated a series of investigations on feeding practices which might be employed for rearing dairy heifers in Puerto Rico. Major emphasis was given to maximum or near maximum use of pastures. This study is concerned with an evaluation of results from two trials conducted at the Corozal Substation.

EXPERIMENTAL PROCEDURE

FIRST TRIAL

Four groups of Holstein heifers (15 each) were used. At the start of the trial they ranged from 8 to 10 mo of age and weighed about 170 kg. Each group was assigned to one of four feeding regimes. The heifers continued on the same feeding regime until about 1 mo before calving.

The feeding treatments were: T_1—grazing alone; T_2—grazing plus 1.8 kg of ground corn/head/day; T_3—grazing plus 1.8 kg of bulky commercial concentrate/head/day when pasture was poor. The concentrate contained 22% crude fiber, 15% crude protein, and 3% crude fat. T_4—grazing and ad libitum bulky feeding on drylot when pasture was poor, returning again to grazing alone.

All animals grazed mixed-grass pastures (principally Para-Carib grasses), fertilized every 3 mo with 561.7 kg of a 15-5-10 commercial fertilizer/ha. Lime to keep the soil pH at about 5.8 was applied at the rate of 2,247 kg/ha/yr in a single application.

[3] Anderson, A., and Kaiser, J. J., 1963. Introductory Animal Science, 4th ed., The McMillan Co., New York.

[4] Cole, H. H., 1962. Introduction to Livestock Production, W. H. Freeman and Co., San Francisco.

The stocking rate was based on 1.15 animals/0.40 ha of pasture. A grazing pressure that provides an opportunity for selective grazing under either continuous or rotational grazing management usually gives higher animal output than a grazing pressure under either management that does not provide an opportunity for selective grazing.[5]

Mineralized salt and water were available at all times. To prevent overgrazing, pasture rotation was also practiced by changing the animals from each lot at intervals of 10 to 15 days in accordance with the growth rate of the grass. Animals were weighed monthly throughout the trial.

Most of the heifers were naturally bred to a dairy Holstein bull when about 18 mo of age. They were sent back to the owner's farm about 2 weeks before freshening.

Bulky feed was not used during the first year in T_3 and T_4 because the animals were small and there was sufficient pasture even during the winter season. Both of those groups received bulky feed from December 18, 1972 to March 5, 1973. Heifers on T_4 consumed 9.6 kg of bulky feed/head/day.

The results were based on animal gains up to 24 mo. Although they continued on the different feeding regimes until about 2 weeks before freshening, weights after 24 mo of age were not considered because it was assumed that they were affected by pregnancy.

SECOND TRIAL

Three groups of 26 Holstein heifers each were assigned to one of three feeding regimes:

A—grazing alone; B—grazing plus 1.4 kg of bulky feed/head/day when pasture was poor, returning to pasture alone at its complete recovery; C—grazing plus 1.4 to 2.7 kg of bulky feed/head/day when pasture was poor. The 2.7 kg were given when the conditions of the pasture were judged to be extremely poor, returning again to the 1.4 kg, and finally to grazing alone at the complete recovery of the pasture.

At the beginning of the trial, the heifers ranged in age from 11 to 16 mo. The average initial weight was 211 kg.

Pasture management, schedule for weighing, and general management were similar to that in the first trial; however, stocking rate was increased to 2 animals/0.40 ha.

As in the first trial, the evaluations were based on weights up to 24 mo, even though the heifers remained on the respective feeding regimes until about 2 weeks before expected parturition. Calving age, weight at calving, and number of services per conception were also used.

All breeding was by natural service to two Holstein bulls.

[5] Bryant, H. T., Braser, R. E., Hammer, R. C., Jr., and Fontanot, J. P., 1970. Symposium on Pasture Methods for Maximum Production in Beef Cattle. Effect of Grazing Management on Animal and Area Output, J. Anim. Sci. Vol. 30, No. 2, January.

Treatment B received supplementary feeding at the rate of 1.4 kg of bulky feed to grazing from December 21, 1973 to March 31, 1974, and again from November 14, 1974 to March 21, 1975. Treatment C received bulky feed as pasture supplement at the rate of 1.4 kg/head/day from December 21, 1973 to January 3, 1974, at which time it was increased to 2.8 kg/head/day until the end of January and again reduced to 1.4 kg from then until March 31, 1974. From November 14, 1974 to December 30, 1974, this group of heifers received 1.4 kg/head/day, but it was increased to 2.8 kg from that date until January 28, 1975, when it was lowered to 1.4 kg until March 21, 1975.

The criterion for establishing the different supplementary feeding regimes was based on the weight gains made by the heifers. As soon as they failed to gain at least 1 lb/day, they received feed supplementary to pasture. The increased amount of supplementary feed to pasture in treatment C was necessitated by the very poor conditions of the pasture.

TABLE 1.—*Average initial and final weights, as well as average daily gains, of the dairy heifers in all treatments, in the first trial*

Treatment	Initial weight	Final weight	Gain	Rate of gain
	Kg	*Kg*	*Kg*	*Kg*
T_1	175.3 ± 17.7	427.4 ± 40.6	252.1 ± 40.4	0.54
T_2	173.9 ± 17.4	463.8 ± 45.9	290.0 ± 39.2	.61
T_3	173.3 ± 17.0	423.7 ± 42.7	250.8 ± 39.3	.54
T_4	174.2 ± 18.0	438.9 ± 37.4	264.7 ± 34.8	.55
	T_2[1]	T_4	T_1	T_3
	290.0	264.7	252.1	250.8

[1] Any two averages not underlined by the same line are statistically significant at the .05 level of probability.

RESULTS AND DISCUSSION

FIRST TRIAL

The first trial was terminated by December 1973, when all heifers were pregnant or had freshened. Table 1 shows the average initial weight as well as the average final weight of the heifers at 24 mo of age for the four treatments. These data were subjected to statistical analysis. There was no significant difference when treatment T_1 was compared to either T_3 or T_4 in net gain of the heifers at that age. There was no significant difference when treatment T_2 was compared to T_4, and T_3 compared to T_4 for the same characteristic. A significant difference was determined when treatment T_2 was compared to either T_1 or T_3 for net gain of the heifers at 24 mo of age. Treatment T_2 outgained T_1 and T_3 by 37.9 and 39.2 kg, respectively.

The rate of gain for treatments T_1, T_3, and T_4 was about the same (0.54 kg/day), whereas treatment T_2 was 0.61 kg. Figure 1 shows the cumulative rate of gain of the heifers in all treatments from the beginning of the experiment to 480 days on trials or after 16 mo. The least amount of gain is shown in the first 60 days. This was no doubt due to acclimatization of the heifers to a new environment.

Although all heifers were weighed until about 1 week before freshening, the corresponding weights after 5 mo of pregnancy were disregarded in the statistical analysis. This was done purposely because those weights were affected by being pregnant.

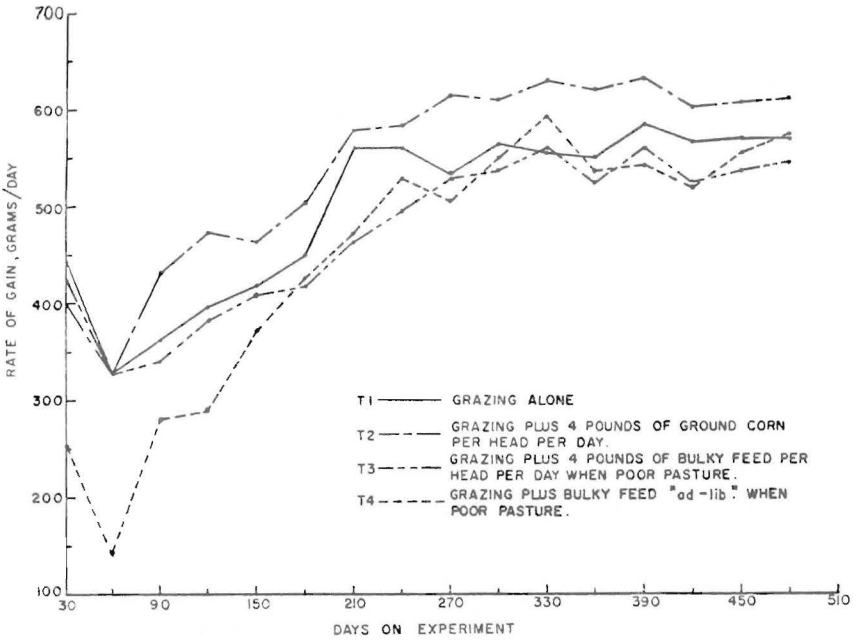

FIG. 1.—Cumulative rate of gain of the heifers in all treatments in the first trial.

As stated before, the heifers on treatment T_2 were significantly heavier than those on T_1 and T_3 but were not significantly heavier than heifers on treatment T_4. The superiority of heifers on treatment T_2 was due to the use of corn throughout the experimental period. However, the cost of corn and the extra labor involved with this group of heifers more than offset the value of the weight gain. They ate 1.8 kg of the supplement/day, or about 864 kg/heifer with an estimated cost of $148 for corn.

Supplemental concentrate (bulky) used either at the rate of 1.8 kg/day/head or ad libitum when pastures were poor (treatment T_3 and

T_4, respectively) produced no benefit compared to grazing alone (T_1) prior to age 24 mo.

Table 2 shows the average age and weight of the heifers at calving together with the services needed for conception. Treatment effects were not significant for age at calving, body weight, or services per conception.

The least calving age was shown by the heifers in treatment T_2 with an average of 28.73 ± 2.49 mo, followed by those on treatment T_4 with an average of 29.66 ± 2.63, treatment T_3 with 30.13 ± 2.97, and finally treatment T_1 with an average age of 30.83 ± 4.19 mo at calving. The largest variation was observed in treatment T_1, with standard deviation of 4.19 mo. The least variation was exhibited by the heifers on treatment T_2, with 2.49 mo. However, none of these differences of calving ages among the different treatments was statistically significant.

Many previous experiments have demonstrated that good nutrition of the animals is fundamental for a good reproductive performance. This

TABLE 2.—*Average age, weight at calving, and services/conception of dairy heifers in the different treatments in the first trial*

Treatment	Heifers	Mean calving age	Mean weight at calving	Services per conception
	No.	*Mo.*	*Kg*	
T_1	12	30.83	541.05	1.64
T_2	14	28.73	552.76	1.60
T_3	13	30.13	538.68	1.67
T_4	12	29.66	547.46	1.40

was confirmed in this trial, where the use of supplemental corn to grazing decreased age of calving about two months (table 2).

Services per conception were about the same for treatment T_1, T_2, and T_3 with 1.64, 1.60, and 1.67, respectively, while it was 1.40 for treatment T_4. Three heifers of treatment T_1 showed reproductive failures. One proved to be a freemartin and the other two were served 3 times without conception, although they were treated with gonadotropin. One heifer in this treatment aborted after 35 days of being pregnant.

On T_2, 3 heifers appeared to lose their embryos after 35 days. One returned to estrus after 4 months and 26 days, a second after 3 months and 16 days, and the third after 2 months and 15 days after being served.

On T_3, one heifer returned to estrus after 60 days. On T_4, one heifer returned to estrus after 2 months and 20 days and a second after 2 months and 24 days of pregnancy.

All these heifers, except for one in T_2, were served again and reported carrying a calf when sent back to their home farm. Two heifers in T_1 were artificially inseminated, 6 in T_2, and 3 in treatments T_3 and T_4. All the rest were naturally bred to a Holstein bull. All of the heifers artificially inseminated had but one service/conception.

First trial, results show that, with or without supplementary feeding, replacement dairy heifers weighing more than 450 kg, can be brought to first calving within 28 to 30 mo of age.

The data suggest that the use of a supplement to pasture may not be of benefit. However, the use of corn shortened the age of first calving by more than two months, besides possibly improving milk production and reproductive performance of these heifers. It seems worthwhile to carry out another experiment including postcalving observations. In this way the precise value of pasture supplementation may be evaluated.

SECOND TRIAL

The second trial was terminated by April 1975 when all heifers were pregnant or some had freshened. Table 3 shows the initial average weight of the heifers for all treatments, average final weights at 24 mo of age, average net gains, and average rate of gain. Analysis of variance of the

TABLE 3.—*Average initial and final weights, as well as average daily gains, of the dairy heifers in all treatments in the second trial*

Treatment	Initial weight	Final weight	Gain	Rate of gain
	Kg	*Kg*	*Kg*	*Kg/day*
A	211.0	393.2	182.2	0.56
B	212.9	395.6	182.8	.59
C	210.4	395.7	185.3	.57
	C[1]	B	A	
	185.3	182.8	182.2	

[1] Averages underlined by the same line are not significant at the .05 level.

data determined no significant difference between the means of 3 treatments compared. This is clearly shown in the final average weights of the animals, where there was only a difference of 2.5 kg when the heaviest group was compared to the lightest one (395.7 to 393.2). Although no significant difference was found, the average weight gains showed the effect of the bulky supplementation to grazing when pastures were poor (figure 2). Heifers on treatment B that were supplemented at the rate of 1.4 kg gained more as compared to those on pasture alone. They were outgained by those on treatment C that were supplemented with more feed during the same period of time.

Figure 2 shows the cumulative rate of gain of the heifers for the 3 treatments. As in trial 1, all groups showed a low rate of gain during the first 60 days of the trial.

Table 4 shows the average age and weight at calving, as well as services per conception. Treatment effects were not significant for the three trials. Treatment B heifers tended to calve earliest, followed by treatment C. Also treatment B had the least services per conception, with 1.24 as compared to heifers of either treatments A or C, which both needed 1.34

services/conception. The heaviest heifers at calving were those on treatment B, followed by treatment C.

These data indicated that about 2/3 of the heifers on treatment B freshened when they were between 27.8 and 32.3 mo of age. Those on treatment C were between 28.5 and 33.1 mo of age, while those on treatment A were between 28.85 and 33.07 mo of age at calving.

The two trials show that if Holstein heifers weigh as much as 200 kg by

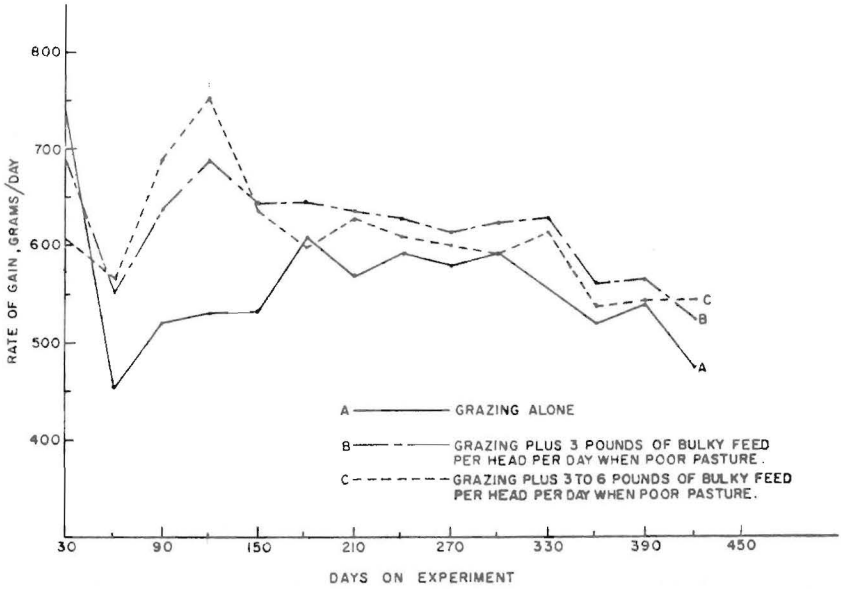

FIG. 2.—Cumulative rate of gain of the heifers in all treatments in the second trial.

TABLE 4.—*Average age, weight at calving, and services per conception of the dairy heifers in all treatments in the second trial*

Treatment	Heifers	Average calving age	Mean weight at calving	Services per conception
	No.	*Mo.*	*Kg*	
A	25	30.96 ± 2.06	450.1	1.34
B	26	30.04 ± 2.24	471.4	1.24
C	25	30.84 ± 2.27	461.9	1.34

12 mo, heavily fertilized grass pastures, grazed at the rate of 1.50 to 2 animals/acre, can provide sufficient feed for attaining a body weight of 400 kg by 28 to 30 mo. The data collected in these two trials, do not warrant the use of supplementary feeding. However, animals receiving supplement tended to be heavier both at 24 mo and at calving. Possibly the additional fat carried by those receiving supplement, especially when fed corn, may afford advantages in the early stages of lactation.

The average age at calving for all heifers in the first trial was 29.8 mo and for those in the second trial was 30.6 mo of age. Average body weight at calving for all animals in the first trial was 545 kg, while for those in the second it was 461 kg. Average services needed for conception in the first trial were 1.58, while those needed for the group of heifers in the second trial were 1.30. These figures do not show great differences for the same characteristic, except for the average body weight at calving where the heifers in the first trial were 83.8 kg heavier than those in the second trial. Variation in this respect might be explained in one of the following ways: Animals in the second trial were older and showed less weight for age; duration of trial 2 was 12–13 mo instead of 16 mo; stocking rate in trial 2 was higher, which suggests that stocking rate may need reduction to 1.5 animals/acre after the heifers reach about 350 kg.

No abortion problems were encountered in the second trial, and only one heifer on treatment C had conception problems and was recommended for sale. The use of corn supplementation to grazing decreased the age of calving by about 2 mo in the first trial, while the bulky supplementation to grazing in neither of two trials seemed to benefit in this respect. The heifers in T_3 of the first trial and those on treatment B in the second were submitted to more or less the same feeding regime, and were about the same age at calving, 30.13 months for those in the first trial as compared to 30.04 in the second.

The cumulative rate of gain of the heifers for the first and second trials is shown in figures 1 and 2, respectively. They followed more or less the same trend, showing a negative slope of the curves for the first 60 days of the experiment. This can be explained in terms of acclimatization of the heifers to a new environment in the case of the first trial and to a completely new situation in the case of the heifers in the second trial. However, the initial gains in the first trial were considerably less than those in the second; 0.38 kg/day on the average for the first as compared to 0.67 for the second. This is understandable if it is considered that heifers of the first trial were brought directly from the farm of origin immediately before the beginning of the experiment, while those in the second trial had been at the Corozal Substation for some time before entering the trial.

RESUMEN

Los efectos de diferentes sistemas de alimentación en novillas para reemplazo de vaquerías se estudiaron en dos experimentos realizados en la Subestación Experimental de Corozal. El primero de ellos cubrió el período comprendido de octubre de 1971 a diciembre 1973. Se utilizaron 60 novillas de la raza Holstein con un peso medio inicial de 174.1 kg y edad entre 8 y 10 meses, repartidas restrictivamente en los siguientes 4 tratamientos de 15 cada uno: T_1—pastoreo sólo; T_2—pastoreo + 1.8 kg de maiz molido por cabeza y día; T_3—pastoreo + 1.8 kg de alimento concentrado por cabeza y día durante el período de escasez de pasto; T_4—pastoreo + alimento concentrado discrecional durante el período de escasez de pasto.

En la segunda prueba se utilizó el mismo tipo de ganado con un peso inicial medio de 211.0 kg y edad entre 11 y 16 meses. Las 78 novillas se distribuyeron restrictivamente en los

siguientes 3 tratamientos de 26 cada uno: A—pastoreo sólo; B—pastoreo + 1.4 kg de alimento concentrado por cabeza y día durante el período de escasez de pasto; C—pastoreo + 1.4 a 2.8 kg de alimento concentrado por animal y día durante el período de escasez de pasto. Los 2.8 kg de alimento se utilizaron sólo durante el período en que el pasto se juzgó extremadamente pobre.

El pasto utilizado en ambas pruebas se cultivó apropiadamente en lo referente a abonamiento, encalado y rotación. En la primera prueba se pastó a razón 1.15 cabezas por 0.40 ha, mientras que en la segunda se pastó a razón de 2.

Los resultados obtenidos en la primera prueba demonstraron que hubo una diferencia significativa en el peso final de los animales al comparar el T_2 (pastoreo + maíz) con el T_1 (pastoreo sólo) o con el T_3 (pastoreo + 1.8 kg de alimento por cabeza y día) según se demuestra en el cuadro 1. La segunda demostró que la complementación alimentaoria en cualesquiera de los niveles de pastoreo utilizados no redundó en ganancia significativamente superior al comparársele con pastoreo sólo (cuadro 3).

Desde luego, el uso de cualquier tipo de complementación alimentaria al pastoreo encarece grandemente los costos de producción, y si la aptitud futura del animal en términos de producción lechera y de reproducción no es satisfactoria, tal complentación no se justifica.

Se demostró que las novillas pueden desarrollarse adecuadamente, aun pastando solamente, ya que en todos los casos estudiados sobrepasaron los 450 kg de peso vivo al momento del parto, el cual ocurrió entre los 29 y 30 meses de edad, como promedio. El uso de maíz durante todo el período experimental acortó la edad al parto por unos 2 meses.