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The effects of feeding two sources of protein with and without hay on the performance of beef heifers and steers

James L. Giffin

To the Graduate Council:

I am submitting herewith a thesis written by James L. Giffin entitled "The effects of feeding two sources of protein with and without hay on the performance of beef heifers and steers." I have examined the final electronic copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Animal Husbandry.

C.C. Chamberlain, Major Professor

We have read this thesis and recommend its acceptance:

J.A. Corrick, J.B. McLaren

Accepted for the Council:
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(Original signatures are on file with official student records.)

November 13, 1973

To the Graduate Council:

I am submitting herewith a thesis written by James L. Giffin entitled "The Effects of Feeding Two Sources of Protein With and Without Hay on the Performance of Beef Heifers and Steers." I recommend that it be accepted for nine quarter hours of credit in partial fulfillment of the requirements for the degree of Master of Science, with a major in Animal Husbandry.

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Major Professor

We have read this thesis
and recommend its acceptance:

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J. A. Reid, Jr.

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Vice Chancellor for
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THE EFFECTS OF FEEDING TWO SOURCES OF PROTEIN WITH AND WITHOUT HAY ON THE PERFORMANCE OF BEEF HEIFERS AND STEERS

A Thesis

Presented to

the Graduate Council of

The University of Tennessee

In Partial Fulfillment

of the Requirements for the Degree

Master of Science

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by

James L. Giffin

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ABSTRACT

There are two major objectives in this study: (1) to compare a natural protein source, cottonseed meal, with urea, and (2) to determine the effect of adding limited quantities of hay to a high concentrate finishing ration. Both heifers and steers were used so a sex comparison was also made.

One hundred and seventy medium grade heifers were involved in a three-year study at the Greeneville Tobacco Experiment Station. The heigers were pregnancy checked, implanted with DES, weighed, and alloted. There were two general phases of feeding each year. During the first phase, the heifers were given corn silage ad libitum with five pounds of ground ear corn and one pound of protein supplement for an average of 112 days. Following the high silage phase was a concentrate phase, during which each heifer consumed a maximum amount of ground ear corn and either one pound of urea supplement or 1.25 pounds of cottonseed meal (1967, 1 pound of cottonseed meal). The concentrate phases lasted an average of 58 days.

The heifers receiving cottonseed meal as a protein source gained significantly faster than the heifers receiving a high urea supplement during the first 28 days of the forage phases ($P \leq .05$). However, when both the total forage and concentrate feeing periods were considered, no differences between urea and cottonseed meal were observed. The ADG obtained in the total forage and total concentrate feeding periods were higher for the cottonseed meal supplement but these differences were not

significant ($P \leq .05$). Heifers receiving hay gained significantly faster than heifers receiving no hay during the first 28 days of the forage and concentrate phases ($P \leq .05$).

One hundred and sixty medium to good grade steers were utilized in the study. The steers were weighed, implanted with DES, and lotted to treatments. The feeding period consisted of only a concentrate phase for the steers which averaged 92 days. The feeding program was the same as for the heifers in the concentrate phase.

The steers receiving cottonseed meal gained significantly faster during the initial 28 days feeding and during the entire 92 days than the steers receiving urea ($P \leq .05$). Steers receiving hay gained at a significantly faster rate than the steers receiving no hay during the total concentrate phase ($P \leq .001$).

When both the heifers and steers were marketed at similar visual condition grades, the final weight for the heifers was from 150 to 200 pounds less than the steers. The ADG of the steers for the feeding period was also slightly higher than for the heifers.

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CHAPTER I

INTRODUCTION

A management program designed to produce desirable slaughter heifers from thin 500-700 pounds medium grade yearling heifers is needed in the feeder cattle industry. This type of heifer is often pregnant as well as being older and larger than the heifer calves marketed in the fall. She was probably born late in the season (in May or later), ran with the cow herd all winter and spring and appears on the auction market in the summer or early fall when the available grass supply is reduced. However, this medium grade heifer showing beef breeding can be profitable when included in a feet lot operation.

These heifers can be purchased for less than comparable or younger heifers which are guaranteed to be open and will obtain market weight and grade in a shorter period of time. Since they are older, these heifers generally are larger framed and have a capacity to utilize larger amounts of forages than younger or smaller animals. This increased rumen capacity should favor larger heifers for low cost production. Intermuscular injection of DES has been shown by Stansbury (1971) to successfully abort heifers at a low cost while the heifers are recovering from shipping stress.

Large numbers of medium to good grade steers are available in the fall from local feeder calf sales. A feeding program needs to be established whereby this type of animal can be backgrounded with limited winter feed, pastured during the following summer and finished on a high

concentrate ration. The major advantage of this program would be the relative cheap gains obtained during the winter and pasture phases. Data collected by The University of Tennessee indicates that steers can be successfully background in this manner.

The objectives of this study were (1) to compare the effect of adding limited amounts of good quality legume hay to the rations of the heifers and steers; (2) to evaluate the relative merit of a high urea protein supplement and cottonseed meal (CSM) as supplemental nitrogen sources; and, (3) to observe the differences between steers and heifers during the concentrate phase.

CHAPTER II

REVIEW OF LITERATURE

I. UREA VERSUS NATURAL PROTEIN

Armsby (1911) stated that non-protein nitrogen appears to be converted into protein by the microorganisms in the disgestive tract of the ruminant and this protein is digested and utilized by the animal. This observation was shown to be correct when Gallup, Pope and Whitechair (1953) found that 20 to 50 percent of the nitrogen of natural protein supplements could be replaced with nitrogen from urea without adversely effecting the rate of gain of the steers. However, when urea nitrogen supplied 85 percent of the nitrogen in the protein supplement gains were reduced by 0.32 lb daily.

In a summary of results of feeding urea to cattle in the feedlot, Morrison (1961) stated that most satisfactory results from feeding urea were obtained when it was substituted for one-fourth to one-third of the total protein in a balanced ration. By using urea as a protein extender, Seiden and Pfander (1957) found that urea could replace one-third of the total crude protein equivalent in the ration, or make up 3 percent of the concentrate ration or 1 percent of the total ration.

Stangel (1963) cited fifteen hundred and thirty-five published articles from 1879 to 1963 with respect to the use of urea and non-protein nitrogen in ruminant nutrition. Numerous experiments in the review indicated that urea could be successfully and efficiently used as

a nitrogen source when it furnishes not more than one-third of the protein equivalent in protein supplements fed to cattle.

In experiments conducted by Ross et al. (1948), Ross et al. (1949), Ross et al. (1950), Long et al. (1951), and Long et al. (1952) at Oklahoma, three levels of cottonseed meal were compared to urea as a protein source for fattening steers. The basal diet consisted of 8 lb. corn silage, 12 lb ground corn, 1 lb alfalfa hay and mineral supplement. The urea supplement failed to equal the cottonseed meal supplement as a source of nitrogen.

Fontenot, McClure, and Carter (1967) compared a complex protein supplement containing urea with standard protein supplement of cottonseed meal in two feeding trials. The basal diet contained a limited amount of corn silage and a full feed of grain. The difference in average daily gain (ADG) for the two supplements was not statistically significant ($P \geq .05$).

Hammack and Marion (1970) conducted an experiment to compare cottonseed meal (CSM) and urea as a source of supplement protein. Both rations contained 13 percent protein equivalent on a dry matter basis and consisted of sorghum grain full fed with sorghum silage. The ADG of the animals fed the two protein sources were the same, 2.8 lb per day.

A review of several experiments in which corn silage was full fed with soybean meal (SBM) or a urea based supplement as a source of supplemental protein, found no significant difference in the ADG of cattle fed SBM or urea supplements (Baker, Arthaud, and Gregory, 1949; Van Arsdell et al., 1953; Johnson, Keith, and Lelher, 1959; and Sellers et al., 1960).

In contrast Bradley et al. (1969), Young et al. (1969), and Potter et al. (1969) conducting feeding experiments in which fattening steers were fed a basal ration of corn silage ad libitum but with the addition of 9 lb of grain per day, found that the steers fed SBM as a supplement gained significantly faster than those receiving urea as the additional nitrogen source.

Perry, Beeson, and Mohler (1967) compared high levels of urea in beef cattle supplements with standard protein supplements. The basal diet consisted of a full feed on high moisture ground ear corn and 6-9 kg corn silage. In the experiment four different supplements were compared with different levels of crude protein. The four supplemental treatments were (1) 32 percent crude protein supplement containing 65 percent SBM and 14 percent dehydrated alfalfa meal; (2) 64 percent crude protein equivalent supplement containing 21.1 percent of a urea-based compond, 36 percent dehydrated alfalfa meal, and 28 percent cane molasses; (3) 80 percent crude protein equivalent supplement containing 27.9 percent of a urea based compound, 40.7 percent dehydrated alfalfa meal, and 14 percent cane molasses; (4) 90 percent crude protein equivalent supplement containing 34.7 percent of a urea based compound, 30.6 percent dehydrated alfalfa meal, and 14 percent cane molasses. The ADG for the treatments were 1.09 kg (SBM), 1.06 kg (64 percent CP), 1.03 kg (80 percent CP), and 1.05 kg (96 percent CP). There were no significant differences in the gains of steers fed rations supplemented with high levels of urea compared to those fed the natural protein supplement. They suggested that properly formulated high urea supplements could

replace at least 90 percent of the natural protein of supplements for high-energy fattening rations in beef cattle.

Bell, Murphree, and Hobbs (1954) used a basal ration of grass hay, ground corn, cane molasses, CSM and minerals to fatten yearling steers. The steers in the experiment were fed according to four treatments as follows: Lot 1. Basal; Lot 2. 50 percent of the protein equivalent from the CSM was replaced with urea and corn; Lot 3. 100 percent of the protein equivalent of the CSM was replaced with urea and corn; and Lot 4. same as (3) plus 10 mg oral diethylstilbestrol (DES) per day. The ADG for the treatments were 2.05, 2.12, 1.76, and 2.11 lb, respectively. Only slight differences were noted in carcass grade and dressing percent. In this study, a mixture of urea and corn was effective in replacing one-half of the protein equivalent of the CSM, but there was a reduction in ADG when all the protein was supplied by urea.

Bell, Odom, and Reynolds (1957) conducted fattening experiments to evaluate the substitution of urea and corn for part or all of the protein supplement needed to balance "low protein ration." In Trial I, the basal ration consisted of 9.5 lb grass hay and 7 lb ground-shelled corn and in Trial II the basal ration contained 6.5 lb grass hay and 13 lb ground shelled corn. Protein equivalent intake on a dry matter basis was 11 percent in Trial I and 13 percent in Trial II. Treatments in both trials were as follows: (1) cottonseed meal; (2) 50 percent of the protein equivalent from cottonseed meal and 50 percent from urea; and (3) 100 percent of the protein equivalent from urea. The ADG in the first trial were 2.05, 2.12, and 1.76 lb, respectively and in second

trial were 2.08, 2.17, and 2.08 lb, respectively. These results indicated that urea and corn can be substituted for 50 percent of the cottonseed meal when the ration contains 11 percent protein equivalent and urea and corn can replace all the cottonseed meal in fattening rations for steers when the protein equivalent is 13 percent.

Clark, Hall, and Felts (1967) conducted feeding experiments comparing a complex protein supplement containing urea to cottonseed meal. The basal ration consisted of a full feed of ground ear corn with 4 lb alfalfa hay or 4 lb orchardgrass hay. Both the cottonseed meal supplement and the complex protein supplements were isonitrogenous. The ADG for the treatments were 2.27 lb (orchardgrass and CSM), 2.25 lb (orchardgrass and complex protein supplement), 2.46 lb (alfalfa and CSM), and 2.39 lb (alfalfa and complex protein supplement). The results of the feeding experiments indicated that there were no significant differences between steers fed a complex protein supplement and those fed cottonseed meal in either trial.

Kirk et al. (1958) and Kirk et al. (1963) compared a cottonseed meal supplement to a cottonseed meal-urea supplement when fed with a basal ration of pangolargrass hay and citrus pulp or pangolargrass silage and citrus pulp. The results showed that there was no significant difference in rate of gain and TDN for gains between the two protein supplements.

Richardson, Smith, and Brent (1968) conducted a feeding trial in which urea and soybean meal were compared as protein supplements for fattening rations. The basal diet consisted of 14 lb sorghum grain,

2.5 lb prairie hay and 2.0 lb alfalfa hay. There were no significant differences in rate of gain or carcass data between the two protein supplements.

Boling et al. (1970) compared the gains and carcass characteristics of steers fed ground shelled corn rations supplemented with soybean meal or urea and fed 10 percent alfalfa hay as the forage source. The ADG for steers fed the soybean meal supplemented ration was 2.41 lb per day and for the urea supplemented rations was 2.31 lb per day which was not significant. Also, there were no significant differences in the feed efficiency and carcass characteristics for either treatment.

Weber and Hughes (1942) conducted balance studies with fattening steers using rations containing a cottonseed meal supplement and a urea supplement. The nitrogen balance showed that the percentage retention of urea nitrogen was equal to that of cottonseed meal nitrogen. Also, the nutrients in the rations containing urea were digested as well as those rations including cottonseed meal as the source of supplemental nitrogen.

Harris, Work, and Henkle (1943) conducted Metabolism tests with 6 to 8 month old fattening steers being fed urea and soybean meal as a source of supplemental protein. They stated that the average apparent digestion coefficient of urea nitrogen was 74 and that of soybean oil meal 78. However, when corrected, for the metabolic nitrogen in the feces, the values were 94 for each source of protein. Also, the biological value of urea nitrugen was 34 and that of soybean oil meal nitrogen was 60 when fed at 12 and 14 percent protein equivalent levels. The

authors stated that the poor utilization of the urea nitrogen was probably due to the urea being fed above the maximum conversion to true protein by the microorganisms of the rumen.

Nix and Anthony (1964) and Lowrey and McCormick (1969) both reported that dry matter and apparent protein digestibilities were significantly higher for rations containing urea compared to those using cottonseed meal. However, Bradley et al. (1966) found no difference in apparent nitrogen digestibility when urea was substituted for soybean meal in a steer finishing diet.

Barth, McConnell, and Wang (1968), comparing cottonseed meal and urea as protein supplements in digestion and metabolism experiments, found that the total digestibile nutrient values were higher with the urea ration. However, they found that nitrogen utilization was approximately the same when a high concentrate ration was fed. When a high silage ration was fed, the steers fed the urea containing supplement retained less of the absorbed nitrogen than those fed rations containing cottonseed meal.

Stansbury (1971) studied the effects of feeding cottonseed meal supplement and complex protein supplement including urea to fattening heifers on a basal diet of 15 to 20 pounds ground ear corn. There were no significant differences in ADG and carcass characteristics between heifers fed the two types of protein supplement.

Oltjen, Davis, and Hiner (1965) working with yearling steers and Haskins et al. (1967) working with steer calves reported that the substitution of urea for all the supplemental protein (soybean meal) in an all-concentrate ration did not have an affect on weight gain.

Little et al. (1968) compared urea and soybean meal as a protein supplement for fattening steers fed a basal ration of ground ear corn. The three treatments were as follows: (I) concentrate with sufficient soybean meal supplement to provide 10.3 percent crude protein, fed ad libitum; (II) concentrate with a complex protein supplement containing urea added to be isonitrogenous with treatment I, fed ad libitum; and (III) concentrate with soybean supplement added to be isonitrogenous with treatment I, but with the level of intake restricted to that of treatment II. The steers on a full feed or urea ration (II) gained 0.56 lb less per day, consumed 1.81 lb less feed per day, and required 0.95 lb more feed per pound gain than steers full-fed soybean ration (I). Steers receiving the soybean meal supplemented ration at a level of intake equal to that of the urea ration (II) gained 0.29 lb per day more and required 0.82 lb less feed per pound gain than did the urea-fed steers. The results indicated that the ADG and feed efficiency for the steers fed ad libitum soybean meal supplemented ration or the limited soybean supplemented ration was superior to the steers fed the ad libitum urea supplemented ration. However, the intake of the urea supplemented ration may partially account for the decrease in ADG and feed efficiency of the urea supplemented steers.

Swan and Lamming (1968) studied the affects of a cottonseed meal protein supplement and a urea protein supplement on dairy steers fed a basal ration of ground barley straw, ground corn, and mineral supplement. There was no significant difference between the urea supplement or cottonseed meal supplement in average daily gain, feed intake, or carcass acceptability.

II. HAY VERSUS NO HAY IN ALL-CONCENTRATE RATION

According to Wise et al. (1968), beef cattle may be finished on all-concentrate rations. Body weight gains obtained from all-concentrate rations compare to those on conventional rations. However, Newman and Snapp (1969) report that feeding experiments have shown that feeding small amounts of dry roughages such as hay in all-concentrate rations results in a slight improvement in average daily gain.

Newman and Snapp (1969) summarized experiments conducted at Nebraska and Illinois Experiment Stations on the effects of using high quality hay in conjunction with high energy rations. The basal ration contained a full-feed of ground grain and protein supplement with or without alfalfa hay. The amount of hay added ranged from 2.01 lb to 3.20 lb per head per day. The ADG for the treatments containing hay ranged from 1.97 lb to 3.15 and for the treatments containing no hay the ADG ranged from 1.63 to 2.68 lb. The results showed that the addition of a small amount of hay to the ration increased the ADG of the animal.

Dowe, Arthaud, and Matsushima (1955), studied the ratio of shelled corn - SBM concentrate to alfalfa hay forage in fattening rations. The ratio which consisted of two parts concentrate and one part forage resulted in the most rapid daily gain. Total feed consumption decreased as the concentrate in the ration was increased and the forage replacement value of the concentrate decreased as the level of concentrate in the ration was increased.

Anthony et al. (1960) comparing rations fed to steers containing 30, 10, and 0 percent bermuda-grass hay mixed with a grain mixture showed no difference in either average daily gain or feed efficiency.

Davis et al. (1963) reported that cattle consumed significantly more corn and cob ration than a ground shelled corn ration; however, gains, feed efficiency, and carcass data were not significantly different.

Wise et al. (1961) indicate that the addition of ground on long hay failed to improve the performance of cattle consuming all-concentrate rations.

Wise et al. (1965) conducted feeding experiments where all-concentrate rations were compared to concentrate rations with either limited hay or ad libitum hay additions. The results of the two experiments conducted indicated that there was no significant differences ($P \leq .05$) in the ADG, carcass grade, dressing percentage, or rib-eye area for animals fed long hay in limited amounts (3 lb per head daily) or fed long hay ad libitum.

Hall, Hobbs, and High (1961) reported that during a finishing experiment, steers fed a limited amount of good quality alfalfa hay in addition to a concentrate ration of ground ear corn and protein supplement gained significantly faster and were more efficient than steers fed liberal amounts of alfalfa hay with a similar concentrate ration.

Barth, McConnell, and Wang (1968) conducted digestion and metabolism studies to test a high urea supplement against cottonseed meal in a 2 x 2 factorial model with and without hay. They found that hay significantly improved the percent crude protein digestibility of the ration used in one trial but not in the other. Also, the results indicated that hay did not improve the total digestible nutrients or the dry matter digestibility in either the urea or cottonseed meal treatment.

III. HEIFERS VERSUS STEERS

Newman and Snapp (1969) and Morrison (1961) stated that when heifers are properly fattened but are not overly fattened, they produce carcasses that are equal to those of steers. Heifers finish out from 6 to 10 weeks faster than steers and weigh from 100 to 200 pounds less than steers.

Gramlich and Thalman (1930) conducted feeding trials where open yearling heifers were compared to yearling steers. The heifers made more rapid and economical gains, and had a higher dressing percentage, but sold for less per cut. However, McCampbell and Horlacher (1924) and Vaughan (1927) showed that steers gain more rapidly and economically and sold higher than heifers, although the heifers were fatter.

Bull, Olson, and Longwell (1930), reported that during a 140-day trial, heifers gained slightly more than steers but there was little difference in economy of gain, although the heifers were fatter. Bull et al. (1930), conducted a 200 day feeding trial where steers and heifers were compared. There was little difference in rate of gain between steer and heifers but the steers gained more economically and heifers were fatter at the end of the trial.

The review of several feeding experiments conducted in the 1930's indicated steers make larger and more economical daily gain than heifers, however, the heifers finish out sooner than steers. (Potter, Withycombe, and Edwards (1931); Hasking (1932); Trowbridge and Moffett (1932); Peters (1933); and McCall and Hachedorn (1937)).

Dyer and Weaver (1955) compared heifers and steers in an experiment consisting of three phases: (1) cattle fed in dry lot and marketed at a weight of 700-750 pounds; (2) cattle wintered liberally (1.6 pounds daily gain) then full fed grain on pasture; (3) cattle wintered at a medium rate (1 pound daily gain) and finished in dry lot. The results indicated that the heifers performed better than the steers when full-fed and marketed at 700-750 pounds. However, when wintered liberally and finished on pasture the steers performed better than the heifers. When the cattle were wintered at a medium rate and finished in dry lot they found that the average daily gain was more and the feed requirement was less for the steers than for the heifers.

Whittenburg (1963) found that steer calves and yearlings gained faster than heifers when a ration consisting of a full-feed of corn silage, 5 pounds cracked corn, 3 pounds alfalfa hay and 1 pound cottonseed meal was fed.

Newman and Snapp (1969) reviewed a feeding trial which was conducted at the Illinois Experiment Station where steers and heifers were compared. The heifers made larger and more economical gain during a feeding period of 5 to 6 months than did steers during a feeding period that was 2 or 3 months longer.

Anderson, High, and Chapman (1971) conducted feeding experiments in which the performance of steers and heifers of different grades were compared. They found that heifers required a shorter feeding period than the steers to reach the desired slaughter grade. Also, the average daily gains were higher for the calf and yearling steers grading good and

medium than for heifers. However, the steers took longer to reach the desired market grade and were marketed at heavier weights.

CHAPTER III

PROCEDURE

Experiments studying methods of finishing steers and heifers to acceptable market weight and condition were conducted at the Tobacco Experiment Station (TES) at Greeneville, Tennessee. One series of experiments involved feeding heifers through both a forage phase and a concentrate phase. The other series of experiments consisted of feeding steers during the concentrate phase only.

The objective of both experiments was to study the effect of two types of protein supplements when fed with and without supplemental hay. The protein supplements used were (1) cottonseed meal (CSM), a natural protein source, and (2) a supplement containing a high percentage of its protein equivalent from urea. The experimental design, during the concentrate phase, is shown in Table I. There were two replications of each treatment.

TABLE I

EXPERIMENTAL DESIGN OF THE FEEDING TRIALS CONDUCTED IN 1965, 1966, AND 1967

	2 lb of hay/ head/day	No hay
CSM Supplement		
High Urea Supplement		

I. PURCHASING AND LOTTING OF HEIFERS

One hundred and seventy medium (standard if bought from a stockyard) grade yearling heifers were purchased in October and November from stockyard sales in East Tennessee during 1965, 1966, and 1967. Between purchase time and until lotted the heifers were placed on pasture and given access to hay, fresh water, salt, and minerals. The heifers were observed daily in order to detect and treat any shipping fever, disease, or stress-related disturbances. There was a period of 14-28 days after the purchase of the last heifers before they were lotted to treatment. Heifers were weighed on two consecutive days, pregnancy checked and given a 24 mg ear implant of diethylstilbesterol (DES). They were then lotted to treatment in the second week of December. Heifers determined pregnant were injected with 100 mg of DES in oil intermuscularly in addition to the 24 mg implant and were equally divided among treatments.

In 1965 and 1966 the open heifers received no additional treatment. In 1967 half the open heifers were also injected with 100 mg of DES. Thus the effects of the intermuscular injection of 100 mg of DES could be partitioned from abortion effects for statistical analysis in the 1967 data. In 1965, approximately one-fourth of the heifers were determined to be pregnant; in 1966 and 1967, about one-third were pregnant. A detailed report on the effectiveness of DES as an abortant was published in 1971 by Stansbury *et al*. The results indicated that there was a highly significant difference ($P \leq .01$) in ADG during the first 28 days of the forage phase in favor of the open heifers as compared to the

DES treated heifers. The ADG was statistically significant ($P \leq .05$) during the concentrate feeding phase in favor of the open heifers.

Each year, the treatments were divided into two weight groups based on the two-day, average initial feedlot weight. The heifers were divided into light and heavy groups at the start of the experiment with the heavy group averaging 100 pounds heavier than the light group. The results showed that the light heifers had higher rates of gain especially during the first 28 days on feed. Although the difference continued throughout the feeding period, it tended to become smaller as the feeding period progressed. However, the final condition scores and carcass differences were in favor of the heavy heifers (Stansbury, 1971).

II. FEEDING OF HEIFERS

The feeding experiments were divided into two general phases. The first phase began in the second week of December and lasted until March, about 112 days. The heifers on this phase reserved high quality corn silage free choice, five pounds of ground ear corn, and one pound of protein supplement. Animals in lots fed hay were given two pounds of good quality alfalfa-grass hay daily per animal. The heifers were fed once per day during the forage phase. Fresh water, salt, and mineral was available to the heifers at all times. All of the dietary constituents were held constant during the forage phase except corn silage. At the beginning of the forage phase, the heifers consumed 15-20 pounds of corn silage and toward the end, the heifers consumed approximately 30 pounds of corn silage per day.

A transition period of 4-6 days was taken to change the heifers from a high forage phase to a concentrate phase. The heifers were fed twice a day in the second phase. During the first part of the concentrate phase the heifer consumed about ten to fifteen pounds of concentrate (including the protein supplement) and at the end of the phases the animals were consuming approximately 20 pounds per animal per day. Heifers were marketed when it was estimated that the majority would grade high good or low choice.

A urea based supplement and cottonseed meal were used to supply the added crude protein equivalent in the ration. The complex protein supplement containing urea is described in Table II. During the forage phase, the urea supplement and the CSM were each mixed in a ratio of five parts of ground ear corn to one part of protein supplement. During the concentrate phase, a protein equivalency level was maintained between the two premixes. The crude protein level of the grain protein concentrate was held at approximately 11.5 percent.

Fresh water, salt, and a mineral mixture was available to the heifers at all times.

III. PURCHASING AND LOTTING OF STEERS

One hundred and sixty-six medium and good grade steers were purchased in 1965, 1966, and 1967 during the fall weighing 400 to 500 pounds from feeder calf sales in East Tennessee. The steers were grazed on late pasture and corn fields in the fall and winter. They were fed enough hay or silage during this period to gain from 1 to 1.3 pounds per

TABLE II

UREA SUPPLEMENT FORMULATION

Ingredient	Percent of Supplement	Pounds Per Animal Per Day
Ground ear corn[1]	68.0	.680
Urea[1]	15.0	.150
Dicalcium phosphate	10.0	.100
Limestone	6.0	.060
Vitamin A premix (4 million units per lb.)	.5	.005
Trace mineral premix[2]	.5	.005
Total	100.0	1.000

(Thirty pounds of salt was added per ton of premix.)

[1]The percent composition and pounds per animal daily for ground shelled corn and urea in 1966 and 1967 were 69 percent and 14 percent and 0.690 lb and 0.140. The change in formula from 1965 was due to using 280 percent equivalent urea in 1966 and 1967. This maintains the nitrogen consumption from urea at the same level as in 1965.

[2]Trace mineral premix (minimum percentages): Manganese, 4.4 percent; iron, 6.6 percent; copper, 1.3 percent; cobalt, 0.2 percent; iodine, 0.3 percent; zinc, 12.0 percent; and magnesium, 20.0 percent.

day. The steers were observed daily, when they were first put on pasture, in order to detect and treat any shipping fever, disease or stress-related disturbances. During the following spring and summer the steers were grazed on permanent type pasture of blue grass and white clover or hop clover, orchardgrass and ladino clover or fescue and ladino clover. In both pasture phases fresh water, salt, and mineral mixture was available at all times.

The steers were brought from the pasture to the feeding barn in August or September, weighed on two consecutive days, implanted with 24 mg of DES, lotted to treatments, and brought to a full feed of ground ear corn plus a protein supplement within one to two weeks.

IV. FEEDING OF STEERS

The feeding trials consisted of a concentrate phase varying from 82 days to 102 days. The differences in the length of the feeding period was due to (1) the variation in the initial condition grade, and (2) the variation in ADG between years.

The treatments which received hay were given 2 pounds of good quality alfalfa-grass hay per animal per day. Fresh water, salt, and mineral mixture was available free choice to the steers throughout the concentrate phase. The steers were sold when it was estimated that the majority would grade high good to low choice.

A crude protein equivalent of about 11.5 percent in the concentrate ration was maintained in both the urea and cottonseed meal rations. The complex protein supplement containing urea was the same as the one used in the heifer experiments.

V. WEIGHING AND RECORD KEEPING OF HEIFERS AND STEERS

The initial weight was determined by weighing the heifers and steers on two consecutive days, before being placed in the feedlot. To minimize error due to shrink and fill, feed and water were available after the animals were weighed each day. The water and feed were removed at 6 p.m. of the day before weighing, and the animals were weighed at 8 a.m. the following morning. The animals were then weighed at 28 day intervals throughout the feeding experiment. At the end of the feeding period, heifers and steers were again weighed on two consecutive days.

After the final weighing the animals were transported immediately to the packing house (a one and one-half hour drive) and were weighed and given their final condition grade. Also in order to be able to collect carcass data, each animal was identified with a kill number.

The hot carcass weights on the kill floor were recorded and the stomach lining and liver were examined to detect any irritation and abscesses in the heifers. The carcasses were then chilled for 48 hours, and the following carcass data were taken: backfat thickness, loin-eye area (made with tracings in 1966 and 1967 and measured with a planimeter and, in 1968, the area was taken with a plastic overlay grid), and the estimated percentage of kidney and pelvic fat. Also, after the carcass was chilled, carcass grade, the marbling, maturity, and carcass conformation estimates were obtained from the USDA grader.

The Tobacco Experiment Station personnel kept the buying, weighing, and feeding records and the Experiment Station personnel at the Knoxville Station collected the allotting, grading, and slaughter data.

VI. STATISTICAL ANALYSIS OF HEIFERS AND STEERS

The data was analyzed by the method of analysis variance. Duncan's (1955) New Multiple Range Test was applied to test the significance of difference between means where the "F" test was significant.

The mathematical model used to describe the expected variation is given as follows:

$$\hat{Y}_i = \mu + Y_i + H_j + (P \times H)_{jk} + L/R + e$$

where, $\hat{Y}$ is the expected or predicted performance,

μ is Mu, the overall mean,

Y is the effect due to year,

H is the effect due to the addition or deletion of two pounds of hay,

P is the effect due to urea or CSM as nitrogen supplying compounds,

(P x H) is the interaction between protein source hay or no hay,

L/R is the difference between lot within ration, and

e is the normal variation associated with individual observations.

CHAPTER IV

RESULTS AND DISCUSSION

I. HEIFERS

The results of feeding 170 heifers (59 in 1965, 56 in 1966, and 55 in 1967) rations varying in protein source (cottonseed meal and urea) and with and without hay are presented in Tables III and IV. The effects of the independent treatment effects on (a) the dependent feedlot variables are shown in Table III, and (b) the dependent carcass variables are shown in Table IV. The independent treatment effects giving rise to animal performance variations are listed down the left-hand margin and the dependent performance variables are given as column heads across the top margin. The overall mean, Mu, is given as the first figure in each column to compare each treatment effect and its deviation from the overall mean. In Appendix, Tables XVIII through XXXIX are summary tables of each year broken down into forage, concentrate, and total feeding phase, which are further broken down into lots within rations.

There was no interaction ($P \geq .10$) between protein source and hay. However, there was a difference ($P \leq .01$) between lots within ration for the heifers (Appendix, Tables IX and X). This difference, between lots within ration, could be attributed to the fact that the heifers were lotted in heavy and light groups. At the start of the experiment the heavy group averaged 100 pounds heavier than the light group.

TABLE III

MEANS FOR INITIAL WEIGHTS, FINAL WEIGHTS, TOTAL GAIN, AND ADG FOR HEIFERS (THREE YEAR ANALYSIS)

	Animal Weights		Total	Average Daily Gain				
				Forage Phase		Concentrate Phase		Forage and Concentrate
	Initial	Final	Gain	F-28[1]	Total[2]	F-28[1]	Total[3]	Total[4]
MU[5]	520	795	275	1.26	1.54	1.39	1.81	1.63
Year								
1965	523	779	256	1.40[a]	1.36[c]	2.30[a]	2.15[a]	1.60[c]
1966	508	810	302	1.48	1.79	1.30	1.77	1.79
1967	528	797	269	.90	1.49	.51	1.50	1.48
Forage								
Hay	518	803[d]	285	1.40[c]	1.58	1.53[b]	1.87	1.67
No Hay	521	787	266	1.11	1.51	1.24	1.76	1.59
Protein								
CSM	517	798	281	1.42[c]	1.62	1.41	1.77	1.68
Urea	522	793	271	1.11	1.47	1.37	1.86	1.60

Statistically significant variation among the independent effects:

[a]Significantly different ($P \leq .001$).

[b]Significantly different ($P \leq .01$).

[c]Significantly different ($P \leq .05$).

[d]Significantly different ($P \leq .10$).

[1]F-28. Average daily gain made the first 28 days of each feeding phase.

[2]The forage phase was 112 days long each year.

[3]The concentrate phase was 48 days in 1965, 57 days in 1966, and 69 days in 1967.

[4]The average daily gain for the combined forate and concentrate phase.

[5]MU: The overall, mean.

TABLE IV

MEANS FOR FINAL CONDITION SCORES AND CARCASS DATA FOR HEIFERS (THREE YEAR ANALYSIS)

	Final[1] Condition Score	Loin[2] Eye (in.)	Fat[2] Thickness (in.)	Marbling[3] Score	Carcass[1] Grade	Dressing[4] Percentage Geeeneville	Dressing Percentage Knoxville	Drift[5]
MU[6]	9.98	10.22	.30	4.70	10.01	.57	.59	2.7
Year								
1965	10.14	10.47[d]	.30	5.23[a]	10.83[a]	.57	.58[c]	2.7[a]
1966	9.89	9.97	.30	4.13	9.88	.58	.59	1.1
1967	9.91	--	--	4.73	9.33	.56	.59	4.4
Forage								
Hay	10.09	10.09	.32[d]	4.69	10.23	.57	.59	2.6
No Hay	9.87	10.18	.27	4.72	9.89	.57	.58	2.5
Protein								
CSM	10.12	10.21	.31	4.61	10.02	.57	.59	2.7
Urea	9.84	10.06	.28	4.79	10.12	.57	.58	2.4

Statistically significant variation among the independent effects:
[a]Significantly different ($P \leq .001$). [c]Significantly different ($P \leq .05$).
[b]Significantly different ($P \leq .01$). [d]Significantly different ($P \leq .10$).
[1]Grades are as follows: 6, 7, 8 - Standard; 9, 10, 11 - Good.
[2]1965 and 1966 only.
[3]Marbling scores: 3 - Traces; 4 - Slight.
[4]The Greeneville dressing percentage was calculated by dividing the hot carcass weight by the final Greeneville weight.
[5]Drift is expressed as the percentage of final weight lost in transit from Greeneville to Knoxville, Tennessee.
[6]MU: The overall, mean.

Years Effects

The variation in feedlot and carcass characteristics among the three years are shown in Table V. The year of 1965 was considered a poor year for corn silage production, 1966 was an exceptionally good year for the production of corn silage and 1967 represented a normal corn silage year. The variation in heifer feedlot performance during the silage feeding phase followed a similar pattern with corn silage production, 1966 being the best year for heifer gains followed in order by 1967 and 1965 (total forage-ADG, Table V).

In 1967, ADG, during the F-28 forage phase, was lower ($P \leq .05$) than in 1965 and 1966. As reported by Stansbury in 1971, the number of heifers aborting in 1967 may have had a bearing on the low average daily gain during the F-28 forage phase.

The ADG during the total forage phase in 1966 was .30 and .43 pounds higher than in 1967 and 1965, respectively ($P \leq .05$). However, there was only a difference in ADG of .13 pounds between 1965 and 1967. The variation due to years effect follows the variation in the quality of the corn silage produced. The feed efficiency of the heifers in both periods follows the same pattern as the ADG, with the 1966 heifers being the most efficient (appendix, Table XI and Table XII).

The ADG in the F-28 concentrate phase in 1967 was .51 pounds compared to 2.30 and 1.30 pounds in 1965 and 1966, respectively ($P \leq .05$). Both the 1966 and 1967 heifers had trouble adjusting to the concentrate ration as shown by the differences in the F-28 and total concentrate phase. The ADG in the total concentrate phase in 1965 was .38 and .65 pounds more than in 1966 and 1967 ($P \leq .05$). The feed efficiency

TABLE V

VARIATION IN FEEDLOT AND CARCASS CHARACTERISTICS OF HEIFERS AMONG THE THREE YEARS

	Average Daily Gain								
	Forate Phase		Concentrate Phase		Forage and Concentrate	Marbling[5]	Carcass[6]	Dressing[7] Percentage	
Year	F-28[1]	Total[2]	F-28[1]	Total[3]	Total[4]	Score	Grade	Greeneville	Drift[8]
MU[9]	1.26	1.54	1.39	1.81	1.63	4.70	10.01	.57	2.7
1965	1.40[a]	1.36[a]	2.30[a]	2.15[a]	1.60[b]	5.23[a]	10.83[a]	.57[ab]	2.7[ab]
1966	1.48[a]	1.79[b]	1.30[b]	1.77[b]	1.79[b]	4.13[b]	9.88[b]	.58[b]	1.1[a]
1967	.90[b]	1.49[a]	.51[c]	1.50[c]	1.49[a]	4.73[c]	9.33[c]	.56[a]	4.4[b]

[a,b,c]Means within a column not superscripted by the same letter are significantly different ($P \leq .05$).

[1]F-28. Average daily gain made the first 28 days of each feeding phase.

[2]The forage phase was 112 days each year.

[3]The concentrate phase was 48 days in 1965, 57 days in 1966, and 69 days in 1967.

[4]The ADG for the combined forage and concentrate phase.

[5]Marbling scores: 3 - Traces; 4 - Slight.

[6]Grades are as follows: 6, 7, 8 - Standard; 9, 10, 11 - Good.

[7]The Greeneville dressing percentage was calculated by dividing the hot carcass weight by the final Greeneville weight.

[8]Drift is expressed as the percentage of final weight lost in transit from Greeneville to Knoxville, Tennessee.

[9]MU: The overall, mean.

(Appendix, Table XI and Table XII) for the 1965 heifers was the best (least feed/pound of gain) and the 1967 heifers was the poorest (most feed/pound of gain).

The ADG during the combined forage and concentrate periods was .31 pounds more in 1966 than in 1967 ($P \leq .05$) but only .19 pounds more than in 1965. The 1967 heifers had difficulty adjusting to the feed change in both the silage and concentrate phases which resulted in the lowest total average daily gain of the three years.

With only two years of data available for loin eye, 1965 heifers had .5 square inches more loin eye area than the 1966 heifers ($P \leq .10$). Also, the 1965 heifers had more square inches of loin eye area per cwt. of carcass than 1966 heifers (2.35 and 2.12 square inch of loin eye/cwt. in 1965 and 1966, respectively). The 1965 heifers had a higher marbling score of 5.23 compared to 4.13 and 4.73 for the heifers in 1966 and 1967 ($P \leq .05$). The carcass grade in 1965 was 10.83 compared to 9.88 and 9.33 in 1966 and 1967 respectively ($P \leq .05$). The higher marbling score and carcass grade in the 1965 heifers can partly be attributed to the increased average daily gain of these heifers in the concentrate phase.

The 1965 heifers would be expected to have the highest carcass grade because of the higher marbling score. However, the 1967 heifers had a slightly higher marbling score than the 1966 heifers, but a slightly lower carcass grade. The 1967 heifers had a 3.3 higher percentage of drift than the 1966 heifers ($P \leq .05$) but there was no difference in the drift between the 1965 and 1966 heifers (Table V).

Hay Versus No Hay

The ADG of the heifers which received hay during the F-28 forage

period was 1.40 pounds compared to 1.11 pounds for those with no hay ($P \leq .05$) (Table III, page 25). This was due primarily to the difficulty of getting the heifers on feed in 1966 and 1967. However in the entire forage period there was no difference in gain due to the addition of hay.

In the F-28 concentrate period, there was a difference of .29 pounds of gain per day in favor of the heifers who received hay ($P \leq .01$). There was no difference in the ADG during the total concentrate phase nor in the combined ADG of the forage concentrate phases. These results are in agreement with work done by Wise et al. (1961) and Wise et al. (1965) in which limited hay was added to all-concentrate rations and no significant increase in ADG was obtained. Thus the addition of hay seems to help the heifers in adjusting to change in ration, but the differences obtained during this initial period are eliminated by the end of the feeding period.

The feed efficiency for the heifers which received hay was equal to or improved when compared to those receiving no hay in all periods (Appendix, Table XI and Table XIII). In the F-28 forage period, the addition of two pounds of hay reduced the amount of silage needed by the heifers and in the concentrate phase the addition of hay reduced the amount of corn required by the heifers to add each additional pound of weight.

Fat thickness for the hay fed heifers was .32 inches compared to .27 inches for the non-hay heifer group ($P \leq .10$). The slightly higher final condition score (Table IV, page 26) for the hay fed heifers might be due to the increased fat thickness of hay fed heifers. The final

weight for the hay fed heifers of 803 pounds was higher than for the non-hay fed steer of 787 pounds, Table III, page 25 ($P \leq .10$). The heavier final weight for the hay fed heifers is a reflection of the slightly higher ADG obtained by hay fed heifers throughout both feeding periods. Hay feeding did not result in an improvement in marbling scores, carcass grades, or dressing percents.

Urea Versus Cottonseed Meal

Cottonseed meal improved ADG during the F-28 forage period 1.42 pounds compared to 1.11 pounds for urea, Table III, page 25 ($P \leq .05$). However, there were no differences in ADG made during the total forage period, the concentrate phase nor the combined period. The results presented are in agreement with other workers in the field. Fontenot, McClure, and Carter (1967) and Hammack and Marion (1970) have compared a complex protein supplement containing urea with standard protein supplement of cottonseed meal and have found no differences in gain obtained on either supplement.

The heifers which received cottonseed meal supplement were more efficient than the heifers that received urea supplement in the forage phase but in the concentrate phase the urea supplemented heifers were more efficient than the cottonseed meal supplemented heifers (Appendix, Table XI and Table XIII). This is in agreement with the work by Dinning, Briggs, and Gallup (1949) in which urea nitrogen was more efficiently utilized with fattening rations than with maintenance rations involving both sheep and cattle. There were no differences due to the protein source in any of the carcass data collected (Table IV, page 26).

II. STEERS

The results presented in Table VI describe the independent treatment effects on dependent feedlot variables and in Table VII on the dependent carcass variables studied in the steer phase of the project conducted at the Tennessee Tobacco Experiment Station during 1965, 1966, and 1967 with 166 steers.

There was no interaction between protein and hay ($P \geq .10$). However, there was a difference ($P \leq .05$) between lot within ration for the steers (Appendix, Tables XIV and XV). The difference between lots within ration could be a result of the fact that the 1966 steers were lotted into groups in which the initial weights varied from 75 to 100 pounds between lots within rations.

In Tables VI and VII, the independent treatment effect giving rise to animal performance variation are listed down the left-hand margin. The dependent performance variables are given as column heads across the top margin. The overall, mean Mu is given as the first figure in each column to compare each treatment effect and its deviation from the overall mean. In Appendix, Tables XXX through XXXIII are summary tables of each year broken down into lots within rations.

Years Effects

In Table VIII, the variations in feedlot performance among the three years are shown. The ADG in Period I was 2.49 pounds in 1965 compared to 1.05 pounds for 1966 ($P \leq .05$) and .25 pounds in 1967($P \leq .05$). The steers in 1966 and 1967 had trouble adjusting to the concentrate

TABLE VI

MEANS FOR INITIAL WEIGHTS, FINAL WEIGHTS, TOTAL GAIN AND ADG FOR STEERS (THREE YEAR ANALYSIS)

	Animal Weights		Total	Average Daily Gain			
	Initial	Final	Gain	Period 1[1]	Period 2	Period 3[2]	Total
MU[3]	800	989	188	1.26	2.40	2.40	2.06
Year							
1965	815	1055[d]	190	2.49[a]	2.20[c]	2.26[b]	2.32[a]
1966	769	977	208	1.05	2.47	2.39	2.04
1967	817	984	167	.25	2.52	2.55	1.83
Forage							
Hay	801	1008[a]	207	1.57[a]	2.48	2.59[d]	2.25[a]
No Hay	799	971	172	.97	2.31	2.21	1.88
Protein							
CSM	779	997	218	1.66[a]	2.42	2.32[a]	2.16[b]
Urea	802	981	279	.88	2.37	2.48	1.97

Statistically significant variation among the independent effects:

[a]Significantly different ($P \leq .001$).
[b]Significantly different ($P \leq .01$).
[c]Significantly different ($P \leq .05$).
[d]Significantly different ($P \leq .10$).

[1]Period 1, Period 2, and Period 3: Average daily gains made during the first, second, and third periods of feeding. Total: Total average daily gain.

[2]The length of the third period in 1965, 1966, and 1967 are as follows: 26 days, 46 days, and 35 days.

[3]MU: The overall, mean.

TABLE VII

MEANS FOR TYPE AND CONDITION SCORES AND CARCASS DATA FOR STEERS (THREE YEAR ANALYSIS)

	Initial[1] Type Score	Initial[1] Condition Score	Final[1] Condition Score	Fat Thickness (in.)	Marbling[2] Score	Carcass[1] Grade	Dressing[3] Percentage Greeneville	Dressing Percentage Knoxville	Drift[4]
MU[5]	10.43	8.30	10.90	.32	3.96	10.22	.58	.60	2.4
Year									
1965	10.81[b]	8.73[b]	11.55[c]	.32[c]	4.11	10.39	.59[a]	.61[b]	2.5
1966	10.07	7.74	10.82	.29	4.02	10.31	.58	.59	2.3
1967	10.40	8.43	10.32	.34	3.75	9.96	.57	.59	2.5
Forage									
Hay	10.43	8.33	11.90[d]	.32	4.08	10.41	.58	.59	2.4
No Hay	10.43	8.27	10.61	.30	3.84	10.04	.58	.59	2.5
Protein									
CSM	10.40	8.28	10.96	.33[c]	3.99	10.24	.58	.59	2.5
Urea	10.46	8.32	10.84	.30	3.94	10.20	.58	.59	2.4

Statistically significant variation among the independent effects:

[a]Significantly different ($P \leq .001$).

[b]Significantly different ($P \leq .01$).

[c]Significantly different ($P \leq .05$).

[d]Significantly different ($P \leq .10$).

[1]Grades are as follows: 6, 7, 8 - Standard; 9, 10, 11 - Good.

[2]Marbling scores: 3 - Traces; 4 - Slight.

[3]The Greeneville dressing percentage was calculated by dividing the hot carcass weight by the final Greeneville weight.

[4]Drift is expressed as the percentage of final weight lost in transit from Greeneville to Knoxville Tennessee.

[5]MU: The overall, mean.

TABLE VIII

VARIATION IN FEEDLOT AND CARCASS CHARACTERISTICS OF STEERS AMONG THE THREE YEARS

Year	ADG Period 1[1]	ADG Period 2	ADG Period 3[2]	ADG Total	Final Wt.	Initial[3] Type Score	Initial[3] Condition Score	Final[3] Condition Score	Fat[4] Thickness (in.)	Dressing[5] Percentage Greeneville	Dressing Percentage Knoxville
MU	1.26	2.40	2.40	2.06	989	10.43	8.30	10.90	.32	.58	.60
1965	2.49[a]	2.20[a]	2.26[a]	2.32[a]	1005[a]	10.81[a]	8.73[a]	11.55[a]	.32[ab]	.590[a]	.605[a]
1966	1.05[b]	2.47[ab]	2.38[ab]	2.04[b]	977[b]	10.07[b]	7.74[b]	10.83[b]	.29[a]	.578[ab]	.592[b]
1967	.25[c]	2.52[b]	2.55[b]	1.83[c]	984[ab]	10.40[c]	8.43[c]	10.32[b]	.34[b]	.572[b]	.586[b]

[a,b,c]Means within a column not superscripted by the same letter are significantly different ($P \leq .05$).

[1]Period 1, Period 2, and Period 3: average daily gains made during the first, second, and third period of feeding. Total: total average daily gain.

[2]The length of the third period in 1965, 1966, and 1967 are as follows: 26 days, 46 days, and 35 days.

[4]Marbling scores: 3 - Traces; 4 - Slight.

[5]The Greeneville dressing percentage was calculated by dividing the hot carcass weight by the final Greeneville weight.

phase, as indicated by the very low gains obtained this period. However, in period II, the adjustment had been made and the steers in 1965 had an ADG in this period of 2.20 pounds compared to 2.52 pounds for the 1967 steers ($P \leq .05$). Also, in period III, the 1967 steer had a higher ADG. The feed efficiency figures for the steers followed the same general pattern as ADG (Appendix, Table XVI). As would be expected the animals obtaining the highest ADG were the most efficient.

The total ADG during the concentrate feeding was different during the three years with the 1965 steers having the highest ADG of 2.32 pounds followed by 1966 with 2.04 pounds and 1967 with 1.83 pounds ($P \leq .05$). The 1966 and 1967 steers had higher ADG in periods II and III compensating in part for the low ADG in period I. The difficulty in getting the steers on feed in 1966 and 1967 reduced the total ADG below that of the 1965 steers. This stresses the importance of getting animals started on feed at the beginning of the feeding period. Again the overall feed efficiency was higher for animals which obtained the highest ADG (Appendix, Table XIV).

The final weight of the 1965 steers was 28 pounds more than the final weight of the 1966 ($P \leq .06$). The higher final weight was indicated by the higher total ADG obtained by the 1965 steers. The initial type score was 10.8 in 1965 compared to 10.0 in 1966 ($P \leq .05$) and 10.4 in 1967 ($P \leq .05$). The initial condition grade varies by years 8.7, 7.7 and 8.4 in 1965, 1966, and 1967, respectively ($P \leq .05$), and was probably a reflection of the quality of pasture used before the steers were fed concentrate. The 1965 steers had a higher final condition score of 11.5 compared to 10.8 and 10.3 for the steers in 1966 and 1967

($P \leq .05$). Carcass data indicated that the fat thickness in 1966 of .29 inches, was different from that in 1967 of .34 inches ($P \leq .05$). The dressing percent was higher in 1965 when compared to the other two years using either the Greeneville or Knoxville weights. There was no yearly variation in either marbling scores or carcass grade.

Hay Versus No Hay

Steers which received hay as compared to those receiving no hay, gained more in period I ($P \leq .001$) but in period II there was no difference in ADG. The ADG in period III was .38 pounds per day more ($P \leq .10$) and .37 pounds more ($P \leq .001$) for the entire concentrate phase for the steers receiving hay. The results are in agreement with experiments summarized by Newman and Snapp (1969) who reported that small amounts of hay in all-concentrate rations results in a slight improvement in ADG. As shown in Table XVII, see Appendix, the total concentrate consumption is fairly equal but the feed efficiency for the hay fed steers was improved.

The hay-fed steers appeared to have more condition than the non hay-fed steers as indicated by the final condition score ($P \leq .10$) but this was not evident in actual backfat thickness (Table VII, page 34). However, there was a slight improvement in marbling score of 4.08 versus 3.84 and in carcass grade of 10.41 versus 10.04. The final weight for the hay fed steers of 1008 pounds was higher than for the non-hay fed steers of 971 pounds (Table VI, page 33)($P \leq .0001$).

The heavier final weight for the hay fed steers can be attributed

to the higher ADG obtained by the hay fed steers throughout the entire feeding period. Thus, the addition of hay seems to help the steers in the transition from pasture to concentrate improving ADG, and the consumption of hay improved feed efficiency.

Cottonseed Meal Versus Urea

In period I, the steers which received cottonseed meal gained .78 pounds per day more than the steers that received urea ($P \leq .001$) (Table VI, page 33). Kirk et al. (1958) and Meiske and Goodrich (1966) have reported that cattle gains on urea rations were lower during the initial phase of the feeding period but approached gains from natural protein later. There were no differences in ADG in period II. In period III, the steers which received cottonseed meal gained more than the steers that received urea ($P \leq .001$) and in the total concentrate period the steers which received cottonseed meal gained more, 2.16 versus 1.97 pounds, than the steers which received urea ($P \leq .01$). These results are in agreement with work done by Ross et al. (1950), Long et al. (1952), and Bell, Murphree, and Hobbs (1954) in which cottonseed meal was compared with urea and they found that the ADG obtained on cottonseed meal was higher.

Fat thickness was higher in the steers fed cottonseed meal with .33 inches versus .30 inches (Table VII, page 34)($P \leq .05$). However there were no other differences in any of the carcass characteristics observed.

III. HEIFERS VERSUS STEERS

In the two experiments conducted, the heifers and steers were managed differently in the pre-concentrate phase. Because of this a statistical analysis was not run on the combined data. However, some general comparisons between the heifers and steers follow.

When both the heifers and steers were marketed at similar lot average condition grades, the final weight of the heifer was less than the steers (Table III, page 25 and Table VI, page 33) but the fat thickness, marbling score, and dressing percent were similar for heifers and steers (Table IV, page 26 and Table VII, page 34). The difference in final weight ranges from 150 to 200 pounds more for the steers in the separate years. Also, the ADG of the steers for the total concentrate period was slightly higher than for heifers. Work by Potter, Withycombe, and Edwards (1931), McCall and Hachedom (1937), and Anderson, High and Chapman (1971) indicated that heifers finish out at a lighter weight than steers and that steers obtain higher average daily gains.

Both the heifers and steers obtained slightly higher ADG, higher carcass grades, and adjusted to the concentrate ration better when they were on the rations containing hay. In the rations for the heifers containing cottonseed meal as a protein supplement, the slightly higher ADG was not significant ($P \leq .10$). However, the steers fed cottonseed meal had a higher ADG than the steers fed the urea ($P \leq .01$). There was no interaction observed between hay and no hay or cottonseed meal and urea in either the heifers or steers. In general, the heifers and steers obtained similar results on either hay or no hay and cottonseed meal or urea.

CHAPTER V

SUMMARY

The major objectives of this study were (1) to compare a natural protein source cottonseed meal with urea, and (2) to determine the effect of limited quantities of hay on a high concentrate finishing ration. In addition, since both heifers and steers were used in this study, a sex comparison was made.

In 1965, 1966, and 1967, 170 medium grade yearling heifers were purchased for the experiment conducted at the Tennessee Tobacco Experiment Station. The heifers were pregnancy checked, implanted with DES, weighed on two consecutive days, and alloted.

The heifers were fed for an average of 170 days with the feeding period being divided into two phases. During the initial feeding phase (112 days), one half of the heifers received a ration consisting of a full feed of corn silage, one pound of protein supplement, and five pounds of ground ear corn. The other half received the same ration plus two pounds of hay per head per day. Half of the heifers in each of these two groups (hay versus no hay) received the necessary additional protein from cottonseed meal while the other half were given a high urea supplement. In the second phase, after a 3-4 day transition period, they were full fed ground ear corn. Hay and protein source variables were continued in this phase which lasted an average of 58 days.

Heifers receiving cottonseed meal as a protein source gained at a significantly faster rate than heifers receiving the high urea

supplement during the first 28 days of the forage feeding phases. The ADG obtained in the total forage and total concentrate feeding periods for the heifers were higher for the CSM supplement but these differences were not significant. The heifers receiving hay gained significantly faster than heifers receiving no hay during the first 28 days of the forage and concentrate feeding phases. The addition of hay seemed to help the heifers in adjusting to change in ration.

One hundred and sixty medium to good grade steers were purchased in 1965, 1966, and 1967. The steers were weighed on two consecutive days, implanted with DES, and lotted to treatments.

The feeding period consisted of only a concentrate phase for the steers which averaged 92 days. The feeding program utilized was the same as for the heifers in the concentrate phase.

The steers receiving CSM gained significantly faster during the initial 28 days feeding and during the entire 92 days than the steers receiving urea. Steers receiving hay gained at a significantly faster rate than the steers receiving no hay during the total concentrate phase. Also, the addition of hay seemed to help the steers in adjusting to change in ration.

When both the heifers and steers were marketed at similar visual condition grades, the final weight for the heifers was from 150 to 200 pounds less than the steers. Also, the ADG of the steers for the feeding period was slightly higher than for the heifers.

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LITERATURE CITED

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APPENDIX

TABLE IX

ANALYSIS OF VARIANCE FOR INITIAL WEIGHT, FINAL WEIGHT, AND ADG FOR HEIFERS

		Mean Squares[1]						
				Average Daily Gain				
		Animal WEights		Forage Phase		Concentrate Phase		Forage and Concentrate
Source	d.f.	Initial	Final	F-28	Total	F-28	Total	Total
Year	2	2681.4024	16678.3374	5.5614[b]	2.7757[c]	45.8979[c]	6.005[a]	1.2510[c]
Protein	1	1039.4794	1360.5847	3.8397	.9303	.0560	.3841	.1611
Hay	1	696.5666	12762.5441[d]	3.3078[c]	.2972	2.5332[b]	.3381	.2833
Protein x Hay	1	3291.3231	249.7084	.0453	.1468	.5812	.0098	.0594
Lot/Ration	4	88949.0333[b]	60599.6041[b]	.8328	.2376[c]	.2575	.0735	.1459[d]
Residue	160	3442.7558	41319.7087	.6369	.0979	.4631	.2742	.0710

[a] $\leq$ 0.001
[b] $\leq$ 0.01
[c] $\leq$ 0.05
[d] $\leq$ 0.10

[1] When there was no significance in protein and hay and between lots within ration, the mean squares of protein and hay lots within ration, and residual were pooled.

TABLE X

ANALYSIS OF VARIANCE FOR CONDITION SCORE AND CARCASS DATA FOR HEIFERS

Source	d.f.	Mean Squares[1]					
		Final Condition Score	Marbling Score	Carcass Grade	Dressing Percentage Greeneville	Drift	Loin[2] Eye
Year	2	.8933	17.2931[a]	32.5381[a]	.0066[c]	.0162	.1852
Protein	1	3.4854	1.2686	1.3216	.0001	.0004	68.8491[d]
Hat	1	1.9475	.1673	2.2145	.0025	.0001	105.3962[d]
Protein x Hay	1	.6904	.0486	.3924	.0010	.0001	.0351
Lot/Ration	4	4.5711[b]	1.1026	1.7198	.0008[d]	.0015	1.0611
Residual	160	.7877	.8497	.9354	.0003	.0013	.0143

[a] $\leq$ 0.001
[b] $\leq$ 0.01
[c] $\leq$ 0.05
[d] $\leq$ 0.10

[1] When there was no significance in protein and hay and between lots within ration, the mean squares of protein and hay, lots within ration and residual were pooled.

[2] Only two years data available for loin eye, so degrees of freedom for year was 1 and for residual 106.

TABLE XI

THE AMOUNT OF DRY MATTER PER POUND OF GAIN FOR THE F-28 PERIOD AND TOTAL PERIOD IN BOTH THE FORAGE AND CONCENTRATE PHASES FOR THE HEIFERS

	Dry Matter/Pound Gain			
	Forage Phase		Concentrate Phase	
	F-28[1]	Total[2]	F-28[1]	Total[2]
Year				
1965	11.45	11.62	7.08	7.49
1966	8.69	7.91	13.24	10.07
1967	15.56	10.71	37.56	10.86
Average	10.90	10.08	19.29	9.47
Forage				
Hay	10.49	10.03	15.13	8.36
No Hay	12.99	9.98	22.58	9.20
Protein				
CSM	10.53	9.44	19.44	10.45
Urea	12.83	10.46	18.04	7.98

[1]F-28: The first 28 day feeding period.

[2]Total: The total forage or concentrate feeding period.

TABLE XII

THE AVERAGE DAILY FEED CONSUMPTION AND THE FEED REQUIRED PER POUND OF GAIN FOR THE HEIFERS IN THE THREE DIFFERENT YEARS

	Av. Daily Feed, lb				Feed Req./lb Gain			
	Corn Silage	Ground Ear Corn	Protein Supplement	Hay	Corn Silage	Ground Ear Corn	Protein Supplement	Hay
Year								
1965								
F-28 Forage[1]	28.68	5.51	1.00	1.00	20.91	4.01	.73	.80
Total Forage[2]	28.56	5.26	1.00	1.00	21.76	3.90	.74	.79
F-28 Concentrate[1]	--	16.00	1.17	1.04	--	7.02	.52	.53
Total Concentrate[2]	--	16.05	1.13	1.00	--	7.53	.53	.49
1966								
F-28 Forage	21.06	5.00	1.00	1.00	15.51	3.67	.73	.58
Total Forage	28.59	5.00	1.00	1.00	16.08	2.81	.57	.53
F-28 Concentrate	1.07	16.54	1.11	1.00	1.69	13.00	.86	.73
Total Concentrate	1.05	17.59	1.13	1.00	.61	10.11	.65	.55
1967								
F-28 Forage	23.31	4.89	1.00	1.00	27.88	5.73	1.17	.96
Total Forage	31.38	4.90	1.00	1.00	21.11	3.36	.68	.69
F-28 Concentrate	6.26	13.89	1.03	1.00	15.13	33.28	2.47	1.66
Total Concentrate	2.50	15.14	1.00	1.00	1.71	10.33	.69	.72

[1]F-28 Forage and F-28 Concentrate: The first 28 day feeding period.

[2]Total Forage and Total Concentrate: The total forage and concentrate period.

TABLE XIII

THE AVERAGE DAILY FEED CONSUMPTION AND THE FEED REQUIRED PER POUND OF GAIN FOR THE HEIFERS ON THE HAY OR NO HAY AND COTTONSEED MEAL AND UREA

	Av. Daily Feed, lb				Feed Req./lb Gain			
	Corn Silage	Ground Ear Corn	Protein Supplement	Hay	Corn Silage	Ground Ear Corn	Protein Supplement	Hay
Forage								
Hay								
F-28 Forage[1]	23.04	4.93	1.00	2.00	17.51	3.71	.76	1.51
Total Forage[2]	28.07	5.06	1.00	2.00	18.19	3.29	.65	1.30
F-28 Concentrate[1]	2.27	15.13	1.08	2.03	3.63	13.22	.95	1.81
Total Concentrate[2]	1.12	16.06	1.08	2.00	7.50	7.50	.61	1.13
No Hay								
F-28 Forage	25.93	5.37	1.00	--	25.46	5.24	.99	--
Total Forage	30.64	5.00	1.00	--	21.33	3.51	.69	--
F-28 Concentrate	2.45	15.91	1.12	--	7.28	21.76	1.60	--
Total Concentrate	1.17	16.47	1.08	--	.86	9.60	.63	--
Protein								
CSM								
F-28 Forage	24.77	5.21	1.00	1.05	19.22	4.02	.77	.70
Total Forage	29.15	4.99	1.00	1.05	18.56	3.19	.63	.65
F-28 Concentrate	2.44	15.48	1.21	1.06	5.78	18.14	1.31	.78
Total Concentrate	1.17	15.97	1.17	1.05	.79	9.32	.68	.60
Urea								
F-28 Forage	24.11	5.07	1.00	1.02	23.43	4.86	.97	.86
Total Forage	29.46	5.06	1.00	1.02	20.52	3.59	.70	.69
F-28 Concentrate	2.27	15.17	1.00	1.04	5.00	16.56	1.23	1.09
Total Concentrate	1.12	16.54	1.00	1.02	.71	7.73	.56	.56

[1]F-28 Forage and F-28 Concentrate: The first 28 days feeding period.
[2]Total Forage and Total Concentrate: The total forage or concentrate period.

TABLE XIV

ANALYSIS OF VARIANCE FOR INITIAL WEIGHT, FINAL WEIGHT, AND ADG FOR STEERS

		Mean Squares[1]					
		Animal Weight		Average Daily Gain			
Source	d.f.	Initial	Final	Period I	Period II	Period III	Total
Year	2	41535.3853	11963.2014[d]	71.4187	1.6729[d]	1.2024[b]	3.2350[a]
Protein	1	89.4281	12042.9118	24.8535[a]	0.1026	1.1180[a]	1.5848[b]
Hay	1	375.1723	55808.0023[a]	14.5842[a]	1.2540	6.25555[a]	5.6071[a]
Protein x Hay	1	27.6972	1226.9664	0.7290	2.5708	0.1214	0.0888
Lot/Ration	4	13536.1819[a]	7565.2020	0.6331	0.2862	0.3237	0.1309
Residual	156	2739.4206	4693.3224	0.9566	0.5881	0.3820	0.1548

[a] $\leq$ 0.001
[b] $\leq$ 0.01
[c] $\leq$ 0.05
[d] $\leq$ 0.10

[1] When there was no significance in protein and hay and between lots within ration, the mean squares of protein and hay, lots within ration, and residual were pooled.

TABLE XV

ANALYSIS OF VARIANCE FOR TYPE AND CONDITION SCORE AND CARCASS DATA FOR STEERS

		Mean Squares[1]								
Source	d.f.	Initial Type Score	Initial Condition Score	Final Condition Score	Fat Thickness	Marbling Score	Carcass Grade	Dressing Percentage Greeneville	Dressing Percentage Knoxville	Drift
Year	2	7.6206[b]	14.4671[b]	21.0406[d]	.0427[b]	1.9257	2.7200	.0051[b]	.0055[b]	.000048
Protein	1	.1501	.0377	.5487	.0507[b]	.0705	.0764	.0004	.0009	.0003
Hay	1	.0053	.1757	13.3520[d]	.0221	2.2726	5.8709	.0003	.0005	.0001
Protein x Hay	1	.3671	1.8082	1.6218	.0012	.6445	4.2634	.0003	.0026	.0005
Lot/Ration	4	.9666	.3212[c]	3.5998[b]	.0040	1.1516[c]	2.9174[c]	.0001	.0002	.0003[c]
Residual	156	.7614	.4141	1.1999	.0125	.4207	.9445	.0002	.0002	.0001

[a] $\leq$ 0.001
[b] $\leq$ 0.01
[c] $\leq$ 0.05
[d] $\leq$ 0.10

[1] When there was no significance in protein and hay and between lots with ration, the mean squares of protein and hay, lots within ration, and residual were pooled.

TABLE XVI

THE AVERAGE DAILY FEED CONSUMPTION AND THE FEED REQUIRED PER POUND OF GAIN FOR THE STEERS IN THE THREE DIFFERENT YEARS

	Av. Daily Feed, lb			Feed Req./lb Gain		
	Ground Ear Corn	Protein Supple-ment	Hay	Ground Ear Corn	Protein Supple-ment	Hay
Year						
1965						
Period I[1]	12.74	1.53	1.02	5.33	.62	.38
Period II	18.65	1.50	1.00	8.55	.69	.46
Period III	19.83	1.47	.98	9.10	.71	.39
Total	17.01	1.50	1.00	7.37	.65	.41
1966						
Period I	11.94	1.50	1.00	20.84	2.11	.79
Period II	16.61	1.50	1.00	6.77	.61	.39
Period III	19.13	1.50	1.01	8.03	.64	.41
Total	16.54	1.50	1.01	8.17	.73	.46
1967						
Period I	10.98	1.50	1.00	22.08	3.11	2.24
Period II	16.36	1.50	1.00	6.50	.59	.37
Period III	18.48	1.48	.98	7.27	.58	.35
Total	15.46	1.49	.99	8.60	.81	.48

[1]Period I, Period II and Period III: The first, second, and third feeding periods. Total: Total feeding period.

TABLE XVII

THE AVERAGE DAILY FEED CONSUMPTION AND THE FEED REQUIRED PER POUND OF GAIN FOR THE STEERS ON THE HAY OR NO HAY AND COTTONSEED MEAL AND UREA

	Av. Daily Feed, lb			Feed Req./lb Gain		
	Ground Ear Corn	Protein Supple-ment	Hay	Ground Ear Corn	Protein Supple-ment	Hay
Forage						
Hay						
Period I[1]	11.99	1.51	2.01	13.18	1.47	2.28
Period II	17.25	1.50	2.00	7.08	.60	.82
Period III	19.10	1.49	1.98	7.40	.59	.77
Total	16.34	1.50	1.99	7.30	.66	.90
No Hay						
Period I	11.78	1.51	--	19.00	2.43	--
Period II	17.10	1.50	--	7.46	.67	--
Period III	19.20	1.49	--	8.87	.70	--
Total	16.33	1.50	--	8.80	.73	--
Protein						
CSM						
Period I	11.97	2.01	1.00	12.70	2.22	.66
Period II	17.13	2.00	1.00	7.20	.84	.38
Period III	19.14	1.99	.99	8.51	.88	.39
Total	16.33	2.00	1.00	7.66	.94	.42
Urea						
Period I	11.80	1.01	1.01	19.52	1.67	1.62
Period II	17.21	1.00	1.00	7.34	.43	.44
Period III	19.16	.99	.99	7.76	.41	.38
Total	16.34	1.00	1.00	8.44	.45	.48

[1]Period I, Period II, and Period III: The first, second, and third feeding periods. Total: Total feeding period.

TABLE XVIII

EFFECTS OF TWO PROTEIN SUPPLEMENTS WITH AND WITHOUT HAY ON PERFORMANCE OF BEEF HEIFERS - FORAGE PHASE (DECEMBER 6, 1965 TO MARCH 30, 1966 - 112 DAYS)

	Urea Base Supplement				Cottonseed Meal			
	With Hay		Without Hay		With Hay		Without Hay	
Lot No.	1	2	3	4	5	6	7	8
No. of animals/lot	8	8	6[1]	8	8	8	6[1]	7[1]
Av. wt and gn./head, lb								
Initial wt	589	457	478	570	587	458	446	576
Final wt	726	616	650	698	741	627	621	713
Total gain	137	159	172	128	154	169	175	137
Av. daily gain	1.22	1.42	1.53	1.14	1.38	1.51	1.56	1.22
Av. daily feed, lb[2]								
Corn silage	30.1	25.0	28.1	33.3	28.6	24.2	26.4	32.6
Ground ear corn	5.3	5.2	5.3	5.3	5.2	5.3	5.2	5.3
Protein supplement	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Hay	2.0	2.0	--	--	2.0	2.0	--	--
Feed req./lb gain[2]								
Corn silage	24.57	17.63	18.28	29.17	20.78	16.01	16.92	26.67
Ground ear corn	4.32	3.67	3.42	4.60	3.81	3.50	3.35	4.32
Protein supplement	.82	.70	.65	.88	.73	.66	.64	.82
Hay	1.64	1.41	--	--	1.45	1.33	--	--
Initial type grade[3]	8.4	7.0	7.8	8.6	8.4	7.7	6.8	8.2
Initial condition grade[3]	6.4	5.7	6.2	6.7	6.7	6.0	5.4	6.7

[1]Two animals were sold out of lot 3 and one each were sold out of lots 7 and 8. Also in lot 7, one animal died.

[2]Calculated on an as-fed basis.

[3]Grades are as follows: 6, 7, 8 - Standard; 9, 10, 11 - Good.

TABLE XIX

EFFECTS OF TWO PROTEIN SUPPLEMENTS WITH AND WITHOUT HAY ON PERFORMANCE OF BEEF HEIFERS - CONCENTRATE PHASE (MARCH 30, 1966 TO MAY 17, 1966 - 48 DAYS)

	Urea Base Supplement				Cottonseed Meal			
	With Hay		Without Hay		With Hay		Without Hay	
Lot No.	1	2	3	4	5	6	7	8
No. of animals/lot	8	8	6[1]	8	8	8	6[1]	7[1]
Av. wt and gn./head, lb								
Initial wt	726	616	650	698	741	627	621	713
Final wt	838	735	749	795	851	722	725	801
Total gain	112	119	99	97	110	95	104	88
Av. daily gain	2.33	2.48	2.06	2.02	2.29	1.98	2.17	1.83
Av. daily feed, lb[2]								
Corn silage	--	--	--	--	--	--	--	--
Ground ear corn	17.0	14.6	17.9	16.4	16.70	14.30	15.20	16.60
Protein supplement	1.0	1.0	1.0	1.0	1.26	1.26	1.26	1.26
Hay	2.0	2.0	--	--	2.00	2.00	--	--
Feed req./lb gain[2]								
Corn silage	--	--	--	--	--	--	--	--
Ground ear corn	7.30	5.87	8.65	8.11	7.31	7.22	7.06	9.03
Protein supplement	.43	.40	.48	.49	.55	.64	.58	.69
Hay	.88	.82	--	--	.89	1.03	--	--
Final condition[3]	10.3	9.5	10.2	10.4	10.7	9.9	9.7	10.4

[1]Two animals were sold out of lot 3 and one each were sold out of lots 7 and 8. Also in lot 7, one animal died.

[2]Calculated on an as-fed basis.

[3]Grades are as follows: 6, 7, 8 - Standard; 9, 10, 11 - Good.

TABLE XX

EFFECTS OF TWO PROTEIN SUPPLEMENTS WITH AND WITHOUT HAY ON PERFORMANCE OF BEEF HEIFERS - FORAGE AND CONCENTRATE PHASES (DECEMBER 6, 1965 TO MAY 17, 1966 - 160 DAYS)

	Urea Base Supplement				Cottonseed Meal			
	With Hay		Without Hay		With Hay		Without Hay	
Lot No.	1	2	3	4	5	6	7	8
No. of animals/lot	8	8	6[1]	8	8	8	6[1]	7[1]
Av. wt and gn./head, lb								
Initial wt	589	457	478	570	587	458	446	576
Final wt	838	735	749	795	851	722	725	801
Total gain	249	278	271	225	264	264	279	225
Av. daily gain	1.56	1.74	1.69	1.41	1.65	1.65	1.74	1.41
Av. daily feed, lb[2]								
Corn silage	21.03	17.52	19.66	23.34	20.00	16.91	18.51	22.84
Ground ear corn	8.80	8.01	9.03	8.59	8.69	7.99	8.27	8.67
Protein supplement	1.00	1.00	1.00	1.00	1.08	1.08	1.08	1.08
Hay	2.01	2.01	--	--	2.01	2.01	--	--
Fed req./lb gain[2]								
Corn silage	13.52	10.08	11.60	16.59	12.12	10.25	10.61	16.24
Ground ear corn	5.65	4.61	5.33	6.11	5.26	4.84	4.73	6.16
Protein supplement	.64	.57	.59	.61	.65	.69	.61	.77
Hay	1.29	1.15	--	--	1.11	1.11	--	--
Initial type grade[3]	8.4	7.0	7.8	8.6	8.4	7.7	6.8	8.2
Initial condition grade[3]	6.4	5.7	6.2	6.7	6.7	6.0	5.4	6.7
Final condition grade[3]	10.3	9.5	10.2	10.4	10.7	9.9	9.7	10.4

TABLE XX (Cont'd)

	Urea Base Supplement				Cottonseed Meal			
	With Hay		Without Hay		With Hay		Without Hay	
Carcass Information								
USDA grade[3]	11.4	10.4	11.0	11.3	11.0	10.1	10.3	11.1
Hot carcass wt, lb	486	416	422	457	489	410	405	466
Marbling score[4]	5.8	4.8	5.4	5.6	5.1	4.7	5.0	5.3

[1]Two animals were sold out of lot 3 and one each were sold out of lots 7 and 8. Also in lot 7 one animal died.

[2]Calculated on an as-fed basis.

[3]Grades are as follows: 6, 7, 8 - Standard; 9, 10, 11 - Good.

[4]Marbling scores: 3 - Traces; 4 - Slight.

TABLE XXI

EFFECTS OF TWO PROTEIN SUPPLEMENTS WITH AND WITHOUT HAY ON PERFORMANCE OF BEEF HEIFERS - FORAGE PHASE (DECEMBER 13, 1966 TO APRIL 4, 1967 - 112 DAYS)

	Urea Base Supplement				Cottonseed Meal			
	With Hay		Without Hay		With Hay		Without Hay	
Lot. No.	1	2	3	4	5	6	7	8
No. of animals/lot	7	7	7	7	7	7	7	7
Av. wt and gn./head, lb								
Initial wt	545	461	492	561	554	458	467	529
Final wt	751	679	670	762	757	684	670	721
Total gain	206	218	178	181	203	226	203	192
Av. daily gain	1.84	1.95	1.59	1.62	1.81	2.02	1.81	1.71
Av. daily feed, lb[1]								
Corn silage	29.3	26.6	27.6	30.9	29.3	26.8	27.3	30.9
Ground ear corn	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Protein supplement	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Hay	2.0	2.0	--	--	2.0	2.0	--	--
Fed req./lb gain[1]								
Corn silage	15.91	13.65	17.35	10.10	16.19	13.31	15.08	18.01
Ground ear corn	2.72	2.57	3.15	3.09	2.76	2.48	2.76	2.92
Protein supplement	.54	.51	.63	.62	.55	.50	.55	.58
Hay	1.09	1.03	--	--	1.10	.99	--	--
Initial type grade[2]	8.4	7.1	7.4	7.4	7.6	6.9	7.1	8.5
Initial condition grade[2]	6.5	5.9	5.7	5.9	6.0	5.8	5.9	6.4

[1]Calculated on an as-fed basis.
[2]Grades are as follows: 6, 7, 8 - Standard; 9, 10, 11 - Good.

TABLE XXII

EFFECTS OF TWO PROTEIN SUPPLEMENTS WITH AND WITHOUT HAY ON PERFORMANCE OF BEEF HEIFERS - CONCENTRATE PHASE (APRIL 4, 1967 TO MAY 31, 1967 - 57 DAYS)

	Urea Base Supplement				Cottonseed Meal			
	With Hay		Without Hay		With Hay		Without Hay	
Lot No.	1	2	3	4	5	6	7	8
No. of animals/lot	7	7	7	7	7	7	7	7
Av. wt and gn./lot								
Initial wt	751	679	670	742	757	684	670	721
Final wt	848	787	772	820	858	795	773	824
Total gain	97	108	102	78	101	111	103	103
Av. daily gain	1.70	1.89	1.79	1.37	1.77	1.95	1.81	1.81
Av. daily feed, lb[1]								
Corn silage	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05
Ground ear corn	17.53	17.53	18.36	18.36	17.25	17.22	17.16	17.28
Protein supplement	1.00	1.00	1.00	1.00	1.25	1.25	1.25	1.25
Hay	2.00	2.00	--	--	2.00	2.00	--	--
Feed req./lb gain[1]								
Corn silage	.62	.56	.59	.77	.59	.54	.58	.58
Ground ear corn	10.30	9.25	10.26	13.42	9.73	8.84	9.50	9.56
Protein supplement	.59	.53	.56	.73	.71	.64	.69	.69
Hay	1.18	1.06	--	--	1.13	1.03	--	--
Final condition grade[2]	10.5	9.6	9.1	9.6	10.1	9.7	9.5	10.9

[1]Calculated on an as-fed basis.

[2]Grades are as follows: 6, 7, 8 - Standard; 9, 10, 11 - Good.

TABLE XXIII

EFFECTS OF TWO PROTEIN SUPPLEMENTS WITH AND WITHOUT HAY ON PERFORMANCE OF BEEF HEIFERS - FORAGE AND CONCENTRATE PHASES (DECEMBER 13, 1966 TO MAY 31, 1967 - 169 DAYS)

	Urea Base Supplement				Cottonseed Meal			
	With Hay		Without Hay		With Hay		Without Hay	
Lot No.	1	2	3	4	5	6	7	8
No. of animals/lot	7	7	7	7	7	7	7	7
Av. wt and gn./head, lb								
Initial wt	545	461	492	561	554	458	467	529
Final wt	848	787	772	820	858	795	773	824
Total gain	303	326	280	259	304	337	306	295
Av. daily gain	1.79	1.95	1.66	1.53	1.80	2.99	1.81	1.75
Av. daily feed, lb[1]								
Corn silage	19.87	18.07	18.75	20.94	19.91	18.26	18.58	20.94
Ground ear corn	9.28	9.28	9.56	9.56	9.18	9.18	9.15	9.20
Protein supplement	1.00	1.00	1.00	1.00	1.09	1.09	1.09	1.09
Hay	2.01	2.01	--	--	2.01	2.01	--	--
Feed req./lb gain[1]								
Corn silage	11.01	9.30	11.24	13.57	11.00	9.10	10.19	11.92
Ground ear corn	5.14	4.78	5.73	6.20	5.07	4.57	5.02	5.23
Protein supplement	.55	.51	.60	.65	.60	.54	.60	.62
Hay	1.11	1.03	--	--	1.11	1.00	--	--
Initial type grade[2]	8.4	7.1	7.4	7.4	7.6	6.9	7.1	8.5
Initial condition grade[2]	6.5	5.9	5.7	5.9	6.0	5.8	5.9	6.4
Final condition grade[2]	10.5	9.6	9.1	9.6	10.1	9.7	9.5	10.9

TABLE XXIII (Cont'd)

	Urea Base Supplement				Cottonseed Meal			
	With Hay		Without Hay		With Hay		Without Hay	
Carcass Information								
USDA grade[2]	10.6	10.3	9.9	9.1	10.0	9.6	9.4	10.1
Hot cardass wt, lb	498	454	446	479	507	463	442	479
Marbling score[3]	4.8	4.2	3.9	4.3	4.0	3.6	3.7	4.5

[1]Calculated on an as-fed basis.
[2]Grades are as follows: 6, 7, 8 - Standard; 9, 10, 11 - Good.
[3]Marbling scores: 3 - Traces, 4 - Slight.

TABLE XXIV

EFFECTS OF TWO PROTEIN SUPPLEMENTS WITH AND WITHOUT HAY ON PERFORMANCE OF BEEF HEIFERS - FORAGE PHASE (DECEMBER 13, 1967 TO APRIL 3, 1968 - 112 DAYS)

	Urea Base Supplement				Cottonseed Meal			
	With Hay		Without Hay		With Hay		Without Hay	
Lot NO.	1	2	3	4	5	6	7	8
No. of animals/lot	7	7	7	7	7	7	7	6[1]
Av. wt and gn./head, lb								
Initial wt	563	499	481	559	581	500	488	550
Final wt	719	663	620	709	749	679	687	728
Total gain	156	164	139	150	168	179	199	178
Av. daily gain	1.39	1.46	1.24	1.34	1.50	1.60	1.78	1.59
Av. daily feed, lb[2]								
Corn silage	31.02	28.06	28.28	33.04	30.80	27.68	33.86	37.08
Ground ear corn	4.90	4.90	4.90	4.90	4.90	4.90	4.90	4.90
Protein supplement	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Hay	2.00	2.00	--	--	2.00	2.00	--	--
Fed req./lb gain[2]								
Corn silage	22.28	19.16	22.79	24.67	20.54	17.32	19.06	23.33
Ground ear corn	3.55	3.38	3.98	3.69	3.30	3.09	2.78	3.11
Protein supplement	.72	.68	.81	.75	.67	.63	.56	.63
Hay	1.44	1.37	--	--	1.34	1.24	--	--
Initial type grade[3]	7.2	7.3	7.0	7.6	7.6	7.1	7.3	7.7
Initial condition grade[3]	6.8	6.9	6.5	6.7	6.6	6.4	6.4	6.8

[1]One animal was sold out of lot 8.
[2]Calculated on an as-fed basis.
[3]Grades are as follows: 6, 7, 8 - Standard; 9, 10, 11 - Good.

TABLE XXV

EFFECTS OF TWO PROTEIN SUPPLEMENTS WITH AND WITHOUT HAY ON PERFORMANCE OF BEEF HEIFERS - CONCENTRATE PHASE (APRIL 3, 1968 TO MAY 29, 1968 - 69 DAYS)

	Urea Base Supplement				Cottonseed Meal			
	With Hay		Without Hay		With Hay		Without Hay	
Lot No.	1	2	3	4	5	6	7	8
No. of animals/lot	7	7	7	7	7	7	7	6[1]
Av. wt and gn./head, lb								
Initial wt	719	663	620	709	749	679	687	728
Final wt	837	750	726	849	841	780	787	810
Total gain	118	87	106	140	93	101	100	82
Av. daily gain	1.71	1.26	1.54	2.03	1.33	1.46	1.45	1.19
Av. daily feed, lb								
Corn silage	2.50	2.38	2.38	2.59	2.38	2.59	2.54	2.64
Ground ear corn	15.93	14.96	14.45	15.93	14.95	14.95	14.95	14.95
Protein supplement	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Hay	2.00	2.00	--	--	2.00	2.00	--	--
Feed req./lb gain								
Corn silage	1.44	1.89	1.55	1.28	1.79	1.77	1.75	2.22
Ground ear corn	9.32	11.87	9.41	7.85	11.21	10.21	10.31	12.58
Protein supplement	.58	.79	.65	.49	.75	.68	.69	.84
Hay	1.17	1.59	--	--	1.50	1.37	--	--
Final condition grade	10.2	10.0	9.5	9.1	10.8	9.8	9.9	10.1

[1]One animal was sold out of lot 8.
[2]Calculated on an as-fed basis.
[3]Grades are as follows: 6, 7, 8 - Standard; 9, 10, 11 - Good.

TABLE XXVI

EFFECTS OF TWO PROTEIN SUPPLEMENTS WITH AND WITHOUT HAY ON PERFORMANCE OF BEEF HEIFERS - FORAGE AND CONCENTRATE PHASES (DECEMBER 13, 1967 TO MAY 29, 1968 - 181 DAYS)

	Urea Base Supplement				Cottonseed Meal			
	With Hay		Without Hay		With Hay		Without Hay	
Lot No.	1	2	3	4	5	6	7	8
No. of animals/lot	7	7	7	7	7	7	7	6[1]
Av. wt and gn./head, lb								
Initial wt	563	499	481	559	581	500	488	550
Final wt	837	740	726	849	841	780	787	810
Total gain	301	251	245	290	260	280	299	260
Av. daily gain	1.66	1.39	1.35	1.60	1.44	1.55	1.65	1.44
Av. daily feed, lb[2]								
Corn silage	19.36	18.27	18.41	21.43	19.97	18.11	21.92	23.95
Ground ear corn	9.13	8.72	8.57	9.14	8.76	8.76	8.76	8.76
Protein supplement	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Hay	2.00	2.00	--	--	2.00	2.00	--	--
Feed req./lb gain[2]								
Corn silage	13.30	13.17	13.60	13.37	13.90	11.70	13.27	16.67
Ground ear corn	6.03	6.32	6.33	5.70	6.09	5.66	5.30	6.09
Protein supplement	.66	.72	.73	.62	.69	.64	.60	.69
Hay	1.32	1.44	--	--	1.39	1.28	--	--
Initial type grade[3]	7.2	7.3	7.0	7.6	7.6	7.1	7.4	7.7
Initial condition grade[3]	6.8	6.9	6.5	6.7	6.6	6.4	6.4	6.8
Final condition grade[3]	10.2	10.0	9.5	9.1	10.8	9.8	9.9	10.1

TABLE XXVI (Cont'd)

	Urea Base Supplement				Cottonseed Meal			
	With Hay		Without Hay		With Hay		Without Hay	
Carcass Information								
USDA grade[3]	9.4	9.6	9.3	9.0	9.7	9.6	9.1	8.8
Hot carcass wt, lb	472	425	411	456	481	440	429	451
Marbling score[4]	4.4	4.6	5.2	4.4	4.7	5.1	4.7	4.7

[1]One animal was sold out of lot 8.
[2]Calculated on an as-fed basis.
[3]Grades are as follows: 6, 7, 8 - Standard; 9, 10, 11 - Good.
[4]Marbling scores: 3 - Traces; 4 - Slight.

TABLE XXVII

EFFECTS OF TWO PROTEIN SUPPLEMENTS WITH AND WITHOUT HAY ON PERFORMANCE OF BEEF HEIFERS - THREE YEAR SUMMARY OF FORAGE PHASE

	Urea Base Supplement				Cottonseed Meal			
	With Hay		Without Hay		With Hay		Without Hay	
Lot NO.	1	2	3	4	5	6	7	8
No. of animals/lot	22	22	20[1]	22	22	22	20[1]	20[1]
Av. wt and gn./head, lb								
Initial wt	567	471	484	564	575	471	468	552
Final wt	732	651	646	716	749	662	661	720
Total gain	165	180	162	152	174	191	193	168
Av. daily gain	1.47	1.60	1.45	1.36	1.55	1.71	1.72	1.50
Av. daily feed, lb[2]								
Corn silage	30.11	26.48	27.97	32.45	29.52	26.13	29.35	33.34
Ground ear corn	5.08	5.05	5.05	5.07	5.06	5.08	5.05	5.08
Protein supplement	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Hay	2.00	2.00	--	--	2.00	2.00	--	--
Feed req./lb gain[2]								
Corn silage	20.43	16.53	19.27	23.93	18.99	15.38	17.01	22.16
Ground ear corn	3.45	3.15	3.48	3.74	3.26	2.99	2.92	3.37
Protein supplement	.67	.62	.68	.73	.64	.58	.57	.66
Hay	1.35	1.24	--	--	1.28	1.17	--	--
Initial type grade[3]	8.0	7.1	7.4	7.9	7.9	7.3	7.1	8.2
Initial condition grade[3]	6.5	6.1	6.1	6.5	6.5	6.0	5.9	6.6

[1]Two animals were sold out of lot 3 in 1965 and one each were sold out of lots 7 in 1965, lot 8 in 1965 and lot 8 in 1967. Also in lot 7, one animal died in 1965.

[2]Calculated on an as-fed basis.

[3]Grades are as follows: 6, 7, 8 - Standard; 9, 10, 11 - Good.

TABLE XXVIII

EFFECTS OF TWO PROTEIN SUPPLEMENTS WITH AND WITHOUT HAY ON PERFORMANCE OF BEEF HEIFERS - THREE YEAR SUMMARY OF CONCENTRATE PHASE

	Urea Base Supplement				Cottonseed Meal			
	With Hay		Without Hay		With Hay		Without Hay	
Lot no.	1	2	3	4	5	6	7	8
No. of animals/lot	22	22	20[1]	22	22	22	20[1]	20[1]
Av. wt and gn./head, lb								
Initial wt	732	651	646	716	749	662	661	720
Final wt	841	756	749	820	850	764	763	813
Total gain	109	105	103	104	101	102	102	93
Av. daily gain	1.89	1.91	1.79	1.81	1.82	1.80	1.79	1.65
Av. daily feed, lb[2]								
Corn silage	1.27	1.24	1.34	1.31	1.24	1.31	1.40	1.31
Ground ear corn	16.76	15.64	16.62	16.83	16.21	15.46	15.78	16.22
Protein supplement	1.00	1.00	1.00	1.00	1.15	1.15	1.15	1.15
Hay	2.01	2.01	--	--	2.01	2.01	--	--
Feed req./lb gain[2]								
Corn silage	.67	.67	.76	.72	.70	.74	.80	.82
Ground ear corn	8.83	8.55	9.48	9.26	9.20	8.72	9.03	10.19
Protein supplement	.52	.54	.57	.54	.65	.65	.65	.73
Hay	1.06	1.09	--	--	1.14	1.13	--	--
Final condition grade[3]	10.3	9.7	9.6	9.8	10.5	9.8	9.7	10.5

[1]Two animals were sold out of lot 3 in 1965 and one each were sold out of lot 7 in 1965, lot 8 in 1965 and lot 8 in 1967. Also in lot 7 one animal died in 1965.

[2]Calculated on an as-fed basis.

[3]Grades are as follows: 6, 7, 8 - Standard; 9, 10, 11 - Good.

TABLE XXIX

EFFECTS OF TWO PROTEIN SUPPLEMENTS WITH AND WITHOUT HAY ON PERFORMANCE OF BEEF HEIFERS - THREE YEAR SUMMARY OF FORAGE AND CONCENTRATE

	Urea Base Supplement				Cottonseed Meal			
	With Hay		Without Hay		With Hay		Without Hay	
Lot NO.	1	2	3	4	5	6	7	8
No. of animals/lot	22	22	20[1]	22	22	22	20[1]	20[1]
Av. wt and gn./head, lb								
Initial wt	567	471	484	564	575	471	468	552
Final wt	841	756	749	820	850	764	763	813
Total gain	274	285	265	256	275	293	295	261
Av. daily gain	1.61	1.68	1.56	1.50	1.62	1.72	1.74	1.53
Av. daily feed, lb[2]								
Corn silage	20.32	17.91	18.83	21.88	19.92	17.71	19.76	22.48
Ground ear corn	9.05	8.65	9.02	9.06	8.85	8.60	8.73	8.86
Protein supplement	1.00	1.00	1.00	1.00	1.05	1.05	1.05	1.05
Hay	2.00	2.00	--	--	2.00	2.00	--	--
Feed req./lb gain[2]								
Corn silage	12.57	10.66	12.11	14.46	12.26	10.27	11.40	14.65
Ground ear corn	5.59	5.15	5.80	5.99	5.44	4.99	5.04	5.77
Protein supplement	.61	.59	.64	.66	.64	.61	.60	.68
Hay	1.23	1.19	--	--	1.23	1.16	--	--
Initial type grade[3]	8.0	7.1	7.4	7.9	7.9	7.3	7.1	8.2
Initial condition grade[3]	6.5	6.1	6.1	6.5	6.5	6.0	6.0	6.6
Final condition grade[3]	10.3	9.7	9.6	9.8	10.5	9.8	9.7	10.5

TABLE XXIX (Cont'd)

	Urea Base Supplement				Cottonseed Meal			
	With Hay		Without Hay		With Hay		Without Hay	
Carcass Information								
USDA grade[3]	10.5	10.1	10.0	9.9	10.3	9.8	9.6	10.1
Hot carcass wt, lb	485	431	427	463	492	437	427	466
Marbling score[4]	5.1	4.5	4.8	4.8	4.7	4.5	4.5	4.8

[1]Two animals were sold out of lot 3 in 1965 and one each were sold out of lot 7 in 1965, lot 8 in 1965 and lot 8 in 1967. Also in lot 7, one animal died in 1965.

[2]Calculated on an as-fed basis.

[3]Grades are as follows: 6, 7, 8 - Standard; 9, 10, 11 - Good.

[4]Marbling scores: 3 - Trace; 4 - Slight.

TABLE XXX

EFFECTS OF TWO PROTEIN SUPPLEMENTS WITH AND WITHOUT HAY ON PERFORMANCE OF BEEF STEERS - CONCENTRATE PHASE (SEPTEMBER 16, 1965 TO DECEMBER 7, 1965 - 82 DAYS)

	Urea Base Supplement				Cottonseed Meal			
	With Hay		Without Hay		With Hay		Without Hay	
Lot No.	1	2	3	4	5	6	7	8
No. of animals/lot	7	7	7	7	7	7	7	7
Av. wt and gn./head, lb								
Initial wt	824	814	813	814	808	820	815	812
Final wt	1014	1026	989	990	1022	1016	994	990
Total gain	190	212	176	176	214	196	179	178
Av. daily gain	2.32	2.59	2.15	2.15	2.61	2.39	2.18	2.17
Av. daily feed, lb[1]								
Ground ear corn	16.93	16.93	16.93	16.93	17.09	17.26	17.12	16.86
Protein supplement	1.00	1.00	1.00	1.00	2.00	2.00	2.00	2.00
Hay	2.00	2.00	--	--	2.00	2.00	--	--
Feed req./lb gain[1]								
Ground ear corn	7.31	6.54	7.88	7.88	6.54	7.22	7.84	7.76
Protein supplement	.86	.79	--	--	.76	.83	.91	.92
Hay	.86	.77	--	--	.76	.83	--	--
Initial type grade[2]	11.1	11.0	11.0	10.9	10.4	10.7	10.7	10.7
Initial condition grade[2]	8.9	9.1	8.9	8.3	8.4	8.7	8.9	8.7
Final condition grade[2]	11.8	11.6	11.7	10.9	11.6	10.6	11.7	11.5
Carcass Information								
USDA grade[2]	11.0	10.7	9.9	10.0	10.1	11.0	10.6	9.9
Hot carcass wt, lb	600	602	580	589	607	597	591	585
Marbling score[3]	4.5	4.1	3.7	4.0	3.9	4.5	4.2	3.8

[1]Calculated on an as fed-basis.
[2]Grades are as follows: 6, 7, 8 - Standard; 9, 10, 11 - Good.
[3]Marbling scores: 3 - Traces; 4 - Slight.

TABLE XXXI

EFFECTS OF TWO PROTEIN SUPPLEMENTS WITH AND WITHOUT HAY ON PERFORMANCE OF BEEF STEERS - CONCENTRATE PHASE (SPETEMBER 2, 1966 TO DECEMBER 13, 1966 - 102 DAYS)

	Urea Base Supplement				Cottonseed Meal			
	With Hay		Without Hay		With Hay		Without Hay	
Lot No.	1	2	3	4	5	6	7	8
No. of animals/lot	7	7	6[1]	7	7	7	7	7
Av. wt and gn./head, lb								
Initial wt	826	714	716	817	714	820	716	821
Final wt	1023	931	924	981	964	1055	926	1008
Total gain	197	217	208	164	250	235	210	187
Av. daily gain	1.93	2.13	2.04	1.61	1.76	2.30	2.06	1.83
Av. daily feed, lb[1]								
Ground ear corn	16.78	16.74	16.70	16.98	16.14	16.14	16.33	16.44
Protein supplement	1.00	1.00	1.00	1.00	2.00	2.00	2.00	2.00
Hay	2.02	2.02	--	--	2.00	2.00	--	--
Feed req./lb gain[2]								
Ground ear corn	8.69	7.51	8.18	11.55	6.58	7.00	7.93	8.96
Protein supplement	.52	.44	.49	.62	.81	.86	.97	1.09
Hay	1.05	.90	--	--	.81	.86	--	--
Initial type grade[3]	10.4	9.6	9.8	10.3	9.7	10.4	9.7	10.6
Initial condition grade[3]	8.0	7.6	7.3	7.9	7.4	7.9	7.6	8.1
Final condition grade[3]	11.0	11.6	11.8	9.0	11.4	10.9	10.7	10.3
Carcass Information								
USDA grade[3]	11.1	10.1	9.5	10.6	10.0	10.0	10.1	10.6
Hot carcass wt, lb	603	528	526	572	553	622	531	581
Marbling score[4]	4.5	3.9	3.6	4.2	3.9	4.0	3.9	4.1

[1]One animal was sold in lot 3.

[2]Calculated on an as-fed basis.

[3]Grades are as follows: 6, 7, 8 - Standard; 9, 10, 11 - Good.

[4]Marbling scores: 3 - Traces; 4 - Slight.

TABLE XXXII

EFFECTS OF TWO PROTEIN SUPPLEMENTS WITH AND WITHOUT HAY ON PERFORMANCE OF BEEF STEERS - CONCENTRATE PHASE (SEPTEMBER 12, 1967 TO DECEMBER 12, 1967 - 91 DAYS)

	Urea Base Supplement				Cottonseed Meal			
	With Hay		Without Hay		With Hay		Without Hay	
Lot No.	1	2	3	4	5	6	7	8
No. of animals/lot	7	7	7	7	7	6[1]	7	7
Av. wt and gn./head, lb								
Initial wt	803	832	809	827	820	826	814	808
Final wt	984	998	945	959	1025	1028	961	979
Total gain	181	166	136	132	205	202	147	979
Av. daily gain	1.95	1.83	1.48	1.45	2.26	2.23	1.62	1.88
Av. daily feed, lb[2]								
Ground ear corn	15.53	15.34	15.34	14.89	15.50	15.68	15.64	15.75
Protein supplement	1.00	1.00	1.00	1.00	1.99	1.99	1.98	1.98
Hay	1.98	1.98	--	--	1.98	1.98	--	--
Feed req./lb gain[2]								
Ground ear corn	7.80	8.45	10.32	10.26	6.88	7.06	9.68	8.37
Protein supplement	.50	.54	.66	.69	.88	.89	1.22	1.05
Hay	.99	1.08	--	--	.87	.89	--	--
Initial type grade[3]	10.6	10.4	10.4	10.0	10.4	10.5	10.4	10.4
Initial condition grade[3]	8.6	8.4	8.6	8.1	8.4	8.4	8.4	8.4
Final condition grade[3]	10.9	10.4	9.7	9.7	10.6	10.6	10.1	10.3
Carcass Information								
USDA grade[3]	10.6	9.7	9.6	9.6	9.7	10.5	10.3	9.9
Hot carcass wt, lb	560	574	543	542	584	585	552	563
Marbling score[4]	3.9	3.6	3.4	3.6	3.8	4.1	3.8	3.8

[1]One animal died in lot 6.

[2]Calculated on an as-fed basis.

[3]Grades are as follows: 6, 7, 8 - Standard; 9, 10, 11 - Good.

[4]Marbling scores: 3 - Traces; 4 - Slight.

TABLE XXXIII

EFFECTS OF TWO PROTEIN SUPPLEMENTS WITH AND WITHOUT HAY ON PERFORMANCE OF BEEF STEERS - THREE YEAR SUMMARY

	Urea Base Supplement				Cottonseed Meal			
	With Hay		Without Hay		With Hay		Without Hay	
Lot NO.	1	2	3	4	5	6	7	8
No. of animals/lot	21	21	20[1]	21	21	20[1]	21	21
Av. wt and gn./head, lb								
Initial wt	818	787	782	819	781	822	781	813
Final wt	1007	989	954	976	1004	1033	960	992
Total gain	189	202	172	157	223	211	179	179
Av. daily gain	2.02	2.16	1.85	1.68	2.39	2.30	1.92	1.92
Av. daily feed, lb[2]								
Ground ear corn	16.11	16.06	16.01	15.97	15.91	16.35	16.04	16.04
Protein supplement	.98	.98	.99	.98	1.96	2.00	1.96	1.96
Hay	1.96	1.96	--	--	1.96	1.99	--	--
Feed req./lb gain[2]								
Ground ear corn	7.95	7.43	8.67	9.48	6.66	7.09	8.38	8.38
Protein supplement	.48	.45	.53	.58	.82	.87	1.02	1.02
Hay	1.96	1.96	--	--	.82	.86	--	--
Initial type grade[3]	10.7	11.3	10.5	10.4	10.2	10.6	10.3	10.6
Initial condition grade[3]	8.5	8.4	8.3	8.1	8.1	8.3	8.3	8.4
Final condition grade[3]	11.2	11.2	11.1	9.9	11.2	11.1	10.9	10.7
Carcass Information								
USDA grade[3]	10.9	10.2	9.7	10.1	10.0	10.6	10.3	10.1
Hot carcass wt, lb	587	568	551	568	581	602	558	576
Marbling score[4]	4.3	3.9	3.6	3.9	3.9	4.2	3.9	3.9

TABLE XXXIII (Cont'd)

[1]One animal each were sold out of lot 7 in 1966 and lot 6 in 1967.
[2]Calculated on an as-fed basis.
[3]Grades are as follows: 6, 7, 8 - Standard; 9, 10, 11 - Good.
[4]Marbling scores: 3 - Traces; 4 - Slight.

VITA

James Luther Giffin was born in Maryville, Tennessee, on April 28, 1948. He attended elementary and high school in Friendsville, Tennessee and graduated from Friendsville High School in 1966. He enrolled at Hiwassee College in Madisonville, Tennessee in September, 1966, and received an Associate of Arts degree in Agriculture in 1968. In June, 1968, he entered The University of Tennessee and received a Bachelor of Science degree in Animal Husbandry in December, 1970. He worked for Knox-Farmers Cooperative from 1971 to 1972. He entered the Graduate School at The University of Tennessee in September, 1972. He received the Master of Science degree in Animal Husbandry in December, 1973.