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To the Graduate Council:

I am submitting herewith a thesis written by Rodger P. Pile entitled "The Comparative Feeding Value of Lindsey 77, Alfalfa, and Corn Silage for Finishing Beef Heifers." 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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THE COMPARATIVE FEEDING VALUE OF LINDSEY 77, ALFALFA, AND CORN SILAGE FOR FINISHING BEEF HEIFERS

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

Rodger P. Pile

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ABSTRACT

Data collected on 120 Angus heifers at the Middle Tennessee Experiment Station, Spring Hill, Tennessee, were used to determine the comparative value of hybrid-grass (Lindsey 77), alfalfa and corn silage for finishing beef heifers for slaughter. The heifers were fed a ration of either Lindsey 77, alfalfa or corn silage ad lib. plus limited concentrates for 119 days in Trial I, conducted during the winter of 1966-67, and for 56 days in Trial II conducted during the summer of 1967. The heifers in Trial I were changed to a full-feed of concentrates plus a limited amount of the same silage fed during the previous phase for an additional 50 days. In Trial II, the heifers were changed to a full-feed of concentrates plus limited corn silage for 47 days following the 56-day period of corn silage full-fed.

Average daily gains in Trial I were 1.35, 1.60 and 1.73 pounds per head per day during the silage phase and 1.51, 1.50 and 1.58 during the full-feed phase for heifers fed Lindsey 77, alfalfa and corn silage, respectively. In Trial II, average daily gains of the heifers fed Lindsey 77, alfalfa and corn silage were 1.53, 2.07 and 1.67 pounds per head per day during the silage phase and 2.25, 2.20 and 2.15 pounds per head per day during the full-feed period. Heifers fed corn silage gained significantly faster ($P < .05$) than those fed alfalfa or Lindsey 77 silage during the winter trial. However, during the summer trial, heifers fed alfalfa silage gained significantly ($P < .05$) faster than those fed the other two silages.

Feed costs per hundred pounds of gain for heifers fed Lindsey 77, alfalfa and corn silage during Trial I were $27.40, $24.82 and $23.62, respectively, and $21.88, $19.61 and $21.81, respectively, during Trial II. Average return per head above feed and initial cost was highest from heifers fed corn silage in Trial I and highest from heifers fed alfalfa silage in Trial II.

These data indicated that these silages, when fed with a limited amount of concentrates followed by a short full-feed period, could be used profitably for finishing beef heifers. The season of year (winter or summer) may affect the results obtained from corn silage. This could be a result of severe heating and spoilage of corn silage in the feed bunk, which was observed during the summer feeding trial. The lower rate of gain and higher feed requirement per unit of gain of heifer fed Lindsey 77 silage in both trials indicated that this type of silage was less desirable as a component of a finishing ration for beef heifers than either alfalfa or corn silage.

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CHAPTER I

INTRODUCTION

During the last twenty years, corn silage has been the basic ingredient of rations used by Tennessee feeders to finish steers and heifers for slaughter. Recent interest in systems of double cropping in forage production has focused attention on various crops other than corn for silage. Hybrid grass, such Lindsey 77, is adapted to an intensified cropping system. Therefore, many beef producers and feeders have considered its use as a silage crop.

Alfalfa has been one of the major forage crops used for hay production in Tennessee for several years. Adverse weather conditions in April and May, generally, makes harvesting difficult and uncertain. With improved silage harvesting equipment, interest has increased in harvesting the first cutting of alfalfa for silage.

In past experiments, corn silage utilization has been investigated but only a small amount of information is available with respect to the feeding value of hybrid-grass or alfalfa silage. The objective of this study was to determine the comparative feeding value of alfalfa, hybrid grass (Lindsey 77) and corn silages, fed during various seasons of the year, for finishing beef heifers for slaughter.

CHAPTER II

LITERATURE REVIEW

Weanling heifers were fed rations of corn silage and ground shelled corn in the ratios of 1:5 and 1:1 by Richardson et al. (1961). They found that the highest average daily gain was made by the steers fed the 1:5 ration and lowest by those fed the 1:1 ration. They suggested that beef cattle can be fattened economically on large quantities of roughage. Steers fed corn silage at the rate of 80 to 90 percent of their dry matter (DM) intake plus limited amounts of cottonseed meal (Hammes et al., 1964) gained slower than those fed a high grain fattening ration. However, these differences were not significant. Steers and heifers were fed similar total amounts of ground shelled corn at varying rates throughout the finishing period by Young, Branaman, and Deans (1962). They found that delaying the feeding of corn for 98 days, followed by a full feeding period, did not alter the total gain of the animals. Good, Choice and Medium steers and heifers gained an average of 1.83 pounds per head per day during the fifth 28-day period (last weight interval) on a feeding program of silage and limited concentrates (Anderson, High, and Chapman, 1964). During the subsequent 49-day full-feed period, these cattle averaged 1.81 pounds per head per day.

Hall and Felts (1963) reported that heifers fed corn silage, free-choice, 3.8 pounds of ground ear corn and 1.1 pounds of cottonseed meal per head daily gained 1.67 pounds per head daily while

heifers fed the same concentrates plus sorghum silage ad lib. gained 1.57 pounds per head daily. Similar heifers fed alfalfa silage, ad lib., plus four pounds of ground ear corn and one pound of cottonseed meal gained 1.53 pounds per head daily. Woods and Winger (1961) reported that steer calves full-fed wilted alfalfa-brome silage supplemented with three pounds of shelled corn per head per day gained at the rate of 2.03 pounds per day. Steers fed alfalfa-orchardgrass silage ad lib. plus eight pounds of ground ear corn by Hammes et al.(1964) gained 1.70 pounds per head daily while those fed corn silage ad lib. plus two pounds of cottonseed meal gained 1.87 pounds per head daily. When fed alone, grass silages produced poor feedlot performance. Steers fed only grass silage gained 1.09 pounds per head daily. However, performance was increased when this silage was supplemented with eight pounds of ground ear corn. Rate of gain of the steers fed corn silage as 100 percent of their forage dry matter intake plus limited amounts of cottonseed meal was lower (1.87 pounds per head daily) than for those fed a conventional high-grain fattening ration (2.02 pounds per head daily) but the difference was not significant ($P < .05$). Wilson, Hall, and Hobbs (1964) fed corn and alfalfa silage ad lib. supplemented with one pound of cottonseed meal to steers and obtained gains of 1.27 and 1.08 pounds per head per day, respectively. The difference in gains was not statistically significant ($P < .10$). In a later trial, steers fed the same ration gained 1.50 and 0.87 pounds per head daily when fed corn and alfalfa silage, respectively. These differences were significantly different at the 1 percent level of probability. Anderson, High, and Chapman (1968) reported average daily gains of 1.74 pounds for

heifers fed corn silage and limited concentrates for 140 days and 1.64 pounds per head per day during the subsequent 56-day full feed of concentrates. In a further study, Hammes et al. (1968) found that feedlot performance of beef steers was not substantially altered by substituting alfalfa-orchardgrass silage for 20 percent of the corn silage dry matter. In this study, cattle fed the high-grain ration tended to gain faster (1.23 Kg. per head daily) than those fed corn silage plus cottonseed meal (1.17 Kg. per head daily) but the difference was not significant ($P < .05$).

In four experiments conducted by Canton and Matsuskima (1960), the basal ration for beef steers was alfalfa silage full fed. They found that alfalfa silage alone did not produce satisfactory results (0.16 pounds per head daily). The limiting factor was silage intake. When small amounts of alfalfa hay, corn, or corn plus prairie hay were fed, the steers gained 0.9 to 1.3 pounds per head daily. According to Miller et al. (1957) steers fed three pounds of concentrates consumed an average of 20.4 pounds of corn silage compared to 28.9 pounds of grass silage per head daily. Average daily gains of the steers fed the two rations were 1.24 and 1.13 pounds, respectively.

Montgomery, Bearden, and Plummer (1966) compared alfalfa, corn and Lindsey 77 silage for dairy cows. Average milk production was 45.2, 41.3 and 42.7 pounds of fat corrected milk per head per day and average daily gain was 0.83, 0.49 and 0.97 pounds per day for the three silages, respectively. Corn and Lindsey 77 silage resulted in significantly lower ($P < .05$) FCM production when compared to alfalfa but there was no significant difference ($P < .05$) in body weight change.

Dry matter (DM) content of alfalfa and corn silage was higher than Lindsey 77 silage (37.1, 34.3 and 25.0 percent, respectively). Crude protein content of alfalfa was higher than corn or Lindsey 77 silage (16.3, 6.9 and 9.2 percent, respectively). Crude fiber percentages were 36.5, 27.3 and 39.9 for alfalfa, corn and Lindsey 77 silage, respectively. They suggested that the dry matter content of corn silage was lowest due to its higher grain content. Cows fed alfalfa silage produced significantly more milk per day than cows consuming either of the other two forages. Milk production was positively correlated with daily dry matter intake. Forage intake on an as-feed basis was significantly higher for alfalfa silage. The dry matter intake of alfalfa, corn, Lindsey 77 silage was 2.19, 1.64 and 1.54 percent of body weight, respectively.

As a general rule, high quality grass silage or grass-legume silage contained more digestible protein than corn silage. However, good corn silage, due to its content of grain, contain more digestible calories than grass silage. Hammes et al. (1968) reported higher daily gain for cattle fed a high-grain ration than for those fed corn silage plus cottonseed meal but the difference was not significant ($P < .05$). Intake of DM and total digestible nutrients (TDN) were consistently higher ($P < .05$) for the high-grain ration. Feed efficiency was slightly lower for the high-grain fed cattle when expressed as TDN required per kilo of gain. Miller et al. (1957) found that more grass silage than corn silage was required to produce 100 pounds of gain in steers. Total dry matter required per 100 pounds of gain was 441 pounds of corn silage and 776 pounds of grass silage. On this basis, one pound of DM in corn

silage was equal to 1.76 pounds of DM in grass silage. Average daily DM intake of steers fed alfalfa silage alone was 8.3 pounds compared to 13.3 pounds by those fed alfalfa silage ad lib. plus limited concentrates (Clanton and Matsuskima, 1960). Feed efficiency, expressed as pounds of DM or TDN per pound of gain (Hammes et al., 1964) was highest when steers were fed corn silage as the only forage, or corn silage as 80 to 100 percent of the forage dry matter plus limited protein supplement. Burroughs et al. (1964) reported that 21 percent less TDN per pound of gain was required by weanling calves fed a high corn silage ration than by those fed on all-concentrate ration and 16 percent less than for those receiving one-half full-feed of concentrates during a 182-day finishing period.

CHAPTER III

EXPERIMENTAL PROCEDURE

I. EXPERIMENTAL ANIMALS

Sixty Angus heifers were fed at the Middle Tennessee Experiment Station during the fall and winter of 1966-67 (Trial I). Another group of 60 heifers were fed during the spring and summer of 1967 (Trial II). These heifers were purchased at graded feeder calf sales in the Middle Tennessee area.

Following purchase, the heifers were allowed a two to three week adjustment period prior to the experimental period. They were grazed and/or fed roughage in one group during this adjustment period. The heifers, weighing 500 to 600 pounds and grading Good, were divided into 12 comparable groups of 5 head each on the basis of condition grade and body weight.

In Trial I, four groups of heifers were fed hybrid grass silage (Lindsey 77) ad lib., four groups were fed alfalfa silage ad lib. and four groups were fed corn silage ad lib. for 119 days. All groups received six pounds of concentrates (ground shelled corn and cottonseed meal necessary to balance the ration with respect to protein) and three pounds of alfalfa-grass hay per head per day. After 119 days of full-feeding silage (high silage phase), the amount of silage being fed was gradually reduced and the amount of concentrates increased until the heifers were receiving a full-feed of concentrates (7:1 corn-cottonseed

meal mixture), three pounds of alfalfa-grass hay and about eight to ten pounds of the same silage that had been fed during the silage phase. The period of concentrates full-fed with limited silage was continued for 50 days in Trial I. In order to simplify terminology, the two feeding regimes described above will subsequently be referred to as the silage and full-feed phase, respectively.

In Trial II, 60 heifers were allotted to the three treatments as described for Trial I. The heifers were fed the high silage ration for 56 days and were full fed for 47 days. The supply of Lindsey 77 silage was exhausted during the silage phase of Trial II and during the full-feed phase all groups were fed eight to ten pounds of corn silage per head per day.

In Trial I, the heifers were started on experimental feed October 17, 1966, and the experiment was terminated on April 14, 1967. Trial II was started on June 26 and terminated October 10, 1967. All heifers were marketed as soon as they were weighed off the experiment. Water, salt, and a mineral mixture (2 parts dicalcium phosphate and 1 part salt) were accessible at all times.

An average of two weights taken on consecutive days was used as the beginning and end weight for each experimental period. The heifers were also weighed at 28-day intervals throughout the experiment. All heifers were graded by at least two qualified graders at the beginning and end of each phase. Numerical codes used in analyzing grade differences between the groups are shown in Table I. At the end of the full-feed phase, the cattle were marketed at a packing plant in the Middle Tennessee area where carcass information was obtained.

TABLE 1. Numerical code for various conformation and condition grades

Numerical code	Type grade	Condition grade
7	Av. Medium	Av. Standard
10	Av. Good	Av. Good
13	Av. Choice	Av. Choice

After about 24 to 48 hours in the cooler, the carcasses were ribbed and U.S.D.A. grades were obtained. Tracings were made of each loin eye at the 12th rib, fat thickness was measured at the 12th rib, hot carcass weight, carcass length, marbling score, and an estimate of the percent kidney fat were obtained on each carcass.

II. FACILITIES

The experimental animals were fed in pole-type barns open to either the east or south with the west and north side of each barn completely walled. About one-half of each pen was outside with concrete floors which were scraped periodically with a tractor and blade. The covered portion of the pens had plain soil floors and were bedded with straw to provide a resting area. The fences in the barns were constructed of steel cables to allow maximum air movement through each pen.

III. FEED AND CATTLE PRICES

The feed prices used to compute cost at gain are shown in Table 2. These prices are approximately the cost of each ingredient during the two years of this experiment. The prices of various feed ingredients will vary from year to year or even from day to day. However feed cost per pound of gain can be computed by multiplying current or applicable prices per pound of each ingredient times the amount of each ingredient required per pound of gain.

The initial value per hundredweight was based on the average price paid for Angus feeder heifers of this weight and grade at all

TABLE 2. Feed prices used to compute cost of gain in both trials

Feed	Cost
Corn silage/ton	$ 8.00
Alfalfa silage/ton	8.00
Lindsey 77 silage/ton	8.00
C.S.M./ton	90.00
Alfalfa-grass hay/ton	35.00
Shelled corn/bu.	1.55

of the Tennessee feeder calf sales in the Fall of 1966 and in the Spring of 1967. These values were $23.50 and $24.00 per hundredweight for Trial I and II, respectively.

Initial value was based on the state average price to provide a more realistic evaluation than would have resulted from the use of actual cost at the sales where the cattle were purchased. The cattle were sold on grade and yield basis and individual selling price was computed on the basis of live weight at the packing plant.

IV. STATISTICAL PROCEDURE

Difference between means for various performance traits were analyzed by methods outlined by Steele and Torrie (1960) for analysis of data with subsamples within the experimental units. The variation among animals in lots treated alike (experimental error) was considered the appropriate error term for testing differences among treatment means.

Treatment (type of silage) effects were considered fixed. The individual errors associated with the experimental and sampling error were considered normally and independently distributed with zero mean variance σ_e^2 and σ^2, respectively.

CHAPTER IV

RESULTS AND DISCUSSION

I. TRIAL I

Four lots of five Angus heifers were fed each of the following silage rations: (1) hybrid-grass, (2) alfalfa or (3) corn silage ad lib., six pounds of concentrates (ground shelled corn and cotton-seed meal necessary to balance the ration with respect to protein) and three pounds of alfalfa-grass hay for a period of 119 days. This silage phase was followed by a 50-day full-feed phase. The data collected in each period (silage and full-feed) were analyzed separately and combined (overall experiment) to determine the relative performance of beef heifers fed the different silages.

Silage Phase

The heifers fed Lindsey 77 silage gained 1.35 pounds per head per day compared to 1.73 pounds per head per day for those fed corn silage and 1.60 pounds for those fed alfalfa silage. These gains were significantly different ($P < .05$) as shown in Table 3. This was similar to the results reported by Hall and Felts (1963).

The heifers consumed more corn silage (31.8 pounds per head per day) than alfalfa (30.7 pounds) or Lindsey 77 silage (29.1 pounds) on an as-fed basis. However, in terms of dry matter, this trend was reversed with 9.2, 11.8 and 15.4 pounds of dry matter consumed by the heifers fed corn, Lindsey 77 and alfalfa silage, respectively. The

TABLE 3. Feed consumption and requirements of yearling beef heifers fed Lindsey 77, alfalfa and corn silage during the roughage phase (Trial I)

	Lindsey 77 silage	Alfalfa silage	Corn silage
Number of animals	20	20	20
Days on feed	119	119	119
Avg. daily feed, lb./hd.			
Shelled corn	6.3	6.3	4.8
Cottonseed meal			1.1
Lindsey 77 silage[a]	29.1 (11.8)		
Alfalfa silage[a]		30.7 (15.4)	
Corn silage[a]			31.8 (9.2)
Alfalfa-grass hay	3.0	3.0	3.0
Total feed consumed, lb./hd.			
Shelled corn	752	752	632
Cottonseed meal			
Lindsey 77 silage[a]	3463 (1400)		
Alfalfa silage[a]		3657 (1832)	
Corn silage[a]			3781 (1099)
Alfalfa-grass hay	360	360	360
Gain/head, lb.			
Total gain	161[b]	191[c]	206[c]
Daily gain	1.35[b]	1.60[c]	1.73[c]
Feed requirement/cwt. gain, lb.			
Shelled corn	468	393	274
Cottonseed meal			
Lindsey 77 silage[a]	2156 (872)		
Alfalfa silage[a]		1916 (960)	
Corn silage[a]			1834 (533)
Alfalfa-grass hay	244	187	175
Feed cost/cwt. gain[d]	25.10	21.48	20.64

[a]First number designates lb. silage as fed, number in parenthesis represents lb. of dry matter.

[b,c]Means in this line not superscripted with the same letter are significantly different ($P < .05$).

[d]Feed prices are shown in Table 1.

heifers fed Lindsey 77 silage required more shelled corn, silage and hay per unit of gain than those fed either alfalfa or corn silage. Likewise, the heifers fed alfalfa silage required more feed per unit of gain than those fed corn silage.

Feed cost per hundred pounds of gain was $4.46 greater for the heifers fed Lindsey 77 silage than for those fed corn silage and $3.62 greater than for those fed alfalfa silage. Feed costs were $25.10, $21.48 and $20.64 per hundred pounds of gain for the heifers fed Lindsey 77, alfalfa and corn silage, respectively.

Full-feed Phase

Following the 119-day silage phase, the heifers were full-fed concentrates plus a limited amount of the same silage they had received during the silage phase for 50 days. Results of the full-feed phase are shown in Table 4. The heifers fed Lindsey 77, alfalfa and corn silage gained 1.51, 1.50 and 1.58 pounds per head per day, respectively, during the full-feed phase. Feed costs per hundred pounds of gain was higher for each group during the full-feed phase than during the silage phase. These costs were $32.28, $33.37 and $31.43 for the heifers fed the three silages, respectively.

Overall Performance

When the entire 169 day finishing period was considered, the heifers fed corn silage gained significantly ($P < .05$) faster than those fed either Lindsey 77 or alfalfa silage. Heifers fed alfalfa silage gained faster ($P < .05$) than those fed Lindsey 77 silage. Average daily gain was 1.40, 1.57 and 1.69 pounds per head per day for heifers

TABLE 4. Feed consumption and requirements of yearling heifers fed Lindsey 77, alfalfa and corn silage during the full feed phase (Trial I)

	Lindsey 77 silage	Alfalfa silage	Corn silage
Number of animals	20	20	20
Days in period	50	50	50
Avg. daily feed, lb./hd.			
Shelled corn	12.6	12.6	12.6
Cottonseed meal	1.3	1.3	1.3
Lindsey 77 silage	8.3 (4.6)		
Alfalfa silage		10.5 (4.0)	
Corn silage			10.1 (2.7)
Alfalfa-grass hay	3.0	3.0	3.0
Total feed consumed, lb./hd.			
Shelled corn	632	632	632
Lindsey 77 silage[a]	398 (231)		
Alfalfa silage[a]		527 (200)	
Corn silage[a]			506 (137)
Alfalfa-grass hay	150	150	150
Gain/head, lb.			
Total gain[b]	75	75	79
Daily gain[b]	1.51	1.50	1.58
Feed required/cwt. gain, lb.			
Shelled corn	837	847	801
Cottonseed meal	84	85	80
Lindsey 77 silage[a]	532 (306)		
Alfalfa silage[a]		706 (268)	
Corn silage[a]			640 (154)
Alfalfa-grass hay	198	201	190
Feed cost/cwt. gain[c]	32.28	33.37	31.43

[a]First number designates lb. silage as fed, number in parenthesis represents lb. of dry matter.

[b]Differences were not statistically significant ($P < .05$).

[c]Feed prices are shown in Table 1.

fed Lindsey 77, alfalfa and corn silage, respectively (Table 5). The heifers fed alfalfa and corn silage were fatter ($P < .05$) than those fed Lindsey 77 silage. The final condition grades of the heifers fed Lindsey 77, alfalfa and corn silage were 11.3, 11.8 and 12.0, respectively.

Feed cost per hundred pounds of gain for heifers fed Lindsey 77 silage was $3.78 higher than for those fed corn silage and $2.58 higher than for those fed alfalfa silage. Returns per head above feed and initial cost were $22.78, $15.82 and $8.48 for corn, alfalfa and Lindsey 77 silage, respectively. These differences indicate a definite advantage in favor of corn silage over alfalfa and Lindsey 77 silage during the winter finishing period.

Carcass Data

The heifers fed alfalfa and corn silage were heavier ($P < .05$) at slaughter than those fed Lindsey 77 silage. Therefore, carcasses of the heifers fed alfalfa and corn silage were heavier ($P < .05$) than carcasses of those fed Lindsey 77 silage. Average carcass weights of the heifers fed Lindsey 77, alfalfa and corn silage were 489, 517 and 518 pounds, respectively. Dressing percent, marbling score, fat thickness, loin eye area and percent kidney fat were similar for the three groups.

II. TRIAL II

In Trial II the same rations used in Trial I were compared during the summer. The Lindsey 77 and corn silage used in Trial II was from the same silo as that used in Trial I. However, the alfalfa

TABLE 5. Performance of yearling heifers fed Lindsey 77, alfalfa and corn silages (Trial I)

	Lindsey 77 silage	Alfalfa silage	Corn silage
Number of animals	20	20	20
Days on feed	169	169	169
Avg. wt. and gain/hd., lb.			
Initial wt.[a]	610	607	598
Final wt.	846[b]	872[c]	883[c]
Total gain	236[b]	266[c]	258[c]
Daily gain	1.40[b]	1.57[c]	1.69[d]
Grades[e]			
Initial type[a]	9.4	9.3	9.4
Initial condition[a]	8.2	8.0	8.0
Final condition	11.3[b]	11.8[c]	12.0[c]
Carcass, USDA[a]	11.8	12.1	11.9
Carcass data			
Hot carcass wt., lb.	489[b]	517[c]	518[c]
Dressing percent[a]	58.7	59.8	59.2
Marbling score[a,f]	5.2	5.4	5.2
Fat thickness, mm.[a]	9.9	9.8	9.3
Loin eye area/cwt., sq. in.[a]	1.04	1.14	1.10
Percent kidney fat	2.50	2.33	2.60
Financial information, $			
Feed cost/cwt., gain	27.40	24.82	23.62
Selling price per cwt.	25.23[b]	25.39[b,c]	25.78[c]
Return/hd. above feed and initial cost[g]	8.48	15.82	22.78

[a]Means in this line were not significantly different ($P < .05$).

[b,c,d]Means in this line not superscripted with same letter are significantly different ($P < .05$).

[e]Avg. good = 10, High good = 11, Low choice = 12, Avg. choice = 13.

[f]Trace = 3, slight = 4, small = 5, modest = 6.

[g]Feed prices are shown in Table 1.

silage used during the last one-half of Trial II was new silage harvested during the spring of 1967. The supply of Lindsey 77 silage was exhausted at the end of the silage phase and all groups were fed a limited amount of corn silage during the full-feed phase.

Silage Phase

Average daily gain of the heifers fed corn and Lindsey 77 silage during Trial II were similar to those in Trial I. However, the average daily gain of heifers fed alfalfa silage was higher than during Trial I.

Average daily gain of the heifers fed Lindsey 77, alfalfa and corn silage was 1.53, 2.07 and 1.67 pounds per head per day. As shown in Table 6, the heifers fed alfalfa silage gained significantly faster ($P < .05$) than those fed either Lindsey 77 or corn silage. The rate of gain of heifers fed corn silage was higher ($P < .05$) than those fed Lindsey 77.

Heifers fed alfalfa and corn silage consumed more silage on an as-fed and dry matter basis than those fed Lindsey 77 silage. Average daily consumption of the three silages was 30.0, 29.7 and 25.8 pounds per head, respectively. The heifers fed Lindsey 77 silage required more shelled corn and hay per hundred pounds of gain than those fed alfalfa or corn silage. Heifers fed corn silage required more silage than those fed alfalfa or Lindsey 77 silage. Feed cost per hundred pounds of gain was lowest for the heifers fed alfalfa silage and highest for those fed Lindsey 77 silage. Feed costs were $22.08, $17.11 and $20.73 for heifers fed Lindsey 77, alfalfa and corn silage, respectively.

TABLE 6. Feed consumption and requirements of yearling beef heifers fed Lindsey 77, alfalfa and corn silage during the roughage phase (Trial II)

	Lindsey 77 silage	Alfalfa silage	Corn silage
Number of animals	20	20	20
Days on feed	56	56	56
Avg. daily feed, lb./hd.			
Shelled corn	7.0	7.0	6.0
Cottonseed meal			1.0
Lindsey 77 silage	25.8		
Alfalfa silage		30.0	
Corn silage			29.7
Alfalfa-grass hay	2.9	2.9	2.9
Total feed consumed/hd., lb.			
Shelled corn	393	393	336
Cottonseed meal			56
Lindsey 77 silage	1447		
Alfalfa silage		1680	
Corn silage			1663
Alfalfa-grass hay	144	144	144
Gain/head, lb.			
Total gain	86	116	101
Daily gain	1.53[a]	2.07[b]	1.67[c]
Feed required/cwt. gain, lb.			
Shelled corn	459	339	333
Cottonseed meal			60
Lindsey 77 silage	1690		
Alfalfa silage		1449	
Corn silage			1778
Alfalfa-grass hay	193	142	176
Feed cost/cwt. gain, $[d]	22.08	17.11	20.73

[a,b,c]Means in this line not superscripted with the same letter are significantly different ($P < .05$).

[d]Feed prices are shown in Table 1.

Full-feed Phase

Following the 56-day silage phase the heifers were full-fed concentrates with limited corn silage for 47 days. Results of this full-feed phase are presented in Table 7.

Average daily gains of the heifers fed the various silages during the earlier silage were not significantly different ($P < .05$) during the full-feed phase. The average daily gains were 2.25, 2.20 and 2.15 for the heifers which had previously been fed Lindsey 77, alfalfa and corn silage, respectively. Average daily feed consumption and feed required per hundred pounds of gain were similar for the three groups. Feed cost per hundred gain was $21.73, $22.40 and $22.80, respectively, for the three groups.

Overall Performance

Animal performance during the entire 103-day finishing period is presented in Table 8. Average daily gain was 1.86, 2.13 and 1.89 for the heifers fed Lindsey 77, alfalfa and corn silage, respectively. The heifers fed alfalfa silage gained significantly faster ($P < .05$) than those fed corn or Lindsey 77 silage.

Final condition grade, carcass grade, dressing percent, marbling score, fat thickness at the 12th rib, and loin eye area were similar for the three groups. The heifers fed alfalfa were heavier ($P < .05$) and the carcasses of these heifers were heavier than those fed corn or Lindsey 77 silage.

Feed cost per hundred pounds of gain during the entire 103-day finishing period was $21.88, $19.61 and $21.81 for heifers fed

TABLE 7. Feed consumption and requirements of yearling heifers fed Lindsey 77, alfalfa and corn silage during the full-feed phase (Trial II)

	Lindsey 77 silage	Alfalfa silage	Corn silage
Number of animals	20	20	20
Days in period	47	47	47
Avg. daily feed, lb./hd.			
Shelled corn	11.7	11.8	11.8
Cottonseed meal	1.7	1.7	1.7
Corn silage	15.8	15.9	16.0
Alfalfa-grass hay	3.1	3.1	3.1
Total feed consumed/hd., lb.			
Shelled corn	549	554	551
Cottonseed meal	78	79	79
Corn silage	742	747	751
Alfalfa-grass hay	144	144	144
Gain/head, lb.			
Total gain	106	103	101
Daily gain[a]	2.25	2.20	2.15
Feed required/cwt. gain, lb.			
Shelled corn	519	536	544
Cottonseed meal	74	77	78
Corn silage	703	723	742
Alfalfa-grass hay	136	139	142
Feed cost/cwt. gain, $[b]	21.73	22.40	22.80

[a]Means in this line were not significantly different ($P < .05$).

[b]Feed prices are shown in Table 1.

TABLE 8. Performance of yearling beef heifers fed Lindsey 77, alfalfa and corn silage (Trial II)

	Lindsey 77 silage	Alfalfa silage	Corn silage
Number of animals	20	20	20
Days on feed	103	103	103
Avg. wt. and gain/hd., lb.			
Initial wt.[a]	562	566	569
Final wt.	753[b]	785[c]	764[b]
Total gain	191[b]	219[c]	195[b]
Daily gain	1.86[b]	2.13[c]	1.89[b]
Grades[d]			
Initial type[a]	9.2	9.1	9.4
Initial condition[a]	7.4	7.1	7.2
Condition, end of roughage	9.2[b]	10.2[c]	9.4[b]
Final condition[a]	11.6	11.7	12.2
Carcass, USDA[a]	10.8	10.8	11.0
Carcass data			
Hot carcass wt., lb.	417[b]	444[c]	428[b]
Dressing percent[a]	56.9	57.6	57.6
Marbling score[a,e]	4.4	4.6	4.5
Fat thickness, mm.[a]	9.4	10.4	10.4
Loin eye area/cwt., sq. in.[a]	2.56	2.50	2.58
Percent kidney fat	1.94[b]	2.12[c]	1.85[b]
Financial information, $			
Feed cost/cwt. gain[f]	21.88	19.61	21.81
Selling price/cwt.[a]	23.95	24.15	24.10
Return above initial and feed cost	9.29	16.45	10.72

[a]Means in this line were not significantly different ($P < .05$).

[b,c]Means in this line not superscripted with same letter are significantly different ($P < .05$).

[d]Avg. good = 10, High good = 11, Low choice = 12, Avg. choice = 13.

[e]Trace = 3, slight = 4, small = 5, modest = 6.

[f]Feed prices are shown in Table 1.

Lindsey 77, alfalfa and corn silage, respectively. Selling price per pound of liveweight was similar for the three groups. Average return per head above initial and feed costs was $9.29, $16.45 and $10.72 for heifers fed Lindsey 77, alfalfa and corn silage, respectively.

CHAPTER V

SUMMARY

Data collected on 120 Angus heifers at the Middle Tennessee Experiment Station, Spring Hill, Tennessee, were used to determine the comparative value of hybrid-grass (Lindsey 77), alfalfa and corn silage for finishing beef heifers for slaughter. The heifers were fed a ration of either Lindsey 77, alfalfa or corn silage ad lib. plus limited concentrates for 119 days in Trial I, conducted during the winter of 1966-67, and for 56 days in Trial II conducted during the summer of 1967. The heifers in Trial I were changed to a full-feed of concentrates plus a limited amount of the same silage fed during the previous phase for an additional 50 days. In Trial II, the heifers were changed to a full-feed of concentrates plus limited corn silage for 47 days following the 56-day period of silage full-fed.

Average daily gains in Trial I were 1.35, 1.60 and 1.73 pounds per head per day during the silage phase and 1.51, 1.50 and 1.58 during the full-feed phase for heifers fed Lindsey 77, alfalfa and corn silage, respectively. In Trial II, average daily gains of the heifers fed Lindsey 77, alfalfa and corn silage were 1.53, 2.07 and 1.67 pounds per head per day during the silage phase and 2.25, 2.20 and 2.15 pounds per head per day during the full-feed period. Heifers fed corn silage gained significantly faster ($P < .05$) than those fed alfalfa or Lindsey 77 silage during the winter trial. However, during the summer trial, heifers fed alfalfa silage gained significantly ($P < .05$) faster than those fed the other two silages.

Feed costs per hundred pounds of gain for heifers fed Lindsey 77, alfalfa and corn silage during Trial I were $27.40, $24.82 and $23.62, respectively, and $21.88, $19.61 and $21.81, respectively, during Trial II. Average return per head above feed and initial cost was highest from heifers fed corn silage in Trial I and highest from heifers fed alfalfa silage in Trial II.

These data indicated that these silages, when fed with a limited amount of concentrates followed by a short full-feed period, could be used profitably for finishing beef heifers. The season of year (winter or summer) may affect the results obtained from corn silage. This could be a result of severe heating and spoilage of corn silage in the feed bunk, which was observed during the summer feeding trial. The lower rate of gain and higher feed requirement per unit of gain of heifers fed Lindsey 77 silage in both trials indicated that this type of silage was less desirable as a component of a finishing ration for beef heifers than either alfalfa or corn silage.

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APPENDIX

TABLE 9. Analysis of variance of various performance trials (Trial I)

Source	df	Mean square				
		A.D.G. roughage	Condition end of roughage	A.D.G. full-feed	A.D.G. entire experiment	Slaughter grade
Treatment (T)	2	0.7655**	0.8375	0.0415	0.4178	2.7875
Replication (R)	3	0.1755	0.4611	0.0721	0.0628	1.1444
R X T	6	0.0686	1.0486	0.0650	0.4252	1.7986
Residual	48	0.0702	0.7188	0.1275	0.0557	0.7145

**P < .01.

TABLE 10. Analysis of variance of various carcass traits (Trial I)

Source	df	Mean square									
		Carcass grade	Carcass weight	Dressing percent	Selling price	Loin eye area	Fat thickness	Carcass length	Marbling score	Kidney fat	Percent shrink
Treatment (T)	2	0.5167	5311.40	6.7005*	1.5812	0.0165	1.9500	19.4615	0.2667	0.0875	1.3562
Replication (R)	3	0.2833	130.56	3.1055	0.7023	0.0091	6.5056	6.7260	0.3278	0.1944	1.3747
R X T	6	0.5167	503.22	0.6492	0.2277	0.0437	2.7056	6.3048	0.7778	0.1819	0.7182
Residual	48	0.9917	1547.37	1.3853	0.4023	0.0150	9.3333	12.0291	0.5167	0.1354	0.9294

*P < .05.

TABLE 11. Analysis of variance of various performance traits (Trial II)

Source	df	Mean square				
		A.D.G. roughage	Condition end of roughage	A.D.G. full-feed	A.D.G. entire experiment	Slaughter grade
Treatment (T)	2	1.5927**	5.2167*	0.0433	0.4399**	1.9500
Replication (R)	3	0.0833	3.9333	0.0875	0.0382	1.0222
R X T	6	0.0768	0.8833	0.2527	0.0704	1.6389
Residual	48	0.0691	1.1083	0.1432	0.0619	0.6833

*P < .05.

**P < .01.

TABLE 12. Analysis of variance of various carcass traits (Trial II)

Source	df	Mean square								
		Carcass grade	Carcass weight	Dressing percent	Selling price	Loin eye area	Fat thickness	Carcass length	Marbling score	Kidney fat
Treatment (T)	2	0.2000	3736.02	3.0832	0.2148	0.0368	1366.47	15.3002	0.0667	0.3902
Replication (R)	3	0.8167	220.51	3.2521	0.7651	0.0416	721.60	1.2793	1.1778	0.1827
T X R	6	0.6667	933.33	2.9665	0.5464	0.0560	1583.53	11.8766	0.5111	0.1102
Residual	48	0.5167	1163.93	2.5148	0.4093	0.0906	1103.52	11.6128	0.5833	0.1068

VITA

Rodger P. Pile was born July 8, 1934 in Fentress County, Tennessee. He attended public school at Delk Creek and Jamestown, Tennessee, where he graduated from high school in 1952. During the next five years, he attended The University of Tennessee (College of Agriculture) at Knoxville, Tennessee, and was graduated in March 1957 with a Bachelor of Science degree in Animal Husbandry.

After graduating from The University of Tennessee, he spent the summer farming for his father. He entered the U. S. Army in August, 1957, and spent 15 months in Germany. After being discharged from the Army, he was employed by The University of Tennessee Agricultural Extension Service in October, 1959, as Assistant County Agent in Lawrence County where he is active in 4-H Club work.

He married Patricia L. Walker in February, 1958. They live three miles east of Lawrenceburg in a rural area and have two boys and one girl, Jeff, John, and Jeanne, ages 11, 9 and 8 years, respectively.