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COMBINATIONS OF ORCHARDGRASS, FESCUE, AND LADINO CLOVER PASTURES FOR PRODUCING YEARLING STEERS

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Summary

A study was conducted over a 5-year period, 1953 through 1957, to evaluate four different pasture treatments for the production of yearling slaughter steers: 1) orchardgrass-ladino clover, 2) orchardgrass-fescue-ladino clover; 3) fescue-ladino clover; and 4) fescue-ladino clover with 250 pounds of ammonium nitrate applied in five 50-pound increments at 56-day intervals each year. Each treatment was in duplicate.

For the winter period, all treatments plus hay, *ad libitum,* produced about 1.25 pound gain per head per day. There was no significant difference between treatments. Grazing days and beef gain per acre averaged higher on fescue-clover plus nitrogen (treatment 4), but results were not consistent over the 4 years. Hay consumption per steer for the winter period was significantly higher on treatment 1 (orchardgrass-clover) than on the others.

During the summer grazing period, rate of gain and grazing days were highest on orchardgrass-clover (treatment 1). However, due to one dry summer and another dry spring, results were not consistent among the treatments over the five summer periods. Beef gain per acre was significantly less on the fescue-clover (treatment 3).

For the combined winter and summer period, rate of gain was significantly higher on orchardgrass-clover (treatment 1) than on the others. There were significantly more grazing days per acre on the nitrogen fertilized fescue-clover (treatment 4). Also, orchardgrass-fescue-clover (treatment 2) provided significantly more days of grazing than treatments 1 and 3. Beef gain per acre was significantly less on treatment 3. Based on the appraised value of the steers at the beginning and end of the grazing period, gross returns per head and per acre were highest on treatment 1 and lowest on treatment 4. Returns per head above hay and nitrogen costs were about the same on treatments 1, 2, and 3; on a per-acre basis, treatment 2 was highest; treatment 4 was lowest in both respects.

Pasture composition changed during the experiment. Fescue tended to crowd out the clover in treatments 2, 3, and 4. Nitrogen accelerated the loss of clover in treatment 4 which was almost void of clover after 2 years. Also, the Danish orchardgrass had poor per-

sistency and less than one-fourth of the original stand remained after 4 years.

Forage yields were determined on eight pasture treatments by clipping small plots adjacent to the grazed area; four of the treatments were the same as used for the grazing work. Over the 5-year period 1953-57, the orchardgrass-clover treatment produced the least forage (average of 1.85 tons per year), and the fescue-clover nitrogen treatment the most (3.02 tons per year). The clover in the treatments with fescue declined sharply; this was true in both the grazed and clipped plots. Overseedings of clover were disappointing.

Forage yield-beef production ratios.—Forage yields obtained on the clipped plots and summer beef gains on the grazed areas were used to calculate the pounds of forage required to produce 1 pound of beef gain. The orchardgrass-clover mixture required the least amount of forage (16 pounds), and the nitrogen-fertilized fescue-clover mixture the greatest amount (30 pounds) per pound of gain.

Contents

Combinations of Orchardgrass, Fescue, and Ladino Clover Pastures for Producing Yearling Steers

by

Joe W. High, Jr., L. M. Safley, O. H. Long, H. R. Duncan, and T. W. High, Jr.*

The development of slaughter yearlings on pasture has been an important phase of the rapidly-growing beef cattle industry in Tennessee. This is partly because much of the land in this area is suited for pastures, of the relatively long summer grazing period, and of the usually favorable climatic conditions. These all combine to reduce the need for more expensive feeds.

The production of slaughter yearlings of desirable finish for today's market requires the feeding of some costly and locally scarce concentrates. Usually, the more growth and finish obtained from pasture, the less the total cost of producing slaughter cattle. Of course, the reliability of this statement hinges on the producer's ability to provide quality forage at a minimum cost through improved pastures.

The development and management of improved pastures presents the beef producer with many problems such as: initial cost and ease of establishing the various species; the quality and quantity of the forage produced by each species during the various seasons of the year as reflected in beef gains; and the persistency of the various species under grazing conditions. Stocking rates and fertilization practices are factors of management that also must be considered.

Objectives

Results of 5 years' work conducted at the Highland Rim Experiment Station, Springfield, are included in this report. The objectives of this investigation were to obtain information on the following questions:

1. How do mixtures of orchardgrass-clover, fescue-clover, and

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orchardgrass-fescue-clover compare in terms of quality and quantity of beef produced per acre?

2. How much grazing will each pasture provide during the winter and summer pasture seasons?

3. Can a balance of grass and clover be maintained in the various mixtures under grazing conditions?

4. Will nitrogen applications be profitable in terms of increased gains and profits?

5. What can the producer expect in the way of costs and returns from various pastures?

Experimental Procedure

Treatments

This investigation was conducted over a 5-year period from 1953 through 1957. A 24-acre tract of land with fairly uniform soil, topography, and fertility level was used. The land was divided into eight 3-acre pastures. The treatments, in duplicate, were as follows:

Treatment	*Seeding rates, lb./A.*
1	Orchardgrass, 14; ladino clover, 2 (O-C)
2	Orchardgrass, 7; fescue, 5; ladino clover, 2 (O-F-C)
3	Fescue, 10; ladino clover, 2 (F-C)
4	Fescue, 10; ladino clover, 2; plus nitrogen (F-C+N)

Seeding and Fertilization

The seedings were made in the fall of 1952. Fertilizer applications were made initially and throughout the study according to recommendations based on soil tests. Initially, about 1.5 tons of lime, 275 pounds of 47% superphosphate, 275 pounds of muriate of potash, and 100 pounds of ammonium nitrate were applied per acre. Five 50-pound applications of ammonium nitrate (33% N) were made at 56-day intervals, beginning in February and ending in September, on treatment 4. No additional nitrogen was applied to the other treatments.

Soils

The soils in each treatment are given in Table 1. The predominant soils were Sango and Dickson silt loams: Dickson included slopes of 2% to 12% and Sango included slopes of 2% to 5%. In each treatment these soils occupied approximately 75% or more of the area. Small areas of Baxter cherty silty clay loam on 12% to 20% slopes were in all treatments. Lobelville silt loam, local alluvium phase, occupied a small area in treatments 2 and 3.

Table 1. Kinds of soil and percentage in each treatment

Soil	O-C 1	O-F-C 2	F-C 3	F-C +N 4
		Percent		
Sango silt loam, 2% to 5% slopes	22	23	30	
Dickson silt loam, 2% to 5% slopes	38	53	38	74
Dickson silt loam, 5% to 12% slopes, eroded	34	13	10	23
Baxter cherty silty clay loam, 12% to 20% slopes, severely eroded	6	8	15	3
Lobelville silt loam, local alluvium		3	7	

Cattle

Weanling beef steer calves were used as the experimental animals and were obtained, usually in October, from University of Tennessee herds, and at feeder calf sales. Care was taken to select animals as similar in age, weight, type, and condition as possible. Two steers were allotted to each pasture, for a total of four steers per treatment, and these steers were termed "test" steers.

The test steers were scheduled to remain on pasture from about November 1 to August 30. However, the pastures were not grazed the first winter. Also, they were not grazed until January 1 of the second winter to allow recovery from a dry fall, and the animals on treatment 1 were removed from the pastures during portions of the winter to prevent damage to the sod from trampling. The grazing period was divided into two phases; winter—from November 1 until sufficient growth occurred to support the steers entirely, usually about April 1, and summer—from the end of the winter period until the steers were removed for feeding in late August.

Whenever the test steers were unable to graze the pastures to the desired level, extra steers were put on the pastures to utilize the excess forage, and for use in estimating the total grazing days produced. If needed, changes in animal numbers were made at biweekly intervals or oftener when the pastures were evaluated.

The pastures were clipped as needed during the summer to remove seed heads and weeds.

Winter Feeding

During periods when grazing was short or unavailable, the cattle were restricted to the shelter areas. Each pasture contained shelters enclosed on three sides, in which medium-grade alfalfa hay and minerals were fed *ad libitum.*

Dry Lot Feeding

At the end of the summer pasture period, the steers were placed in dry-lot for finishing. They were fed a ration of 7 parts ground ear corn, 1 part cottonseed meal, good quality legume hay, *ad libitum,* and minerals. When the steers were finished sufficiently to grade high Good to low Choice, they were sold to a packing company.

Observations

The test steers were weighed on 2 consecutive days and were graded at the beginning of the winter, summer, and dry-lot periods and at the end of the dry-lot period, and were weighed at 28-day intervals during the entire experimental period. A cattle buyer appraised the cattle for each of the three periods.

Each pasture was carefully scored and evaluated at bi-weekly intervals during both the winter and summer phases. This procedure was carried out by the project leader and/or the station superintendent. Consideration was given to height of the individual pasture species (range and estimated average), the estimated percentage of each species (based on total vegetation present), stage of growth, condition, color, and estimated carrying capacity.

Grazing days per acre is a total of the days on pasture of the test and extra steers. The beef gain per acre for each 28-day period was estimated by multiplying the average daily gain of the test steers and total grazing days per acre.

Portions of these data were analyzed by analysis of variance. Where applicable, the multiple range test (Duncan, 1955) was used to test differences among means.

Results and Discussion

Winter Period

Cattle performance and pasture production data for the four winter periods, averaging 132 days, are shown in Table 2. The daily gains of steers on the orchardgrass-fescue-clover pastures (treatment 2) were slightly lower than for those on the other treatments, but these differences were not significant.[1] Daily gains ranged from 1.19 to 1.31 pounds per head. The feeding of hay probably accounts for much of the consistency of winter gains among the treatments. The winter gains of this study are somewhat higher than those produced in similar studies at other locations in the state, and possibly are too high for most efficient gains later during the summer grazing period.

The average winter hay consumption per steer was significantly higher (standard error = .59 pound per day) on the orchardgrass-clover pastures (treatment 1) than on the other treatments. The average winter consumption of hay per steer was 1,438, 781, 821, and 731 pounds for treatments 1, 2, 3, and 4, respectively.

To produce 1.25 pounds daily gain on cattle of this age in dry lot would require feeding some concentrates. According to feeding standards (Morrison, 1959), approximately 4 pounds of concentrates

Table 2. Performance of steers during winter grazing period, 4-year average

	Treatment			
	1 O-C	2 O-F-C	3 F-C	4 F-C +N
Total no. test steers	16	16	16	16
Av. wt. and gain per head, lb.:				
Initial wt.	494	487	488	492
Final wt.	662	644	661	664
Total gain	168	157	173	172
Daily gain	1.27	1.19	1.31	1.30
Av. hay consumed per test steer, lb.[a]	1,438[b]	781[a]	821[a]	731[a]
Productivity of pastures:				
Grazing days per acre	83	102	98	119
Estimated beef gain per acre	119	122	130	156
Carrying capacity, acres per steer, including hay	1.59	1.30	1.35	1.11

[a] Means with the same superscript do not differ significantly (P>.05).

(cracked corn) and 10 pounds of medium quality alfalfa hay (or the equivalent of this ration), would be required per head per day to

[1] (P<.05) is used as the level of significance throughout this article, and no distinction is made for higher levels of significance.

produce similar gains. This would amount to 528 pounds of concentrates and 1,320 pounds of hay per head for the 132-day period. This gives some idea of the relative values of the various pastures for the winter.

The amount of hay consumed must be considered in evaluating grazing days and estimated beef gain per acre. For example, there were some days when the cattle received no forage from the pastures. On the other days, especially during the early and late portions of the winter period, most all of the forage came from the pastures. Therefore, these figures give only a very general idea of what may be expected from the various pastures in terms of grazing days and beef gains per acre.

Daily gains of the steers within treatments varied considerably from year to year (Appendix 1). The winter of 1954-55 followed a very dry summer and about half the orchardgrass in treatment 1 did not survive this winter. The winters of 1953-54 and 1955-56 were rather mild and the clover in treatment 1 made good growth, as is indicated by the daily gains. The winter of 1956-57 was rather severe. Therefore the daily gains on all pastures were depressed. Although efforts were made to keep the hay quality consistent from year to year, some of the between-year variability in rate of gain may have been due to differences in hay quality.

The large amount of hay consumed per day on all treatments during the winter of 1954 may be partly accounted for by the fact that the steers were started 2 months later and consequently were slightly heavier at the beginning of the winter period than in other years. Also, these steers were maintained primarily on hay during the intervening 2 months between weaning and going on pasture. Therefore, they would be more adapted to hay consumption than would the recently weaned steers of the subsequent winters.

Summer Grazing Period

The five summer periods averaged 138 days in length. Data are summarized in Table 3. The differences among treatments for average daily gain for the five summers were significant. However, the daily gains were not consistent among the treatments over the 5 years (Appendix 2). Consequently, the treatment-by-year interaction was also significant. The daily gains of steers on the orchardgrass-clover pasture (treatment 1) were the highest of any of the pastures and were consistently good except for the summer of 1954. This was a very dry summer and apparently the pastures in treatment 1 were less drought resistant than the others. The ranking with respect to daily gains among treatments 2, 3, and 4 was 1, 2, and 3, respectively, and was consistent each summer period except for 1957 (see Appendix 2). For this period the order was reversed. Thus, most of the interaction is attributable to the 1954 and 1957 summer periods. The daily gains on all treatments, especially treatments 2, 3, and 4, tended to decline over the years. Much of this decline was probably due to changes in pasture composition, as will be discussed later.

The between-treatment component of variance for grazing days per acre was significant. However, again the treatment-by-year interaction was significant. Decisions regarding the stocking rates of the various pastures were made every 2 weeks. Height of the various species, time of year, stage of growth, and ground moisture were among the more important factors considered in changing the stocking rates. Because of the many factors involved, keeping the pastures grazed uniformly was sometimes difficult. However, the grazing days per acre are representative for this method of stocking.

Table 3. Performance of steers during summer grazing period, 5-year average

	Treatment			
	1 O-C	2 O-F-C	3 F-C	4 F-C +N
Total no. of test steers	20	20	20	20
Av. wt. and gain per head, lb.:				
Initial wt.	651	638	651	654
Final wt.	847	818	819	805
Total gain	196	180	168	151
Daily gain	1.42	1.31	1.22	1.10
Productivity of pastures:				
Grazing days per acre	168	177	152	188
Estimated beef per acre, lb.[a]	253[a]	234[a]	189[b]	228[a]
Carrying capacity, acres per steer	0.82	0.78	0.90	0.73

[a] Means with the same superscript do not differ significantly ($P<.05$).

The fescue-clover pasture receiving nitrogen (treatment 4) produced about 36 more grazing days per acre than was produced by the no-nitrogen fescue-clover pasture (treatment 3). The orchardgrass-fescue clover combination (treatment 2) produced more grazing days per acre than did either treatments 1 or 3. Also, treatment 1 produced more grazing days per acre than did treatment 3.

The average daily gain for 28-day periods beginning about March

30 is given in Appendix 3. In treatment 4, the highest rate of gain occurred during the first 28-day period. This was probably due to earlier growth of forage as a result of the added nitrogen. In treatments 1, 2, and 3, the highest rate of gain was made during the second 28-day period (around the last week of April and the first 3 weeks of May). After the first two 28-day periods, the rate of gain on all treatments declined sharply. However, probably because of more clover, the drop in daily gains on treatment 1 was less sharp.

The average grazing days per acre (expressed as a percent of the total) for the above 28-day periods are given in Appendix 4. Approximately half the grazing days for the summer period occurred during the second and third 28-day periods.

The estimated beef gain per acre was significantly less for treatment 3 than for the other treatments. Since the most grazing days occurred during 28-day periods when the rate of gain for the "test" steers was highest, the method used to calculate the beef gains per acre gave slightly higher results than would be obtained by multiplying average daily gain for the summer grazing period by total grazing days for the summer. However, the relative order of the treatments would remain the same.

Combined Winter and Summer Periods

Combining the winter and summer periods (Table 4) tended to level out some of the differences noted when these periods were considered separately. Because of superior gains produced during the summer period, daily gains on treatment 1 were significantly higher than for the other treatments. However, no treatment was consistently the highest or lowest for both periods. As would be expected, rate of gain was reflected in the condition scores of the "test" steers at the end of the grazing season. The average condition score of steers on treatment 4, the pastures producing the lowest daily gains, was significantly lower than for the other treatments. Treatment 4 produced the most grazing days per acre for both periods and, consequently, was significantly higher for this factor than were treatments 1 and 3. Treatment 3 produced significantly less beef gain per acre.

The carrying capacity for all pastures averaged about one steer per acre. As was pointed out earlier, the carrying capacity for each treatment was the result of the forage produced on the pastures and the hay fed during the winter period. There was no way of separating these two factors. Also, the carrying capacity is based on

Table 4. Performance of steers during entire grazing period, 4-year average

	Treatment			
	1 O-C	2 O-F-C	3 F-C	4 F-C +N
Total no. of test steers	16	16	16	16
Av. wt. and gain per head, lb.:				
Initial wt.	494	487	488	492
Final wt.	854	819	823	810
Total gain	360	332	335	318
Daily gain[a]	1.33[a]	1.22[b]	1.23[b]	1.17[b]
Av. animal grades[d]				
Initial feeder	11.3	11.6	12.0	11.8
Initial condition	8.3	8.3	8.2	8.5
Final conditiond	8.3[a]	8.1[a]	7.9[a]	6.3[b]
Productivity of pastures:				
Grazing days per acre	253[bc]	278[b]	239[c]	302[a]
Estimated beef gain per acre	369[a]	346[a]	297[b]	370[a]
Carrying capacity, acres per steer:	1.08	0.98	1.14	0.90
Financial results for test steers.		Dollars		
Initial value per cwt.	19.82	19.73	19.82	19.69
Final value per cwt.	18.32	17.72	17.72	16.13
Initial value per head	97.91	96.09	96.72	96.87
Final value per head	156.45	145.13	145.84	130.65
Gross returns per head	58.54	49.04	49.12	33.78
Cost of hay and N per head	25.16	13.67	14.37	21.24
Returns per head over hay and N[e]	33.38	35.37	34.75	12.54
Financial results per acre:				
Gross returns per acre	54.44	50.02	43.23	37.50
Cost of hay and N per acre	23.40	13.94	12.65	23.58
Returns per acre over hay and N[e]	31.04	36.08	30.58	13.92

[a,b,c] Means with the same superscript letter do not differ significantly ($P < .05$).
[d] 7.0 = Av. Standard; 8.0 = high Standard; 11.0 = high Good; 12.0 = low Choice.
[e] Does not include labor and machinery cost of applying nitrogen or feeding hay.

the number of days in the yearly grazing period (average of 271.5 days for the 4 years), rather than on a whole year basis. No forage was removed from the pastures during the non-grazing period. The very dry summer of 1954 depressed the average carrying capacity on all treatments.

The financial statement for the entire grazing period is also given in Table 4. Gross returns per "test" steer were calculated from initial and final weights and appraised values. Gross returns per acre were calculated by multiplying the gross returns per "test" steer by the carrying capacity per acre. Similarly, the cost of hay per acre was calculated by multiplying the cost of hay per head by the carrying capacity. The cost of nitrogen per head was calculated by dividing the cost per acre by carrying capacity. Prices of $75 and $35 per ton were used for ammonium nitrate and hay, respectively.

Gross and net returns per head over nitrogen and hay costs were substantially smaller for treatment 4 than for the other treatments, indicating that adding this much nitrogen to a fescue-clover pasture is not profitable under these conditions. Gross returns per head were slightly higher for treatment 1 than for treatments 2 and 3. However, because of the additional hay required during the winter period on treatment 1, the latter treatments gave slightly higher net returns.

Returns per acre over nitrogen and hay costs were substantially smaller for treatment 4 than for the other treatments. Higher carrying capacity, along with less hay cost for the winter period, produced slightly higher net returns in treatment 2 than in treatments 1 and 3.

A point overlooked many times when only grazing days and beef gain per acre are considered is the quality of the beef produced, or more precisely, the condition of the steers at the end of the grazing period. For example, treatment 4 produced over 70 pounds more beef per acre than did treatment 3; however, gross returns per acre were higher for treatment 3 than for treatment 4 due to the higher slaughter value per hundredweight of the steers. Possibly these cattle were more valuable as feeders than as slaughter steers, and if so, this would have changed the financial estimates.

The cost of initial land preparation, seed, fertilizer, and booster fertilizer applications amounted to around $8 per acre per year. In addition, $5 per acre per year should be added to treatment 4 for the cost of applying the additional nitrogen five times annually ($1 per acre for each application).

Pasture Composition

An important aspect of this study was how well the various species persisted over the years in the different treatments. The percentages of the various species—or percent of total available forage—given in Table 5 are the averages of all estimates made during the summer period each year. Initially (1953), the percent of clover ranged from 43% in treatment 4 to 54% in treatment 3.

In treatment 1 the percent of orchardgrass declined sharply the second and third summers and increased again during the fifth summer. However, most of the percentage increase was the result of less clover due to a dry spring, rather than to a material increase of orchardgrass.

In treatment 2 the percent of orchardgrass and clover declined each summer while the percent of fescue increased. In treatments 3 and 4 the fescue increased steadily while the clover declined. This change was accelerated in treatment 4, possibly due to the nitrogen applied. The decline of the clover content in all the pastures the fifth summer was partly due to a dry spring.

Table 5. Percent composition of the various pasture treatments for the summer periods—1953 through 1957

Treatment		Species—Percent			
No.	Description	Orchardgrass	Fescue	Ladino	Other
			1953		
1	O-C	43	0	48	9
2	O-F-C	22	23	45	10
3	F-C	0	44	54	2
4	F-C +N	0	56	43	1
			1954		
1	O-C	25	0	69	6
2	O-F-C	17	37	43	3
3	F-C	0	55	43	2
4	F-C +N	0	79	21	trace
			1955		
1	O-C	11	0	76	13
2	O-F-C	13	37	42	8
3	F-C	0	58	38	4
4	F-C +N	0	94	5	1
			1956		
1	O-C	9	0	89	2
2	O-F-C	11	50	39	trace
3	F-C	0	65	35	trace
4	F-C +N	0	98	2	trace
			1957		
1	O-C	22	0	68	10
2	O-F-C	9	76	14	1
3	F-C	0	79	21	trace
4	F-C +N	0	100	trace	trace

In this study, the Danish variety of orchardgrass was considerably less persistent than common orchardgrass has been in later pasture trials at this and other locations. Therefore, these data should be considered as applying only to the Danish variety.

The clover content of the pastures apparently affected the daily gains for the summer periods. Average daily gains for the five summer periods were highest on treatment 1 where the percent of clover was highest and lowest on treatment 4 where the percent of clover was lowest. Treatments 2 and 3 were intermediate with respect to average daily gain and clover content. The differences in rate of gain would probably have been more pronounced had the rainfall for the summer of 1954 and spring of 1957 been more nearly normal.

Dry-Lot Period

Although this was primarily a study of pastures, the dry-lot feeding period is an important phase in a complete slaughter steer production program. The average results of the four dry-lot periods are given in Table 6. Feeding results the first year were not

Table 6. Performance of steers during dry-lot feeding period, 4-year average

	Treatment			
	1 O-C	2 O-F-C	3 F-C	4 F-C +N
Total no. test steers per year	16	16	16	16
Av. wt. and gain per head, lb.:				
Initial wt.	867	837	832	824
Final wt.	1030	978	984	982
Total gain	163	151	152	158
Daily gain	2.16	2.00	2.01	2.09
Av. feed per cwt. gain, lb.:				
Concentrates	711	772	759	754
Roughage	447	470	453	429
Av. animal grades[a]:				
Initial condition	9.0	8.5	8.2	6.7
Final condition	11.4	11.6	11.3	10.5
Federal	11.5	11.8	11.2	10.9
Returns per test steer:				
Initial value per cwt.	$18.32	$17.72	$17.72	$16.12
Final value per cwt.	21.70	22.11	21.39	21.31
Initial value per head	158.83	146.54	147.43	132.83
Final value per head	223.51	216.24	210.48	209.26
Feed cost per head[b]	$37.39	$37.20	$36.58	$37.17
Returns per head over feed cost	27.29	32.50	26.47	39.26
Returns per head for pasture and feedlot, combined	$58.33	$68.58	$57.05	$53.18

[a] 7.0 = Av. Standard; 10.0 = av. Good; 13.0 = av. Choice.

[b] Corn, cob, and shuck meal $40.00 per ton; cottonseed meal $60.00 per ton; medium grade alfalfa hay $35.00 per ton.

included since all the steers were fed together. However, the gains and profits were similar to the 4-year average. The dry-lot periods averaged 75.5 days in length and ranged from 71 to 86 days. A ration of 1 part cottonseed meal, 7 parts ground corn, cob and shuck meal, and good quality alfalfa hay, *ad libitum,* was fed. Daily gains were rather poor for the 1954 and 1955 dry-lot periods (1.50 to 1.75 pounds per day), but were good the last 2 years (2.50 pounds per day).

The condition score was raised on all steers as a result of the dry-lot feeding period. The average increase per treatment ranged from a little over two-thirds of a grade in treatment 1 to almost one and one-third grades in treatment 4. Average increase in price per hundredweight ranged from $3.38 in treatment 1 to $5.19 in treatment 4. The dry-lot period returned a profit every year in this study.

Forage Yields of Pasture Mixtures

The same pasture mixtures and fertilizer treatments described in the forepart of this publication were used by the Agronomy Department on a separate piece of land located near the center of the 24-acre grazing area. These agronomic plots were established to measure forage yields over the same years (1953-1957) covered by the grazing trials. The soil is Dickson silt loam, B slope (2% to 5%). In addition to the four treatments used in the grazing trials, four other treatments were included. All treatments, replicated four times, were seeded September 4, 1952.

The procedure used for managing these plots was as follows: Forage growth was allowed to accumulate until it reached a height (4 to 8 inches) sufficient to provide a yield estimate by clipping with a mower. A small portion of each plot was clipped, raked, weighed, and sampled for moisture determination, and the green yield later converted to air-dry yield of forage per acre. After each yield measurement, several cattle were turned in on the area to graze the pasture down quickly to a height approximately that of the clipped portion. The entire area was clipped after the cattle were removed. This procedure was repeated as often as renewed growth provided a yield estimate.

Air-dry forage yields for the 5-year period, 1953-1957, are presented in Table 7. The first four seeding mixtures (in bold-face type) are the same as those used in the grazing experiment. The last four treatments are included for the purpose of comparison. Note that the last two listings in the table are pure stands of grasses fertilized with nitrogen at twice the rate of that used on the grass-clover mixtures. The table also indicates the number of clippings (yield estimates) that were made each year and the dates of those clippings.

Forage yields varied considerably among the various seeding mixtures and from year to year for the mixtures as a group. However, among the first four treatments, the fescue-clover mixture plus nitrogen consistently produced the highest yield of forage; over the 5-year period the average yield was 3.02 tons of air-dry forage per acre. Among these same four treatments the orchardgrass-clover mixture produced an average yield of only 1.85 tons of forage, being the lowest-yielding treatment 3 years out of 5. The orchardgrass-fescue-clover and fescue-clover mixtures produced yields about halfway between these two extremes.

Attention is now directed to the last four treatments in Table 7—treatments that were not included in the grazing experiment. The orchardgrass-clover and the orchardgrass-fescue-clover mixtures fertilized with 50 pounds of ammonium nitrate five times a year (equivalent to 84 pounds of N per acre per year) produced yields of 2.56 and 2.94 tons of air-dry forage per acre, respectively. These yields are 0.71 ton and 0.56 ton higher than the yields of the corresponding mixtures that were not fertilized with nitrogen. A pure stand of orchardgrass fertilized with nitrogen at a rate twice that applied to the grass-clover mixtures produced an average yield of 2.41 tons of forage—about the same yield as those of the orchardgrass-fescue-clover and fescue-clover mixtures not fertilized with nitrogen. A pure stand of fescue, fertilized at this higher rate of nitrogen, produced the highest yield of forage of the eight treatments; its yield of 3.71 tons is 1.30 tons (54%) higher than that of the pure stand of orchardgrass.

The number of clippings was as low as two (1956) and never exceeded four. The first clipping was made in the period mid-April to early May. The last clipping usually was made in the period early June to mid-August, although the second and last clipping in 1956 was made on June 7. In only 1 year (1955) was pasture growth sufficient for a yield measurement in the fall.

The major part of pasture growth occurred in the months of April, May and June. This is to be expected because both orchardgrass and tall fescue are cool-seasoned grasses and they languish in hot weather. Moreover, without irrigation, soil moisture conditions are better for growth in the spring and early summer.

In Figure 1, the 5-year average production of forage by separate clippings is shown for the first four pasture mixtures listed in Table

Table 7. Forage yields of grass-clover mixtures and pasture stands of grass with and without nitrogen fertilization, 5-year period, 1953-1957

Seeding mixture and fertilization	1953 4 clippings (Apr. 14, May 6, June 8, and Aug. 13)	1954 3 clippings (Apr. 19, May 18, and June 24)	1955 4 clippings (Apr. 18, May 31, July 18, and Nov. 8)	1956 2 clippings (May 4 and June 7)	1957 3 clippings (Apr. 18, May 9, and June 25)	Average yield 5-year period
	Tons of air-dry forage per acre					
Orchardgrass-clover (O-C)	2.47	1.37	2.31	1.92	1.18	1.85
Orchardgrass-fescue-clover (O-F-C)	3.35	1.86	2.54	2.10	2.06	2.38
Fescue-clover (F-C)	4.09	2.25	2.13	1.70	1.96	2.43
Fescue-clover + nitrogen (F-C + N)	4.89	2.55	3.29	1.91	2.47	3.02
Orchardgrass-clover + nitrogen	3.88	2.04	3.06	2.22	1.58	2.56
Orchardgrass-fescue-clover + nitrogen	4.54	2.62	3.10	1.98	2.46	2.94
Orchardgrass + nitrogen[a]	3.24	2.04	3.07	1.80	1.90	2.41
Fescue + nitrogen[a]	5.17	3.42	4.03	2.56	3.37	3.71
L. S. D. (5%)	1.07	0.60	0.59	0.48	0.48	....

[a] Ammonium nitrate applied at a rate of 100 pounds per acre five times per year, or twice the rate of the other nitrogen treatments.

7. By the time of the second clipping (average date = May 19), 69% of the total yearly forage production of the above-mentioned four mixtures had already occurred; by the time of the third clipping (average date = June 24), 94% of the total yearly production had been produced. From these data it would appear that any appreciable amount of grazing beyond the month of June would have to be provided by growth that had taken place earlier.

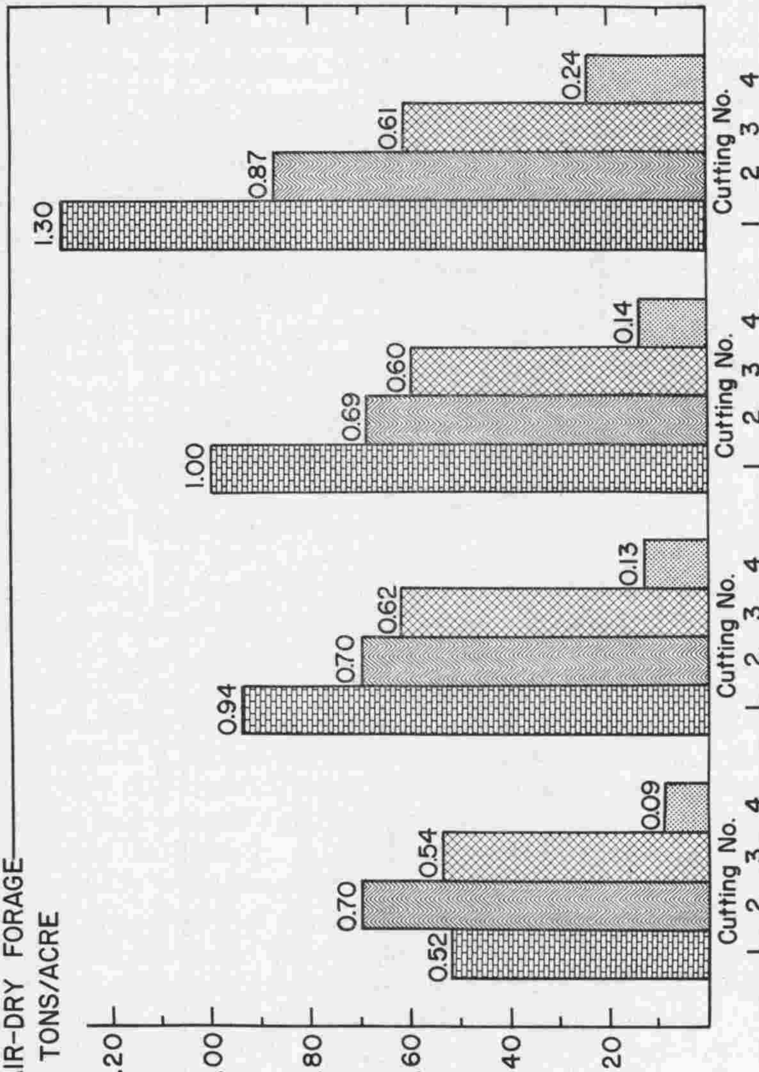

Figure 1. Forage yields by cuttings of four seeding mixtures, 5-year average, 1953-1957

Figure 1 also shows that the higher yields of the seeding mixtures containing fescue (O-F-C, F-C, and F-C+N) over the yield of the mixture containing orchardgrass (O-C) are the result of higher yields in the first cutting. Later cuttings registered about the same yield for the four treatments. Also, a comparison between fescue-clover with and without nitrogen fertilization shows that all nitrogen applications beyond the first two were ineffective insofar as forage yields are concerned. On these two treatments, the third-clipping yields were essentially the same, and the yields obtained at the fourth clipping were in both cases so small that a difference is meaningless.

Forage Yields and Beef Production

One objective in the pasture evaluation experiment presented in this publication was to determine the relationship between forage yields and beef production. For example, would the pasture mixture that produced the highest yield of forage show the greatest beef gains, and the pasture mixture that produced the lowest yield of forage show the least beef gains?

This forage yield-beef production relationship is presented in Table 8. Forage yields for the 4-year period 1953-1956 have been taken from Table 7 and beef gains for the summer period have been calculated from data on average daily gains and grazing days in Appendix 2. Beef production for the winter period is not included because hay was fed to supplement the limited pasturage available on the grazing areas at that time. Data for 1957 are not included because the cattle were removed from the pastures in July of that year to permit plowing and re-seeding for a new experiment.

In Table 8 the four seeding mixtures are evaluated in terms of the forage yield required to produce 1 pound of beef $\frac{(FY)}{(GG)}$. Orchardgrass-clover (O-C) was consistently the most efficient mixture, requiring from 12 to 19 pounds of air-dry forage to produce 1 pound of beef; the average for the 4-year period was 16 pounds of forage. Fescue-clover, fertilized with nitrogen (F-C+N), was the least efficient treatment, requiring from 21 to 36 pounds of forage to produce 1 pound of beef, with an average of 30 pounds. The orchardgrass-fescue-clover (O-F-C) and the fescue-clover (F-C) and orchardgrass-fescue-clover (O-F-C) and the fescue-clover (F-C) mixtures gave values somewhat intermediate between these two extremes.

These differences in forage yield beef gain ratios may be due to one or several factors. One of these is probably the clover content of the various seeding mixtures. The decline in clover content on the grazed areas where the seeding mixture contained tall fescue has already been mentioned. These same mixtures also showed a sharp decline in clover on the clipped plots. For example, the clover had largely disappeared on the F-C+N treatment when botanical readings were made in March 1955. Clover content undoubtedly affected the nutritive value of the forage mixtures.

Other factors that could account for differences in forage yield-beef gain ratios are differences in palatability and in the amount of wastage among the seeding mixtures. Low palatability could result in selective or uneven grazing and reduced forage intake. Both the amount and percentage of wastage could vary greatly. High forage production involves higher animal density or more animals per acre, and hence more trampling and more fouling results than would occur with low forage production.

It is clear from the results of this experiment that estimates of total forage produced cannot be used by themselves to predict beef production.

Table 8. Forage yields on clipped plots and beef gains during summer period on pastured areas, 4-year period, 1953-1956

Seeding mixture	1953			1954			1955			1956			$\frac{FY^a}{BG}$ 4-year av.
	Forage yield	Beef gain	$\frac{FY^a}{BG}$	Forage yield	Beef gain	$\frac{FY^a}{BG}$	Forage yield	Beef gain	$\frac{FY^a}{BG}$	Forage yield	Beef gain	$\frac{FY^a}{BG}$	
	Tons/A	Lb./A		Tons/A	Lb./A		Tons/A	Lb./A		Tons/A	Lb./A		
O-C	2.47	258	19	1.37	161	17	2.31	282	16	1.92	317	12	16
O-F-C	3.35	274	24	1.86	182	20	2.54	273	19	2.10	232	18	20
F-C	4.09	281	29	2.25	158	28	2.13	201	21	1.70	171	20	25
F-C + N	4.89	270	36	2.55	186	27	3.29	217	30	1.91	178	21	30

[a] $\frac{FY}{BG}$ means forage yield-beef gain ratio, or pounds of air-dry forage required to produce 1 pound of beef.

Note: Summer grazing periods were as follows:

1953–grazed from April 16 to Aug. 25 (131 days)
1954–grazed from March 30 to Aug. 14 (137 days)
1955–grazed from March 29 to Aug. 30 (154 days)
1956–grazed from March 27 to Aug. 28 (154 days)

Appendix

Appendix 1. Summary of individual winter periods

	Days in period	Average initial wt., lb.	Average daily gain, lb.	Lb. hay per head
Treatment 1 (orchard.-clover)				
1954	84	534	1.51	1,352
1955	145	448	1.06	1,088
1956	146	505	1.51	1,489
1957	154	488	1.12	1,823
Treatment 2 (orchard.-fescue-clover)				
1954	84	508	1.20	815
1955	145	450	1.14	560
1956	146	502	1.28	978
1957	154	487	1.14	772
Treatment 3 (fescue-clover)				
1954	84	529	1.42	764
1955	145	452	1.29	557
1956	146	489	1.45	1,051
1957	154	484	1.11	913
Treatment 4 (fescue-clover + N)				
1954	84	532	1.48	630
1955	145	446	1.24	454
1956	146	502	1.49	1,110
1957	154	489	1.08	730

Appendix 2. Summary of individual summer periods

	Days in period	Average daily gain	Average final weight	Final[a] condition grade	Grazing days per acre
Treatment 1 (orchard.-clover)					
1953	131	1.63	817	9.0	158
1954	137	1.15	818	9.3	140
1955	154	1.47	828	8.7	192
1956	154	1.49	954	9.0	213
1957	112	1.40	818	9.0	138
Treatment 2 (orchard.-fescue-clover)					
1953	131	1.53	813	9.0	179
1954	137	1.36	795	7.3	134
1955	154	1.49	846	8.7	183
1956	154	1.20	874	10.0	193
1957	112	0.88	760	8.0	195
Treatment 3 (fescue-clover)					
1953	131	1.45	802	9.3	194
1954	137	1.18	810	7.3	134
1955	154	1.34	846	8.3	150
1956	154	1.12	873	9.3	153
1957	112	0.97	764	8.0	129
Treatment 4 (fescue-clover + N)					
1953	131	1.31	783	8.7	206
1954	137	1.02	796	6.3	182
1955	154	1.22	814	6.3	178
1956	154	0.91	860	6.3	196
1957	112	1.04	771	8.0	179

[a] 6.0 = Low Standard; 7.0 = Standard; 8.0 = high Standard; 9.0 = low Good; 10.0 = Good.

Appendix 3. Daily gains of test steers on the various pastures during summer grazing period by 28-day intervals—1953 through 1957

Treatment		28 Day Period[a]				
No.	Description	1	2	3	4	5
1	O-C	1.01	2.24	1.25	1.27	1.55
2	O-F-C	1.78	2.09	.77	1.02	1.04
3	F-C	1.69	1.97	.82	1.10	.55
4	F-C +N	2.05	1.89	.53	.37	.58

[a] Beginning approximately March 30 and ending approximately August 17; the summers of 1955 and 1956 were 14 days in excess of the five 28-day periods; these 14 days were not included.

Appendix 4. Grazing days per acre on the various treatments during summer period by 28-day intervals expressed as percent of total—1953 through 1957

Treatment		28 Day Period[a]				
No.	Description	1	2	3	4	5
				Percent		
1	O-C	14.8	28.6	25.9	19.9	10.8
2	O-F-C	16.5	29.6	25.5	17.0	11.3
3	F-C	16.4	28.7	24.3	19.4	11.2
4	F-C +N	17.0	33.7	23.1	16.4	9.8

[a] Beginning approximately March 30 and ending approximately August 17; the summers of 1955 and 1956 were 14 days in excess of the five 28-day periods; these 14 days were not included.

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