Production Characteristics of Oklahoma Forages

Grazing Characteristics and Clipping Responses of BERMUDAGRASS

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CONTENT

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Bermudagrass was recognized as an outstanding pasture grass early in Oklahoma agriculture. Rootstock from a hardy strain was released from the Oklahoma Station in 1904 and 1905—before statehood. In recent years the need for a plant to use on the large acreage of land abandoned from cultivation has encouraged bermudagrass planting in the area of the state where rainfall is 30 inches or more. The recent release of Midland and Greenfield strains has also accelerated interest in bermudagrass pastures.

Since bermudagrass is a persistent plant after it is established, and will withstand heavy grazing, it is considered an easy plant to manage in a pasture. However, to acquire the greatest potential use from the grass it must be fertilized, and it is usually grown with legumes. There is some criticism of bermudagrass as a pasture plant because of its lack of palatability, resulting in low daily gain on grazing animals.

In an attempt to solve some of the problems of bermudagrass production and grazing management, grazing tests have been conducted on the Heavener Experiment Station for ten years, and grazing and clipping tests on the Stillwater Station for six years. The grazing tests were designed to determine the carrying capacity, daily gain, and production of beef per acre for bermudagrass under different management practices.

The studies involved the grazing of Midland bermudagrass under irrigation; a comparison of the results of grazing common bermudagrass with and without the use of nitrogen fertilizer; the value of winter legumes in a pasture management program; the winter grazing of bermudagrass; and the use of grain in supplementing grazing during the summer months. Clipping studies were conducted to determine the effect of nitrogen on the production of Midland bermudagrass and the influence of overseeding Greenfield bermudagrass with legumes.

The research reported in this publication was done under Oklahoma Station Project No. 785.

Previous Work

During early investigations at the Oklahoma Station, bermudagrass was recognized as having great possibilities as a pasture forage. Four station bulletins published before 1912 dealt with the production and distribution of a winter-hardy strain of the grass. All early production comparisons, analytical data, and digestion trials were favorable for bermudagrass.

Grazing trials on the Pasture Fertility Research Station at Coalgate have contributed much information on cattle performance on common bermudagrass (*1* & *2*). Abandoned upland soil planted to common bermudagrass and annual legumes produced 75 pounds of beef per acre, whereas soil treated with lime and 50 pounds of 0-20-0 per acre produced 129 pounds of beef. Production increased up to 200 pounds per acre on better soil sites. All animal gains were very good for April, May, and June, but extremely low for the remainder of the grazing season. Increased production per acre on the fertilized soil was due primarily to greater capacity rather than increased individual animal gain.

Most of the research on bermudagrass in recent years in the states where bermudagrass is adapted has involved comparisons of improved strains vs. common bermudagrass. In all tests where Coastal bermudagrass is adapted, it has shown superiority over common. Midland is surpassing common in the states where Coastal is not adapted. Midland overseeded with rye was better than common in grazing trials at the Maryland Experiment Station. This combination produced 620 pounds of beef per acre as compared with 401 pounds from Orchard grass and Ladino clover (*3*).

Considerable attention has been given to the possibility of supplementing bermudagrass pastures in the summer months in order to maintain uniform gain, and to the growing of forage crops in bermudagrass sod while it is dormant. The feeding of corn and cotton seed meal to animals during July, August and September on the Arkansas North Central Pasture Station increased gain, but it was not profitable (*4*). Overseeding of oats produced short time high gains in the spring, but the animal weight loss in July and August offset the early gain.

Grazing Trials on the Heavener Station

The Heavener Station is located in eastern Oklahoma, 2.5 miles north of Heavener in LeFlore County. The pasture area is situated on Waynesboro loam and gravelly loam soils with slopes of 3 to 8 percent. These soils are shallow, have some stones on the surface, and have low fertility. Common bermudagrass had been established on the areas several years before the pasture studies were started in 1949. Hop clover and annual lespedeza overseeded in the bermudagrass was thriving due to the use of intermittent applications of potash and phosphorus.

Fertilization vs. No Fertilization on Common Bermudagrass and Annual Legumes

In 1949 four small pastures were arranged in the old bermudagrass pasture. Two tons of agricultural lime per acre were applied in 1948 on two of the pastures. In 1949 the same pastures were treated with 200 pounds of 0-20-0 and 100 pounds of 0-0-60 per acre. The same application of phosphorus was made annually in October and potash was added every third year. Two pastures were not fertilized during the 10-year study.

Choice grade yearling Hereford steers were used to evaluate the pastures. All animals were wintered under uniform conditions and feed was controlled to allow a daily gain of 0.6 to 0.7 pounds. The steers weighed approximately 500 pounds at the beginning of the grazing season in April.

The steers were added or removed from the pastures in an effort to maintain good forage for grazing throughout the grazing season. The animals were weighed every month after being held in a dry lot for 15 hours.

Grazing Time

Temperature variations from year to year in March and April affected growth in the pastures. However, the most important factor that determined starting of grazing was the presence of hop clovers. Failure of the clovers to establish themselves through volunteer seeding made it necessary to delay grazing until the middle of April two years of the experiment. Stocking rates were low in April when hop clover failed.

Table 1 shows the dates grazing started and ended each year, and the number of days on pasture. Grazing was terminated by frost—usually about the first of November. For three of the ten years it was necessary to remove animals from the pastures in August or September because of drought.

Rainfall data (Appendix Table 1) reveals severely dry conditions in 1954 and 1956. Animals were removed from pastures in August 1952 because of stock water failure.

Steer Gains

Average yearly steer gains for the 10 years show only 8 pounds difference in favor of the fertilized over the non-fertilized pastures. It is difficult to account for all of the variations in the yearly steer gains for the 10 years, but a study of Table 2 presenting daily gains by months is helpful. Animals made high daily gain in April and May, especially on the fertilized pastures where clover growth was greater. The high steer gain in 1955 is associated with good clover growth in March and April and high daily gain in October.

TABLE 1. Ten year Average Grazing Performance of Common Bermudagrass Overseeded with Annual Legumes and Fertilized Annually with 200 Pounds of 0-20-0 and 33 Pounds of 0-0-60 per acre vs. No Fertilizer. (Heavener Experiment Station)

	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	Ave.
Date Grazing Began	Apr. 13	Apr. 5	Apr. 5	Apr. 2	Apr. 2	Mar. 23	Apr. 2	Apr. 2	Apr. 15	Apr. 14	Ave.
Date Grazing Ended	Nov. 11	Nov. 5	Aug. 17	Oct. 28	Aug. 17	Nov. 4	Sept. 28	Oct. 28	Nov. 1	Oct. 30	
Days on Test	213	214	136	210	137	225	180	210	200	200	193
Total Yearly Gain Pounds per Steer Fertilized	271	205	237	283	201	282	185	229	228	168	229
Total Yearly Gain Pounds per Steer Not Fertilized	244	235	162	231	210	310	194	229	225	174	221
Total Beef Production Pounds per acre—Fertilized	316	222	218	344	215	332	162	301	225	195	253
Total Beef Production Pounds per acre—not fertilized	213	177	116	196	147	224	143	172	165	118	167

TABLE 2. Average Daily Gain of Steers Grazing Fertilized and Non-Fertilized Common Bermudagrass, for Each Month of Grazing Season. (Heavener Experiment Station)

	April	May	June	July	August	September	October
1950 Fert.	2.0	2.1	2.0	.8	1.4	.9	.4
1950 Non-fert.	1.5	1.6	1.8	1.2	.8	1.2	.4
1951 Fert.	1.4	2.0	1.4	.9	.8	.2	.2
1951 Non-fert.	.6	1.9	1.3	1.0	.9	1.2	.6
1952 Fert.	2.3	2.3	1.1	1.4	.9	*	*
1952 Non-fert.	.5	1.6	1.2	1.2	.8	*	*
1953 Fert	2.5	2.4	2.0	0	1.4	1.2	0
1953 Non-fert.	1.7	1.6	2.0	.1	1.4	.9	0
1954 Fert.	2.1	2.7	1.4	.5	*	*	*
1954 Non-fert.	2.0	2.8	1.5	.7	*	*	*
1955 Fert.	2.0	2.0	1.6	.3	.9	.6	1.2
1955 Non-fert.	2.1	2.1	1.8	.3	1.0	.8	1.4
1956 Fert.	1.5	1.6	1.3	.4	.8	*	*
1956 Non-fert.	1.4	1.6	1.5	.5	.8	*	*
1957 Fert.	2.3	2.2	.8	.4	.5	1.3	.2
1957 Non-fert.	2.2	1.9	1.1	.3	.2	1.8	.2
1958 Fert.	2.0	1.9	1.6	.2	1.3	1.1	.4
1958 Non-fert.	2.1	1.8	1.6	.2	1.1	1.1	.5
1959 Fert.	1.3	2.2	.9	.4	.5	.5	.3
1959 Non-fert.	.8	2.2	.9	.4	.3	.9	.6
Ave. for 10 yrs.							
Fertilized	1.9	2.14	1.41	.53	.94	.83**	.38**
Non Fertilized	1.5	1.9	1.47	.59	.81	1.1**	.53

* Removed from pasture.
** Seven year average.

Average daily gains were higher in the fertilized pastures in April, May and August, but daily gains were higher in the non-fertilized pastures the other four months. A comparison of the animals the first of July showed the steers from fertilized pastures to be in better condition. However, little difference could be detected between the two groups at the end of the grazing period, either by scale or by observation.

The low daily gain in July and the remainder of the season is discouraging. Considerable attention is given to this problem in this publication. The monthly gain of steers presented in Figure 1 makes this low summer gain more vivid. The low July gain cannot be associated with low rainfall or poor grass growth .The animals were in good flesh from grazing clover in the spring months and the change to bermudagrass and hot weather was not encouraging to high intake.

An examination of steer gains by months, presented in Table 3, reveals that 70 percent of the average increase in animal weight was from April, May and June grazing on the fertilized pastures. Steers on non-fertilized pastures gained 65 percent of their total gain by July 1. Gains of only 70 to 80 pounds on 700 pound steers during July, August, September and October is convincing evidence that serious consideration should be given the problem to determine the factors involved and the possible remedial measures which may be taken.

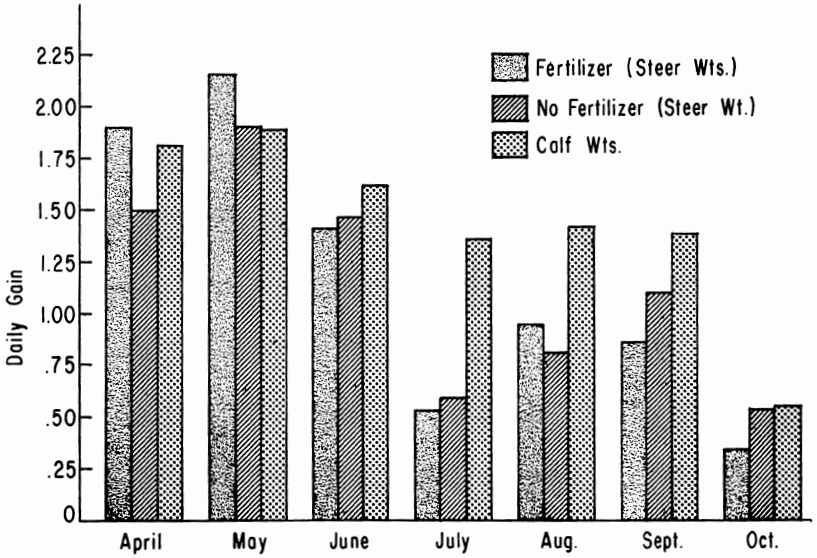

Figure 1. Comparison of daily gain of steers on fertilized and non-fertilized bermudagrass pastures and calf weights from cows on fertilized pastures.

Beef Production Per Acre

The fertilization program in this test produced 86 pounds more beef per acre than was produced on the non-fertilized pastures. This gain was due to higher carrying capacity. The average carrying capacity for the 10-year study was 0.9 acre per steer on the fertilized pastures and 1.3 acres per steer for the unfertilized area. Since steers were added or removed from the pastures to maintain good grazing conditions, the carrying capacity varied from this average. Usually more animals were necessary in the fertilized pastures in the spring months to utilize the heavy growth of clovers.

The beef production per acre by months, given in Table 4 and shown in Figure 2, clearly reveals that the increased production in the fertilized pastures is made before July 1. This indicates that the grass is aided very little in the summer months by growth of the clovers. It is easy to check the clover failures by the low gain in the fertilized pastures in April and May.

Animal gain of 253 pounds per acre is considered high when compared with other pastures grown in this area. The 10-year average of 167 pounds per acre on the non-fertilized pastures was higher than expected. Data from other pasture studies comparing similar fertility test show much lower production from the non-fertilized pastures.

TABLE 3. Monthly Beef Gains of Steers Grazing Fertilized and Non-fertilized Common Bermudagrass and Annual Legumes. (Heavener Experiment Station)

	April	May	June	July	August	Sept.	Oct.	Nov.	Total Yearly Gain P/Steer
1950 Fert.	34	65	60	25	43	27	12	5	271
1950 Non-fert.	25	50	54	37	25	36	12	5	244
1951 Fert.	35	62	42	28	25	6	6	1	205
1951 Non-fert.	15	59	45	31	28	36	18	3	235
1952 Fert.	62	71	33	43	28				237
1952 Non-fert.	14	50	36	37	25				162
1953 Fert.	70	74	60	0	43	36			283
1953 Non-fert.	48	50	60	3	43	27			231
1954 Fert.	59	84	42	16					201
1954 Non-fert.	56	87	45	22					210
1955 Fert.	74	62	48	9	28	18	37	6	282
1955 Non-fert.	77	65	54	9	31	24	43	7	310
1956 Fert.	56	50	42	12	25				185
1956 Non-fert.	59	50	45	15	25				194
1957 Fert.	64	68	24	12	16	39	6		229
1957 Non-fert.	62	59	33	9	6	54	6		229
1958 Fert.	30	59	48	6	40	33	12		228
1958 Non-fert.	32	56	48	6	34	33	16		225
1959 Fert.	21	68	27	12	16	15	9		168
1959 Non-fert.	13	68	27	12	9	27	18		174
Ave. Fert.	50.5	66.3	42.6	16.3	26.4	17.4	8.2	1.2	
Ave. Non-fert.	40.1	59.4	44.7	18.1	22.6	23.7	11.3	1.5	

The high production can be accounted for possibly because the study started on well established pastures that had been grazed several years. Although the fertilizers increased annual clover growth, some clovers were always present in the non-fertilized pastures. Annual lespedeza was more prevalent in the non-fertilized pastures, because in the fertilized pastures it was crowded out early in the season by a heavy growth of clover. Lespedeza was not a factor in these pastures after 1954 because of the drought situation. Some white clovers appeared in favorable years in the fertilized pastures, but they contributed very little to total gain.

Grain Feeding Steers

In an attempt to stabilize gains in the summer, 5 pounds of ground sorghum grain were fed daily to steers on bermudagrass pastures from July 1 to November 1. Weights were compared with similar animals under like pasturing conditions without the grain supplement. Table 5 shows weight data during 1957, 1958 and 1959. Moisture conditions were favorable during these years and all pastures were in excellent condition for grazing.

TABLE 4. Monthly Beef Production per Acre of Steers Grazing Fertilized and Non-fertilized Common Bermudagrass. (Heavener Experiment Station)

	April	May	June	July	August	September	October	November	Total
1950 Fert.	40	79	73	28	50	28	14	4	316
1950 Non-fert.	20	45	49	34	20	30	12	3	213
1951 Fert.	40	70	46	29	25	6	6		222
1951 Non-fert.	13	46	31	24	21	28	14		177
1952 Fert.	53	78	34	39	14				218
1952 Non-fert.	11	38	28	29	10				116
1953 Fert.	87	92	75	0	50	40			344
1953 Non-fert.	39	42	49	6	38	22			196
1954 Fert.	69	97	31	18	0				215
1954 Non-fert.	39	62	31	15	0				147
1955 Fert.	82*	74	58	11	34	22	45	6	332
1955 Non-fert.	56	47	39	7	21	17	32	5	224
1956 Fert.	44	52	38	10	18				162
1956 Non-fert.	35	41	35	14	18				143
1957 Fert.	84	85	31	19	23	48	11		301
1957 Non-fert.	45	43	25	7	5	39	8		172
1958 Fert.	30	56	44	7	42	34	12		225
1958 Non-fert.	23	40	36	5	26	24	11		165
1959 Fert.	23	81	32	14	18	17	10		195
1959 Non-fert.	8	48	18	8	6	18	12		118
Average Fertilized	55	76	46	18	27	20	10	1	
Average Non-fert.	29	45	34	15	17	18	9	1	

* Grazing in March was credited to April.

In this test 615 pounds of ground sorghum grain produced 91 pounds of beef. The daily gain of less than 1.5 pounds was not sufficient to finish all the steers for the packer. Two-thirds of the animals fed grain had to be sold as stockers when the tests were concluded. The three-year average cost of sorghum grain was $2.25 per 100 pounds, and the steers averaged $26 per 100 pounds when sold. During the summer of 1957, animals in another similar pasture were fed one pound of protein supplement (40 percent protein) daily. The additional protein increased weights slightly, but it was not profitable. These data indicate that bermudagrass is not deficient in nutrients during the summer months, but that animals do not consume enough.

Cow and Calf Gain on Bermudagrass

High grade Hereford cows and calves were allowed to graze on bermudagrass pastures similar to the fertilized pastures on which the steers grazed (Table 1). The calves were born in February and March and averaged from 100 to 150 pounds when grazing started in April. Monthly daily gain for the calves is presented in Table 6. The calves averaged 1.5 pounds daily gain for approximately 200 days of grazing, or a total of 300 pounds while on pastures.

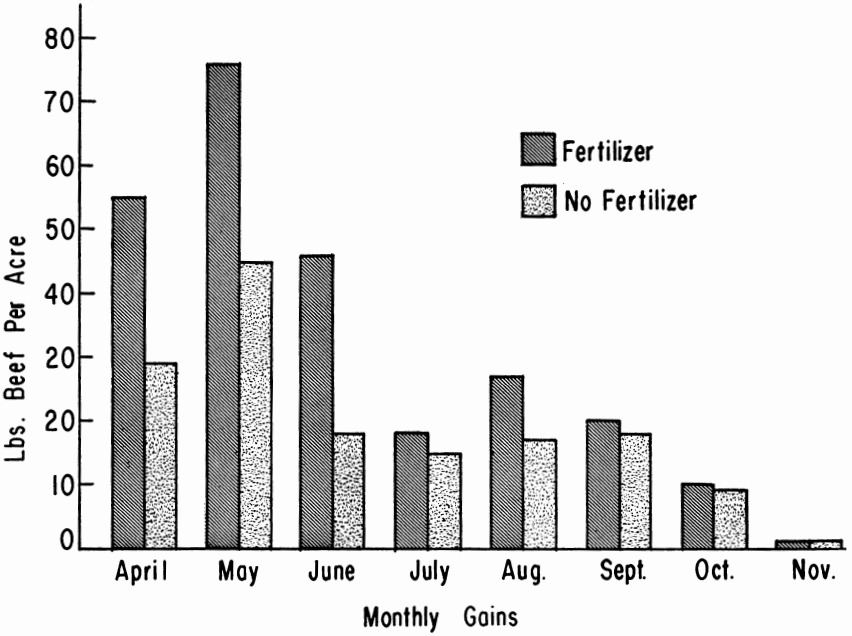

Figure 2. Pounds of beef per acre per month from steers grazing fertilized and non-fertilized bermudagrass.

TABLE 5. Effects of Feeding Grain in the Summer to Steers Grazing Bermudagrass. (Heavener Experiment Station)

Year	Feed	Daily Gain Pounds Per Steer				Steer Gain for 123 Days
		July	August	September	October	
1957	No Feed	.4	.5	1.3	.2	73 lbs.
1957	5 lbs. Daily	1.5	1.5	1.8	1.4	170 lbs.
1958	No Feed	.2	1.3	1.1	.4	97 lbs.
1958	5 lbs. Daily	1.1	1.3	1.5	1.2	157 lbs.
1959	No Feed	.4	.5	.5	.3	52 lbs.
1959	5 lbs. Daily	1.2	1.5	1.5	1.3	168 lbs.

* Average three years, no feed: 74 pounds. Average three years, 5 pounds feed: 165 pounds.

Best gains were in the spring months, but the summer weights were much higher than from one year old steers. Figure 1 shows a comparison of calf and steer daily gains for each month.

Individual cow weights varied greatly each year, but usually the cow weights were closely correlated with the steer weights. The condition of the cows when they started grazing in April greatly influenced their total summer gain. Cows wintered on small grain pastures and in good

TABLE 6. Average Daily Gain of Calves with Cows on Bermudagrass Pastures for Each Month of the Grazing Season. (Heavener Experiment Station)

Year	April	May	June	July	August	September	October
1955	1.9	2.2	1.6	1.3	1.6	1.4	1.0
1956	2.0	2.0	1.8	1.2	1.4	1.3	
1957	1.7	1.9	1.8	1.5	1.4	1.4	.4
1958	1.8	1.7	1.6	1.3	1.3	1.4	.6
1959	1.7	1.6	1.3	1.5	1.4	1.4	.7
Average	1.81	1.88	1.62	1.36	1.42	1.38	.54

flesh gained some in the spring months, but lost weight during the summer months. Cows in poor flesh made gains up to 2 pounds daily during April and May, which is similar to that of the steers. Loss of cow weight during the summer months did not affect the calf weight unless it was extended over a long period (60 days or more).

It appears from this test that bermudagrass pasture in the summer is better adapted to a cow-calf program than to a steer program. October grazing added very little to the calf weights.

Grazing Studies on the Stillwater Station

One year old Hereford heifers from the same herds as the steers grazed on the Heavener Station were used to evaluate the Stillwater pastures. The heifers were wintered the same as the steers and all handling and management procedures were the same for both groups.

Effect of Nitrogen on Bermudagrass Pastures

The test pastures of common bermudagrass were located on Port loamy soils. Nitrogen was applied broadcast at the rate of 50 pounds per acre about the first of April every year from 1952 through 1956. Nitrogen at the same rate was applied again about the first of July. In 1954 and 1956, the July application was omitted because of severe drought conditions. At the time of the first nitrogen application in 1952 and again in 1955, 200 pounds of 0-20-0 per acre were applied. A comparison pasture received the same phosphate treatments but no nitrogen.

Grazing information given in Table 7 shows the daily gain for each month, time of grazing, and total beef production per acre for the different treatments.

Early nitrogen application encouraged growth that was reflected in high individual gains in April. Some of this early gain was from annual wild bromegrass that responded to the fertilizers. After April, daily

gains were practically the same for both pastures the entire season if a good growth of forage was in the pastures. Since the grazing time in April was short, the higher gain from nitrogen did not greatly affect the total animal weight for the season.

Beef production was higher in the nitrogen-treated pasture because of higher carrying capacity and not as the result of individual gain. Carrying capacity could be regulated easily in the early part of the grazing season. However, nitrogen application in July made grazing management difficult. Under good moisture conditions bermudagrass made rapid growth when the nitrogen was applied in July. However, some years the weather stopped the growth, making it necessary to move animals in and out of the fertilized pastures frequently.

Total beef production per acre for the 5-year test was 1308 pounds where nitrogen was used and 707 pounds where it was not used. Since 400 pounds of nitrogen were used, the animal gain rate was 1.5 pounds gain for each pound of nitrogen used. This ratio may not be economical, especially where legumes can be grown in bermudagrass. Many times annual legumes fail to become established, making it necessary to use nitrogen to maintain high production.

Midland Bermudagrass Under Irrigation

In all early comparative forage tests at the Oklahoma Station, Midland bermudagrass was superior to common (*5*). Since this strain carries such high forage production potential, in 1955 a pasture of Midland was established on Port and Renfrow soils at Stillwater and was placed under an irrigation program.

Heavy applications of nitrogen were needed during the experiment. During 1955, two applications of 100 pounds of nitrogen per acre were made. The nitrogen was applied July 1 and repeated again August 1. The 200 pounds of nitrogen resulted in 349 pounds of animal gain per acre. Grazing on this experiment was conducted from July 6 through October 10 for a total of 119 grazing days.

TABLE 7. Performance of Hereford Heifers Grazing Common Bermudagrass Fertilized with Nitrogen vs. No Nitrogen. (Stillwater Experiment Station)

Fert. Used	April	May	June	July	Aug.	Sept.	Oct.	Start of Grazing	End of Grazing	Lbs. Beef Per Acre
1952 100 lbs. N	2.2	2.2	1.4	.5	1.4	.6		Apr. 14	Oct. 4	316
1952 No N	1.2	2.1	1.5	.6	.1	0				133
1953 100 lbs. N	1.7	2.1	1.7	.9	1.4	1.4	1.4	Apr. 16	Oct. 9	327
1953 No N	1.5	1.3	.9	1.5	1.5	1.0	1.0			169
1954 100 lbs. N	2.1	1.5	1.5	.5	.3	0		Apr. 14	Aug. 25	298
1954 No N	1.4	1.4	1.1	.6	0	0				153
1955 100 lbs. N	2.3	1.2	1.3	1.5	.9	.1	— 3	Apr. 5	Oct. 25	235
1955 No N	1.7	1.6	1.4	1.2	1.0	.3	4			155
1956 100 lbs. N	1.7	.8	1.0	.8				Apr. 17	Aug. 8	132
1956 No N	1.3	.7	1.2	.8						97

In 1956, the grazing was started March 7 and continued through October 12 for 220 days of grazing. Five applications, 50 pounds each, of nitrogen were applied. The applications were made on April 15, May 11, June 4, July 20 and September 3. This resulted in 696 pounds of animal gain per acre.

Ladino clover was established in the pasture in 1956 in an effort to reduce the nitrogen requirements and also to increase summer animal gains. Rye was planted in the pasture during October with a sod type drill each year after 1956. The fertilizer program beginning in 1957 was 300 pounds of 0-20-0 and 100 pounds of 0-0-60 per acre broadcast in September and 100 pounds of 16-20-0 drilled with the rye in October. Nitrogen, in the form of ammonium nitrate, was broadcast at the rate of 50 pounds of nitrogen per acre in March, June and August each year. A rotation grazing system was used.

Grazing Results

Three year average (1957, 1958 and 1959) carrying capacity, daily animal gain, and gain per acre are given in Table 8. All of the production in March was from rye. In April the sward was Ladino and rye, and thereafter it was bermudagrass and Ladino. The carrying capacity ranged from 3 to 4 animals per acre after the bermudagrass became available (for 6 months). A daily gain of 2 pounds in the spring months follows closely all other grazing studies. The daily gain of slightly over 1 pound for the summer months was disappointing, but these gains were higher than bermudagrass grazed separately. All animals were graded feeders at the end of grazing study.

Animal gain per acre of over 900 pounds annually is much higher than any other experimental pasture studies on the Oklahoma Station. Floods in 1957 and 1959 and insects in 1958 made it necessary to remove animals from the pasture for approximately 15 days during the summer season.

TABLE 8. Three Year Average Beef Production from One Year Old Heifers on Irrigated Midland Bermuda-Ladino and Rye Pasture. (1957, 58 & 59 Stillwater Experiment Station)

Month	Head per Acre	Daily Gain	Lbs. Beef Per Acre
March	1.5	2.0	39
April	1.7	2.0	102
May	4.0	1.5	188
June	4.0	1.1	132
July	3.7	1.1	126
August	3.7	1.2	138
September	3.5	1.1	116
October	3.0	1.1	73
Average			914

Management of the Irrigated Pasture

Rye not only contributed to early beef production, but prevented bloat from the Ladino clover. Clover growth was 30 days earlier than bermudagrass. Ladino clover and Midland bermudagrass were compatible crops. Rotation grazing time, set up for every 21 to 24 day intervals, was desirable for both crops. It was easy to maintain the two species growing together by the application of nitrogen.

Clipping Test

To determine the response of Midland bermudagrass to nitrogen fertilizer, an enclosure was fenced in the irrigation pasture at Stillwater for study in 1955 and 1956. Rates of 0, 50, 100 and 200 pounds of nitrogen per acre were applied on June 15 and again in August. Clippings were made every 20 days during the 120 day period. Total production for the different treatments for 1955 and 1956 is given in Table 9. In addition, the average percentage of protein is given.

The production of 7000 to 8000 pounds of dry forage per acre for the 4-month period clearly shows the potential of this strain of bermudagrass. The total production was significantly higher for each increased rate of nitrogen applied. Also, the protein content was raised materially for each increased rate of nitrogen.

Grazing Steers on Bermudagrass in Winter Months

Wintering cattle on dry native grass with a protein supplement has been checked carefully; however, the value of bermudagrass for wintering cattle is not well known. Steers weaned in October were turned into a dense growth of dry bermudagrass in November or December for two years on the Heavener and Perkins Stations.

TABLE 9. Total Production of Midland Bermudagrass for Different Treatments of Nitrogen Fertilizer for 1955 and 1956. (Stillwater Experiment Station)

Lbs. Nitrogen Per Acre	Lbs. Forage Per Acre		Average Percent Protein
	1955	1956	
None	3759	3224	12.5
100	6448	4786	14.3
200	7356	6604	16.2
400	8580	8415	18.8

During the winter of 1957-58 steers at Heavener fed 1.5 pounds of oats and 1.2 pounds of 40 percent protein supplement daily, gained an average of 35 pounds per head in 140 days. During the winter of 1958-59, 2 pounds of protein supplement were fed with the dry bermudagrass for 112 days, resulting in a 32-pounds average gain per steer for the period.

Steers fed 2 pounds of cotton seed pellets daily on Midland bermudagrass on the Perkins Station gained 0.7 pounds daily for a period of 129 days during the winter of 1958-59. The gain for the winter of 1959-60 was 0.5 pounds daily for 124 days.

Drilling Small Grains in Permanent Pastures

The development of the sod drill has made it feasible to obtain stands of cereals without seedbed preparation. A common practice is to plant these crops in bermudagrass sod. Tests on the Heavener Station without irrigation and at Stillwater with irrigation show clearly that very little grazing can be expected from this system before the middle of March. Planting time had to be delayed until late October, which is late for the fall growing season.

If plantings were made in September, grazing animals injured the young plants. When animals were removed from the pastures to permit September seeding, two months of full grazing were lost and the bermudagrass competed severely with young cereals for moisture and plant food.

Three years of clipping of rye drilled in an irrigated pasture of Midland bermudagrass and Ladino clover produced one-half the forage that was received from September plantings on a prepared seedbed. Production was closely associated with the amount of nitrogen applied. Treatments of 0, 50, 100 and 200 pounds of nitrogen per acre gave a three-year average of 940, 1400, 2000 and 2150 pounds of dry matter per acre respectively.

October sod drilling of oats in bermudagrass, on the Heavener Station, furnished grazing for March and April before the summer grass was available. However, the same grazing time was secured when vetch or annual winter legumes were fertilized with phosphorus.

Legumes for Bermudagrass Pastures

Bermudagrass rates very high in its response to fertilization, especially to nitrogen. If a program of fertilization is not provided through commercial fertilizers or legumes, bermudagrass will produce little more than native grasses. In most bermudagrass grazing trials, legumes have been used because they are good forage plants and are supposed to furnish nitrogen for the grass plant.

Since several species of legumes are used in combination with bermudagrass pastures, questions arise as to which is the most compatible, which furnishes the most nitrogen, which is the best for grazing animals, which is best adapted, and so forth. With these questions in mind, a grazing test was started in 1957 to compare vetch and bermudagrass, and bermudagrass supplied with 100 pounds of nitrogen each season. Two years of clipping data have been obtained where bermudagrass was overseeded with six legumes in an attempt to evaluate their attributes.

The grazing test was made on the same pastures on the station used for the comparison of nitrogen versus no nitrogen (Table 7).

In the fall of 1956, 20 pounds of vetch and 200 pounds of 0-20-0 per acre were drilled in the non-fertilized pastures. This treatment was repeated each year. In the comparative pastures, nitrogen was applied at the rate of 50 pounds per acre in April and again in July.

Animal gain per acre is given in Table 10 for three years grazing. Production was the same for both treatments in 1958 but lower for the legume treatment in 1957 and 1959. This difference can be accounted for by the poor stand of vetch these two years. An excellent crop of vetch in 1958 produced grazing results similar to the use of 100 pounds of nitrogen per acre. Vetch increased grazing time and animal gain over nitrogen in March and April. An application of nitrogen in July increased stocking rates in the summer months.

Clipping tests were conducted at Stillwater to determine the value of overseeding six legume species on Greenfield bermudagrass. The plots were established on a good stand of Greenfield bermudagrass growing on a soil very low in nitrogen. A heavy rate of seed of the following legumes was broadcast on the plots the first of October each year. Vetch, Big Hop clover, Crimson clover, Button clover, alfalfa and Ladino clover. Alfalfa and Ladino clover became established the first year and were not reseeded. A sprinkler irrigation system was used to aid in the establishment. Sufficient phosphorus and potash were broadcast on all plots in September for high production of alfalfa.

Three different clipping procedures were used in the test:

(A) All legume forage was clipped, weighed and removed from the plots. This required cutting in April and again in May.

TABLE 10. Beef Production from Bermudagrass Pastures Fertilized with Nitrogen vs. Overseeding with Vetch. (Stillwater Experiment Station)

	Lbs. Beef per Acre for Three Years		
Treatment	1957	1958	1959
100 lbs. N per acre	248	370	261
Vetch	207	365	212

(B) The legumes were harvested in April. They were not harvested in May but were allowed to be returned to the soil.

(C) None of the legumes were clipped and all forage remained on the plots. Clippings in (C) were delayed until June or after all residue from the annual legumes had become fairly well decomposed. Only bermudagrass weights were secured in (C) for the annuals.

Samples of alfalfa and Ladino clover were separated from the grass during the summer in all clipping treatments. Another treatment in the test was the use of nitrogen fertilizer applied at rates of 0, 50 and 100 pounds per acre without legumes. In all plots the clippings were spaced approximately 30 days apart throughout the growing season (May until September).

Table 11 gives the average production for the legumes and bermudagrass under the different clipping systems for the 2-year period. Button clover data were collected only in 1958 as the stand was lost in 1959, possibly by winter temperatures. Legume growth for vetch and crimson clover was approximately one ton per acre, while Hop clover was 25 percent lower. Greater variation can be found in the grass production.

TABLE 11. Evaluation of Legumes Overseeded on Greenfield Bermudagrass. (Stillwater Experiment Station)

Legume and Clipping Treatment		Lbs. Legume Forage	Lbs. Bermudagrass	Total Production
Vetch	A	2008	1890	3898
	B	1368	2940	4308
	C		3823	3823
Crimson	A	2087	1472	3559
	B	1100	2354	3454
	C		3250	3250
Hop	A	1657	1931	3588
	B	1141	1782	2923
	C		1908	1908
Alfalfa	A	4747	1011	5758
	B	4926	901	5827
	C	3617	1507	5124
Ladino	A	2369	2206	4575
	B	1906	2030	3936
	C	994	2611	3605
No Nitrogen			1345	1345
50 lbs. P/A			2744	2744
100 lbs. N P/A			3796	3796

A. All legumes cut and removed from plot. Grass cut later in season.
B. All legumes cut once and second growth returned to soil.
C. All legume growth returned to the soil and only grass harvested. Nitrogen applied in May 50 Lbs. P/A and 50 Lbs. again in July.

One ton of vetch remaining on the soil increased bermudagrass production 1,933 pounds per acre. On the other hand, the addition of Hop clover to the soil did not increase bermudagrass growth. Crimson clover residue gave a response similar to vetch. Total production for the different clipping treatments were practically the same for vetch. This was also true for Crimson clover but total production was slightly under vetch.

These data indicate that vetch and Crimson clover growth can be grazed at any degree of intensity and still not affect total production seriously. Since these legumes make growth in early spring before the bermudagrass, it would be desirable to pasture them to lengthen the grazing season and to take advantage of high animal gain possible at this time of year. Grazing management can be regulated to permit partial seed production of the legume for volunteer seeding for the next year, without too much loss of grazing.

A close relationship was not found between Hop clover growth and total production. To secure maximum production, the Hop clover would have to be consumed completely by the animal. Fortunately, Hop clover can reseed under close grazing conditions.

The clipping methods imposed on the perennial legumes of alfalfa and Ladino clover affected total production less than the annual legumes. The (C) treatment lowered production because clipping was delayed too long in the spring months. Table 11 does show Ladino clover to be more compatible with bermudagrass than alfalfa. Alfalfa cut once a month kept bermudagrass production low. Production of Ladino and the grass was equal under the (A) and (B) methods of management.

Fifty pounds of nitrogen per acre doubled bermudagrass production over the no nitrogen plots. The addition of 100 pounds of nitrogen per acre produced a yield comparable to vetch and Crimson clover in combination with bermudagrass. In this test the legumes made maximum growth under the fertility program and irrigation. Unfortunately, the annual legumes do not become established every year, making it necessary to use nitrogen to secure maximum production from bermudagrass these off-years.

Conclusions

Common bermudagrass and Hop clover pastures at the Heavener Station fertilized with 200 pounds of 0-20-0 annually and 100 pounds of muriate potash every third year produced a 10-year average of 253 pounds of animal gain per acre from 1-year old beef steers.

Comparative non-fertilized pastures produced 167 pounds per acre. The high production from non-fertilized pastures was possible because the grazing test started on a thriving pasture that had been fertilized and pastured for several years previous to the test period.

Increased gain per acre for the fertilized pasture was due to higher carrying capacity and not to higher individual gain.

Steer gains were high in the spring months but very low in summer. Seventy percent of the seasonal gain occurred before July 1. The average carrying capacity for fertilized pastures was 0.9 acre per steer, and 1.3 acres for non-fertilized pastures.

Steers on bermudagrass pastures fed 5 pounds of ground sorghum grain daily for 123 days, July to November, gained 91 pounds over animals not receiving the grain. The extra gain did not finish the animals for slaughter.

Calves weighing 100 to 150 pounds each from grade Hereford cows grazing bermudagrass-Hop clover pastures gained 1.5 pounds daily or 300 pounds for 200 days. These gains were more uniform during the season than were the gains with the steers. Calf gains were low in October.

Gains from the cows were closely associated with their condition at the beginning of the grazing period. Generally, cow and steer weight followed the same trend.

On the Stillwater Station, 1 pound of nitrogen applied on Common bermudagrass growing on good soils produced 1.5 pounds of beef over non-nitrogen treated pastures. Increased gains on grade Hereford heifers were from higher carrying capacity and not higher gain per animal.

Nitrogen application in the summer months made it difficult to maintain proper carrying capacity.

A pasture of Midland bermudagrass-Ladino clover over-seeded with rye in the fall produced more than 900 pounds of animal gain per acre. The carrying capacity for 8 months grazing was 3 to 4 animals per acre.

Midland bermudagrass irrigated and treated with 200 to 400 pounds of nitrogen per acre produced 7,000-8,000 pounds of dry matter per acre in 120 days.

Nine-month to one-year old steers grazing dry bermudagrass in the winter months and fed 2 pounds of 40 percent protein supplement daily made gains from 0.25 to 0.70 pounds per day.

Small grains could not be established in bermudagrass in the fall in time for enough fall growth to provide winter grazing. Spring growth depended upon the amount of nitrogen available.

Vetch and Crimson clover over-seeded on Greenfield bermudagrass under good fertility and moisture conditions produced total forage comparable to 100 pounds of nitrogen per acre.

The addition of vetch and Crimson clover residue to the soil stimulated bermudagrass growth but Hop clover residue did not affect grass growth.

APPENDIX 1—Monthly Rainfall Data During the Bermudagrass Grazing Season. (Stillwater Station)

	Inches of Rainfall Per Month								Total for 8 Mos.
	March	April	May	June	July	August	September	October	
1950	.39	1.58	5.23	2.39	6.53	3.06	1.26	.27	20.71
1951	.90	4.27	4.41	5.40	3.80	3.04	7.47	3.72	33.01
1952	2.88	2.48	3.41	1.78	1.38	3.54	.76	--	16.23
1953	4.19	2.67	2.21	2.55	7.85	7.85	2.65	2.16	27.93
1954	.17	2.27	5.25	2.08	--	1.56	.88	1.26	13.47
1955	1.79	.32	9.51	2.80	1.41	1.93	1.08	4.77	23.61
1956	.59	.38	3.81	1.27	1.03	1.27	.16	2.06	10.57
1957	2.40	5.10	14.91	9.46	.89	1.66	4.85	2.18	41.45
1958	4.84	1.35	1.40	6.72	4.47	4.96	3.72	.46	27.92
1959	2.28	2.12	4.49	4.11	12.46	2.02	11.26	12.93	51.67
Average	2.04	2.25	5.46	3.86	3.98	2.57	3.36	3.13	26.66

APPENDIX 2—Rainfall Data During Ten Years of Grazing Tests. (Heavener Experiment Station)

	Inches of Rainfall Per Month								Total for 8 Mos.
Year	March	April	May	June	July	August	September	October	
1950	1.10	2.45	4.46	1.99	1.00	3.10	4.80	1.01	28.91
1951	1.23	3.43	2.60	6.32	4.57	3.65	6.98	4.75	33.53
1952	5.14	7.36	3.88	2.28	2.31	2.27	3.78	1.12	28.14
1953	6.32	9.18	5.19	.32	10.16	.59	1.97	1.30	35.03
1954	.80	5.64	4.32	1.11	.32	2.81	1.64	6.08	22.72
1955	7.28	3.08	2.51	2.91	3.08	4.57	3.49	.79	27.71
1956	2.07	2.75	4.88	1.13	1.68	1.66	1.10	.84	16.11
1957	5.01	12.46	11.77	6.43	1.65	9.20	7.87	.96	55.35
1958	4.61	4.92	6.51	9.47	5.03	6.68	5.09	1.90	44.21
1959	4.44	3.10	3.48	2.76	6.09	2.92	3.55	5.65	31.89
Average	3.80	5.44	4.96	3.47	4.49	3.75	4.03	2.43	32.36

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