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PRODUCING YEARLING STEERS ON IRRIGATED BLUEGRASS-CLOVER

AND ORCHARDGRASS-CLOVER PASTURES

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Summary

A 7-YEAR study of the comparative value of old stands of bluegrass-clover pastures and improved orchardgrass-clover pastures for yearling steer production was conducted at the Tobacco Experiment Station, Greeneville, Tennessee. Also, the effects of irrigation on the productivity and costs of these two types of pastures were studied. Results showed the following:

1. Daily gains of steers did not differ significantly ($P > .05$) regardless of treatment. Gains ranged from 1.43 to 1.50 pounds per head daily for the grazing season of approximately 150 days.
2. Non-irrigated orchardgrass pastures produced 49 more animal grazing days per acre than did non-irrigated bluegrass pastures.
3. Although irrigation did not increase daily gains on either type of pasture, animal grazing days per acre were significantly increased due to irrigation. Irrigation did not prevent a summer slump in animal gains.
4. Pasture costs were increased $28 to $30 per acre annually where irrigation was used. The increased beef produced as a result of higher carrying capacities was not enough to meet this additional expense.
5. During the course of this study, weeds increased in the orchardgrass pastures and the stand became too thin for optimum production. The bluegrass pastures, on the other hand, retained dense sods even though they had been established for a long period of years.
6. All steers graded about average to high Standard, and required an additional dry-lot feeding period to get them to a desirable market condition.

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ENVIRONMENTAL conditions in the upper east Tennessee area are very favorable to producing bluegrass-white clover pastures. It is not uncommon to find pastures of this type that have been established for 20 years or more. This is a distinct advantage, because much of the general topography in this area is unfavorable to plowing and reseeding pastures. Also, the expense and uncertainty that goes with pasture re-establishment can be eliminated.

The fertility and drainage of the soils in this area also favor producing orchardgrass-ladino clover pastures, which are usually considered the standard for evaluating other pastures.

Previous work in Tennessee has shown that both types of pastures produce good rates of gain on yearling beef steers, but both pastures have not been compared at the same location. A 7-year study (1956-1962) was conducted at the Tobacco Experiment Station, Greeneville, Tennessee, to compare the beef-producing qualities of these pastures, and to evaluate the effects of irrigation on them.

Procedure

The following table shows the experimental design employed in this study:

Treatments	No. of replicate plots	Size of plots, A.	No. of test animals/plot
1. Bluegrass-white clover	3	3	3
2. Same as 1, with irrigation	3	2½	3
3. Orchardgrass-Ladino clover	3	2½	3
4. Same as 3, with irrigation	3	2	3

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Pastures and Soils

The bluegrass pastures, which had been established about 20 years, were limed and fertilized initially according to soil test. These pastures were located on a creek bottom with some limestone rock outcroppings. Previously these pastures had been used in a 4-year study involving irrigation and nitrogen.

The land for the orchardgrass-clover pastures lay adjacent to the bluegrass pastures. These pastures were seeded in the fall of 1955 with a mixture of 16 pounds of orchardgrass, 1 pound of ladino clover, 1 pound of Louisiana white clover, and 6 pounds of alfalfa per acre. This land was limed and fertilized according to soil test. With the help of some good fall rains and about 1½ inches of irrigation water, a reasonably good stand was obtained, and these pastures were ready for grazing the following spring.

The soils included in each treatment are given in Table 1. Each bluegrass pasture was about four-fifths bottomland and low terrace. The remainder was sloping upland. Approximately half of each orchardgrass pasture was bottomland and low terrace with the remainder being severely eroded sloping upland. Differences in soil types on which the bluegrass and orchardgrass pastures grew make comparisons between kinds of pasture less meaningful than comparisons within kinds of pasture.

Dewey and Dunmore are deep, well-drained soils developed from limestone residuum. Where uneroded, the surface is a silt loam and the subsoil a red clay. A considerable portion of the experimental area now has a silty clay loam surface because of erosion and the mixing of the surface and subsoil by cultivation. Slopes range from 2% to 12%.

Hermitage silt loam is a deep, well-drained soil that has medium textures to depths greater than 36 inches. It is on a low bench between more sloping soils and the bottomland.

Huntington and Lindside are bottomland soils. Huntington silt loam is well-drained. Lindside silt loam is moderately well to somewhat poorly-drained. Huntington and Lindside have medium textures throughout. Wolftever silt loam is a moderately well-drained soil on a low terrace. It has a silt loam surface and a firm, compact silty-clay loam subsoil.

Table 1. Kind and percentage of soils in each treatment

Kind of soil	Percent of soil in treatments			
	I	II	III	IV
Dewey silty clay loam, severely eroded, 5% to 12% slopes			50	45
Dunmore silt loam, eroded, 2% to 5% slopes	10	18		
Dunmore silty clay loam, severely eroded, 5% to 12% slopes	10	3		
Hermitage silt loam, 5% to 12% slopes	14		5	
Huntington silt loam, 2% to 5% slopes			41	25
Lindside silt loam	33	54	1	25
Wolftever silt loam, 2% to 5% slopes	33	25	3	5

Animals

Yearling Hereford steers were used as test animals. These steers had been used in silage wintering trials the winter previous to each year's test, and had gained about 1 pound per head per day. They were allotted to the individual pasture plots on the basis of weight, type grade, condition, and winter gain.

Management and Observations

The grazing season began each spring whenever the pastures would support the steers, usually about the middle of April. The three test animals remained on the pastures until about the first of September, at which time they were removed and finished in dry-lot. Extra animals were put on or taken off the pastures as needed to control grazing levels and to be used in estimating total grazing days.

The test animals were weighed on 2 consecutive days at the beginning and end of the test, and at 28-day intervals during the grazing season.

All pastures were clipped as needed to remove seed heads and coarse, stemmy material. An average of 200 pounds of 0-20-20 analysis fertilizer was applied each year to all pastures during the 7 years of the experiment.

The pastures were visually evaluated at 14-day intervals during the entire test period. Such factors as stage of growth, estimated percent species composition, condition of pastures, color, and carrying capacity were noted. At these times decisions regarding changes in animal numbers were made. Also daily records of precipitation and temperature extremes were kept. It was felt that a description of the pastures for any period during the test might possibly be used in helping to explain the results.

These pastures were also grazed some in the fall by weanling calves and brood cows, but an account of that is not included in this report.

Irrigation

Irrigation water was obtained from a small stream flowing through the test area and was applied with a portable sprinkler system. During the first 4 years of the test, periodic soil samples were taken to determine the need for irrigation. During the last 3 years, the "bookkeeping" method was utilized. With this procedure, daily evapo-transpiration rates were subtracted from the base moisture of the surface soil, which was 1.80 inches at field

Figure 1. The sprinkler irrigation system is in operation on a bluegrass-cover pasture.

capacity. Rainfall was added to this base, but never more than 1.80 inches for a single rain. Whenever the base moisture reached zero, 2 inches of water was applied to all irrigated plots. The water was added in increments of 1 inch on successive days to

avoid run-off. The cost of irrigation was calculated very conservatively to be $4 per acre inch. Daily evapo-transpiration rates were as follows:

April — .07 in.	July — .19 in.
May — .12 in.	August — .17 in.
June — .12 in.	September — .12 in.

Results and Discussion

Animal Performance

Average daily gains of the steers for the entire experiment were very similar for the four groups (Table 2), and did not differ significantly ($P > .05$). Daily gains ranged from 1.43 pounds per day on non-irrigated bluegrass to 1.49 pounds per day on irrigated orchardgrass. There was some yearly variation in daily gain, with a range for all lots of 1.30 pounds per day in 1959 to 1.88 pounds per day in 1957, and there was a highly significant year effect for daily gain. Tables showing yearly summaries are presented in the appendix. Although daily gains were similar for the four treatments when the 7 years were averaged, there were considerable variations between treatments within years, particularly 1956 (treatment 3), as is shown in the yearly summaries.

When planning the use of irrigation on these pastures, it was felt that possibly the usual summer slump in daily gains could be prevented by irrigating. However, examination of Figure 2 shows that daily gains declined at about the same rate in the irrigated and non-irrigated pastures, and that the decline occurred at about the same time in the bluegrass and orchardgrass pastures. Probably maturity of forages and maximum daily temperatures were important factors in causing the decline.

Final condition grades of the steers averaged about the same for all treatments, ranging from 7.2 to 7.7 (based on 7.0 = standard, 8.0 = high standard). Cattle of this weight and grade usually require a 60- to 90-day dry-lot feeding period to get them to the desired slaughter condition.

In 1957, three steers grazing on orchardgrass-clover pastures died of bloat during the early spring. At this time, the amount of clover in these particular pastures was not unusually high (15-20%). This was the only year that bloat was a serious problem.

Pasture Productivity

Total grazing days per acre during the grazing season are shown in Table 2. In this respect the non-irrigated orchardgrass pastures were definitely superior to the non-irrigated bluegrass pastures, with 222 days of grazing as compared with 173 days (Table 2).

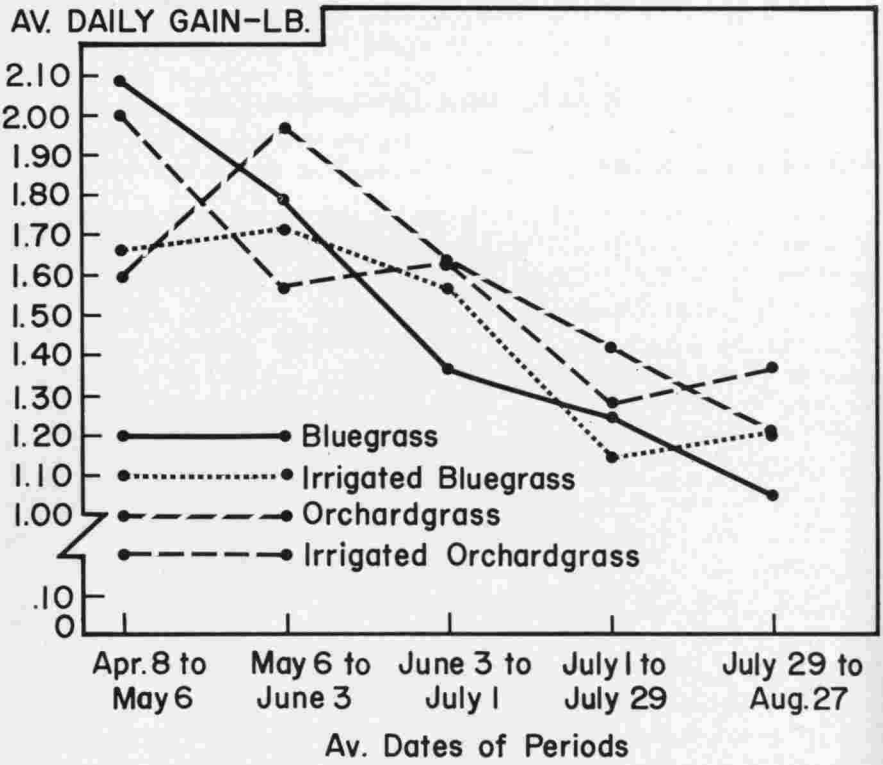

Figure 2. Distribution of animal gains by 28-days periods.

This difference was significant ($P < .05$). As was previously mentioned, these figures represent the cumulative total of days that both the test steers and extra steers were on the pastures, and represents what was considered to be the optimum grazing level at all periods during the grazing season.

Both types of pastures responded to irrigation by producing significantly more ($P < .05$) grazing days per acre, but the response was considerably greater on the bluegrass pastures (77 days increase) than on the orchardgrass pastures (50 days in-

crease). All pastures reached their peak carrying capacity during the second 28-day period (May 6 to June 3). Irrigated and non-irrigated pastures declined considerably in grazing days produced during the third period, but the irrigated pastures remained above the non-irrigated ones (Fig. 3).

Table 2. Summary of animal performance, average of 7 years

	Treatments			
	1 Bluegrass-Clover	2 Blue.-Clover Irrigated	3 Orchardgrass-Clover	4 Orch.-Clover Irrigated
No. days on pasture	154	154	154	154
Av. wt. and gain per head, lb:				
Initial wt.	598	601	602	595
Final Wt.	819	824	826	825
Daily gain [a] (test steers)	1.43	1.45	1.45	1.49
Av. animal grades: [b]				
Initial feeder grade	10.7	10.8	10.8	10.8
Initial slaughter grade	5.8	5.7	5.9	6.0
Final slaughter grade	7.2	7.3	7.5	7.7
Productivity of Pastures:				
Animal grazing days per acre	173[c]	250[e]	222[d]	272[e]
Estimated beef gain per acre	258	364	344	423
Carrying capacity, acres per steer	0.91	0.62	0.67	0.56

a Means do not differ significantly ($P > .05$)
b 5.0 = high utility; 8.0 = high standard; 11.0 = high good.
c, d, e Means with the same subscript letter do not differ significantly ($P > .05$)

Assuming that each grazing day produced the same daily gain as that of the test steers during each period, non-irrigated orchardgrass was estimated to produce 86 pounds more beef per acre than the non-irrigated bluegrass pastures during the entire grazing season. Likewise, irrigation increased beef produced per acre by 106 pounds on bluegrass and by 79 pounds on orchardgrass, simply as a result of increased grazing days per acre (Table 2).

Financial Data

Yearly pasture costs averaged $9.46 for the bluegrass-clover pastures and $13.28 for the orchardgrass-clover pastures. This charge included initial liming and fertilization and yearly maintenance fertilization and clipping for the bluegrass pastures. The charge for orchardgrass included these same factors and in addition, the initial plowing and seeding costs. Nothing was charged for labor in this analysis.

The irrigated pastures received a yearly average of 7.61 and 7.15 acre-inches of water for the bluegrass and orchardgrass pastures, respectively. At a cost of $4 per acre inch, this increased costs by $30.44 and $28.60 per acre per year, respectively.

The test cattle in this study were evaluated on the basis of slaughter value, although at a final weight of 825 pounds and a slaughter grade of standard, they would more correctly be called feeder cattle. Since there were only slight differences in final condition, all cattle were appraised at a similar slaughter value.

Table 3. Financial data. Yearly average for 1956-1962

	Treatments			
	1 Bl.-Cl.	2 Bl.-Cl. Irr.	3 O-Cl.	4 O-Cl. Irr.
Pasture costs per acre, dollars:				
Initial fertilization and seeding prorated over 7 years	2.53	2.53	7.55	7.55
Annual maintenance fertilizer	6.26	6.26	6.26	6.26
Clipping	2.00	2.00	2.00	2.00
Average annual pasture cost	10.79	10.79	15.81	15.81
Irrigation costs per acre, dollars	....	30.44	....	28.60
Total cost per acre, dollars	10.79	41.23	15.81	44.41
Steers returns, dollars:				
Initial value per cwt.	24.14	24.14	24.14	24.14
Initial value per head	144.36	145.08	145.32	143.63
Final slaughter value per cwt.	20.48	20.44	20.47	20.59
Final slaughter value per head	167.73	168.42	169.08	169.87
Gross return per head	23.37	23.34	23.76	26.24
Carrying capacity, steers/acre	1.1	1.6	1.5	1.8
Return per acre above pasture costs:				
Based on slaughter value	14.92	—3.89	19.83	2.82
Based on final feeder value of $22.00 per cwt.	29.82	16.69	38.79	23.76

Financial returns on this basis are shown in Table 3. Although considerably more beef per acre was produced on the irrigated pastures, the cost of the irrigation was such that profits were much greater on the non-irrigated pastures.

Species Composition of Pastures

Table 4 shows the average species composition, as determined by estimates at 14-day intervals during the grazing season, for the first and last years of the study. Composition remained rather constant in the bluegrass-clover pastures, and at the end of the

7-year study they still generally had very dense sods. The orchardgrass-clover pastures, on the other hand, decreased somewhat in percent clover and increased considerably in percent orchardgrass. During the first year, alfalfa was a prominent factor in the orchardgrass pastures, but by the second year it was practically eliminated by the combined pressures of grazing and disease. By the end of this study the orchardgrass-clover sods were becoming rather thin and were in need of re-establishment or renovation.

Species listed under "other" in the table probably were important factors at certain times during the grazing season. This was particularly true of dallisgrass, which was prominent in most of the bluegrass pastures during the mid-summer months. It may have made significant contributions to the total beef produced on

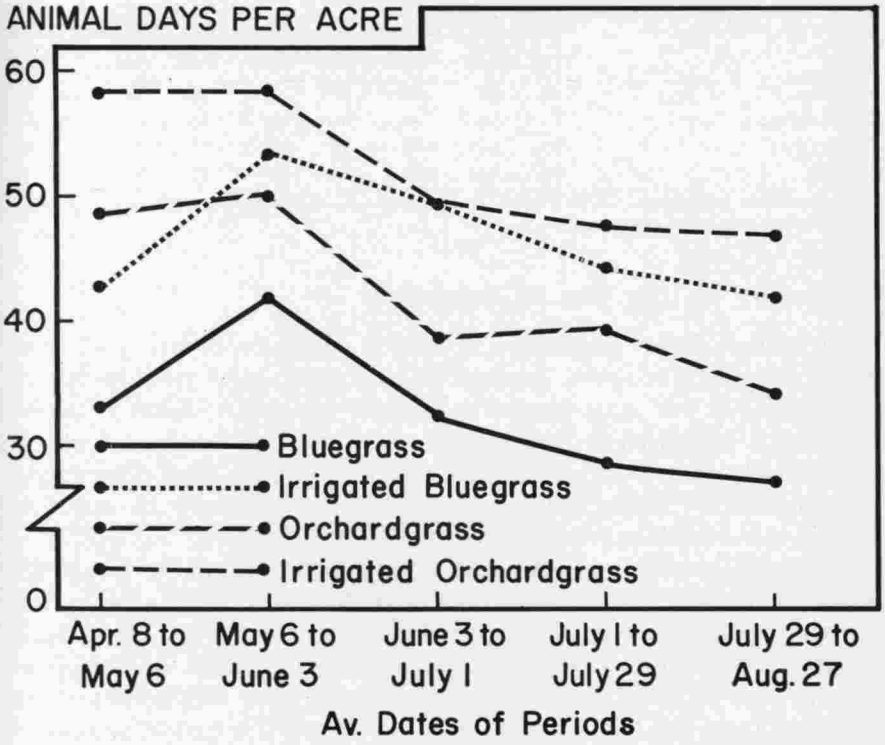

Figure 3. Distribution of animal grazing days by 28-day periods.

the bluegrass pastures, because it became prominent at a time when the bluegrass was in a summer dormant condition. In some of the orchardgrass pastures there was considerable bluegrass present

during the last 2 years of the study.

Longevity or persistence of stand is probably one of the major considerations in evaluating pastures. In this characteristic, bluegrass pastures were definitely superior to orchardgrass pastures in this study. In order for the orchardgrass pastures to be returned to their original productivity, it would probably be necessary to completely re-establish them. The expense and risk involved in this process makes this highly undesirable. The bluegrass pastures, on the other hand, remained dense even though they had been established for over 27 years. With proper care they may possibly be maintained indefinitely. This is certainly a consideration of economic importance.

Table 4. Average estimated percent species composition of pastures

	Bluegrass		Bluegrass-Irr.		Orchardgrass		Orchardgrass-Irr.	
	1956	1962	1956	1962	1956	1962	1956	1962
Bluegrass	58	59	54	51	—	8	—	11
Orchardgrass	—	—	—	—	43	58	41	53
Clover	20	25	26	23	30	22	38	28
Other [a]	22	16	20	26	27	12	21	8

a Includes dallisgrass, hop clover, bull nettles, bermudagrass, foxtail and various other weeds and wild grasses.

Comments on the Use of Irrigation

Irrigation is an expensive operation, with costs being at least $4 per acre-inch of water applied. In this study costs were increased by $28 to $30 per acre due to the use of irrigation. Even with the significant increases in beef yields resulting from increased carrying capacity due to irrigation, considerably higher beef prices than were common during this study would be necessary in order to justify this additional cost.

The matter of timing seemed to be one of the major problems in the irrigation program. Certainly better methods for determining when water is needed for pasture crops is desirable. Frequently significant amounts of rain fell during the irrigation operation or shortly thereafter. Of course, much benefit that might have been obtained from the irrigation was nullified, but the cost of irrigation was nevertheless charged to the pastures.

Had these pastures been used for milk production rather than beef, possibly irrigation would have been an economically sound practice. But for yearling steer production, it did not appear to be profitable under the conditions of this study (Table 5).

Table 5. Summary of rainfall and irrigation—average of 1956-1962

Period	Av. dates	Rainfall	Irrigation, Water	
			Bluegrass	Orchardgrass
		Inches	Inches	Inches
1	Apr. 8 to May 6	3.73	0.60	0.56
2	May 6 to June 3	2.64	1.56	1.50
3	June 3 to July 1	4.17	1.40	1.10
4	July 1 to July 29	4.25	1.81	1.72
5	July 29 to Aug. 27	4.31	2.24	2.27
		19.10	7.61	7.15

Appendix

Appendix 1. Summary of 1956 results (154 days)

	Treatments			
	1 Bl.-Cl.	2 Bl.-Cl. Irr.	3 O-Cl.	4 O-Cl. Irr.
Av. wt. and gain per head, lb.:				
Initial wt.	713	714	728	712
Final wt.	896	900	965	909
Daily gain (test steers)	1.19	1.21	1.63	1.35
Pasture productivity:				
Animal days per acre	153	247	214	311
Estimated beef gain/acre	179	291	360	423
Composition of pastures, percent:				
Bluegrass	57.9	53.7	...	...
Orchardgrass	...	...	42.8	40.6
Clover	20.0	25.6	30.1	38.1
Other grasses and weeds	22.1	20.7	17.1	21.3

Appendix 2. Summary of 1957 results (154 days)

	Treatments			
	1 Bl.-Cl.	2 Bl.-Cl. Irr.	3 O-Cl.	4 O-Cl. Irr.
Av. wt. and gain per head, lb.:				
Initial wt.	598	596	599	584
Final wt.	864	902	887	888
Daily gain (test steers)	1.73	1.98	1.86	1.97
Pasture productivity:				
Animal days per acre	183	257	216	281
Estimated beef gain per acre	321	525	422	564
Composition of pastures, percent:				
Bluegrass	47.4	37.4	...	...
Orchardgrass	...	...	47.0	44.9
Clover	36.6	35.5	41.6	49.8
Other grasses and weeds	16.0	27.1	11.4	5.3

Appendix 3. Summary of 1958 results (154 days)

	Treatments			
	1 Bl.-Cl.	2 Bl.-Cl. Irr.	3 O-Cl.	4 O-Cl. Irr.
Av. wt. and gain per head, lb.:				
Initial wt.	558	579	575	555
Final wt.	800	791	790	790
Daily gain (test steers)	1.57	1.37	1.39	1.52
Pasture productivity:				
Animal days per acre	189	236	240	278
Estimated beef gain per acre	317	321	345	429
Composition of pastures, percent:				
Bluegrass	46.5	50.5	...	...
Orchardgrass	...	...	63.3	57.3
Clover	37.1	27.0	30.5	34.9
Other grasses and weeds	16.4	22.5	6.2	7.8

Appendix 4. Summary of 1959 results (147 days)

	Treatments			
	1 Bl.-Cl.	2 Bl.-Cl. Irr.	3 O-Cl.	4 O-Cl. Irr.
Av. wt. and gain per head, lb.:				
Initial wt.	552	564	557	554
Final wt.	740	745	737	770
Daily gain (test steers)	1.27	1.23	1.22	1.47
Pasture productivity:				
Animal days per acre	167	219	206	254
Estimated beef gain per acre	219	268	260	372
Composition of pastures, percent:				
Bluegrass	70.2	59.0	..	..
Orchardgrass	..	..	79.1	72.8
Clover	18.2	15.4	13.2	15.9
Other grasses and weeds	11.6	25.6	7.7	11.3

Appendix 5. Summary of 1960 results (140 days)

	Treatments			
	1 Bl.-Cl.	2 Bl.-Cl. Irr.	3 O-Cl.	4 O-Cl. Irr.
Av. wt. and gain per head, lb.:				
Initial wt.	622	618	609	611
Final wt.	803	798	793	801
Daily gain (test steers)	1.29	1.29	1.31	1.36
Pasture productivity:				
Animal days per acre	149	238	226	264

Estimated beef gain per acre	196	306	288	356
Composition of pastures, percent:				
Bluegrass	72.1	65.3	5.0	6.7
Orchardgrass	..	..	78.4	67.8
Clover	6.4	15.0	11.0	20.6
Other grasses and weeds	21.5	19.7	5.6	4.9

Appendix 6. Summary of 1961 results (172 days)

	Treatments			
	1 Bl.-Cl.	2 Bl.-Cl. Irr.	3 O-Cl.	4 O-Cl. Irr.
Av. wt. and gain per head, lb.:				
Initial wt.	551	548	549	558
Final wt.	805	815	801	801
Daily gain (test steers)	1.48	1.56	1.47	1.41
Pasture productivity:				
Animal days per acre	193	273	235	289
Estimated beef gain per acre	290	431	354	415
Composition of pastures, percent:				
Bluegrass	61.2	61.4	9.6	11.3
Orchardgrass	..	..	66.2	55.0
Clover	25.1	20.0	15.7	27.7
Other grasses and weeds	14	19	8.5	6.0

Appendix 7. Summary of 1962 results (155 days)

	Treatments			
	1 Bl.-Cl.	2 Bl.-Cl. Irr.	3 O-Cl.	4 O-Cl. Irr.
Av. wt. and gain per head, lb.:				
Initial wt.	591	586	594	594
Final wt.	825	817	809	816
Daily gain (test steers)	1.51	1.49	1.39	1.43
Pasture productivity:				
Animal days per acre	183	251	214	275
Estimated beef gain per acre	281	408	302	400
Composition of pastures, percent:				
Bluegrass	59.1	51.3	8	11
Orchardgrass	..	..	58	53
Clover	24.9	22.5	22	28
Other grasses and weeds	16.0	26.2	12	8

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