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Stilbestrol Studies with Beef Cattle

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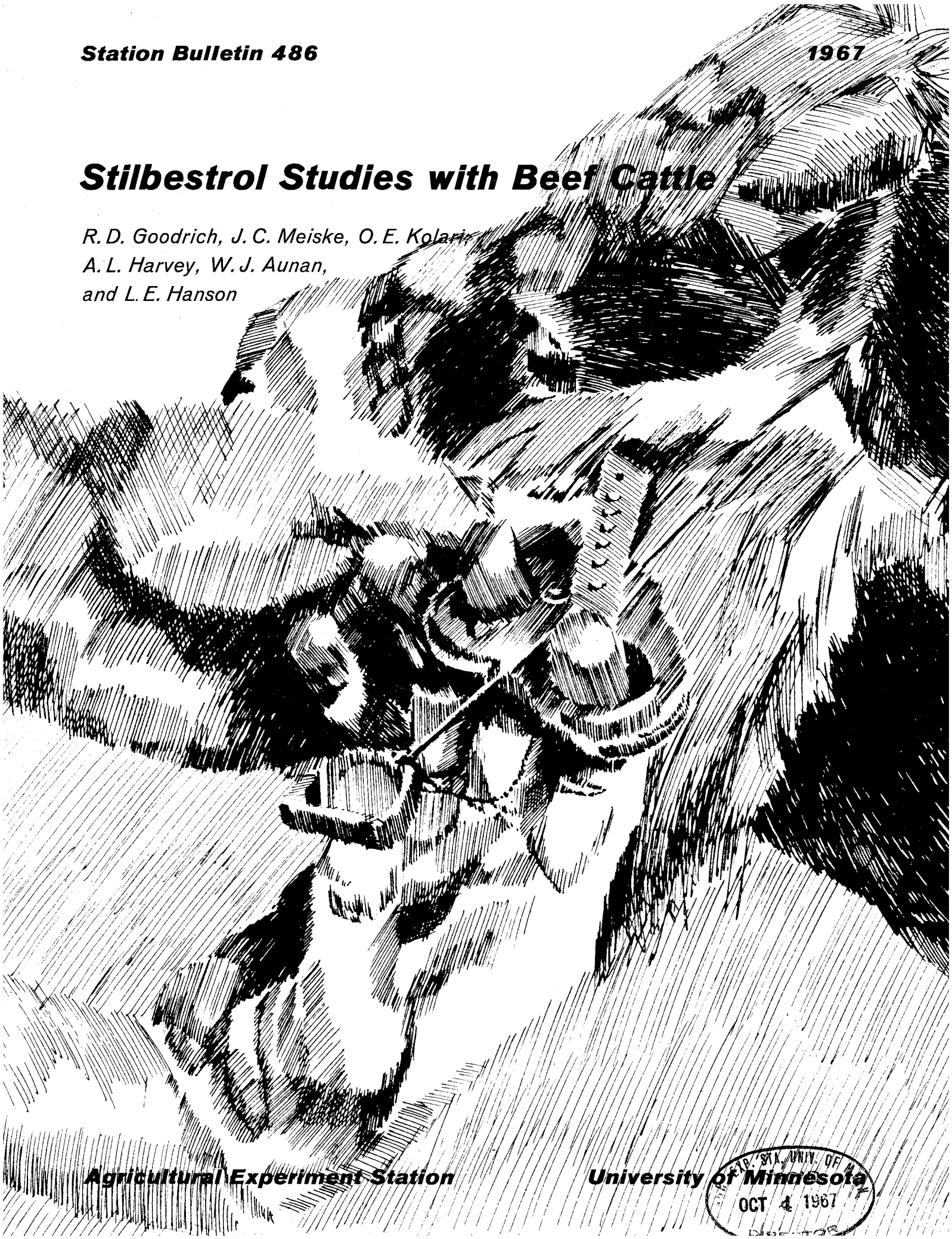

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Study Conclusions And Recommendations

The following conclusions have been drawn from the research reported in this bulletin.

1. With finishing rations, cattle fed 10 mg. stilbestrol per head daily or implanted with stilbestrol under the skin of the ear gained 14.9 percent faster, consumed 4.1 percent more feed, and were 8.3 percent more efficient in converting feed to gains than controls. An average of 81 pounds of feed per 100 pounds of gain was saved by treating cattle with stilbestrol. If feed is worth 2.2 cents per pound and cattle gain 500 pounds each, this saving would increase gross income per steer by $8.90.
2. Steers fed 10 mg. stilbestrol per head daily or implanted with 24 mg. stilbestrol produced carcasses that were nearly as high in quality as those from steers finished without stilbestrol.
3. Steers implanted with 36 mg. stilbestrol at the start of the feeding trial produced lower grading carcasses than steers fed 10 mg. stilbestrol per head daily or steers that received no stilbestrol treatment.
4. Dressing percentage was lowered 1.7 percent as a result of stilbestrol treatment. This decrease probably was due to smaller amounts of carcass fat in stilbestrol-treated cattle.
5. Cooler shrink, color of lean tissue, size of rib eye, lumbar angle, weight of adrenal glands, amount of marbling, and fat depth over the 12th rib were not affected by feeding 10 mg. stilbestrol or by implanting 24 mg. stilbestrol. Teat length was increased by all levels and methods of stilbestrol administration.
6. Carcass composition calculations showed that stilbestrol-treated cattle produced carcasses with slightly more lean and less fat than cattle not receiving stilbestrol.
7. Both types of stilbestrol administration increased rate of gain and feed efficiency. If the same grade is desired as without stilbestrol, the feeding period should be the same length. In these studies, carcass grade was not lowered (it was improved in several instances) when cattle were marketed at a final weight of over 1,050 pounds.
8. The use of 12-mg. stilbestrol implants improved rate of gain 11.5 percent in calves fed growing rations.
9. Creep-fed, suckling calves implanted with 12 mg. stilbestrol gained 6.7 percent faster and at weaning graded 3.7 percent higher than controls. Preweaning stilbestrol treatment had no effect on postweaning rate of gain.
10. Yearling steers grazing improved pastures showed 10-54 percent improvements in rate of gain and beef produced per acre due to 24-mg. stilbestrol implants.
11. Steers that had previously been implanted with 12 mg. stilbestrol showed a similar response to a 24-mg. implant as steers not implanted previously (33 compared to 31 percent improvement in rate of gain). Steers previously implanted with stilbestrol but not reimplanted gained as rapidly as animals that had never received stilbestrol (1.29 compared to 1.28 pounds per head daily).

The following recommendations are made:

1. To comply with federal regulations, stilbestrol must be removed from the ration of slaughter animals at least 48 hours before they are marketed. Removing it will eliminate tissue residues.
2. Cattle implanted with stilbestrol should be reimplanted after 120-140 days, since most of the stilbestrol in the original implant will be absorbed in that length of time.
3. Heifer calves should receive 10 mg. stilbestrol in their daily ration or be implanted with 12 or 15 mg. stilbestrol. Yearling heifers may receive 24-mg. implants. Some undesirable side effects (vaginal and rectal prolapses) have been observed with high levels of stilbestrol implants, with heifers receiving stilbestrol for long periods, and with heifers previously aborted with high levels of stilbestrol.
4. Heifers intended for breeding should not be given stilbestrol.
5. To obtain a maximum response from stilbestrol, the ration must be adequate in protein, energy, minerals, and vitamin A.
6. The use of stilbestrol either as an implant or in the daily ration is recommended strongly.

STILBESTROL STUDIES WITH BEEF CATTLE

R. D. Goodrich, J. C. Meiske, O. E. Kolari, A. L. Harvey,
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Despite the high economic value of diethylstilbestrol (commonly called stilbestrol), many cattle are finished without its use. Between 1955 and 1963, the University of Minnesota conducted a series of experiments at Rosemount and Crookston to: (1) evaluate the utility of stilbestrol for yearling cattle fed finishing rations, (2) compare feeding stilbestrol with implanting stilbestrol, and (3) measure the value of implants for steers grazing pastures, steers fed several kinds of finishing rations, growing calves, and growing calves suckling their dams. The results of these studies have been reported in *Minnesota Cattle Feeders Day Reports*. This bulletin summarizes all of these studies and shows clearly the high value of stilbestrol when used as recommended in beef production.

Sex hormones produced by the male and female reproductive organs influence appearance and secondary sex characteristics. These natural hormones affect growth rate as well as fat and muscle development. Stilbestrol is a synthetic compound that has effects similar to estrogens, the natural female sex hormones. The oral use of stilbestrol was approved by the Food and Drug Administration (FDA) in 1954. The level of feeding was set at 10 milligrams (mg.) per head daily. In 1955, the FDA approved the use of stilbestrol implants.

The specific objectives of the experiments reported in this bulletin were:

1. With cattle fed finishing rations: (a) to determine the influence of stilbestrol on growth and efficiency of feed utilization, (b) to compare implants with the use of oral stilbestrol, (c) to determine the influence of stilbestrol on carcass characteristics, and (d) to compare growth, feed efficiency, and carcass characteristics of stilbestrol-treated and control cattle fed to equal market weights or fed for an equal length of time.
2. To determine the effects of stilbestrol on calves fed growing rations.
3. To evaluate stilbestrol implants for suckling calves.
4. To study the response of pasture cattle to stilbestrol implants.
5. To determine the response of cattle previously implanted with stilbestrol to a second implant.

Stilbestrol For Cattle Fed Finishing Rations

Experimental Procedures. Methods for handling animals were similar in each of the 10 experiments with finishing cattle. Hereford steers were used in all trials except experiment 6, which was conducted with Hereford heifers. Cattle were hand-fed twice daily. Water, trace mineralized salt, and mineral mixtures were available at all times. Cattle were weighed at the start and termination of the experiments and after an overnight shrink without feed or water. Filled weights were measured routinely every 28 days. In all experiments, cattle were housed in open pole sheds with access to outdoor lots. In experiments 5-10, cattle were fed in groups of 6 to 10 head; in experiments 1-4, they were fed individually twice daily in stanchions so the feed intake of each steer could be measured.

In experiments 5-10, cattle received various nutritional treatments in addition to those involving stilbestrol. Stilbestrol treatment was the only variable studied in the remaining experiments.

Steers receiving stilbestrol implants (experiments 8-10) were fed in pens with an equal number of steers that were not implanted. This split-plot design permitted as many stilbestrol/no stilbestrol comparisons as there were pens. In the other experiments, all cattle within a given pen either received stilbestrol or served as control animals.

An outline of the design of each experiment appears on the following page.

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Mention of trade names does not imply endorsement nor does omission imply criticism.

EXPERIMENT 1

Nine steers individually fed a control ration (ground ear corn, supplement, and alfalfa hay) for an equal length of time as those receiving stilbestrol

Nine steers individually fed the control ration and fed to an equal final weight as those receiving stilbestrol

Fifteen steers individually fed the control ration plus 10 mg. oral stilbestrol per steer daily

EXPERIMENT 2

Twelve steers individually fed a control ration (ground ear corn, supplement, and alfalfa hay)

Twelve steers individually fed the control ration plus 10 mg. oral stilbestrol per steer daily

Twelve steers individually fed the control ration and implanted with 36 mg. stilbestrol

All treatment groups were fed to approximately the same final weight.

EXPERIMENT 3

Eleven steers individually fed a control ration (ground ear corn, supplement, and alfalfa hay) plus 10 mg. oral stilbestrol per steer daily

Eight steers individually fed the control ration and implanted with 10 mg. stilbestrol

Eight steers individually fed the control ration and implanted with 20 mg. stilbestrol

Eight steers individually fed the control ration and implanted with 30 mg. stilbestrol

All treatment groups were fed to approximately the same final weight.

EXPERIMENT 4

Ten steers individually fed a control ration (ground ear corn, supplement, and alfalfa hay)

Twelve steers individually fed the control ration plus 10 mg. oral stilbestrol per steer daily

Ten steers individually fed the control ration and implanted with 24 mg. stilbestrol

All treatment groups were fed to approximately the same final weight.

EXPERIMENT 5

Ration 1—Eight steers full-fed ground ear corn and corn silage plus 3.1 pounds alfalfa hay and 1.1 pounds soybean meal

Ration 2—Eight steers full-fed ground ear corn and corn silage plus 3.1 pounds alfalfa hay and 1.4 pounds linseed meal

Ration 3—Eight steers full-fed ground ear corn and corn silage plus 3.1 pounds alfalfa hay and 1.1 pounds soybean meal

Ration 4—Eight steers full-fed ground ear corn and corn silage plus 3.1 pounds alfalfa hay and 1.4 pounds linseed meal

The cattle fed rations 3 and 4 received 10 mg. stilbestrol in their daily allowance of protein supplement.

EXPERIMENT 6

This experiment was similar to experiment 5, but heifers were used and corn silage was not fed.

EXPERIMENT 7

Ration 1—Twenty-three steers full-fed 70 percent barley-30 percent oats (ground)

Ration 2—Twenty-four steers full-fed 70 percent barley-30 percent oats (pelleted)

Ration 3—Twenty-two steers full-fed 70 percent barley-30 percent oats (ground) and 11 mg. oral stilbestrol per steer daily

Ration 4—Twenty-four steers full-fed 70 percent barley-30 percent oats (pelleted) and 11 mg. oral stilbestrol per steer daily

This experiment was conducted during each of 3 years.

EXPERIMENT 8

Ration 1—Twenty steers full-fed 70 percent barley-30 percent oats plus 1 pound soybean meal

Ration 2—Twenty steers full-fed 70 percent barley-30 percent oats plus 1 pound corn grain

Ration 3—Twenty steers full-fed 68 percent barley-29 percent oats-3 percent dried molasses plus 1 pound soybean meal

Ration 4—Twenty steers full-fed 68 percent barley-29 percent oats-3 percent dried molasses plus 1 pound ground corn grain

All steers were fed 6 to 7 pounds alfalfa hay per head daily. Half the steers fed each ration were implanted with 24 mg. stilbestrol.

EXPERIMENT 9

Ration 1—Twenty steers full-fed dry rolled barley plus 1 pound barley supplement

Ration 2—Twenty steers full-fed dry rolled barley plus 4 pounds alfalfa hay

Ration 3—Twenty steers full-fed high moisture rolled barley plus 1 pound barley supplement

Ration 4—Nineteen steers full-fed high moisture rolled barley plus 4 pounds alfalfa hay

Half the steers fed each ration were implanted with 24 mg. stilbestrol.

EXPERIMENT 10

Ration 1—Ten steers full-fed dry rolled barley plus 4 pounds alfalfa hay

Ration 2—Ten steers full-fed dry rolled barley plus 4 pounds alfalfa hay

Ration 3—Ten steers full-fed high moisture rolled wild oats plus 4 pounds alfalfa hay

Ration 4—Ten steers full-fed high moisture rolled wild oats plus 4 pounds alfalfa hay

Half the steers fed each ration were implanted with 24 mg. stilbestrol.

Table 1. Summary of effects of stilbestrol on finishing cattle*

Experiment	Number of cattle		Average daily gain		Average daily feed		Feed/100 pounds gain	
	Control	DES†	Control	DES	Control	DES	Control	DES
			pounds					
1	18	15	2.43	2.68	18.8	19.7	774	736
2	12	24	2.20	2.69	21.5	22.9	976	853
3	....	....	.....	.....	.....	.....	.....	.....
4	10	22	2.13	2.58	21.3	24.9	1,001	966
5	16	16	2.11	2.40	24.3	25.6	1,156	1,067
6	16	15	2.17	2.40	21.2	19.6	979	815
7	47	46	2.48	2.61	24.2	24.4	974	936
8	40	40	2.14	2.63	.....	.....	.....	.....
9	39	40	2.23	2.53	.....	.....	.....	.....
10	20	20	1.99	2.31	.....	.....	.....	.....
Average	218	238	2.21	2.54	21.9	22.8	977	896
					percent			
Improvement	.....	.....	.....	14.9	.....	4.1	.....	8.3

* See tables 3-13 for level and form of stilbestrol administration.
† Stilbestrol-treated cattle.

Table 2. Summary of effects of stilbestrol on finishing cattle*

Experiment	Number of cattle		Carcass grade‡		Dressing percentage	
	Control	DES†	Control	DES	Control	DES
1	18	15	10.2	9.7	57.6	58.3
2	12	24	12.7	11.4	59.7	58.8
3	....	....	.....	.....	.....	.....
4	10	22	10.6	10.5	60.5	57.7
5	16	16	10.4	10.0	59.0	57.2
6	16	15	12.4	11.5	60.6	59.4
7	47	46	12.4§	12.2§	.....	.....
8	40	40	12.4§	12.4§	.....	.....
9	39	40	10.6	10.6	60.8	60.8
10	20	20	10.6	11.0	61.4	60.4
Average	218	238	11.4	11.0	59.9	58.9
Improvement	.....	.....	.....	—⅛ grade	.....	—1.7%

* See tables 3-13 for level and form of stilbestrol administration.
† Stilbestrol-treated cattle.
‡ Carcass grades: 9, low good; 10, average good; 11, high good; 12, low choice.
§ Live market grades.

Results. Rate of gain, feed consumption, feed efficiency, carcass grade, and dressing percentage data from the 10 finishing trials are summarized in tables 1 and 2. Additional data for each of the trials are presented in tables 3-13 (see pages 8-16). Comparisons between cattle not receiving stilbestrol and those treated with stilbestrol (all forms and levels) involved 218 control animals and 238 treated cattle.

Rate of gain was increased from 2.21 to 2.54 pounds per head daily as a result of stilbestrol administration —a 14.9 percent increase in growth rate (table 1). Cattle receiving stilbestrol consumed 4.1 percent more feed (21.9 compared to 22.8 pounds per day) than untreated cattle but were 8.3 percent more efficient in converting feed to gain (977 pounds feed per 100 pounds gain for controls compared to 896 pounds feed per 100 pounds gain for stilbestrol-treated cattle). With feed at 2.2 cents per pound, this improved feed efficiency would increase gross returns by $1.78 per 100 pounds of gain or $8.90 if the cattle gained 500 pounds.

Carcass grade was lowered from 11.4 to 11.0 by feeding stilbestrol (table 2). Since 11 is high good and 12 is low choice, this difference is equal to one-eighth of a lower grade due to stilbestrol. However, data in tables 3-13 show that grades were lowered to the greatest degree when cattle were marketed at light weights. Dressing percentage was lowered 1 percentage unit (1.7 percent) by stilbestrol administration (59.9 compared to 58.9 percent). This lower dressing percentage may have been due to smaller amounts of carcass fat.

Data from experiment 1 are presented in tables 3-7. This experiment was conducted to determine the influence of feeding control cattle for equal lengths of time or to similar final weights as those fed 10 mg. stilbestrol. These comparisons are important since cattle fed stilbestrol gain faster and after a time weigh considerably more than controls.

Cattle fed stilbestrol gained significantly faster and required significantly less total feed per 100 pounds of gain than steers fed for an equal length of time or to an equal final weight. Cattle fed stilbestrol and those receiving the control ration for an equal time did not differ significantly in any carcass traits. However, cattle fed to about the same final weight as those receiving stilbestrol graded higher than those fed stilbestrol or those fed the control ration for a similar length of time.

Experiments 2-4 (tables 3-7) were conducted to compare performance and carcass characteristics of steers fed stilbestrol to those of steers implanted with stilbestrol. In these three trials, all groups of cattle were fed to approximately the same final weight, while in experiments 5-10 the cattle all were fed for equal lengths of time. Results of these trials showed that little difference existed between cattle fed or implanted with stilbestrol with respect to rate of gain or feed efficiency. However, cattle treated with the 36-mg. implant appeared to produce carcasses with lower grades than steers fed stilbestrol. Animals treated with the 36-mg. implant also produced carcasses with significantly less fat in the *longissimus dorsi* or rib eye muscle (a laboratory index of marbling) and significantly lower total carcass fat than steers fed stilbestrol (tables 5 and 6).

With the exception of the 36-mg. stilbestrol implant, stilbestrol treatment (oral or implant) did not greatly affect carcass grade, size of rib eye, fat depth, cooler shrink, color or chemical composition of rib eye muscle, total carcass composition, lumbar angle (the degree of raised tail heads), or weight of the adrenal glands. Teat length was significantly increased by both feeding and implanting stilbestrol.

SUMMARY. In 10 experiments with cattle fed finishing rations, stilbestrol improved rate of gain 14.9 percent, increased feed consumption 4.1 percent, and improved feed efficiency 8.3 percent. Carcass grade was lowered by only one-eighth of a grade and dressing percentage was lowered by 1.7 percent due to stilbestrol treatment.

Control cattle fed to the same final weight as stilbestrol-fed cattle had higher carcass grades, but other carcass measurements were not greatly affected by treatments. However, the control cattle had more expensive gains than stilbestrol-fed steers. When stilbestrol-treated and control cattle were fed for an equal time, only small, nonsignificant differences existed between carcass traits.

Comparisons between cattle receiving stilbestrol implants and cattle fed 10 mg. stilbestrol indicated no important differences in growth rate or feed efficiency. Stilbestrol implants of 36 mg. lowered carcass grade and resulted in less marbling, less total carcass fat, and a smaller lumbar angle. Carcass measurements were not significantly affected by feeding stilbestrol or by implants of 10, 20, 24, or 30 mg.

Stilbestrol Implants For Calves Fed Growing Rations

EXPERIMENTAL PROCEDURES. Six pens of eight steer calves were used in each of 2 years to study the influence of nutritional treatments and stilbestrol implants on rate of gain of growing calves. Nutritional treatments were:

EXPERIMENT 11—REPLICATE 1

Ration 1—Eight steers fed alfalfa-brome silage
Ration 2—Eight steers fed alfalfa-brome silage plus 50 mg. Terramycin
Ration 3—Eight steers fed late-cut oat silage
Ration 4—Eight steers fed late-cut oat silage plus 50 mg. Terramycin
Ration 5—Eight steers fed early-cut oat silage
Ration 6—Eight steers fed early-cut oat silage plus 50 mg. Terramycin

Half (four) of the calves fed each ration were implanted with 12 mg. stilbestrol.

EXPERIMENT 11—REPLICATE 2

Ration 1—Eight steers fed alfalfa-brome silage
Ration 2—Eight steers fed alfalfa-brome silage plus 0.8 pound linseed meal
Ration 3—Eight steers fed oat silage
Ration 4—Eight steers fed oat silage plus 0.8 pound linseed meal
Ration 5—Eight steers fed corn silage
Ration 6—Eight steers fed corn silage plus 0.8 pound linseed meal

Half (four) of the calves fed each ration were implanted with 12 mg. stilbestrol.

In replicate 1, the calves were fed 3 pounds alfalfa-brome hay and 4 pounds ground ear corn per head daily in addition to the silages. In replicate 2, alfalfa-brome hay intake was limited to 3 pounds and ground ear corn intake was limited to 4 and 3.2 pounds for cattle fed forage and cattle fed forage plus protein supplement, respectively. Silages were fed to appetite in both trials. Calves in all lots had access to trace mineralized salt and a mixture of two parts steamed bonemeal to one part salt. Other handling details appear in the section on stilbestrol in finishing rations.

RESULTS. Since stilbestrol treatment was imposed on half the calves in a given pen (split-plot design), measurements of the effect of stilbestrol on feed consumption and feed efficiency were not available. Results of the two replicates showed that rate of gain was increased 0.15 pound (1.30 to 1.45 pounds) per day by stilbestrol treatment (table 14). This increase is an 11.5 percent improvement in growth rate.

Stilbestrol Implants For Suckling Calves

EXPERIMENTAL PROCEDURES. Steer calves produced from the Angus and Hereford cow herds at the Rosemount Agricultural Experiment Station were used in each of 4 years for this study. Half the calves from each breed were implanted with 12 mg. stilbestrol when they were approximately 2 months old. Besides suckling their dams, all calves had access to creep feed during the preweaning period. Final weaning weights were obtained, the calves were moved to the St. Paul Campus, and, in any given year, all calves were fed similar rations. The calves were not implanted with or fed stilbestrol during the postweaning period. Postweaning performance of calves implanted with stilbestrol was compared to that of calves that had never received stilbestrol.

RESULTS. Data from this experiment are presented in table 15. Implanting suckling, creep-fed calves with stilbestrol usually resulted in increased gains. Statistical analysis of data from any 1 year did not always result in gain differences that were statistically significant. However, when data from the 4 years were pooled, a highly significant difference ($P<.01$) due to implanting was noted. The average increase in gain was 18 pounds (0.14 pound per head daily) or an increase of 7.2 percent. Average feeder grade also was improved by the stilbestrol implant.

The postweaning performance of calves receiving preweaning implants was not significantly different from the performance of those not implanted. Therefore, implanting suckling steer calves with stilbestrol can be expected to increase their weight at weaning without affecting their postweaning gains.

Stilbestrol Implants For Cattle On Pasture

EXPERIMENTAL PROCEDURES. Yearling Hereford steers were used in these experiments. In all experiments except experiment 15, pastures had been seeded with 5 pounds alfalfa, 6 pounds bromegrass, 2 pounds orchardgrass, and 0.5 pound ladino clover per acre. When fertilized, the pastures generally received an annual application of 200 pounds 0-20-20. Generally, grazing was initiated during the last 2 weeks in May when forage was 8-12 inches tall. Water and trace mineralized salt were available in all pastures. Cattle were weighed every 28 days; initial and final weights were measured after an overnight shrink without feed or water.

RESULTS. Data showing the response of these cattle to stilbestrol implants appear in tables 16-19.

Experiment 13 (table 16) was conducted to determine the value of feeding ground ear corn and implanting cattle with stilbestrol. Average daily gain was improved 16.7 percent (1.80 compared to 2.10 pounds per head daily) by implanting steers with 24 mg. stilbestrol when grain was not fed. Steers that received about 6 pounds ground ear corn daily showed a 13.9 percent response to the 24-mg. stilbestrol implant (2.16 compared to 2.46 pounds per head daily). The amount of beef produced per acre was increased from 591 to 689 pounds (16.6 percent) by implanting steers consuming pasture only and from 838 to 954 pounds (13.8 percent) by implanting steers fed ground ear corn in addition to pasture.

The response of yearling steers to 24-mg. stilbestrol implants when they were grazed on fertilized and control pastures was studied in experiment 14 (table 17). Rate of gain and pounds of beef produced per acre were increased 44 and 47 percent, respectively, for steers on control pastures and 33 and 39 percent, respectively, for steers on fertilized pastures.

Experiment 15 (table 18) examined the response of steers to 24-mg. stilbestrol implants when they were grazed on grass, fertilized grass, or fertilized grass-legume pastures. A highly significant improvement in rate of gain (1.35 compared to 1.78 pounds per head daily) was obtained from stilbestrol treatment when data from all pastures were pooled. A similar improvement in pounds of beef produced per acre also was observed in this trial (181 compared to 234 pounds).

Experiment 16 compared control steers and steers implanted with 24 mg. stilbestrol in three trials. Results appear in table 19. Twenty-nine steers were implanted and 29 served as controls. Beef production per acre was significantly increased from 296 to 332 pounds (12 percent) with stilbestrol treatment.

Response Of Previously Implanted Steers To A Second Implant

EXPERIMENTAL PROCEDURES. In each of 2 years, cattle that had been implanted the previous winter with 12 mg. stilbestrol and cattle that had not received stilbestrol previously were implanted with 24

mg. stilbestrol and allowed to graze similar pastures. The cattle previously had been fed to gain 1.1-1.6 pounds per head daily. Pastures and methods of handling animals were similar to those described in the section on stilbestrol for pasture cattle.

RESULTS. The results of experiment 17 are reported in table 20. Cattle that had not received stilbestrol during the previous winter and were not implanted while on pasture gained 1.28 pounds per day. Cattle implanted during the winter but not while on pasture gained 1.29 pounds per day. Therefore, winter treatment had no effect on the summer performance of steers not receiving stilbestrol while on pasture.

Steers that had not been implanted during the winter but were implanted with 24 mg. stilbestrol while on pasture gained 1.68 pounds per day—0.40 pound more than steers that did not receive stilbestrol. Cattle that were implanted during the winter as well as while on pasture gained 1.72 pounds per day. This rate of gain was similar to the 1.68 pounds per day for steers that received their first implant while on pasture.

Table 3. Influence of oral and implanted stilbestrol on feedlot performance and carcass characteristics of yearling steers

Experiment	Stilbestrol level	Length of trial	Number of steers	Initial weight	Final weight	Average daily gain
	mg.	days		pounds		
1	0	112	9	688	954	2.39[a]
	0	124	9	686	992	2.47[a]
	10 oral	112	15	684	981	2.68[b]
2	0	140	12	765	1,073	2.20[a]
	10 oral	112	12	764	1,060	2.64[b]
	36 implant	112	12	764	1,072	2.74[b]
3	10 oral	126	11	808	1,127	2.53
	10 implant	132	8	805	1,139	2.53
	20 implant	132	8	804	1,129	2.47
	30 implant	126	8	804	1,126	2.53
4	0	155	10	702	1,032	2.13[a]
	10 oral	140	12	706	1,077	2.65[b]
	24 implant	140	10	709	1,066	2.51[b]

[a,b] Means within experiments with different superscript letters differ significantly ($P<.05$).

Table 4. Influence of oral and implanted stilbestrol on feedlot performance and carcass characteristics of yearling steers

		Average daily feed				Feed per 100 pounds gain			
Experiment	Stilbestrol level	Ground ear corn	Protein supplement	Alfalfa-brome hay	Total	Ground ear corn	Protein supplement	Alfalfa-brome hay	Total
	mg.	pounds				pounds			
1	0	11.00	1.74	5.71	18.45[a]	460	73	239	772[a]
	0	11.86	1.81	5.54	19.21[b]	480	73	224	777[a]
	10 oral	12.07	1.79	5.86	19.72[b]	450	67	219	736[b]
2	0	16.64	1.42	3.41	21.47[a]	756	65	155	976[a]
	10 oral	17.78	1.44	3.39	22.61[b]	673	55	128	856[b]
	36 implant	18.44	1.42	3.42	23.28[b]	673	52	125	850[b]
3	10 oral	16.48	1.38	4.96	22.82	651	55	196	902
	10 implant	16.84	1.43	4.76	23.03	666	57	188	911
	20 implant	16.58	1.39	4.76	22.73	671	56	193	920
	30 implant	17.42	1.43	4.99	23.84	689	57	197	943
4	0	15.81	1.42	4.10	21.33[a]	742	67	192	1,001
	10 oral	18.68	1.61	4.71	25.00[b]	705	61	178	944
	24 implant	18.41	1.57	4.84	24.82[b]	733	63	193	989

[a,b] Means within experiments with different superscript letters differ significantly ($P<.05$).

Table 5. Influence of oral and implanted stilbestrol on feedlot performance and carcass characteristics of yearling steers

Experiment	Stilbestrol level, mg.	Carcass weight, pounds	Dressing percentage	Carcass grade*	Rib eye area, square inches	Fat depth over 12th rib, inches	Cooler shrink, percent†
1	0	547	57.3	9.4[a]	10.5[a,b]	.....	2.1
	0	573	57.8	11.1[b]	9.6[b]	.....	2.4
	10 oral	572	58.3	9.7[a]	11.2[a]	.....	2.0
2	0	641	59.7[a]	12.7[a]	11.2	0.71[a]	1.49
	10 oral	626	59.0[a,b]	12.0[a]	12.1	0.55[b]	1.48
	36 implant	627	58.5[b]	10.7[b]	12.1	0.54[b]	1.64
3	10 oral	676	60.0	10.2	11.9	0.40	.....
	10 implant	662	58.1	11.5	11.8	0.52	.....
	20 implant	653	57.8	11.4	11.4	0.54	.....
	30 implant	674	59.8	9.9	11.1	0.41	.....
4	0	625	60.5[a]	10.6	12.1	0.69	2.07
	10 oral	621	57.7[b]	10.6	11.3	0.66	2.04
	24 implant	615	57.7[b]	10.4	12.5	0.73	2.11

* Carcass grades: 9, low good; 10, average good; 11, high good; 12, low choice.

† Cooler shrink measured after 48-hour chill.

[a,b] Means within experiments with different superscript letters differ significantly ($P<.05$).

Table 6. Influence of oral and implanted stilbestrol on feedlot performance and carcass characteristics of yearling steers

Experiment	Stilbestrol level	Composition of *longissimus dorsi**				Carcass composition‡	
		Protein	Fat	Moisture	Color†	Lean	Fat
	mg.	percent					
1	0	.....	.....	73.3	4.11	57.28	29.26
	0	.....	.....	73.2	3.56	56.40	31.33
	10 oral	.....	.....	73.2	3.38	57.85	28.48
2	0	22.3	4.09[a]	72.6	2.33	56.29[a]	31.75[a]
	10 oral	22.2	3.92[a]	72.6	2.42	58.00[b]	29.85[b]
	36 implant	22.7	3.02[b]	73.0	2.67	59.20[c]	28.00[c]
3	10 oral	22.4	3.95	73.2	.....	57.25	30.84
	10 implant	23.1	3.75	72.7	.....	56.86	30.86
	20 implant	22.9	3.61	73.0	.....	58.01	30.30
	30 implant	22.1	4.23	73.2	.....	58.26	29.27
4	0	22.3	5.82	71.4[a]	.....	56.78	31.54
	10 oral	22.4	4.82	72.2[b]	.....	56.94	31.08
	24 implant	22.6	4.63	72.2[b]	.....	55.74	32.09

* *Longissimus dorsi* stripped of extra fat.

† Color code: 1, bright color; 10, dark color.

‡ Calculated according to Hankins and Howe (1946).

[a,b,c] Means within experiments with different superscript letters differ significantly ($P<.05$).

Table 7. Influence of oral and implanted stilbestrol on feedlot performance and carcass characteristics of yearling steers

Experiment	Stilbestrol level, mg.	Lumbar angle, degrees	Teat length, inches	Adrenal weight, grams
1	0	.....	0.69[a]	16.03*
	0	.....	0.75[a]	.....
	10 oral	.....	1.15[b]	17.21
2	0	134[a]	0.53[a]	18.35
	10 oral	134[a]	0.96[b]	18.56
	36 implant	119[b]	1.36[c]	20.82
3	10 oral	131	.....	.....
	10 implant	135	.....	.....
	20 implant	133	.....	.....
	30 implant	133	.....	.....
4	0	130	.....	.....
	10 oral	131	.....	.....
	24 implant	130	.....	.....

* Average adrenal weight for 18 steers fed control ration.

[a,b,c] Means within experiments with different superscript letters differ significantly ($P<.05$).

Table 8. Effects of feeding 10 mg. stilbestrol on steers fed a ration containing ground ear corn and corn silage (experiment 5)*

	Control	Stilbestrol, 10 mg. oral	Improvement due to stilbestrol
Number of steers	16	16	
Average initial weight, pounds	773	774	
Average final weight, pounds	1,009	1,043	
Average daily gain, pounds	2.11	2.40	13.7% ($P<.05$)
Average daily feed, pounds			
Ground ear corn	14.44	15.02	
Protein supplement†	1.26	1.26	
Corn silage	19.46 (6.49)‡	21.54 (7.18)	
Alfalfa-brome hay	2.14	2.13	
Total	37.30 (24.33)	39.95 (25.59)	5.2%
Feed per 100 pounds gain, pounds			
Ground ear corn	686	626	
Protein supplement†	60	53	
Corn silage	924 (308)	897 (299)	
Alfalfa-brome hay	102	89	
Total	1,772 (1,156)	1,665 (1,067)	7.7%
Carcass grade§	10.4	10.0	—⅛ grade
Dressing percentage	59.0	57.2	—3.1%

* Cattle were fed for 112 days.

† Half the cattle were fed linseed meal and half were fed soybean meal.

‡ Corn silage expressed on air dry basis.

§ Carcass grades: 10, average good; 11, high good; 12, low choice.

Table 9. Effects of feeding 10 mg. stilbestrol on heifers fed a ration containing ground ear corn (experiment 6)*

	Control	Stilbestrol, 10 mg. oral	Improvement due to stilbestrol
Number of heifers	16	15	
Average initial weight, pounds	531	528	
Average final weight, pounds	926	966	
Average daily gain, pounds	2.17	2.40	10.6% (P<.01)
Average daily feed, pounds			
Ground ear corn	16.02	14.75	
Protein supplement†	1.32	1.23	
Alfalfa-brome hay	3.91	3.59	
Total	21.25	19.57	—7.9%
Feed per 100 pounds gain, pounds			
Ground ear corn	738	614	
Protein supplement†	61	51	
Alfalfa-brome hay	180	150	
Total	979	815	16.8%
Carcass grade‡	12.4	11.5	—⅓ grade
Dressing percentage	60.6	59.4	—2.0%

* Cattle were fed for 182 days.

† Half the cattle were fed linseed meal and half were fed soybean meal.

‡ Carcass grades: 10, average good; 11, high good; 12, low choice.

Table 10. Effects of feeding 11 mg. of stilbestrol on yearling steers fed ground or pelleted grain with alfalfa hay and soybean meal (experiment 7)*

	Control		Stilbestrol	
	Ground grain	Pelleted grain	Ground grain	Pelleted grain
Number of steers	23	24	22	24
Average initial weight, pounds	747	755	747	747
Average final weight, pounds	1,089	1,116	1,118	1,112
Average daily gain, pounds	2.41	2.56	2.63	2.59
Improvement due to stilbestrol			9.1%	1.2%
Average daily feed, pounds				
Barley-oats†	14.57	14.45	14.90	14.76
Soybean meal	1.00	1.00	1.00	1.00
Alfalfa hay	8.64	8.70	9.45	7.74
Total	24.21	24.15	25.35	23.50
Improvement due to stilbestrol			4.7%	—2.7%
Feed per 100 pounds gain, pounds				
Barley-oats†	605	564	567	570
Soybean meal	41	39	38	39
Alfalfa hay	359	340	359	299
Total	1,005	943‡	964	908‡
Improvement due to stilbestrol			4.1%	3.7%
Live market grade§	12.2	12.6	12.2	12.3
Improvement due to stilbestrol			0	—1/10 grade

* Results of three replicates in which cattle were fed for 133, 150, and 140 days.

† 70 percent barley and 30 percent oats.

‡ Significant improvement in feed efficiency due to pelleting (P<.05).

§ Market grades: 11, high good; 12, low choice; 13, average choice.

Table 11. Effects of 24-mg. stilbestrol implants on rate of gain and live grade of yearling steers (experiment 8)*

	Control	Stilbestrol implant	Improvement due to stilbestrol
Number of steers	40	40	
Length of trial, days	126	126	
Average initial weight, pounds	746	746	
Average final weight, pounds	1,016	1,078	
Average daily gain, pounds			
Ration 1	2.10	2.68	
Ration 2	2.32	2.60	
Ration 3	2.12	2.63	
Ration 4	2.02	2.62	
Average	2.14	2.63	22.9% ($P<.01$)
Live market grade†			
Ration 1	11.8	12.6	
Ration 2	12.6	11.9	
Ration 3	12.3	12.1	
Ration 4	12.7	12.9	
Average	12.4	12.4	0

* Cattle were fed to determine value of soybean meal and molasses in barley rations which also contained alfalfa hay. This table is a summary of data from 2 years.

† Live grades: 11, high good; 12, low choice; 13, average choice.

Table 12. Effects of 24-mg. stilbestrol implants on rate of gain and carcass characteristics of yearling steers (experiment 9)*

	Control	Stilbestrol implant	Improvement due to stilbestrol
Number of steers	39	40	
Length of trial, days	155	155	
Average initial weight, pounds	784	784	
Average final weight, pounds	1,128	1,173	
Average daily gain, pounds			
Ration 1	2.08	2.45	
Ration 2	2.18	2.67	
Ration 3	2.31	2.66	
Ration 4	2.35	2.33	
Average	2.23	2.53	13.5 ($P<.01$)
Dressing percentage			
Ration 1	60.8	60.7	
Ration 2	61.4	61.8	
Ration 3	61.1	60.6	
Ration 4	60.0	60.2	
Average	60.8	60.8	0.0%
Rib eye area, square inches			
Ration 1	10.70	11.87	
Ration 2	11.14	12.15	
Ration 3	11.74	11.57	
Ration 4	11.10	11.18	
Average	11.17	11.69	4.7%
Fat depth, 12th rib, inches			
Ration 1	0.74	0.66	
Ration 2	0.72	0.84	
Ration 3	0.66	0.76	
Ration 4	0.81	0.71	
Average	0.73	0.74	1.4%

* Cattle were fed high moisture and dry rolled barley, with and without alfalfa hay. This table is a summary of data from 2 years.

Table 12 (continued)

	Control	Stilbestrol implant	Improvement due to stilbestrol
Marbling score†			
Ration 1	5.1	5.0	
Ration 2	5.2	5.3	
Ration 3	4.6	4.5	
Ration 4	4.4	4.5	
Average	4.8	4.8	0.0%
Carcass grade‡			
Ration 1	11.2	10.8	
Ration 2	10.7	11.2	
Ration 3	10.2	10.2	
Ration 4	10.3	10.3	
Average	10.6	10.6	0

† Marbling scores: 4, slight; 5, small; 6, modest.
‡ Carcass grade: 11, high good; 12, low choice; 13, average choice.

Table 13. Effects of 24-mg. implants of stilbestrol on yearling steers (experiment 10)*

	Control	Stilbestrol, 24-mg. implant	Improvement due to stilbestrol
Number of steers	20	20	
Length of trial, days	129	129	
Average initial weight, pounds	803	803	
Average final weight, pounds	1,060	1,101	
Average daily gain, pounds			
Ration 1	2.29	2.63	
Ration 2	2.15	2.42	
Ration 3	1.64	2.30	
Ration 4	1.87	1.88	
Average	1.99	2.31	16.1%
Dressing percentage			
Ration 1	61.9	60.6	
Ration 2	61.5	58.8	
Ration 3	61.8	62.9	
Ration 4	60.4	59.4	
Average	61.4	60.4	—1.6%
Rib eye area, square inches			
Ration 1	12.73	12.08	
Ration 2	11.81	12.46	
Ration 3	12.24	12.12	
Ration 4	11.89	11.90	
Average	12.17	12.14	—0.2%
Fat depth, 12th rib, inches			
Ration 1	0.57	0.63	
Ration 2	0.59	0.61	
Ration 3	0.73	0.83	
Ration 4	0.68	0.46	
Average	0.64	0.63	—1.6%
Marbling score†			
Ration 1	5.2	5.4	
Ration 2	5.0	4.8	
Ration 3	5.0	6.0	
Ration 4	4.6	5.0	
Average	5.0	5.3	6.0%

* Cattle were fed barley and wild oats.
† Marbling scores: 4, slight; 5, small; 6, modest.

Table 13 (continued)

	Control	Stilbestrol, 24-mg. implant	Improvement due to stilbestrol
Carcass grade‡			
Ration 1	11.2	10.4	
Ration 2	10.4	10.5	
Ration 3	10.6	12.4	
Ration 4	10.0	10.6	
Average	10.6	11.0	⅛ grade

‡ Carcass grade: 11, high good; 12, low choice; 13, average choice.

Table 14. Influence of stilbestrol implants on rate of gain of steer calves fed growing rations (experiment 11)

	Control		12-mg. stilbestrol implant		Improvement due to stilbestrol
	Replicate 1*	Replicate 2†	Replicate 1	Replicate 2	
Number of calves	24	24	24	24	
Average initial weight, pounds	355	419	354	418	
Average final weight, pounds	570	640	595	666	
Length of trial, days	168	168	168	168	
Ration	average daily gain, pounds				
1	1.28	1.33	1.44	1.36	
2	1.21	1.46	1.48	1.66	
3	1.47	1.12	1.42	1.24	
4	1.46	1.17	1.48	1.28	
5	1.06	1.26	1.36	1.60	
6	1.20	1.54	1.42	1.71	
Average	1.30		1.45		11.5% (P<.01)

* Steers in replicate 1 were fed alfalfa-brome silage, early cut oat silage, and late cut oat silage, with and without an antibiotic.
† Steers in replicate 2 were fed alfalfa-brome and oat and corn silages, with and without protein supplementation.

Table 15. Effects of 12-mg. stilbestrol implants on preweaning and postweaning performance of steer calves (experiment 12)*

	Hereford		Angus		Both	
	Control	Implant	Control	Implant	Control	Implant
	preweaning period (133 days)					
Number of steers	28	29	29	29	57	58
Average initial age, days	51	50	64	64	58	57
Average initial weight, pounds	141	142	155	153	148	148
Average final weight, pounds	390	410	424	439	407	425
Average daily gain, pounds	1.87	2.02	2.02	2.15	1.94	2.08†
Improvement due to stilbestrol		8.0%		6.4%		7.2%
Average feeder grade‡	10.1	10.6	11.5	11.7	10.8	11.2
Improvement due to stilbestrol		1/6 grade		1/15 grade		⅛ grade
	postweaning period (161 days)§					
Average initial age, days	184♯	182	203♯	204♯	194	193
Average initial weight, pounds	390	410	426	441	408	425
Average final weight, pounds	682	705	701	699	692	702
Average daily gain, pounds	1.81	1.83	1.71	1.60	1.76	1.72

* This table is a summary of data from 4 years.
† Significant improvement due to stilbestrol (P<.01).
‡ Feeder grade: 10, low choice; 11, average choice; 12, high choice.
§ No stilbestrol treatment was used during the postweaning period.
♯ One calf in each of these lots died during the postweaning period.

Table 16. Effects of implanting pasture steers with 24 mg. stilbestrol (experiment 13)*

	Control		Implanted	
	No grain	Grain	No grain	Grain
Number of steers	11	13	11	13
Average initial weight, pounds	563	563	564	564
Average final weight, pounds	767	808	802	843
Average daily gain, pounds	1.80	2.16	2.10	2.46
Improvement due to stilbestrol	.....	.....	16.7%	13.9%
Total feed consumed, pounds/steer				
Ground ear corn	.....	655†	.....	763
Iodized salt	9.9	8.3	10.0	8.3
Total beef produced, pounds	2,244	3,185	2,618	3,627
Total beef produced per acre, pounds	591	838	689	954
Improvement due to stilbestrol	.....	.....	16.6%	13.8%

* Figures in this table are averages from two trials, one for 112 days and one for 115 days.

† Ground ear corn feeding was started at 3 pounds per steer daily and increased according to available pasture. At conclusion of trial, steers were eating about 12 pounds per head daily.

Table 17. Effects of 24-mg. stilbestrol implants on yearling steers grazed on fertilized pastures (experiment 14)

	Control		Implanted	
	Control	Fertilized	Control	Fertilized
Number of steers	8	8	6	10
Average initial weight, pounds	712	706	699	710
Final weight, pounds	841	833	877	860
Gain per steer, pounds	129	127	178	150
Average daily gain, pounds	1.33	1.21	1.91*	1.61*
Improvement due to stilbestrol	.....	.....	44%	33%
Beef produced per acre, pounds	134	159	197*	221*
Improvement due to stilbestrol	.....	.....	47%	39%
Steer days per acre	101	131	103	138

* Significant improvement due to stilbestrol ($P<.01$).

Table 18. Effects of 24-mg. stilbestrol implants on steers grazed on fertilized and unfertilized pastures (experiment 15)

	Control			Implanted		
	Unfertilized grass	Fertilized grass	Fertilized legume x grass	Unfertilized grass	Fertilized grass	Fertilized legume x grass
Number of steers	3*	5†	6	3*	5†	6
Average initial weight, pounds	632	644	633	640	625	623
Average final weight, pounds	750	824	784	833	818	822
Average daily gain, pounds	1.23	1.49	1.34	1.89	1.69	1.76
Improvement due to stilbestrol	.....	.....	.....	54%	13%	31%
Beef per acre, pounds	105	196	242	162	223	318
Improvement due to stilbestrol	.....	.....	.....	54%	14%	31%
Average daily gain, all pastures, pounds		1.35			1.78‡	
Improvement due to stilbestrol		.....			32%	
Beef per acre, all pastures, pounds		181			234‡	
Improvement due to stilbestrol		.....			29%	

* One steer was removed after 17 days.

† Two steers were removed after 35 days.

‡ Significant improvement due to stilbestrol ($P<.01$).

Table 19. Additional evaluations of stilbestrol for yearling steers on pasture (experiment 16)*

	Control	Stilbestrol implant, 24 mg.
Number of steers	29	29
Beef per acre, pounds	296	332†
Improvement due to stilbestrol		12%

* Figures in this table are averages obtained from data collected over 3 years.
† Significant improvement due to stilbestrol ($P<.01$).

Table 20. Influence of previous implanting on pasture gains (experiment 17)*

	Treatment during winter period	
Treatment on pasture	Control	Stilbestrol implant, 12 mg.
Control	1.28† (14 steers)	1.29 (14 steers)
Stilbestrol implant, 24 mg.	1.68 (22 steers)	1.72 (22 steers)
Improvement due to stilbestrol	31%	33%

* Figures in this table are averages obtained from data collected over 2 years.
† Average daily gain, pounds.