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The Effect of Diethylstilbestrol Upon the Performance of Pasture-Fed Zebu Steers

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THE EFFECT OF DIETHYLSTILBESTROL[1] UPON THE PERFORMANCE OF PASTURE-FED ZEBU STEERS

L. R. Quinn,[2] G. O. Mott[3] and W. V. A. Bisschoff[4]

Summary

1. In ten separate experiments including 1086 steers, stilbestrol gave an average increase in average daily gain of 111 grams, an increase of 22 percent over the untreated controls.

2. The average increase in average daily gain during the winter-dry season was 100 grams per steer daily, and during the summer-wet season the increase was 121 grams per steer daily. This indicates that stilbestrol is almost as effective during periods of nutritional stress as during periods when pastures are of good quality.

3. As the carrying capacity of the pastures increased from 1.2 to 3.0 steers per ha. as a result of nitrogen fertilization, stilbestrol-treated steers produced an additional liveweight gain of 33 kg. per ha. with no nitrogen and 117 kg. per ha. when 200 kg. N per ha. was applied to the pasture.

4. The widespread use of stilbestrol on steers intended for slaughter in Brazil could increase beef production by 20 percent, reduce the amount of feed required to produce a kilogram of beef, shorten the period required to produce a slaughter animal, and reduce the cost of production. At present prices, less than the price of 2 kg. of liveweight of beef is required to pay for the stilbestrol which will produce an additional 40 kg. of liveweight.

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[1]Diethylstilbestrol used in these trials was "Stimplants," a pelleted product supplied by Chas. Pfizer & Co., Inc.

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Introduction

Hormones or substances having hormone-like activity are produced by various glands within the animal and are also found in feeds and in certain forage crops. A synthetic hormone, diethylstilbestrol, is similar to estradiol, a natural-occurring female hormone, and has many of the physiological properties of the natural substance. The synthetic substance will also be referred to in this paper as *stilbestrol* or *DES*. Increases in growth rate as a result of subcutaneous implantation of a stilbestrol pellet or from the oral administration of stilbestrol are well known. Quinn *et al.* (1958, 1960), Beeson *et al.* (1956), Dodson *et al.* (1956) and Heinemann and Van Keuren (1962) have reported substantial increases in rates of gain of steers either implanted or fed stilbestrol in the ration. Klosterman *et al.* (1958) and Woods (1962) have reported results indicating increases in rates of gain and increases in feed efficiency.

The Zebu, *Bos indicus*, is the class of cattle upon which the beef industry is built in the tropical and subtropical areas of Brazil. In general, the cattle are almost entirely dependent upon pasture as a source of feed, and during certain seasons of the year the quality may be at a low level and the supply inadequate. The cattle for beef frequently are not slaughtered until they reach an age of four to six years. An objective of the research program of IRI is to develop improved practices for the production of beef which will increase the efficiency of production and decrease the killing age.

This paper presents the results obtained in ten different grazing trials conducted on pastures typical of Central Brazil which contain Colonial Guineagrass, *Panicum maximum*, or common Bahia-Jaraguagrass, *Paspalum notatum-Hyparrhenia rufa*. In addition to implanted stilbestrol, other factors such as supplemental feeding, feed additives and pasture fertilization were studied, but the results presented here relate only to the stilbestrol variable in the trials.

The climate of Central Brazil is subtropical and is

characterized by a six to seven months' warm, wet season from October or November to April, followed by five to six months of cool, dry weather from May to September. Experiments 1 to 5 were located at Fazenda Jangada in the Araçatuba district of São Paulo (Location I) and Experiments 6 to 10 at the IRI headquarters near Matão on Fazenda Cambuhy (Location II). These two farms are located in the northwestern and central parts of the state of São Paulo respectively at elevations of 370 meters for Experiments 1-5 and 560 meters for Experiments 6-10.

The seasonal temperature and rainfall patterns during the four years in which these trials were conducted at each of the two locations are shown in Figure 1. The total rainfall for each of the four years is given in Table 1. The average annual rainfall at Location I was 1067 mm., with a yearly range of 953 to 1476 millimeters. At the IRI headquarters at Matão, the mean precipitation was 1245 millimeters. Approximately three fourths of the yearly precipitation occur during the warm period. January and February are generally the wettest months with rains of high intensity, while July and August often receive no rainfall.

The temperature records at Fazenda Jangada (I) in-

TABLE 1. Winter and summer rainfall — 4-year period, 1960 through 1963.

Season*	Year			
	1960	1961	1962	1963
	millimeters			
Location I — Fazenda Jangada				
Winter	104	50	166	25
Summer	990	1039	1310	928
Winter plus summer	1094	1089	1476	953
Location II — Fazenda Cambuhy				
Winter	163	70	190	24
Summer	1482	1466	1168	866
Winter plus summer	1645	1536	1358	890

*Seasons approximated as follows: Winter, May through September (5 months); summer, the other 7 months of the year.

dicate an annual mean of 23.6°C. The coolest months were June and July with an average of 19.6°C, while the annual average summer temperature remained fairly constant from September through March. The average annual temperature at Matão (II) was 23.1°C, with the mean showing a monthly variation of 19.1°C in June to 24.9°C in January. Daily maximum temperatures at both locations normally range between 26.4-32.8°C during May to September and 30.0-31.6°C from October to April.

The soils are in the class known as *arenito Bauru*, sandy loam (Paiva Neto *et al.* 1951). This type is derived principally from sandstone parent material. On Fazenda Jangada, the location of the first five experiments, the soil is *Bauru superior* with a pH of 5.8 to 6.0. Experiments 6-10 were located on *Bauru inferior*, a poor sandy loam with a soil reaction of pH 5.0.

Results and Discussion of Individual Experiments

Experiment 1 — Diethylstilbestrol and its effect upon the growth of Zebu steers grazed on fertilized and unfertilized pastures of Colonial Guineagrass, *Panicum maximum*

Previous studies conducted by IRI (Quinn *et al.* 1958, 1960) indicated that the implantation of stilbestrol greatly increased the rate of gain on Zebu steers when tropical pasture grasses were the sole source of feed. This occurred without any apparent increase in the consumption of forage. Experiment 1 differed from the trial previously reported (Quinn *et al.* 1961) in that the same tester animals remained in the trial during a 364-day period and received only one 24-mg. implant of diethylstilbestrol. In the previous trial, new tester animals entered the trial at the beginning of the winter season and again at the beginning of the summer season, each group being implanted with 24 mg. of stilbestrol.

The pastures

The experimental pastures provided almost a pure stand of Colonial Guineagrass. An area of 84 hectares was

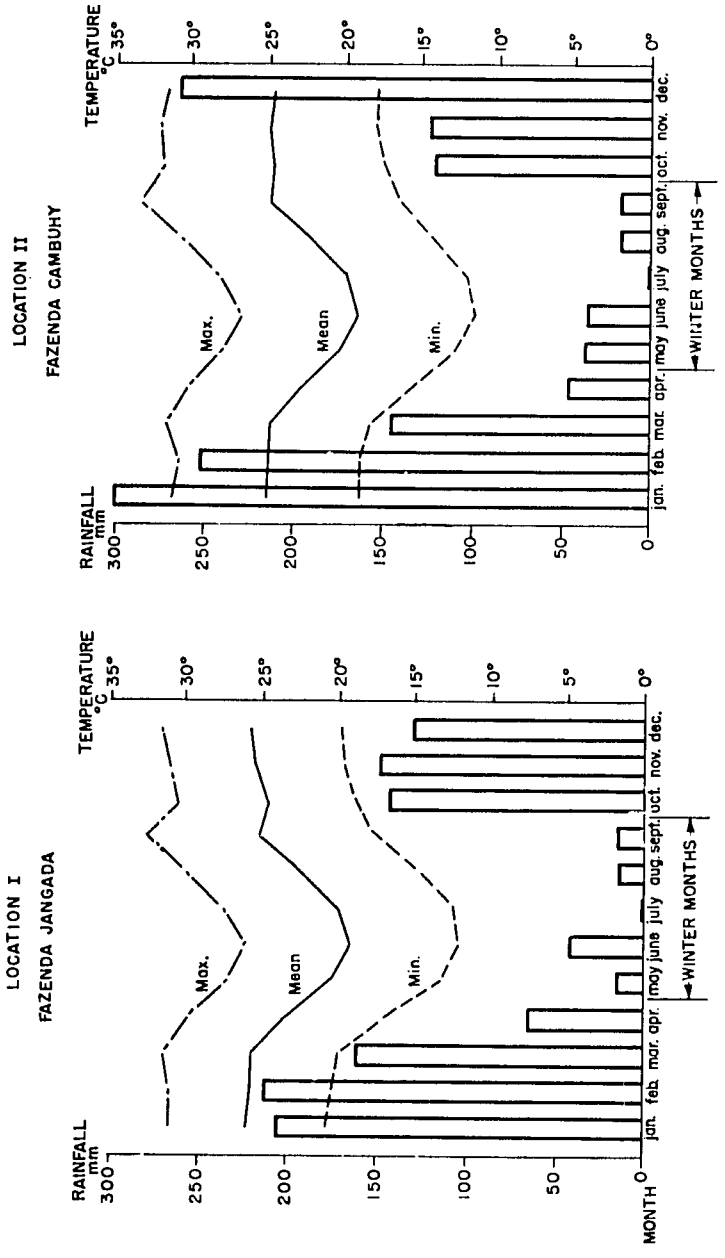

Figure 1. Rainfall and temperature recordings at the two locations of the trials – average of 4 years, 1960 through 1963.

divided into 24 pastures of 3.5 hectares each. The pastures were given various fertilizer treatments, and the 24 pastures provided for eight treatments in a randomized complete block design of three replications. Since there was no interaction between the fertility treatments of the pastures and the effect of stilbestrol on the performance of the grazing animals, only the results for stilbestrol will be reported here.

The animals

Seventy-two 2-year-old Zebu steers of the Nellore breed were selected for use as tester animals. Stilbestrol was implanted in 48 head at the rate of 24 mg. per steer at the beginning of the trial on May 19, 1960 and the remaining 24 head were left as controls. The animals were then distributed at random with two treated and one control allocated to each of the 24 pastures. In most of the pastures, the three tester animals — two treated and one control — remained in the pastures throughout the winter and summer seasons of 364 days. The treated animals were not reimplanted during the period of the trial. Additional steers were added to and removed from the pastures to maintain the forage in near optimum grazing condition. At the end of the trial on May 18, 1961, all testers were removed from the pastures and slaughtered.

Weighings were made at 28-day intervals, following an overnight fast. A mineral supplement containing bone meal, iron, copper and cobalt with common salt was fed *ad libitum* to all animals. The mineral mix had the following formula and was used in all trials reported here, with the exception of Experiment 8 in which the salt was a variable.

In 100 kg. mineral mix:

59.54	kg. salt
40	kg. bone meal
200	gm. copper sulphate
200	gm. iron sulphate
60	gm. cobalt sulphate

Since the winter and summer seasons are greatly different with respect to rainfall and quality of forage, the

TABLE 2 Effect of winter-implanted stilbestrol upon the gains of steers on Colonial Guineagrass pasture, 1960-61 — Experiment 1, Fazenda Jangada, Araçatuba.

Period	No. of days	Steer group	No. of animals	Age	Av. initial weight	Av. final weight	Gain/steer		Increase for stilbestrol		Growth index (control = 100)
							Total[a]	Daily	Total/steer	Daily/steer	
				yrs.	kg.	kg.	kg.	gm.	kg.	gm.	
					1960 Winter						
May 19 to	140	Control	24	2	326.0	390.1	64.1	458			
Oct. 6, 1960		Treated[b]	48	2	326.2	402.4	76.2	544	12.1	86	119
					1960-61 Summer						
Oct. 6, 1960	224	Control	24	2	390.1	508.6	118.5	529			
to May 18, 1961		Treated[b]	39	2	405.2	530.0	124.8	557	6.3	28	105
					Combined 1960 Winter and 1960-61 Summer						
May 19, 1960	364	Control	24	2	326.0	508.6	182.6	502			
to May 18, 1961		Treated[b]	48-39	2	326.2	530.0	201.0	552	18.4	50	110

[a]Statistics — Gain/steer, kg.:

Winter	s = 11.0	C.V. = 15.7%	P < .005
Summer	s = 20.0	C.V. = 16.5%	P > .25
Winter and summer	s = 24.5	C.V. = 12.8%	P < .025

[b]Treated animals were implanted with 24 mg. stilbestrol/head on May 19, 1960.

results are presented separately for the two seasons. In this trial, the winter season began on May 19, 1960 and ended October 6, 1960, and the following summer season was considered to begin on October 6, 1960 and end on May 18, 1961.

The results for Experiment 1 are presented in Table 2.

Stilbestrol vs. no stilbestrol

The winter period of 1960 was quite favorable for the growth of grass and the quality of the forage remained fairly high. The rate of gain for the two-year-old stilbestrol-treated steers was 544 grams per head daily, while the controls averaged 458 grams ($P<.005$). For the 140-day season, the total increase for the stilbestrol-treated group was 12.1 kg., or an increase over the controls of 19 percent.

During the following summer, the same tester animals had average daily gains of 557 grams for the implanted group and 529 for the controls ($P>.25$). This was an increase of only 6.3 kg., equal to 5% over the control group. Other investigations by IRI indicate that a 24-mg. implant of stilbestrol loses its effectiveness after six to seven months (Quinn *et al.* 1958, 1960). Since only one 24-mg. implant was used at the beginning of the trial, it is suspected that the treatment had little if any effect on growth rate during the summer period.

For the combined winter and summer periods, a total of 364 days, the increase for stilbestrol was 18.4 kg. per steer or a 10% increase over the controls ($P<.025$). This is the least response to stilbestrol among the ten trials reported here. The response in most experiments has been twenty percent or more.

Experiment 2 — Influence of two 24-mg. implants of stilbestrol upon the growth rate of Zebu steers grazed on well managed Colonial Guineagrass pasture

This comparison of stilbestrol-implanted and untreated steers was conducted within the same pastures as described in Experiment 1. The winter season of 1961 was

very dry and the quality of feed was reduced to a very low level. This resulted in lower rates of gain of all animals in the trial compared with those obtained during the previous year on the same pastures.

The pastures

The experimental pastures have been described under Experiment 1 above.

The animals

Ninety-six 2-year-old Nellore steers were selected for use as tester animals. Stilbestrol was implanted in 48 head at the rate of 24 mg. per steer on May 31, 1961 at the beginning of the winter season, followed by a second implant of 24 mg. on December 13 during the subsequent summer season. The same tester animals remained in the trial both the winter and summer season — a total of 336 days. The remaining 48 head of tester steers were used as controls. Each group of 48 steers was distributed at random among the 24 pastures, allocating two implanted and two control steers to each pasture. Additional steers were added to and removed from the pastures to maintain the forage in near optimum grazing condition. At the end of the trial on May 2, 1962, all testers were removed from the pastures and slaughtered.

The cattle were weighed at 28-day intervals following an overnight fast. A mineral supplement containing bone meal, iron, copper and cobalt with common salt was fed *ad libitum* to all animals (see page 10). The winter season for purposes of this trial began on May 31, 1961 and ended on October 18, 1961, and the summer season included the period from October 18, 1961 to May 2, 1962.

The results for Experiment 2 are presented in Table 3.

Stilbestrol vs. no stilbestrol

The winter season of 1961 was extra dry and the quality of feed was reduced to a very low level. The rate of gain for the two-year-old stilbestrol-treated steers was 255 grams per steer daily, while the control averaged 143 grams ($P<.01$). For the entire winter season, the treated

TABLE 3. Effect of winter- and summer-implanted stilbestrol upon the gains of steers on Colonial Guinea-grass pasture, 1961-62 — Experiment 2, Fazenda Jangada, Araçatuba.

Period	No. of days	Steer group	No. of animals	Age	Av. initial weight	Av. final weight	Gain/steer		Increase for stilbestrol		Growth index (control = 100)
							Total[a]	Daily	Total/steer	Daily/steer	
				yrs.	kg.	kg.	kg.	gm.	kg.	gm.	
					1961 Winter						
May 31 to	140	Control	48	2	377.5	397.5	20.0	143			
Oct. 18, 1961		Treated[b]	48	2	376.4	412.1	35.7	255	15.7	112	178
					1961-62 Summer						
Oct. 18, 1961	196	Control	48	2	397.5	539.7	142.2	725			
to May 2, 1962		Treated[b]	48	2	412.1	581.0	168.9	862	26.7	137	119
					Combined 1961 Winter and 1961-62 Summer						
May 31, 1961	336	Control	48	2	377.5	539.7	162.2	483			
to May 2, 1962		Treated[b]	48	2	376.4	581.0	204.6	609	42.4	126	126

[a]Statistics — Gain/steer, kg.:

Winter	s = 7.7	C.V. = 27.7%	P < .01
Summer	s = 10.8	C.V. = 7.0%	P < .01
Winter and summer	s = 13.4	C.V. = 7.3%	P < .01

[b]Stilbestrol was implanted as follows: 24 mg./steer on May 31, 1961 (commencement of the winter season period) and 24 mg. on December 13, 1961 (subsequent summer).

steers gained an average of 15.7 kg. more than their respective controls.

During the following summer season, the same tester steers averaged 862 grams per day for those that received the implants and 725 grams per day for the controls ($P<.01$). For the summer season, the implanted steers gained 26.7 kg. more than their respective controls.

For the combined winter and summer seasons, the effect of 48 mg. of stilbestrol was to increase the gain per steer 42.4 kg. or an increase of 26% over the controls ($P<.01$).

Experiment 3 — The effect of two 24-mg. implants of stilbestrol upon the gains of Zebu steers when grazing Colonial Guineagrass pasture

This experiment represents the third comparison of stilbestrol-treated with untreated Nellore steers within the same experimental pastures as reported in Experiments 1 and 2. The treated tester steers in this experiment received two 24-mg. implants of stilbestrol as in Experiment 2, and most of the tester steers remained in the trial during both the winter and summer seasons — a total of 364 days. The winter season of 1962 was quite favorable for a limited amount of forage growth, which maintained the quality of forage at a satisfactory level. The rainfall for the period May through September was 166 mm. at the experiment site.

The pastures

The experimental pastures have been described under Experiment 1 above.

The animals

Nellore steers, two years of age, were selected for this trial. Initially, 96 steers were sorted from a herd of 400-500 head, 48 head were implanted on May 18, 1962 at the start of the trial, and 48 head remained as controls. There was insufficient forage on several of the low-producing pastures to maintain a total of four testers—two implanted and two controls—during the winter season, so it was necessary to remove several testers from the experiment as

TABLE 4. Effect of winter- and summer-implanted stilbestrol upon the gains of steers on Colonial Guinea-grass pasture, 1962-63 — Experiment 3, Fazenda Jangada, Araçatuba.

Period	No. of days	Steer group	No. of animals	Age	Av. initial weight	Av. final weight	Gain/steer		Increase for stilbestrol		Growth index (control = 100)
							Total[a]	Daily	Total/steer	Daily/steer	
				yrs.	kg.	kg.	kg.	gm.	kg.	gm.	
1962 Winter											
May 18 to	140	Control	43-40	2	297.7	355.2	57.7	412			
Oct. 5, 1962		Treated[b]	43-42	2	295.8	373.5	76.7	548	19.0	136	133
1962-63 Summer											
Oct. 5, 1962	224	Control	39-38	2	356.4	478.4	124.5	556			
to May 17, 1963		Treated[b]	42-39	2	373.5	513.0	142.4	636	17.9	80	114
Combined 1962 Winter and 1962-63 Summer											
May 18, 1962	364	Control	43-38	2	297.7	478.4	182.2	501			
to May 17, 1963		Treated[b]	43-39	2	295.8	513.0	219.1	602	36.9	101	120

[a]Statistics — Gain/steer, kg.:

Winter	s = 9.4	C.V. = 13.9%	P < .01
Summer	s = 11.2	C.V. = 8.4%	P < .01
Winter and summer	s = 15.9	C.V. = 7.9%	P < .01

[b]Stilbestrol was implanted as follows: 24 mg./steer on May 18, 1962 (start of the winter season period) and 24 mg. on November 30, 1962 (subsequent summer.)

indicated in Table 4. Most of the tester animals which began the trial on May 18 remained in the experiment throughout the winter and summer period of 364 days. A second implant of 24 mg. stilbestrol was administered on November 30, early in the summer season, to the same steers which had been treated at the beginning of the trial. Additional steers were added to and removed from the pastures to maintain the forage in near optimum grazing condition. At the end of the trial on May 17, 1963, all testers were removed from the pastures and slaughtered.

The cattle were weighed at 28-day intervals following an overnight fast. A mineral supplement containing bone meal, iron, copper and cobalt with common salt was fed *ad libitum* to all animals (see page 10). The winter season for this trial was from May 18 to October 5, 1962 and the summer from October 5, 1962 to May 17, 1963.

The results for Experiment 3 are given in Table 4.

Stilbestrol vs. no stilbestrol

The average gains of the steers during the winter season were only slightly lower than during the following summer season, indicating that the quality of feed remained at a high level during the winter. For the combined winter and summer seasons, the average daily gains for the three years that these experiments were conducted (Experiments 1, 2 and 3, Tables 2, 3 and 4) were nearly identical, indicating rigorous control of grazing management and consistent estimates of stocking rates. The stilbestrol-treated steers gave an average daily gain of 548 grams compared with the untreated controls of 412 grams ($P<.01$). At the end of the winter season, the treated steers had gained an additional 19.0 kg., representing a 33% increase over the controls.

During the subsequent summer season, the average daily gains were 636 grams and 556 grams ($P<.01$) for the treated and untreated steers respectively. The treated steers had gained an additional 17.9 kg. or a 14% increase over the untreated controls.

For the combined winter and summer seasons, the average daily gains were 501 grams and 602 grams for the

control and treated steers, an increase of 101 grams. The treated steers had gained an additional 36.9 kg. over the controls ($P<.01$).

Comparison of Experiments 1, 2 and 3

Since these three experiments were conducted on the same pastures with steers from the same herd but in different years, comparisons between them are of interest. One 24-mg. implant (Experiment 1) gave a total increase in weight gain per steer of 18.4 kg., while two 24-mg. implants gave total increases of 42.4 and 36.9 kg. for Experiments 2 and 3 respectively. The percentage increases were 10%, 26% and 20% for the three experiments. This would indicate that 24 mg. of stilbestrol implanted at the beginning of the trial was not sufficient to remain effective through the 12-month period, and that an additional implant of 24 mg. at the beginning of the summer season was essential to maintain the responses in growth rate. In Experiment 3, it is also of interest to note that the increase in average daily gain—136 grams—during the winter season exceeded the increase in average daily gain—80 grams—obtained during the subsequent summer season. This suggests that responses to stilbestrol occur both during the periods of low-quality forage, as well as under more favorable nutritional conditions.

Experiment 4 — Influence of age of steers upon their response to stilbestrol

Previous studies by IRI indicate that greater responses to stilbestrol can be expected as steers increase in age (Quinn *et al.* 1958). Since most cattle are not slaughtered in Brazil until they reach an age of four to six years, the use of stilbestrol may have a greater impact than in areas where cattle are slaughtered at a younger age. This trial gives additional information relative to the response of different ages of animals since direct comparisons can be made between one- and two-year-old steers grazed in the same pastures as tester animals.

The pastures and other variables

An area of 264 hectares of Colonial Guineagrass pas-

ture on Fazenda Jangada was selected for this trial. It was divided and fenced to provide 24 pastures of about 11 hectares each for eight different feeding treatments with three field replications. At the end of the dry season on October 19, 1961, the experiment was reduced to two replications, thus reducing the pastures to 16 and the number of tester animals by one third. The feeding treatments consisted of several levels of ground ear corn with and without a protein supplement. Since there was no interaction between feeding treatments and treatment with stilbestrol, only the results for stilbestrol and the influence of age of steers will be reported here.

The trial was started on June 29, 1961 early in the winter season, and ended on February 8, 1962 during the summer season. The 112-day period ending on October 19, 1961 was considered the end of the dry season and the beginning of the wet season, and the results are presented for the winter and a summer period.

The animals

Initially, 120 head of 10-month-old steers and 120 head of 22-month-old steers were selected from over 1000 head as tester steers. Five head from each of the two age groups were allocated to each pasture; and within each group of five, three were implanted with 24 mg. stilbestrol on June 29, 1961. A second implant was given on December 14, 1961 on the treated steers which remained in the trial during the summer season.

Weights were taken every 28 days following an overnight fast. A mineral supplement containing bone meal, iron, copper and cobalt with salt was fed *ad libitum* to all animals (see page 10).

The results are given in Table 5, showing a comparison of one- and two-year-olds and their response to stilbestrol.

Response to stilbestrol

During the winter season, the two-year-old steers gained at a more rapid rate than the yearlings. This may be a reflection of a difference in the condition of the two

TABLE 5. Effect of winter- and summer-implanted stilbestrol upon the gains of steers on Colonial Guinea-grass pasture, 1961-62 — Experiment 4, Fazenda Jangada, Araçatuba.

Period	No. of days	Steer group	No. of animals	Age	Av. initial weight	Av. final weight	Gain/steer		Increase for stilbestrol		Growth index (control = 100)
							Total[a]	Daily	Total/steer	Daily/steer	
				yrs.	kg.	kg.	kg.	gm.	kg.	gm.	
					1961 Winter[b]						
June 29 to Oct. 19, 1961	112	Control	48	2	344.3	372.9	28.6	255			
		Treated[c]	72	2	343.3	385.6	42.3	378	13.7	123	148
		Control	48	1	256.0	277.4	21.4	191			
		Treated[c]	72	1	259.0	292.3	33.3	297	11.9	106	156
					1961-62 Summer[d]						
Oct. 19, 1961 to Feb. 8, 1962	112	Control	32	2	365.0	456.6	91.6	818			
		Treated[c]	48	2	376.8	489.3	112.5	1004	20.9	186	123
		Control	32	1	269.5	369.6	100.1	894			
		Treated[c]	48	1	281.9	398.6	116.7	1042	16.6	148	116
					Combined 1961 Winter and 1961-62 Summer						
June 29, 1961 to Feb. 8, 1962	224	Control	48-32	2	344.3	456.6	120.2	537			
		Treated[c]	72-48	2	343.3	489.3	154.8	691	34.6	154	129
		Control	48-32	1	256.0	369.6	121.5	542			
		Treated[c]	72-48	1	259.0	398.6	150.0	670	28.5	128	123

[a]Statistics — Gain/steer, kg.:

Winter	s = 8.4	C.V. = 29.8%	P < .001
Summer	s = 16.0	C.V. = 14.6%	P < .001
Winter and summer	s = 21.3	C.V. = 15.3%	P < .001

[b]Three replications (24 pastures).
[c]Stilbestrol was implanted as follows: 24 mg./steer on June 29. 1961 (start of the experiment in the winter season) and 24 mg. on December 14, 1961 (subsequent summer).
[d]Two replications (16 pastures).

age groups when they entered the trial, since it is well known that the thinner animal will show a greater rate of gain than one that is in good condition. The increase for stilbestrol was 13.7 kg. per steer ($P<.001$) for the two-year-olds, while for the yearlings it was 11.9 kg. per steer ($P<.001$).

During the summer season, the two-year-old steers again showed a greater response to stilbestrol, giving an increase in average daily gain of 186 grams ($P<.001$) compared with the yearlings which had an increase of 148 grams ($P<.001$).

For the total period of winter and summer, the average gain per steer for the control steers was about equal, 120.2 kg. and 121.5 kg. for the two-year-olds and yearlings respectively, whereas the treated two-year steers gained more than the yearlings, 154.8 kg. vs. 150.0 kg. respectively ($P>.1$). In percent increase for stilbestrol, the two-year-olds gave 29% and the yearlings 23% over their respective controls.

Experiment 5 — Influence of stilbestrol upon the growth rate of two-year-old Nellore steers on Colonial Guineagrass pastures

This trial was conducted to determine the influence of protein supplements upon the growth rate of two-year-old steers and to establish if there was any differential response to the implantation of stilbestrol. Since the results indicate no interaction between stilbestrol and the effect of the supplements, the data will be presented for stilbestrol as though no other variables were studied.

The pastures

Six 16-hectare pastures were provided for this trial. The pastures contained nearly a pure stand of Colonial Guineagrass. Each pasture was supplied with water and contained an excess of forage throughout the trial.

The animals

Ninety-six head of two-year-old steers were randomly allocated to the six forage-supplement pastures, 16 steers to each pasture. One half or eight steers in each group

were implanted with 24 mg. stilbestrol per head on July 7, 1961 at the beginning of the trial. The remaining eight steers in each pasture were left as untreated controls. All testers remained in the experiment during both the winter and summer periods, and the treated animals received a second implant of 24 mg. stilbestrol on December 15, 1961.

Excepting for two periods of 21 days and 27 days, weighings were made every 28 days following an overnight fast. A mineral supplement containing bone meal, iron, copper and cobalt with common salt was fed *ad libitum* to all animals (see page 10).

The winter period was considered to be from July 7 to October 20, 1961 and the summer from October 20 to May 3, 1962—a total of 300 days.

The results for Experiment 5 are given in Table 6.

Stilbestrol vs. no stilbestrol

The winter season of 1961 was very dry at this location and the quality of forage was reduced to a very low level, resulting in low rates of gain of all animals. The results are similar to those of Experiment 2. The two experiments were conducted at about the same time and on adjacent areas on the same farm.

During the winter season, the implanted and untreated steers had an average daily gain of 259 grams and 134 grams respectively ($P<.001$). The increase in total average gain per steer during the winter season was 13.1 kg. During the summer season, the average daily gains were 787 grams and 662 grams respectively for the treated and untreated groups or an increase for the 195-day period of 24.4 kg. per steer ($P<.001$). For the combined winter and summer periods, the average increase in average daily gain was 125 grams, which represented an increase of 26% over the controls ($P<.001$).

Experiment 6 — Influence of stilbestrol upon the performance of 3-year-old Zebu steers fed energy-protein supplements on pasture

TABLE 6. Effect of winter- and summer-implanted stilbestrol upon the gains of steers on Colonial Guinea-grass pasture, 1961-62 — Experiment 5, Fazenda Jangada, Araçatuba.

Period	No. of days	Steer group	No. of animals	Age	Av. initial weight	Av. final weight	Gain/steer		Increase for stilbestrol		Growth index (control = 100)
							Total[a]	Daily	Total/steer	Daily/steer	
				yrs.	kg.	kg.	kg.	gm.	kg.	gm.	
					1961 Winter						
July 7 to	105	Control	48	2	322.1	336.2	14.1	134			
Oct. 20, 1961		Treated[b]	48	2	322.0	349.2	27.2	259	13.1	125	193
					1961-62 Summer						
Oct. 20, 1961	195	Control	48	2	336.2	465.2	129.0	662			
to May 3, 1962		Treated[b]	48	2	349.2	502.6	153.4	787	24.4	125	119
					Combined 1961 Winter and 1961-62 Summer						
July 7, 1961	300	Control	48	2	322.1	465.2	143.1	477			
to May 3, 1962		Treated[b]	48	2	322.0	502.6	180.6	602	37.5	125	126

[a]Statistics — Gain/steer, kg.:

Winter	s = 10.1	C.V. = 48.9%	P < .001
Summer	s = 16.9	C.V. = 12.0%	P < .001
Winter and summer	s = 20.6	C.V. = 12.7%	P < .001

[b]Stilbestrol was implanted as follows: 24 mg./steer on July 7, 1960 (start of the trial) and 24 mg. during the subsequent summer season on December 15, 1961.

This experiment was designed to determine the influence of energy-protein supplements upon steer performance when fed on Colonial Guineagrass pastures. In addition, one half the steers were implanted with stilbestrol to determine its effect upon the rate of gain and the interaction with feed supplements. The analysis indicated no interaction between stilbestrol and supplements, so the results only for stilbestrol will be presented here.

The pastures

Fifty alqueires of Colonial Guineagrass pasture was fenced into five pastures of 10 alqueires or 24.2 ha. each to provide for the five feeding treatments of the experiment —one pasture per treatment. No treatment was applied to the pastures, and the variables studied in the trial were applied only to the animals.

The animals

One hundred and twenty mixed-breed Zebu steers were selected from the herd on Fazenda Cambuhy for this trial. Twenty-four head were allocated at random to each of the five pasture-supplement treatments. Within each group of 24, one half the animals were implanted with 24 mg. stilbestrol on July 14, 1960, providing for 12 implanted and 12 untreated controls in each pasture. At the time this trial was conducted, the investigators were not yet aware of the importance of reimplanting steers after 6 months from a previous implant. For this reason, the second implant was not made until late in the summer season on March 23, 1961.

Weights were taken at 28-day intervals following an overnight fast. A mineral supplement containing bone meal, iron, copper and cobalt with common salt was fed *ad libitum* to all animals (see page 10).

The trial began on July 14, 1960, and the end of the winter season was considered to be November 3. The trial ended on May 18, 1961, making a total of 308 days for the combined winter and summer periods.

The results for Experiment 6 are presented in Table 7.

TABLE 7. Effect of winter- and late-summer-implanted stilbestrol upon the gains of steers on Colonial Guineagrass pasture, 1960-61 — Experiment 6, Fazenda Cambuhy, Matão.

Period	No. of days	Steer group	No. of animals	Age	Av. initial weight	Av. final weight	Gain/steer		Increase for stilbestrol		Growth index (control = 100)
							Total[a]	Daily	Total/steer	Daily/steer	
				yrs.	kg.	kg.	kg.	gm.	kg.	gm.	
					1960 Winter						
July 14 to	112	Control	60	3	366.7	379.9	13.2	118			
Nov. 3, 1960		Treated[b]	60	3	363.0	388.2	25.2	225	12.0	107	191
					1960-61 Summer						
Nov. 3, 1960	196	Control	60	3	379.9	508.3	128.4	655			
to May 18, 1961		Treated[b]	60	3	388.2	531.9	143.7	733	15.3	78	112
					Combined 1960 Winter and 1960-61 Summer						
July 14, 1960	308	Control	60	3	366.7	508.3	141.6	460			
to May 18, 1961		Treated[b]	60	3	363.0	531.9	168.9	548	27.3	88	119

[a]Statistics — Gain/steer, kg.:

Winter	s = 11.9	C.V. = 77%	P < .001
Summer	s = 21.1	C.V. = 16%	P < .01
Winter and summer	s = 25.3	C.V. = 17%	P < .001

[b]Stilbestrol was implanted as follows: 24 mg./steer on July 14, 1960 (at the start of the trial) and 24 mg. on March 23, 1961 (latter part of subsequent summer season period).

Stilbestrol vs. no stilbestrol

This trial did not begin until well into the winter-dry season so that the average daily gains were quite low since the quality of forage had already been greatly reduced. The treated steers had an average daily gain of 225 grams and the untreated 118 grams, a difference of 107 grams per steer per day ($P<.001$).

Since a repeat application of 24 mg. of stilbestrol was not made until the end of the summer season, the increase in average daily gain was only 78 grams for the stilbestrol-treated steers during the summer-wet season ($P<.01$). Early in the summer season, the stimulating effect on growth of the 24-mg. stilbestrol implant made at the beginning of the trial had been greatly reduced, resulting in small increase in the average daily gain.

For the combined winter and summer season, the total weight increase per steer due to stilbestrol was 27.3 kg. per steer ($P<.001$), or an increase of 88 grams per steer per day.

Experiment 7 — The effect of stilbestrol upon the growth rate of mixed Zebu steers fed protein supplement and feed additives on Colonial Guineagrass pasture

This experiment consisted of seven treatments including protein supplements and feed additives. Vitamin A and tranquilizers were included among the feed additives, and the analysis of data indicated no interaction between the effect of stilbestrol and the various supplements fed on pasture. Only the results for the stilbestrol response are reported here.

The pastures

Fourteen pastures of 8.9 ha. each were used in this trial, and the seven treatments were arranged in two randomized complete blocks of seven pastures each. The dominant species in the pastures was Colonial Guineagrass, *Panicum maximum*.

The animals

Eight three-year-old mixed-breed Zebu steers were allocated at random to each pasture, four of which were implanted with 24 mg. stilbestrol per head on June 27, 1961 at the beginning of the trial. A second implant of 24 mg. stilbestrol was given on December 12, 1961, early in the wet season.

Weights were taken every 28 days following an overnight fast. A mineral supplement containing bone meal, iron, copper and cobalt with salt was fed *ad libitum* to all animals (see page 10).

During the summer months, four tester animals were removed from the trial in each of the treated and untreated groups (Table 8).

Response to stilbestrol

The winter season of 1961 was very dry at the IRI headquarters on Fazenda Cambuhy, resulting in low average daily gains due to poor-quality forage. The implanted steers gained 119 grams per day compared with 71 grams for the control steers ($P<.05$).

During the subsequent summer season, the average daily gains were 729 and 899 grams for the control and stilbestrol-treated steers respectively. This was an increase in average daily gain of 170 grams or 23% over the control steers ($P<.001$).

For the combined winter and summer seasons, the increase in average daily gain was 125 grams or 26% over the control steers for the 308 days ($P<.001$).

Experiment 8 — The influence of stilbestrol upon the growth rate of steers fed low levels of protein supplement with varying concentrations of salt

This experiment was designed to provide information on the effectiveness of supplement-salt mixtures to control feed intake under pasture conditions. In addition, a stilbestrol variable was included within treatment groups to study the effect of stilbestrol upon the growth rate of steers.

TABLE 8. Effect of winter- and summer-implanted stilbestrol upon the gains of steers on Colonial Guinea-grass pasture, 1961-62 — Experiment 7, Fazenda Cambuhy, Matão.

Period	No. of days	Steer group	No. of animals	Age	Av. initial weight	Av. final weight	Gain/steer		Increase for stilbestrol		Growth index (control = 100)
							Total[a]	Daily	Total/steer	Daily/steer	
				yrs.	kg.	kg.	kg.	gm.	kg.	gm.	
					1961 Winter						
June 27 to	112	Control	56	3	287.6	295.6	8.0	71			
Oct. 17, 1961		Treated[b]	56	3	289.1	302.4	13.3	119	5.3	48	166
					1961-62 Summer						
Oct. 17, 1961	196	Control	56-52	3	295.6	439.2	142.8	729			
to May 1, 1962		Treated[b]	56-52	3	302.4	477.3	176.2	899	33.4	170	123
					Combined 1961 Winter and 1961-62 Summer						
June 27, 1961	308	Control	56-52	3	287.6	439.2	150.8	490			
to May 1, 1962		Treated[b]	56-52	3	289.1	477.3	189.5	615	38.7	125	126

[a]Statistics — Gain/steer, kg.:

Winter	s = 10.4	C.V. = 97.4%	$P < .05$
Summer	s = 21.4	C.V. = 13.4%	$P < .001$
Winter and summer	s = 20.4	C.V. = 12.0%	$P < .001$

[b]Stilbestrol was implanted as follows: 24 mg./steer on June 27, 1961 (start of the trial) and 24 mg. during the subsequent summer season on December 12, 1961.

The pastures

Ten pastures of six hectares each were provided for this trial which included five treatments. The five treatments were distributed at random among five pastures in each of two randomized blocks. Colonial Guineagrass was the principal species in the pastures.

The animals

A total of 60 three-year-old tester steers of mixed Zebu breeds were distributed at random among the ten pastures, six steers to each pasture. One half of each group of six was implanted with stilbestrol on July 7, 1961 at the beginning of the trial. A second implant of 24 mg. was given on December 22 during the summer season.

The steers were weighed every 28 days following an overnight fast. A mineral supplement containing bone meal, iron, copper and cobalt was fed *ad libitum* to all animals. Excepting for the amount of salt furnished, inasmuch as this was a variable in this experiment, the formula of the mineral mix was that as indicated on page 10 of this report.

During the summer months, the number of tester animals per pasture was reduced from six to four—two implanted steers and two controls (Table 9).

Response to stilbestrol

This experiment was conducted in an area adjacent to Experiment 7 and during about the same period. The winter season was very dry, which resulted in low gains due to poor-quality forage. Stilbestrol increased the daily gains by 75 grams ($P<.05$).

During the subsequent summer season of 196 days, the daily gains were quite high with an average of 777 grams for the controls and 906 grams for the treated steers, an increase of 129 grams per steer per day ($P<.025$).

For the 308-day period of winter and summer combined, the 48 mg. of stilbestrol increased the average gain per steer by 33.9 kilograms. This represented an increase of 21% over the controls ($P<.01$).

TABLE 9. Effect of winter- and summer-implanted stilbestrol upon the gains of steers on Colonial Guinea-grass pasture, 1961-62 — Experiment 8, Fazenda Cambuhy, Matão.

Period	No. of days	Steer group	No. of animals	Age	Av. initial weight	Av. final weight	Gain/steer		Increase for stilbestrol		Growth index (control = 100)
							Total[a]	Daily	Total/steer	Daily/steer	
				yrs.	kg.	kg.	kg.	gm.	kg.	gm.	
					1961 Winter						
July 7 to	112	Control	30	3	287.8	294.8	7.0	63			
Oct. 27, 1961		Treated[b]	30	3	288.3	303.8	15.5	138	8.5	75	221
					1961-62 Summer						
Oct. 27, 1961	196	Control	30-20	3	294.8	454.8	152.2	777			
to May 11, 1962		Treated[b]	30-20	3	303.8	485.8	177.6	906	25.4	129	117
					Combined 1961 Winter and 1961-62 Summer						
July 7, 1961	308	Control	30-20	3	287.8	454.8	159.2	517			
to May 11, 1962		Treated[b]	30-20	3	288.3	485.8	193.1	627	33.9	110	121

[a]Statistics — Gain/steer, kg.:

Winter	s = 8.7	C.V. = 76.0%	$P < .05$
Summer	s = 19.2	C.V. = 11.6%	$P < .025$
Winter and summer	s = 24.3	C.V. = 13.8%	$P < .01$

[b]Stilbestrol was implanted as follows: 24 mg./steer on July 7, 1961 (start of the trial) and 24 mg. during the subsequent summer season on December 22, 1961.

Experiment 9 — The influence of stilbestrol upon the growth rate of steers fed energy supplements with and without urea on Colonial Guineagrass pastures

Corn-and-cob meal and molasses, with and without urea, were fed to three-year-old steers untreated and implanted with stilbestrol. In addition to the supplement, the animals had access to an adequate supply of Colonial Guinea pasture throughout the period of the trial. The response to stilbestrol was independent of the response to the feed supplement ($P>.1$). Only the results of the stilbestrol effects will be reported here.

The pastures

This trial was conducted on the same pastures used for Experiment 7 in 1961. Fourteen pastures of 8.9 ha. each were provided, and the seven treatments were arranged in two randomized complete blocks of seven pastures each.

The animals

Three-year-old mixed-breed Zebu steers were selected for this trial. One half of the tester animals—42 head—were implanted with 24 mg. stilbestrol on May 25, 1962 at the beginning of the trial, and 42 head remained as controls. Three treated and three untreated steers were allocated at random to each of the 14 pastures. Initially, a total of 84 tester steers were included in the trial, but this number was reduced to 78 head during the summer period.

A second implant of 24 mg. stilbestrol was given on November 9, 1962 near the beginning of the summer season.

The steers were weighed every 28 days after an overnight fast, and a mineral supplement containing bone meal, iron, copper and cobalt with salt was fed *ad libitum* to all animals (see page 10).

The results are presented in Table 10.

TABLE 10. Effect of winter- and summer-implanted stilbestrol upon the gains of steers on Colonial Guinea-grass pasture, 1962-63 — Experiment 9, Fazenda Cambuhy, Matão.

Period	No. of days	Steer group	No. of animals	Age	Av. initial weight	Av. final weight	Gain/steer		Increase for stilbestrol		Growth index (control = 100)
							Total[a]	Daily	Total/steer	Daily/steer	
				yrs.	kg.	kg.	kg.	gm.	kg.	gm.	
					1962 Winter						
May 25 to	140	Control	42	3	287.8	358.6	70.8	506			
Oct. 12, 1962		Treated[b]	42	3	287.2	373.5	86.3	616	15.5	110	122
					1962-63 Summer						
Oct. 12, 1962	168	Control	42-40	3	358.6	462.8	105.0	625			
to Mar. 29, 1963		Treated[b]	42-38	3	373.8	495.9	123.4	735	18.4	110	118
					Combined 1962 Winter and 1962-63 Summer						
May 25, 1962	308	Control	42-40	3	287.8	462.8	175.8	571			
to Mar. 29, 1963		Treated[b]	42-38	3	287.2	495.9	209.7	681	33.9	110	119

[a]Statistics — Gain/steer, kg.:

Winter	s = 6.4	C.V. = 8.2%	P < .005
Summer	s = 11.5	C.V. = 10.0%	P < .005
Winter and summer	s = 19.5	C.V. = 8.5%	P < .005

[b]Stilbestrol implanted as follows: 24 mg./steer on May 25, 1962 (start of the winter season period) and 24 mg. on November 9, 1962 (subsequent summer).

Stilbestrol vs. no stilbestrol

The 1962 winter season was unusually favorable for the growth of grass (see Table 1) with a winter season rainfall of 190 millimeters. The resulting high-quality forage and the supplemental feeding gave average daily gains of 506 grams and 616 grams for the control and stilbestrol-treated groups respectively. This represented an increase for stilbestrol of 110 grams per steer per day, or 22 percent ($P<.005$).

During the subsequent summer season, the average daily gains were 625 and 735 grams, again an increase of 110 grams over the controls ($P<.005$).

For the combined winter and summer periods, the average increase per steer was 33.9 kilograms ($P<.005$), a percentage increase of 19 percent.

Experiment 10 — The relationship of feed supplements on low-quality pastures and the response to stilbestrol

This was a study of feed supplements on low-quality pastures consisting of six treatments, one treatment on each of six pastures. The analysis of variance indicated no interaction between the supplement treatments and the response to stilbestrol ($P>.25$). The results are presented only for the response to stilbestrol in Table 11.

The pastures

Six pastures of approximately 30 hectares each provided an adequate quantity of feed for each of the six treatments in this trial. The pastures were of a type common to the region containing Jaraguagrass, *Hyparrhenia rufa,* and Batatais, *Paspalum notatum,* as the principal species.

The animals

Twenty three-year-old mixed breed Zebu steers were allocated at random to each of six pastures, ten of which were implanted with 24 mg. stilbestrol on June 6, 1961, the beginning of the trial. A second implant of 24 mg. was given on December 19, 1961 during the subsequent summer season.

TABLE 11. Effect of winter- and summer-implanted stilbestrol upon the gains of steers on Jaragua-Batatais pasture, 1961-62 — Experiment 10, Fazenda Cambuhy, Matão.

Period	No. of days	Steer group	No. of animals	Age	Av. initial weight	Av. final weight	Gain/steer		Increase for stilbestrol		Growth index (control = 100)
							Total[a]	Daily	Total/steer	Daily/steer	
				yrs.	kg.	kg.	kg.	gm.	kg.	gm.	
					1961 Winter						
June 6 to	140	Control	60	3	295.8	300.8	5.0	36			
Oct. 24, 1961		Treated[b]	60	3	298.6	313.7	15.1	108	10.1	72	302
					1961-62 Summer						
Oct. 24, 1961	168	Control	60-47	3	300.8	421.6	116.0	690			
to Apr. 10, 1962		Treated[b]	60-47	3	313.7	457.4	139.1	828	23.1	138	120
					Combined 1961 Winter and 1961-62 Summer						
June 6, 1961	308	Control	60-47	3	295.8	421.6	121.0	393			
to Apr. 10, 1962		Treated[b]	60-47	3	298.6	457.4	154.2	501	33.2	108	127

[a]Statistics — Gain/steer, kg.:

Winter	s = 10.4	C.V. = 103.9%	P < .001
Summer	s = 14.9	C.V. = 11.6%	P < .001
Winter and summer	s = 16.9	C.V. = 12.2%	P < .001

[b]Stilbestrol was implanted as follows: 24 mg./steer on June 6, 1961 (start of the trial) and 24 mg. during the subsequent summer season on December 19, 1961.

Weights were taken every 28 days following an overnight fast. A mineral supplement containing bone meal, iron, copper and cobalt with salt was fed *ad libitum* to all animals (see page 10).

Response to stilbestrol

The average daily gains of all steers were very low during the winter season of 1961 due to the extremely dry season and the poor-quality forage. The increase for stilbestrol in average daily gain was 72 grams, and the steers which had been implanted gained an additional 10.1 kg. over their respective controls during the 140-day winter season ($P<.001$).

During the summer season, the average daily gains were 690 and 828 grams for the control and implanted groups respectively, an increase of 138 grams ($P<.001$) for the stilbestrol-treated animals.

For the combined winter and summer periods of 308 days, the implanted steers had gained an additional 33.2 kg. ($P<.001$), which represented an increase in rate of gain of 27 percent.

Influence of stilbestrol implants upon liveweight gains per hectare

Since stilbestrol has been shown repeatedly to increase the efficiency of utilization of the feed consumed, it would be expected that as the carrying capacity of the pasture increases, the amount of liveweight gain per hectare would also increase. Heinemann and Van Keuren (1962) studied the influence of stilbestrol upon steers grazing high-producing irrigated pastures in Washington, U.S.A. They found that stilbestrol increased the liveweight gains per acre 128, 128 and 144 pounds on Orchardgrass-alfalfa, alfalfa alone and Orchardgrass-Ladino Clover pastures respectively. The corresponding percentage increases were 17, 18 and 18. They also estimated the T.D.N. consumption on the basis of requirements for maintenance and performance of the implanted and nonimplanted steers, and concluded that the implanted animals utilized forage from 13 to 19% more efficiently than the respective nonimplanted animals.

TABLE 12. Influence of stilbestrol upon the production of beef per hectare on Colonial Guineagrass pasture, unfertilized and fertilized with 200 kg. nitrogen per hectare, 1960-1963 — Fazenda Jangada.

Exp.	Period	No. of days	No nitrogen				200 kg. N per hectare			
			Without DES Livewt. gain/ha.	With DES Livewt. gain/ha.	Increase for DES Livewt. gain/ha.	Growth index (control = 100)	Without DES Livewt. gain/ha.	With DES Livewt. gain/ha.	Increase for DES Livewt. gain/ha.	Growth index (control = 100)
			kg.	kg.	kg.		kg.	kg.	kg.	
1	May 19, 1960 — May 18, 1961	364	200	229	29		452	598	146	
2	May 31, 1961 — May 2, 1962	336	194	228	34		468	583	115	
3	May 18, 1962 — May 17, 1963	364	235	273	38		555	647	92	
	Average — 3 experiments		210	243	33	116	492	609	117	124

In Experiments 1, 2 and 3 reported in this paper, the liveweight gains per hectare were also measured in addition to the gain per animal. In Table 12 are given the results of liveweight gains per hectare from the three experiments for pastures fertilized with two levels of nitrogen (0 and 200 kg. N per ha.). In these trials, the pastures contained both implanted and nonimplanted steers as tester animals. The amount of liveweight gain per hectare was computed for each kind of steer using the method described by Mott and Lucas (1952). The following inferences may be made if we can assume that the stilbestrol-implanted animals did not consume additional forage to obtain the extra gain but instead utilized the forage consumed more efficiently.

Stilbestrol-implanted steers gave an increase per hectare of 33 kg. over nonimplanted steers on the unfertilized pastures having an average carrying capacity of 1.2 steers per hectare. An increase per hectare of 117 kg. was obtained on pastures fertilized with 200 kg. of nitrogen having an average carrying capacity of 2.9 steers per hectare. The latter figures are of about the same order of magnitude as those reported by Heinemann and Van Keuren (1962) for high-producing irrigated pastures and stress the importance of using stilbestrol to insure a higher return on money invested in pasture improvement. The percentage increases of 16 and 24% for the unfertilized and fertilized pastures respectively are an indication of the increase in efficiency of utilization of the forage consumed. This is true if the assumption that stilbestrol-implanted steers do not consume additional forage is valid.

Interpretation of Results and Conclusions

The widespread use of stilbestrol on beef animals for slaughter in Brazil should increase the production of carcass beef by at least twenty percent. This is the indication from results presented in this paper and summarized in Table 13 and Figure 2. If Experiments 1 and 6 are omitted from the averages, then the average daily gains would be increased by 121 grams (+24%) as a result of implanting the animals with 48 mg. stilbestrol. The treatment of

24 mg. was first applied at the beginning of the trials, and the treatment was repeated after 5 to 7 months with the exception of Experiments 1 and 6. For an implantation of 48 mg., an increase exceeding 40 kg. in liveweight through a one-year period seems to be a conservative estimate (121 gm. × 365 days = 44 kg.) of what can be expected. Since animals for slaughter are usually marketed between 400-500 kg. in liveweight, the implantation of 24 mg. of stilbestrol every six months beginning at weaning time could easily reduce the killing age of steers from four years to three years or from three years to two years as has been reported by Quinn *et al.* (1966).

Since feed consumption is not increased as a result of

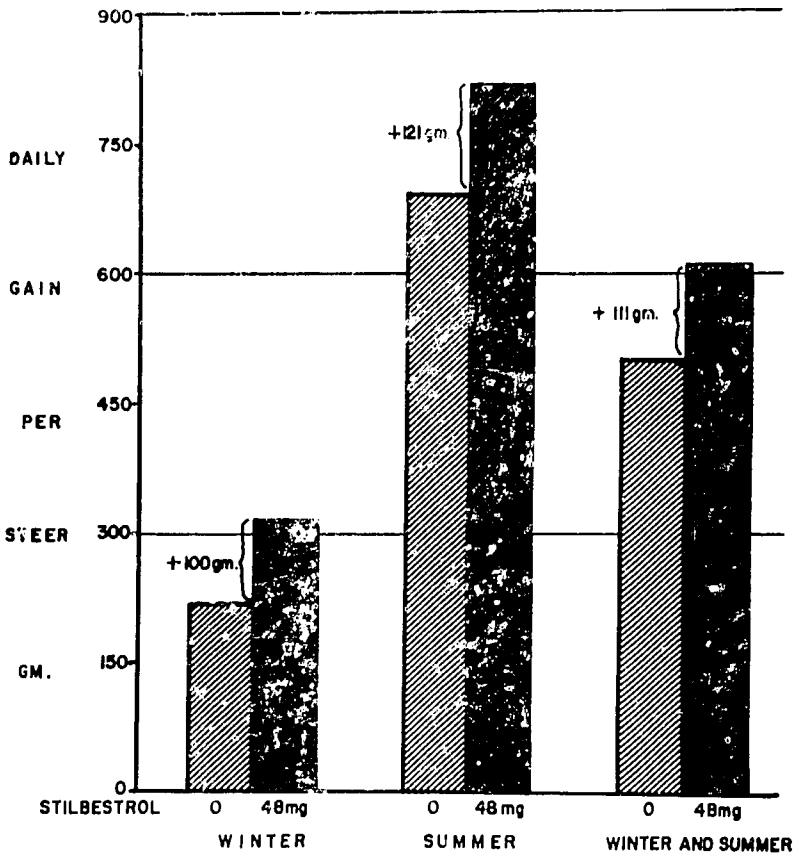

Figure 2. Increase due to stilbestrol upon average daily gains of steers during the winter and summer months—average of 10 experiments.

treatment with stilbestrol, the only cost for the extra gain in weight is the cost of diethylstilbestrol, which at present is about 1,000 cruzeiros[5] for 48 milligrams. If this investment can be expected to produce increases of over 40 kg. in liveweight during a one-year period, then less than 2 kg.[5] of liveweight would pay for the 48 mg. required for each animal during one year.

It is difficult to estimate the overall impact which the use of stilbestrol could have on the efficiency of beef production in Brazil. However, the following effects are obvious: First, a 20% increase in rate of gain seems to be a conservative prediction; second, the length of time required to reach slaughter weight may also save up to 20% on the total amount of feed required to produce the slaughter animal; and third, the decrease in slaughter age would reduce the capital cost of the animals and the interest on the investment.

TABLE 13. Influence of stilbestrol upon the rate of gain — increase in average daily gain — av. of 10 experiments.

Exp. No.	No. of days	No. of steers	Age of steer	Increase for stilbestrol				
				Av. daily gain/steer			Growth index Control = 100	Statistics
				Winter	Summer	Winter plus summer		
			yrs.	gm.	gm.	gm.		
1[a]	364	72	2	86	28	50	110	
2	336	96	2	112	137	126	126	
3	364	86	2	136	80	101	120	
4	224	120	2	123	186	154	129	
4	224	120	1	106	148	128	123	
5	300	96	2	125	125	125	126	
6[a]	308	120	3	107	78	88	119	
7	308	112	3	48	170	125	126	
8	308	60	3	75	129	110	121	
9	308	84	3	110	110	110	119	
10	308	120	3	72	138	108	127	
Total or av. — 10 exps.		1086	–	100	121	111	122	s = 5.4
Total or av. — 8 exps. (omitting 1 and 6)		894	–	101	136	121	124	s = 3.5

[a]Only one 24-mg. implant/head used in Experiment 1 and second implant in Experiment 6 made only two months prior to end of trial.

[5]Price of 12 mg. stilbestrol in Brazil approximately 250 cruzeiros and carcass beef 1,000 cruzeiros per kilo.

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