EFFECTS OF IMPLANTS ON PERFORMANCE AND CARCASS TRAITS OF FEEDLOT STEERS AND HEIFERS

Susan K. Duckett, Fred N. Owens, and John G. Andrae
Animal and Veterinary Science Department
University of Idaho, Moscow, 83844 and Oklahoma State University, Stillwater 74078

ABSTRACT

Performance and carcass data were compiled from available literature to summarize the effects of single implants, reimplanting, and implant schemes on feedlot steers and heifers. Averaged across trials, steers implanted with a combination of estrogen and androgen compounds had the highest gains, feed efficiency, carcass weight and ribeye area. All implant types, except androgen alone, reduced marbling score and percent grading choice in steers compared to those that were not implanted. In head-on comparisons against non-implanted steers, both estrogenic and combination implants increased performance traits, carcass weight and ribeye area, and reduced marbling score. Reimplanting with an additional mild estrogen or estrogen plus androgen (combination) improved gains and feed efficiency, but reduced marbling score compared to a single implant. Implanting with one or two combination implants increased performance as compared to two strong estrogen implants. In heifers, androgen either alone or combined with estrogen was most effective implant for improving performance and quantitative carcass traits. Implanting heifers with estrogenic compounds alone did not improve performance. Marbling scores and quality grades were unchanged by implanting in heifers. Reimplanting with either androgen alone or androgen plus estrogen increased heifer performance traits and carcass weights.

INTRODUCTION

Implants are used commonly in the finishing phase of beef production to improve gain and feed efficiency. Eleven implants are available commercially for feedlot steers and heifers; these can be used alone, in sequence, or in combination. Many questions remain regarding which implant or implant combination is most effective for increasing performance and profitability in the feedlot. Concerns about negative impacts of implants on quality grade and tenderness have developed in the industry (Morgan, 1991; Belk, 1992). The objective of this paper was to summarize the available literature on the effects of various implants and combinations on feedlot performance and carcass traits of steers and heifers.

Methods

Databases were assembled that consisted of treatment means reported in scientific journals and research reports from all available implant trials through mid 1996. The steer database included 77 research trials (cattle number, N = 14,127) and the heifer database consisted of 30 research trials (N = 5,489). Implants were grouped or classified across name brands (Table 1) as either mild estrogen, strong estrogen, androgen, strong estrogen plus androgen, mild estrogen plus androgen, and strong estrogen plus two androgens. In addition, first and second implants were listed. The number of implant treatments represented in the database for steers and for heifers is shown in Tables 2 and 3. Note that many cells are vacant. The General Linear Model of SAS (1990) was used to test the implant type effects weighted by the number of animals per treatment for steers and heifers separately. The experimental unit was defined as the mean from all cattle within a treatment and within a trial that was similar in implant scheme, in breed, in initial weight, and in days fed. Single implant effects are least squares means across all treatments where no second implant was given; responses to two identical implants also were compared. Superscripts denote differences at $P < .05$. Head-on and reimplant comparisons are least squares means comparing implants using groups of cattle from the same trial and identical background.

RESULTS

Single Implant Means for Steers: When only a single implant was used at the start of the trial, the combination of strong estrogen plus androgen resulted in the largest increases in gain, efficiency, carcass weight and ribeye area by steers (Table 4). Steers

Table 1. Implant type classification for the various implants.

Abbrev.	Implant Type	Implant Trade Name
A	Androgen	Finaplix-H, Finaplix-S
SE	Strong Estrogen	Implus-S, Synovex-S
SEA	Strong Estrogen + Androgen	Implus-H, Synovex-H, Revalor-H, Revalor-S, Synovex-S + Finaplix-S, Synovex-Plus
SE-2A	Strong Estrogen + 2 Androgens	Synovex-H + Finaplix-H, Implus-H + Finaplix-H
ME	Mild Estrogen	Compudose, Ralgro
MEA	Mild Estrogen + Androgen	Compudose + Finaplix, Ralgro + Finaplix

Table 2. Number of various implant treatments for feedlot steers.

First	Second Implant				
Implant	NONE	ME	SE	A	SEA
ME	32	16	3	1	1
SE	38	1	34	3	23
A	4	0	0	0	0
MEA	7	0	0	1	0
SEA	70	0	6	5	36
NONE	81	0	0	0	4

Table 3. Number of various implant treatments for feedlot heifers.

First	Second Implant				
Implant	NONE	ME	SE	A	SEA
ME	2	2	0	0	2
SE	2	0	3	3	0
A	15	0	0	11	0
SEA	23	0	0	1	4
SE-2A	8	0	0	1	2
NONE	39	0	0	1	2

implanted with a mild or strong estrogen had higher gains than non-implanted steers but lower than with strong estrogen plus androgen. Steers implanted with androgen implants alone or mild estrogen plus androgen had responses not different from control or other implant types for several traits, probably due to the limited number of observations for these treatments (4 and 7). Dry matter intake was increased with mild estrogen, strong estrogen, and strong estrogen plus androgen implants. On a percent of carcass weight basis, dry matter intake was increased by estrogen but unchanged or decreased by androgen implants. Dressing percent, fat thickness, quality grade, dark cutter incidence and shear force were not significantly changed by implanting regardless of implant type. Carcass weight was greater with strong estrogen implants than with no implant but lower than with strong estrogen plus androgen implants. Percent kidney-pelvic-heart fat was reduced by combination (estrogen plus androgen) and mild estrogen implants. With the exception of androgen alone, all implants reduced marbling score and percent grading choice. Mild estrogen implants lowered yield grade compared to non-implanted controls and to all implants except for androgen alone and mild estrogen plus androgen, the two treatments with very limited data. Weight of closely trimmed lean cuts, as calculated from carcass measurements, and of non-lean (fat plus bone) was increased by the strong estrogen plus androgen implant, primarily due to increased carcass weight.

Table 4. Impact of a single implant on performance and carcass traits of feedlot steers.

First implant / Second implant	None / None	Mild estrogen / None	Strong estrogen / None	Androgen / None	Mild estrogen & androgen / None	Strong estrogen & androgen / None
Contrasts	81	31	42	4	7	70
Treated steers	2355	1221	1730	38	352	3006
ADG, lb.	2.88^{c}	3.11^{b}	3.29^{b}	2.96^{abc}	3.22^{b}	3.64^{a}
ADG, carcass	2.89^{c}	3.25^{b}	3.32^{b}	3.05^{abc}	3.23^{bc}	3.67^{a}
DMI, lb/d	19.45^{c}	21.83^{a}	21.25^{ab}	19.40^{abc}	21.72^{abc}	21.91^{a}
DMI, % of mean wt	2.13^{b}	2.36^{a}	2.22^{ab}	2.00^{ab}	2.30^{ab}	2.14^{b}
Feed/gain	6.77^{a}	6.92^{a}	6.62^{a}	7.51^{ab}	6.86^{ab}	6.12^{b}
Feed ME	2.92^{bc}	2.87^{c}	3.03^{ab}	3.12^{abc}	2.81^{bc}	3.13^{a}
Carcass weight, lb	699^{c}	702^{bc}	723^{b}	683^{abc}	705^{bc}	768^{a}
Dress percent	61.8	61.6	61.7	62.5	61.8	61.8
Rib eye area, sq. in.	12.09^{b}	11.98^{b}	12.32^{b}	12.21^{b}	12.41^{ab}	12.70^{a}
Fat thickness, in.	0.46	0.46	0.47	0.57	0.48	0.46
KPH, %	2.48^{a}	2.15^{bc}	2.37^{ab}	2.24^{abc}	1.85^{c}	2.21^{b}
Marbling score	544^{a}	504^{b}	518^{b}	522^{ab}	500^{b}	515^{b}
Choice, %	74.0^{a}	59.6^{b}	63.1^{b}		45.2^{b}	59.7^{b}
Yield grade	2.85^{a}	2.67^{b}	2.88^{a}	2.91^{ab}	2.70^{ab}	2.85^{a}
Quality grade	4.90	4.71	4.74	4.58	4.58	4.77
Dark cutters, %	0.00		4.00			1.73
Shear force, lb.	7.76		8.60	10.65		8.32
Lean cuts, % carc wt	50.1	49.9	49.9	50.4	50.3	49.9
Lean cuts, pounds	353^{b}	357^{b}	363^{b}	344^{b}	355^{b}	377^{a}
Non-lean cuts, pounds	353^{c}	359^{bc}	365^{b}	339^{bc}	351^{bc}	378^{a}

Repeated Implants for Steers. Effects of repeated implants on steer performance and carcass characteristics of steers are presented in Table 5. The number of trials generally is less than for single implants. Again, the greatest effects on gain, efficiency, carcass weight and rib eye area were for steers reimplanted with strong estrogen plus androgen although dry matter intake was greatest for steers implanted twice with strong estrogen. Marbling scores were reduced by all implants (except androgen alone) and percentage of carcasses grading choice was decreased by strong estrogen and strong estrogen plus androgen implants. Again, weight of closely trimmed lean cuts and of non-lean tissue were increased by combination implants.

Single implant means for Heifers: For feedlot heifers implanted once at the start of the feeding trial (Table 6), androgen alone or in combination with estrogen resulted in higher gains than non- implanted or estrogen-implanted heifers. Implanting with estrogenic compounds alone did not increase gain compared to non-implanted heifers. Dry matter intake was increased by strong estrogen plus androgen implants but reduced by mild estrogen implants compared to heifers that were not implanted or implanted with androgen or strong estrogen plus two androgen implants. This was due primarily to an increased body weight; per hundred pounds live weight, only mild estrogen implants increased dry matter intake. Feed efficiency and calculated metabolizable energy showed the largest improvement with strong estrogen - androgen combination implants followed by androgen implants. Implanting with a mild estrogen reduced dressing percent, ribeye area and fat thickness compared to non-implanted heifers or most other implants, all probably due to a reduced carcass weight at slaughter. Dressing percent was highest with the strong estrogen implant. Implanting with strong estrogen plus one or two androgens increased ribeye area and reduced kidney-pelvic-heart fat when compared to non-implanted heifers. Marbling score, yield grade, quality grade, dark cutter incidence and shear force were not significantly changed by implanting heifers once at the start of the finishing period. Lean and non-lean cut weights were increased by a strong estrogen plus two androgen implant.

Repeated Implants for Heifers. Table 7 presents least square means for heifers reimplanted during the finishing period. The number of reimplant trials was very limited for mild estrogen and for strong estrogen alone or with two androgen implants. Gains and efficiencies were greatest with strong estrogen and strong estrogen plus two androgen implants. Low carcass weights for mild estrogen reimplanted cattle can explain their low dressing percentage, carcass weight and quality grade. In contrast to effects with steers, strong estrogen implants appeared to reduce kidney - heart - pelvic percentage while the combination implants did not. Marbling scores were reduced by combination implants; the percentage choice carcass was reduced by reimplants of strong estrogen plus two androgens. Yield grade was reduced, due primarily to reduced fat thickness, by all implants although the percentage of carcass that were dark cutting tended to be elevated by including androgen in the implants. In general, repeated implants increased carcass cutability of heifers.

Head-on Single Implant Comparisons for Steers: Head-on comparisons in which contrasts are drawn within each trial but summed across trials with feedlot steers (Table 8) showed that implanting with either mild estrogen, strong estrogen, or strong estrogen plus androgen increased gain, feed intake (amount or percent of body weight), efficiency and carcass weight. Of these, implanting with the combination resulted in the largest changes in gain (21%), DMI (7%), feed efficiency (-11%), carcass weight (7%), ribeye area (5%), fat thickness (7%), and percent choice (-17%) Responses were more moderate with mild or strong estrogen implants for gain (9-14%), DMI (4%), efficiency (-4-5%), carcass weight (2-3%), ribeye area (1%), fat thickness (2-4%), marbling score (-2%), and percent choice (-4-10%). Androgen implants (A) used alone increased gain (16%) and tended to increase ribeye area (5%) but had limited effect on other performance and carcass traits. Comparisons between implant types showed that implanting once with combination implants instead of a strong estrogen resulted in greater gain (6%), DMI (2%), efficiency (5%), diet ME (2%), carcass weight (2%) and ribeye area (2%), but also reduced marbling score (2%) and percent choice (11%). None of the differences between the mild versus the strong estrogen implants were significant.

Table 5. Impact of repeated implants or no implant on performance and carcass traits of feedlot steers (least squares means).

First implant / Second implant	None / None	Mild estrogen / Mild estrogen	Strong estrogen / Strong estrogen	Androgen / Androgen	Strong estrogen & androgen / Strong estrogen & androgen
Contrasts	81	16	36	4	36
Treated steers	2355	778	1162	86	1357
ADG, lb.	2.88 c	2.98 c	3.33 b	2.74 c	3.63 a
ADG, carcass	2.89 c	2.88 c	3.36 b	2.62 c	3.61 a
DMI, lb/d	19.45 cd	20.81 ab	21.40 a	17.54 d	19.96 bc
DMI, % of mean wt	2.13 b	2.23 ab	2.28 a	1.98 bc	2.00 c
Feed/gain	6.77 ab	7.06 a	6.44 ab	6.42 bc	5.54 c
Feed ME	2.92 b	2.83 b	2.96 b	2.99 ab	3.34 a
Carcass weight, lb	699 c	708 bc	728 b	672 bc	798 a
Dress percent	61.8 ab	61.0 b	61.5 b	60.4 ab	62.4 a
Rib eye area, sq. in.	12.09 c	12.19 bc	12.53 b	12.04 bc	13.30 a
Fat thickness, in.	0.46 ab	0.42 b	0.48 ab	0.38 ab	0.50 a
KPH, %	2.48 a	2.12 bc	2.41 ab	2.33 abc	2.08 c
Marbling score	544 a	468 c	509 b	496 abc	522 b
Choice, %	74.0 a	82.0 ab	62.6 b	40.8 ab	57.6 b
Yield grade	2.85 ab	2.65 c	2.73 bc	2.54 abc	2.95 a
Quality grade	4.90 a	4.23 c	4.61 b	4.22 abc	4.85 ab
Dark cutters, %	0.00 b		4.40 a		
Shear force, lb.	7.76	9.80	9.07	9.00	7.44
Lean cuts, % carc wt	50.1	50.4	50.1	50.7	49.9
Lean cuts, pounds	353 b	359 b	362 b	341 b	403 a
Non-lean cuts, lbs	353 b	353 b	361 b	331 b	406 a

Table 6. Impact of a single implant on performance and carcass traits of feedlot heifers (least squares means).

First implant	None	Mild estrogen	Strong estrogen	Androgen	Strong estrogen & androgen	Strong estrogen & 2 androgens
Second implant	None	None	None	None	None	None
Contrasts	39	2	2	15	20	8
Treated heifers	1368	201	99	816	888	120
ADG, lb.	2.71 ^{c}	2.44 ^{c}	2.51 ^{bc}	3.14 ^{a}	3.11 ^{ab}	3.64 ^{a}
ADG, carcass	2.59 ^{b}	1.94 ^{c}	2.78 ^{ab}	3.04 ^{a}	3.06 ^{a}	3.38 ^{a}
DMI, lb/d	18.25 ^{ad}	16.68 ^{c}	16.44 ^{cd}	19.10 ^{ab}	19.43 ^{b}	19.62 ^{ab}
DMI, % of mean wt	2.09 ^{b}	2.26 ^{a}	2.06 ^{ab}	2.11 ^{ab}	2.08 ^{b}	2.00 ^{b}
Feed/gain	6.80 ^{b}	6.83 ^{ab}	6.55 ^{abc}	6.17 ^{ac}	6.35 ^{ac}	5.41 ^{c}
Feed ME	3.13 ^{a}	2.67 ^{b}	3.31 ^{ab}	3.33 ^{b}	3.37 ^{b}	3.64 ^{ab}
Carcass weight, lb	642 ^{b}	529 ^{d}	611 ^{abcd}	679 ^{ab}	700 ^{a}	714 ^{abc}
Dressing percent	60.7 ^{b}	57.0 ^{c}	63.5 ^{a}	61.5 ^{ab}	61.9 ^{a}	60.4 ^{ab}
Rib eye area, sq. in.	12.14 ^{b}	11.00 ^{c}	12.06 ^{abc}	12.63 ^{ab}	13.16 ^{a}	13.08 ^{ab}
Fat thickness, in.	0.51 ^{a}	0.44 ^{b}	0.56 ^{a}	0.53 ^{a}	0.52 ^{a}	0.46 ^{ab}
KPH, %	2.61		2.35	2.52	2.33	2.36
Marbling score	555	490	530	543	534	
Choice, %	78.0 ^{a}		58.8 ^{b}	74.6 ^{ab}	77.6 ^{a}	76.6 ^{ab}
Yield grade	2.75	2.80	2.84	2.80	2.74	2.63
Quality grade	5.02	4.00	5.00	4.93	5.03	
Dark cutters, %	0.5			3.9	1.9	
Shear force, lb.	8.3			8.0	8.2	
Lean, % of carc wt	50.3		49.9	50.1	50.6	50.6
Lean cuts, lb.	323 ^{b}		314 ^{b}	332 ^{b}	329 ^{b}	362 ^{a}
Non-lean cuts, lb.	319 ^{b}		315 ^{b}	331 ^{b}	321 ^{b}	353 ^{a}

Table 7. Impact of repeated implants or no implant on performance and carcass traits of feedlot heifers (least squares means).

First implant	None	Mild estrogen	Strong estrogen	Androgen	Strong estrogen & androgen	Strong estrogen & 2 androgens
Second implant	None	Mild estrogen	Strong estrogen	Androgen	Strong estrogen & androgen	Strong estrogen & 2 androgens
Contrasts	39	2	3	11	11	4
Treated heifers	1368	25	158	278	222	74
ADG, lb.	2.71 ^{c}	2.17 ^{cd}	3.47 ^{a}	2.83 ^{bc}	3.13 ^{abd}	3.45 ^{ab}
ADG, carcass	2.59 ^{c}	1.59 ^{c}	3.44 ^{ab}	2.78 ^{bc}	2.69 ^{bc}	3.44 ^{ab}
DMI, lb/d	18.25	16.61	18.81	18.86	17.98	19.61
DMI, % of mean wt	2.09 ^{c}	2.72 ^{a}	2.18 ^{ac}	2.10 ^{bc}	2.27 ^{ab}	2.10 ^{bc}
Feed/gain	6.80 ^{a}	6.46 ^{abc}	5.38 ^{c}	6.43 ^{ab}	5.95 ^{bc}	5.69 ^{abc}
Feed ME	3.13 ^{b}	2.33 ^{ab}	3.53 ^{a}	3.25 ^{ab}	3.07 ^{b}	3.57 ^{ab}
Carcass weight, lb	642 ^{a}	432 ^{b}	658 ^{a}	654 ^{a}	614 ^{ab}	707 ^{a}
Dressing percent	60.7 ^{a}	55.7 ^{b}	61.3 ^{a}	60.9 ^{a}	61.1 ^{a}	61.8 ^{a}
Rib eye area, sq. in.	12.14 ^{b}		12.60 ^{ab}	12.92 ^{ab}	12.40 ^{ab}	14.05 ^{a}
Fat thickness, in.	0.51 ^{a}		0.39 ^{c}	0.40 ^{bc}	0.48 ^{ab}	0.39 ^{bc}
KPH, %	2.61 ^{a}		2.13 ^{b}	2.66 ^{a}	2.64 ^{a}	2.50 ^{ab}
Marbling score	555 ^{ab}	340 ^{d}	561 ^{abc}	658 ^{a}	487 ^{cd}	
Choice, %	78.0 ^{a}		62.2 ^{b}	71.1 ^{ab}	78.0 ^{a}	59.5 ^{b}
Yield grade	2.75 ^{a}	2.20 ^{ab}	2.39 ^{b}	2.19 ^{b}	2.37 ^{b}	2.14 ^{b}
Quality grade	5.02	3.00	5.00	5.35	4.44	
Dark cutters, %	0.5 ^{b}		2.3 ^{b}	2.4 ^{b}	10.0 ^{ab}	15.5 ^{a}
Shear force, lb.	8.3			11.6		
Lean, % of carc wt	50.3 ^{b}		51.3 ^{a}	51.5 ^{a}	50.9 ^{ab}	51.8 ^{a}
Lean cuts, lb.	323 ^{c}		338 ^{abc}	353 ^{ab}	328 ^{bc}	366 ^{a}
Non-lean cuts, lb.	319		321	332	317	341

Table 8. Effects of implant scheme on performance and carcass characteristics of feedlot steers (least squares means from within-trial comparisons).

Implant First	Implant Second	Trials No.	ADG lb.	CADG lb.	DMI lb./d	DMI %BW	F/G	ME Mcal/kg	Carcass lb.	Dress %	REA sq.in.	Fat Th in.	KPH %	Yield grade	Lean %CW	Lean lb.	Non-lean lb.	Marbling score	Quality grade	Choice %	Shear lb.	Dark cu %
Effects of Single Implants																						
Mild Estro	None	14	2.99	3.03	19.70	2.21	6.52	2.88	**690.5**	61.02	11.92	0.44	2.50	2.72	49.70	360.8	365.2	511	4.66	63.72		
None	None		2.72	2.77	18.95	2.17	6.83	2.82	**670.8**	60.99	11.78	0.43	2.63	2.67	49.96	355.9	356.3	522	5.00	66.28		
Probability			0.01	0.01	0.01	0.01	0.01	0.01	**0.01**	0.90	0.31	0.37	0.17	0.60	0.41	0.25	0.14	0.10	0.06	0.88		
% Change			***9.9***	***9.4***	***4.0***	***1.8***	***-4.5***	***2.1***	***2.9***	0.0	1.2	2.3	-4.9	1.9	-0.5	1.4	2.5	-2.1	-6.8	-3.9		
Strong Estro	None	23	3.08	3.14	21.33	2.28	7.00	2.83	**709.0**	61.55	12.13	0.51	2.38	2.95	49.66	356.4	361.6	529	4.94	62.84	10.67	4.0
None	None		2.68	2.77	20.54	2.24	7.38	2.75	**680.8**	61.62	12.06	0.49	2.53	2.87	49.93	344.5	345.7	541	5.00	70.08	9.67	0.0
Probability			0.01	0.01	0.01	0.04	0.01	0.01	**0.01**	0.66	0.38	0.13	0.01	0.08	0.06	0.01	0.01	0.10	0.46	0.06		
% Change			***14.9***	***13.4***	***3.8***	***1.8***	***-5.1***	***2.9***	***4.1***	-0.1	0.6	3.9	***-5.9***	2.8	-0.5	***3.5***	***4.6***	-2.2	-1.2	-10.3	10.3	
Andro & Estro	None	33	3.76	3.64	21.38	2.12	5.81	3.11	**762.8**	61.37	12.68	0.48	2.13	2.86	50.03	380.2	380.4	511	4.73	66.91	9.01	1.7
None	None		3.12	3.05	20.02	2.08	6.52	2.93	**714.4**	61.67	12.06	0.45	2.24	2.86	50.09	360.2	359.3	537	4.77	80.87	8.63	0.0
Probability			0.01	0.01	0.01	0.01	0.01	0.01	**0.01**	0.13	0.01	0.01	0.01	0.89	0.56	0.01	0.01	0.01	0.42	0.01	0.36	0.5
% Change			***20.5***	***19.3***	***6.8***	***1.9***	***-10.9***	***6.1***	***6.8***	-0.5	***5.1***	***6.7***	***-4.9***	0.0	-0.1	***5.6***	***5.9***	***-4.8***	-0.8	***-17.3***	4.4	
Androgen	None	4	2.92	3.04	18.99	1.98	7.30	3.06	**686.0**	62.77	11.91	0.67	2.28	3.10	50.10	344.3	343.6	542	4.84		9.85	
None	None		2.51	2.67	18.48	1.98	7.51	2.94	**678.6**	63.00	11.24	0.62	2.37	3.18	49.58	337.5	343.8	565	5.40		8.85	
Probability			0.04	0.11	0.73	0.97		0.11	**0.53**	0.66	0.02	0.54	0.71	0.69	0.01	0.45	0.97	0.35	0.27		0.29	
% Change			***16.3***	13.9	2.8	0.0	-2.8	4.1	1.1	-0.4	6.0	8.1	-3.8	-2.5	***1.0***	2.0	-0.1	-4.1	-10.4		11.3	
Andro & Estro	None	6	3.50	3.56	20.54	1.99	6.12	3.16	**750.1**	62.02	12.81	0.50	2.21	2.90	49.86	373.7	375.9	507	4.63	52.17	10.03	3.0
Strong Estro	None		3.31	3.35	20.04	1.97	6.46	3.08	**735.0**	62.04	12.50	0.51	2.21	2.96	49.78	365.1	368.5	520	4.62	58.83	10.06	4.0
Probability			0.01	0.01	0.01	0.04	0.01	0.01	**0.01**	0.81	0.01	0.32	0.99	0.09	0.35	0.01	0.01	0.01	0.71	0.01	0.91	0.8
% Change			***5.7***	***6.3***	***2.5***	***1.0***	***-5.3***	***2.6***	***2.1***	0.0	***2.5***	-2.0	0.0	-2.0	0.2	***2.4***	***2.0***	***-2.5***	0.2	***-11.3***	-0.3	-25.0
Strong Estro	None	10	3.13	3.48	19.96	2.23	6.52	3.06	**722.3**	62.17	12.39	0.47	2.56	2.68	49.79	366.7	369.8	512	4.65	45.42		
Mild Estro	None		3.08	3.47	20.11	2.25	6.59	3.03	**721.0**	62.35	12.29	0.48	2.62	2.65	49.61	363.7	369.4	512	4.84	54.49		
Probability			0.33	0.84	0.62	0.51	0.68	0.55	**0.86**	0.58	0.44	0.46	0.41	0.74	0.39	0.35	0.94	0.97	0.42	0.12		
% Change			1.6	0.3	-0.7	-0.9	-1.1	1.0	0.2	-0.3	0.8	-2.1	-2.3	1.1	0.4	0.8	0.1	0.0	-3.9	-16.6		
Effects of Reimplants																						
Mild Estro	Mild Estro	4	3.04	3.01	20.09	2.19	6.57	2.86	**709.3**	61.56	12.24	0.43	2.04	2.61	50.70	366.6	356.5	499	4.55			
Mild Estro	None		2.84	2.87	20.18	2.23	6.87	2.78	**697.9**	61.89	12.03	0.43	2.11	2.54	50.56	361.2	353.2	525	4.94			
Probability			0.01	0.04	0.66	0.13	0.05	0.02	**0.06**	0.11	0.01	0.70	0.38	0.38	0.11	0.18	0.32	0.03	0.26			
% Change			***7.0***	**4.9**	-0.4	-1.8	**-4.4**	**2.9**	1.6	-0.5	1.7	0.0	-3.3	2.8	0.3	1.5	0.9	**-5.0**	-7.9			
Strong Estro	Strong Estro	10	3.08	3.01	12.79	2.32	7.45	2.73	**717.4**	61.36	12.59	0.47	2.29	2.82	50.28	362.4	359.0	526	4.73	61.57		
Strong Estro	None		3.00	2.95	12.90	2.35	7.69	2.68	**710.4**	61.47	12.41	0.48	2.29	2.92	50.00	362.9	363.5	533	5.21	58.85		
Probability			0.21	0.51	0.76	0.18	0.20	0.10	**0.46**	0.54	0.23	0.75	0.99	0.49	0.43	0.85	0.46	0.56	0.07	0.55		
% Change			2.7	2.0	-0.9	-1.3	-3.1	1.9	1.0	-0.2	1.5	-2.1	0.0	-3.4	0.6	-0.1	-1.2	-1.3	-9.2	4.6		

Implant First	Implant Second	Trials No.	ADG lb.	CADG lb.	DMI lb./d	DMI %BW	F/G	ME Mcal/kg	Carcass lb.	Dress %	REA sq.in.	Fat Th in.	KPH %	Yield grade	Lean %CW	Lean lb.	Non-lean lb.	Marbling score	Quality grade	Choice %	Shear lb.	Dark cut %
Andro & Estro	Andro & Estro	6	3.89	3.96	21.62	2.22	5.87	3.06	792.5	62.37	13.37	0.55	2.25	3.10	49.62	392.9	399.6	511	4.83	62.01	8.49	
Andro & Estro	None		3.66	3.65	21.35	2.24	6.24	2.94	764.5	61.85	12.97	0.56	2.26	3.10	49.56	378.6	386.0	534	4.91	77.43	7.79	
Probability			0.01	0.01	0.46	0.54	0.02	0.02	0.01	0.05	0.03	0.84	0.60	0.92	0.70	0.01	0.01	0.03	0.60	0.01	0.30	
% Change			***6.3***	***8.5***	1.3	-0.9	**-5.9**	**4.1**	**3.7**	**0.8**	**3.1**	-1.8	-0.4	0.0	0.1	**3.8**	**3.5**	**-4.3**	-1.6	**-19.9**	9.0	
Effects of Various Implant Combinations																						
Andro & Estro	Androgen	3	3.49	3.54	19.91	2.02	5.70	3.22	748.5	60.44	13.09	0.54	2.04	2.71	49.97	374.0	374.5	482	4.33	71.00	10.00	
Andro & Estro	None		3.55	3.55	20.10	2.04	5.78	3.21	749.8	60.66	12.93	0.55	2.16	2.78	49.76	373.1	376.7	480	4.33	69.00	9.50	
Probability			0.63	0.91	0.61	0.59	0.43	0.74	0.82	0.28	0.11	0.91	0.17	0.20	0.47	0.39	0.65	0.81		0.96	0.66	
% Change			-1.7	-0.3	-0.9	-1.0	-1.4	0.3	-0.2	-0.4	1.2	-1.8	-5.6	-2.5	0.4	0.2	-0.6	0.4	0.0	2.9	5.3	
Andro & Estro	Andro & Estro	2	3.03	2.83	17.00	1.90	5.92	3.03	690.5	60.05	12.14	0.26	2.20	2.39	51.65	357.9	335.1	499		39.80		
Andro & Estro	Androgen		2.99	2.78	16.10	1.85	6.22	2.96	690.0	60.06	12.36	0.24	2.30	2.31	52.92	346.1	315.8	480		33.20		
Probability			0.90	0.87					0.99	0.96	0.46	0.73		0.54						0.72		
% Change			1.3	1.8	5.6	2.7	-4.8	2.4	0.1	0.0	-1.8	8.3	-4.3	3.5	-2.4	3.4	6.1	4.0		19.9		
Andro & Estro	Andro & Estro	6	3.76	3.71	20.25	2.16	5.59	3.15	743.7	61.36	13.23	0.43	1.92	2.63	50.63	388.5	379.9	497	4.31	63.51	9.82	
Andro & Estro	Strong Estro		3.64	3.57	19.84	2.16	5.82	3.07	734.3	61.17	12.89	0.45	1.92	2.77	50.29	379.6	375.6	505	4.44	66.31	9.18	
Probability			0.11	0.06	0.20	0.45	0.14	0.15	0.22	0.34	0.04	0.38	0.92	0.10	0.33	0.05	0.57	0.48	0.56	0.75	0.56	
% Change			3.3	3.9	2.1	0.0	-4.0	2.6	1.3	0.3	**2.6**	-4.4	0.0	-5.1	0.7	**2.3**	1.1	-1.6	-2.9	-4.2	7.0	
Andro & Estro	Andro & Estro	18	3.65	3.55	20.85	2.21	5.89	3.04	745.3	60.98	13.01	0.45	2.22	2.77	50.41	379.1	373.5	515	4.65	57.71	9.22	
Strong Estro	Strong Estro		3.42	3.33	20.69	2.24	6.24	2.91	725.8	60.92	12.57	0.45	2.25	2.84	50.16	368.3	366.6	521	4.71	64.62	8.67	
Probability			0.01	0.01	0.21	0.05	0.01	0.01	0.01	0.68	0.01	0.85	0.50	0.13	0.06	0.01	0.08	0.17	0.57	0.03	0.14	
% Change			**6.7**	**6.6**	0.8	**-1.3**	**-5.6**	**4.5**	**2.7**	0.1	**3.5**	0.0	-1.3	-2.5	0.5	**2.9**	1.9	-1.2	-1.3	**-10.7**	6.3	
Andro & Estro	Strong Estro	5	3.72	3.62	20.08	2.29	5.76	3.02	717.6	61.08	12.66	0.45	1.91	2.79	50.21	368.1	366.0	506	4.50	59.72	9.50	
Strong Estro	Andro & Estro		3.62	3.57	20.17	2.30	5.80	3.00	712.2	61.08	12.62	0.46	1.92	2.81	50.15	366.6	365.6	508	4.50	65.05	9.50	
Probability			0.20	0.18	0.62	0.69	0.73	0.74	0.15	1.00	0.72	0.53	0.86	0.75	0.64	0.27	0.85	0.83		0.46		
% Change			2.8	1.4	-0.4	-0.4	-0.7	0.7	0.7	0.0	0.3	-2.2	-0.5	-0.7	0.1	0.4	0.1	-0.4	0.0	-8.2	0.0	
Andro & Estro	Strong Estro	2	3.67	3.66	19.20	2.17	6.69	2.82	754.4	61.73	12.96	0.53	2.10	3.02	49.87	375.6	378.9	514	5.00	78.98		
Andro & Estro	None		3.60	3.64	18.80	2.13	6.60	2.84	756.4	61.85	12.89	0.53	2.10	2.98	49.82	376.0	380.5	525	5.00	76.32		
Probability			0.50	0.33					0.78	0.48	0.82	0.78		0.78	0.89	0.60	0.81	0.50		0.89		
% Change			1.9	0.5	2.1	1.9	1.4	-0.7	-0.3	-0.2	0.5	0.0	0.0	1.3	0.1	-0.1	-0.4	-2.1	0.0	3.5		
Andro & Estro	None	8	3.78	3.84	22.27	2.21	6.05	2.94	790.5	62.26	12.98	0.55	2.17	3.02	49.73	376.4	381.3	526	5.00	64.48	7.70	0.00
Strong Estro	Strong Estro		3.70	3.61	22.12	2.21	6.12	2.96	772.9	61.39	12.85	0.53	2.17	3.01	49.71	376.5	381.4	523	5.00	67.34	8.01	6.00
Probability			0.03	0.04	0.46	0.76	0.08	0.44	0.04	0.15	0.53	0.67	0.99	0.90	0.91	0.97	0.98	0.81		0.40	0.60	
% Change			**2.2**	**6.4**	0.7	0.0	-1.1	-0.7	**2.3**	1.4	1.0	3.8	0.0	0.3	0.0	0.0	0.0	0.6	0.0	-4.2	-3.9	
Strong Estro	Estro & Andro	3	3.90	3.94	22.29	2.14	5.92	3.11	795.9	61.66	13.06	0.52	2.26	3.11	49.54	394.2	401.7	526	5.00	72.76		
Strong Estro	None		3.67	3.70	22.15	2.18	6.30	2.96	775.0	61.33	12.90	0.53	2.17	3.06	49.63	384.3	390.8	519	5.00	71.62		
Probability			0.12	0.05	0.82	0.64	0.06	0.05	0.31	0.50	0.58	0.88		0.79	0.78	0.23	0.37			0.80		
% Change			6.3	**6.5**	0.6	-1.8	-6.0	**5.1**	2.7	0.5	1.2	-1.9	4.1	1.6	-0.2	2.6	2.8	1.3	0.0	1.6		

Table 9. Effects of implant scheme on performance and carcass characteristics of feedlot heifers (least squares means of within-trial comparisons).

Implant First	Implant Second	Trials No.	ADG lb.	CADG lb.	DMI lb./d	DMI % BW	F/G	ME Mcal/kg	Carcass lb.	Dress %	REA sq.in.	Fat Th in.	KPH %	Yield grade	Lean %CW	Lean lb.	Non-lean lb.	Marbling score	Quality grade	Choice %	Shear lb.	Dark cu %
Effects of Single Implants																						
Mild Estro	None	2	2.46	2.27	17.06	2.25	6.94	2.78	543.5	58.85	11.20	0.43		2.80				490	4.00			
None	None		2.33	2.10	16.55	2.23	7.11	2.71	525.2	58.51	10.66	0.46		2.50				550	5.00			
Probability			0.17	0.37	0.04	0.40	0.38	0.54	0.30	0.70	0.38	0.53										
% Change			5.6	8.1	**3.1**	0.9	-2.4	2.6	3.5	0.6	5.1	-6.5		12.0				-10.9	-20.0			
Strong Estro	None	2	2.52	2.80	16.81	2.11	6.68	3.16	598.6	63.02	12.02	0.52	2.35	2.73	49.91	313.8	314.9	530	5.00	58.80		
None	None		2.32	2.54	16.02	2.05	6.88	3.09	576.7	62.59	11.33	0.49	2.58	2.78	49.67	298.8	302.7	550	5.00	75.70		
Probability			0.21	0.26	0.18	0.23	0.21	0.31	0.24	0.52	0.21	0.25		0.35								
% Change			8.6	10.2	4.9	2.9	-2.9	2.3	3.8	0.7	6.1	6.1	-8.9	-1.8	0.5	5.0	4.0	-3.6	0.0	-22.3		
Estro & Andro	None	16	3.05	3.08	19.46	2.22	6.52	3.17	665.9	61.96	12.16	0.56	2.38	2.90	49.99	335.6	336.5	523	5.39	72.68	8.56	3.8
None	None		2.74	2.74	18.72	2.18	6.96	3.04	639.8	61.80	11.63	0.56	2.49	2.97	49.59	318.2	324.2	548	5.44	74.95	8.47	2.5
Probability			0.01	0.01	0.01	0.03	0.01	0.01	0.01	0.33	0.01	0.57	0.21	0.16	0.12	0.01	0.02	0.01	0.64	0.57	0.83	0.1
% Change			**11.3**	**12.4**	**4.0**	**1.8**	**-6.3**	**4.3**	**4.1**	0.3	**4.6**	0.0	-4.4	-2.4	0.8	**5.5**	**3.8**	**-4.5**	-0.9	-3.0	1.1	52
Estro & 2 Andro	None	8	3.67	3.37	19.65	1.99	5.35	3.50	717.4	60.14	13.06	0.46	2.41	2.67	50.55	362.8	354.7			76.70		
None	None		3.34	3.02	19.31	2.00	5.90	3.30	691.1	60.17	12.45	0.44	2.57	2.73	50.41	348.4	342.7			81.76		
Probability			0.01	0.01	0.14	0.52	0.02	0.01	0.01	0.92	0.01	0.32	0.11	0.53	0.55	0.01	0.01			0.18		
% Change			**9.9**	**11.6**	1.8	-0.5	**-9.3**	**6.1**	**3.8**	0.0	**4.9**	4.5	-6.2	-2.2	0.3	**4.1**	**3.5**			-6.2		
Androgen	None	10	3.08	2.97	18.64	2.07	6.17	3.24	670.5	61.33	12.29	0.54	2.63	2.79	49.67	337.3	342.0	535	4.46	76.98	8.00	2.8
None	None		2.96	2.83	18.71	2.09	6.45	3.14	660.0	61.10	12.10	0.54	2.53	2.76	49.73	328.5	332.5	554	4.54	83.12	8.00	0.9
Probability			0.01	0.01	0.54	0.11	0.01	0.01	0.01	0.16	0.15	0.81	0.04	0.38	0.77	0.02	0.01	0.20	0.71	0.10		0.5
% Change			**4.1**	**4.9**	-0.4	-1.0	**-4.3**	**3.2**	**1.6**	0.4	1.6	0.0	**4.0**	1.1	-0.1	**2.7**	**2.8**	-3.4	-1.8	-7.4	0.0	190
Androgen	None	10	2.99	2.92	18.57	2.07	6.29	3.21	665.2	61.46	12.27	0.54	2.72	2.79	49.57	331.5	337.4	549	4.75	78.97	8.00	3.
Andro & Estro	None		3.07	3.06	18.85	2.09	6.20	3.26	674.2	61.70	12.45	0.54	2.56	2.73	50.02	339.2	339.6	544	4.75	76.95	8.00	3.
Probability			0.02	0.01	0.03	0.11	0.29	0.08	0.01	0.27	0.05	0.76	0.02	0.23	0.03	0.01	0.48	0.59		0.58		0.
% Change			**-2.6**	**-4.6**	**-1.5**	-1.0	1.5	-1.5	**-1.3**	-0.4	**-1.4**	0.0	**6.3**	2.2	**-0.9**	**-2.3**	-0.6	0.9	0.0	2.6	0.0	24
Estro & Andro	None	2	2.65	2.91	16.79	2.08	6.34	3.24	606.2	62.81	11.97	0.51	2.46	2.78	49.89	319.5	320.8	470	4.00	58.70		
Strong Estro	None		2.52	2.77	16.82	2.11	6.67	3.14	595.8	62.73	11.95	0.52	2.35	2.75	49.91	313.8	314.9	530	5.00	58.80		
Probability			0.34	0.04	0.94	0.36	0.20	0.20	0.13	0.92	0.35	0.83		0.55								
% Change			5.2	**5.1**	-0.2	-1.4	-4.9	3.2	1.7	0.1	0.2	-1.9	4.7	1.1	0.0	1.8	1.9	-11.3	-20.0	-0.2		

Implant First	Implant Second	Trials No.	ADG lb.	CADG lb.	DMI lb./d	DMI % BW	F/G	ME Mcal/kg	Carcass lb.	Dress %	REA sq.in.	Fat Th in.	KPH %	Yield grade	Lean %CW	Lean lb.	Non-lean lb.	Marbling score	Quality grade	Choice %	Shear lb.	Dark cut %
Effects of Reimplants																						
Androgen	Androgen	3	2.91	2.81	18.71	2.11	6.47	3.12	660.9	61.38	13.71	0.35	2.60	2.13	51.95	351.4	324.9		5.00	73.60		4.51
Androgen	None		2.89	2.77	18.12	2.05	6.28	3.16	655.9	61.06	13.39	0.43	2.70	2.33	51.30	344.4	326.9		5.00	77.90		1.28
Probability			0.82	0.64	0.38	0.37	0.38	0.67	0.44	0.36	0.57	0.25	0.49	0.12	0.35	0.59	0.65			0.54		0.53
% Change			0.7	1.4	3.3	2.9	3.0	-1.3	0.8	0.5	2.4	-18.6	-3.7	-8.6	1.3	2.0	-0.6		0.0	-5.5		252.3
Effects of Various Implant Combinations																						
Androgen	Androgen	3	3.09	3.07	18.89	2.07	6.15	3.29	685.7	61.91	13.80	0.40	2.67	2.21	51.63	354.0	331.7			73.28		10.00
Andro & Estro	Andro & Estro		2.94	2.83	19.21	2.14	6.58	3.10	664.1	61.22	13.20	0.41	2.53	2.33	51.39	341.3	322.8			75.08		10.00
Probability			0.12	0.17	0.62	0.32	0.06	0.06	0.14	0.29	0.10	0.55	0.18	0.05	0.02	0.11	0.17			0.84		
% Change			5.1	8.5	-1.7	-3.3	-6.5	6.1	3.2	1.1	4.5	-2.4	5.5	**-5.2**	**0.5**	3.7	2.8			-2.4		0.0
Estro & 2 Andro	Estro & 2 Andro	4	3.46	3.45	19.62	2.10	5.68	3.44	707.3	61.85	14.05	0.39	2.50	2.15	51.76	366.0	341.2			59.73		15.20
None	None		2.97	2.84	19.50	2.16	6.59	3.08	662.8	61.15	12.65	0.41	2.56	2.52	50.99	337.9	324.9			84.02		2.30
Probability			0.01	0.01	0.56	0.06	0.01	0.01	0.01	0.15	0.04	0.37	0.48	0.13	0.15	0.01	0.01			0.02		0.33
% Change			***16.5***	***21.5***	0.6	-2.8	***-13.8***	***11.7***	***6.7***	1.1	**11.1**	-4.9	-2.3	-14.7	1.5	***8.3***	***5.0***			**-28.9**		560.9
Androgen	Androgen	10	2.83	2.88	18.93	2.06	6.02	3.31	652.9	60.52	12.76	0.41	2.71	2.29	51.50	353.0	332.5	659	6.00	74.28	11.61	3.39
None	None		2.59	2.64	19.29	2.14	6.76	3.11	632.6	60.59	11.99	0.45	2.79	2.42	50.95	338.3	325.7	652	6.00	75.21	12.37	1.59
Probability			0.01	0.03	0.17	0.01	0.01	0.01	0.01	0.84	0.01	0.19	0.35	0.17	0.05	0.03	0.24	0.51		0.84	0.38	0.40
% Change			***9.3***	**9.1**	-1.9	-3.7	***-10.9***	***6.4***	***3.2***	-0.1	***6.4***	-8.9	-2.9	-5.4	**1.1**	**4.3**	2.1	1.1	0.0	-1.2	-6.1	113.2
Andro & Estro	Andro & Estro	9	3.09	2.79	18.15	2.44	5.99	3.03	604.3	60.97	12.61	0.47	2.65	2.36	50.97	324.9	312.5	438	4.02	72.01		10.00
None	None		2.28	2.50	17.34	2.12	7.51	2.93	577.4	60.65	11.74	0.47	2.80	2.57	50.59	310.0	302.3	495	4.45	87.15		5.00
Probability			0.04	0.01	0.03	0.11	0.06	0.02	0.01	0.11	0.01	0.97	0.11	0.02	0.07	0.03	0.06	0.02	0.08	0.13		
% Change			**35.5**	***11.6***	***4.7***	15.1	-20.2	**3.4**	***4.7***	0.5	***7.4***	0.0	-5.4	**-8.2**	0.8	**4.8**	3.4	**-11.5**	-9.7	-17.4		100.0
Andro & Estro	Andro & Estro	2	2.95	2.80	19.00	2.10	6.81	3.08	671.4	61.36	13.18	0.41	2.33	2.05	51.40	345.0	326.2	580	5.00	86.81		10.00
Andro & Estro	Androgen		3.06	2.89	19.30	2.09	6.26	3.22	679.4	61.16	13.42	0.43	2.11	2.18	51.50	350.0	329.5	556	5.00	78.42		5.00
Probability			0.38	0.53		0.27	0.01	0.22	0.49	0.60	0.66	0.74	0.35	0.84	0.88	0.51	0.67			0.02		
% Change			0.4	-3.1	-1.6	0.5	***8.8***	-4.3	-1.2	0.3	-1.8	-4.7	10.4	-6.0	-0.2	-1.4	-1.0	4.3	0.0	**10.7**		100.0
Andro & Estro	Androgen	2	3.07	2.88	19.30	2.08	6.26	3.22	679.6	61.15	13.43	0.43	2.10	2.18	51.51	350.1	329.5	556	5.00	78.60		5.00
Andro & Estro	None		2.98	2.97	18.70	2.05	6.84	3.28	673.8	61.49	13.42	0.40	2.41	2.03	51.58	347.6	326.2	623	6.00	86.40		10.00
Probability			0.66	0.22		0.11	0.01	0.45	0.67	0.41	0.98	0.59	0.03	0.82	0.91	0.76	0.68			0.05		
% Change			3.0	-3.0	3.2	1.5	***-8.5***	-1.8	0.9	-0.6	0.1	7.5	**-12.9**	7.4	-0.1	0.7	1.0	-10.8	-16.7	**-9.0**		-50.0

Head-on Comparisons-Reimplanting:

Reimplanting steers with a second mild estrogen implant increased gains (5-7%), efficiency (4%), and diet ME (3%) but reduced marbling score (5%) (Table 8). Changes in performance or carcass traits with a strong estrogen reimplant were minor. However, in combination with androgen, a second implant improved gain (6-8%), efficiency (6%), diet ME (4%), carcass weight (4%) and dressing percentage (.8%) but reduced marbling score (4%) and percent choice (20%).

Head-on Comparisons-Implant Schemes:

Comparisons between various implant schemes for steers (Table 8) showed little difference between reimplanting with androgen alone or a combination implant. Differences among specific implant schemes were minor and largely reflected response differences from the first implant. In most cases where growth rate and rib eye area were increased, marbling score tended to be reduced.

Sequence of implant administration (estrogen-androgen/strong estrogen vs. strong estrogen/estrogen-androgen) did not alter performance or carcass traits of steers. Reimplanting with the combination instead of a strong estrogen after a first combination implant produced slight but nonsignificant responses in steers (Table 6) ADG (4%), ribeye area (3%), and yield grade (-5%). For steers, two combination implants of estrogen-androgen compared to two strong estrogen implants resulted in greater gain (7%), improved efficiency (-6%), diet ME (4%), carcass weight (3%) and ribeye area (3%) but reduced percent grading choice by 11%. Compared to two strong estrogen implants, even a single combination implant for steers (Table 8) resulted in greater gain (2-6%) with little effect on efficiency (1%), carcass weight (2%) or marbling score. For steers having a strong estrogen as their first implant, a combination implant given later (as compared to no second implant) improved ADG, efficiency and ME 5 to 6% but did not alter carcass quality in a very limited number of comparisons (3).

Head-on Single Implant Comparisons for Heifers: In head-on comparisons, implanting feedlot heifers once with mild or strong estrogenic compounds did not change any performance or carcass traits with the exception of DMI; DMI was increased 3% with a mild estrogen implant (Table 9). Implanting with an androgen alone increased gain, efficiency, diet ME, and kidney-pelvic-heart fat, all by approximately 4%, and carcass weight (2%) but reduced percent grading choice by 7% compared with no implant. Implanting with a strong estrogen plus one or two androgens increased gain (10-12%), efficiency (6-9%), diet metabolizable energy (4-6%), carcass weight (4%) and ribeye area (5%). Comparisons between implant types showed that the combination estrogen-androgen implant was more effective than an androgen alone for increasing performance traits, carcass weight and ribeye area and reducing kidney-pelvic-heart fat. Implanting with this combination also appeared to increase performance and carcass traits over strong estrogen alone, but the number of trials comparing these two implant schemes was very limited.

For heifers, the only reimplant scheme tested was with androgen alone from which no performance or carcass traits were altered (Table 9).

Responses to androgen alone or combined with estrogen generally were similar for heifers; using either as a second implant had only minor effects on performance or carcass quality. However, compared to non-implanted heifers, those implanted twice with androgen alone or combined with estrogen markedly improved gain (9-35%), efficiency (11-20%), diet ME (3-6%), and carcass weight (3-6%) with the greatest impact generally from the combination. However, the combination also caused the greatest reduction in marbling score.

Effects of MGA on heifer performance and implants response.

Results of head-on comparisons of MGA for heifers with or without implants are presented in Table 10. Based on statistics (right side of table), when averaged across implant presence, MGA feeding increased gain, feed intake, carcass weight, fat thickness, and yield grade while improving feed efficiency primarily through increased DMI; diet ME was not altered. Androgen or androgen plus estrogen implants improved ADG and feed/gain and increased carcass weight. Adding an estrogen to the androgen implant increased feed intake, ribeye area and, surprisingly, increased marbling score of heifers. The only MGA by androgen interaction was a tendency for the androgen to increase percent choice carcasses MGA in heifers not receiving but to decrease percent choice for heifers fed MGA. More interactions between MGA and an estrogen - androgen implant were noted; feeding MGA markedly reduced the implant response. Presumably, fed MGA is replacing the need for or benefit from including estrogen in the implant.

Table 10. Impact of MGA Feeding and Implants on Heifer Performance:Head-on Contrasts from 6 trials (least squares means).

MGA Feeding	None	None	None	MGA	MGA	MGA	Significance Level, P <				
Implant	None	Androgen	SE&A	None	Androgen	SE&A	MGA	Androgen	SE & A	MGA*Andro	MGA*SE&A
ADG, lb.	2.97	3.35	3.43	3.26	3.41	3.47	***0.01***	***0.01***	***0.01***	0.11	***0.01***
ADG, carcass	2.88	3.21	3.31	3.14	3.30	3.35	***0.01***	**0.03**	***0.01***	0.28	**0.02**
DMI, lb/d	18.92	19.34	20.30	20.21	19.71	20.26	***0.01***	0.89	***0.01***	0.08	***0.01***
DMI, % of mean wt	2.13	2.12	2.20	2.22	2.15	2.20	***0.01***	0.14	**0.03**	0.14	***0.01***
Feed/gain	6.42	5.83	5.93	6.22	5.8	5.84	**0.02**	***0.01***	***0.01***	0.38	0.36
Feed ME	3.78	4.08	3.98	3.82	4.06	4.03	0.35	***0.01***	***0.01***	0.63	0.99
Carcass weight, lb	660	684	693	681	692	697	***0.01***	**0.04**	***0.01***	0.30	**0.04**
Dress percent	61.33	61.02	61.17	61.12	61.26	61.23	0.73	0.79	0.89	0.39	0.39
Rib eye area, sq. in.	12.13	12.52	12.96	12.09	12.43	12.93	0.81	0.26	***0.01***	0.93	0.94
Fat thickness, in.	0.51	0.52	0.53	0.59	0.56	0.59	***0.01***	0.78	0.56	0.40	0.52
KPH, %	2.53	2.52	2.54	2.56	2.54	2.56	0.70	0.92	0.96	0.96	0.92
Marbling score	601	467	572	603	557	583	0.38	0.14	**0.05**	0.32	0.56
Choice, %	48.4	53.7	55.2	57.2	48.7	48.3	0.56	0.61	0.51	**0.02**	***0.01***
Yield grade	2.72	2.59	2.61	2.99	2.79	3.00	***0.01***	0.08	0.24	0.66	0.14
Dark cutters, %	0.58	0.19	2.11	0	0.19	0.61	0.09	0.99	0.08	0.52	0.23

Effects of Ovariectomy on Heifer Performance and Implant Response.

Results of head-on comparisons are presented in table 11. Only four trials were available for these comparisons so performance information is not complete. Averaged across implants, ovariectomy reduced feed intake as a percentage of body weight, dressing percentage, fat thickness and kidney-pelvic-heart fat percentage. Implants of estrogen plus androgen increased gain, feed intake, carcass weight, and dressing percentage, while reducing feed/gain, kidney-pelvic-heart fat and marbling score. The androgen implant, when alone, had less impact on DMI and carcass traits, but information is incomplete. No interaction of ovariectomy and implants proved to be significant although numerical responses in gain, feed/gain, and carcass weight from the combination implant tended to be greater for ovariectomized heifers than for intact heifers. This agrees with the general concept discussed by Raun and Preston elsewhere in this publication that hormonal replacement improves performance of ovariectomized heifers.

Time After Implant Administration: Figure 1 shows added weight gain from implanting versus time after the final implant administration for steers with either strong estrogen with or without androgen implants. In almost all trials, weight gain was increased by implants. Broken live regressions indicated that weight gain increased to 143 d and 165 d by a total of 94 and 63 additional pounds for strong estrogen plus androgen and strong estrogen implant, respectively. The rate of added weight gain was .66 lb/d and .38 lb/d for these two implant schemes. Thus, the combination of estrogen and androgen tended to increase weight gain more but for a shorter time than an estrogen implant alone did.

Duration of this implant response seems unusually long compared to most estimates in which responses in sequential periods is compared. Unfortunately, information from individual periods is seldom reported.

Table 11. Impact of ovariectomy and implants on heifer performance:Head-on contrasts from 4 trials (least squares means).

Ovariectomy	None	None	None	Ovx	Ovx	Ovx	Significance Level, P <			
Implant	None	Androgen	SE&A	None	Androgen	SE&A	Ovx	Androgen	SE& A	OVX*Implant
ADG, lb.	2.32	2.44	2.58	2.16	2.40	2.64	0.43	0.19	***0.01***	0.34
ADG, carcass	2.71		3.09	2.34		3.08	0.25		**0.02**	0.22
DMI, lb/d	18.29		19.05	17.48		18.70	0.12		**0.03**	0.46
DMI, % of mean wt	2.28		2.34	2.21		2.29	**0.04**		**0.04**	0.70
Feed/gain	7.89		7.69	8.21		7.3	0.53		**0.02**	0.07
Feed ME	3.59		3.84	3.39		3.94	0.83		**0.04**	0.30
Carcass weight, lb	592		615	569		612	0.21		**0.02**	0.27
Dress percent	61.87		62.59	61.37		61.74	***0.01***		**0.03**	0.28
Rib eye area, sq. in.	11.34	12.14	11.98	10.95	11.14	11.98	0.33	0.42	0.08	0.57
Fat thickness, in.	0.55	0.44	0.54	0.48	0.36	0.47	**0.02**	**0.03**	0.86	0.98
KPH, %	2.67	2.57	2.42	2.52	2.57	2.17	**0.04**	0.64	**0.03**	0.23
Marbling score	599	600	505	567	568	462	0.07	0.98	**0.02**	0.87
Quality grade	5.78	5.49	4.77	5.22	5.5	4.24	0.30	1.00	0.17	0.81
Yield grade	2.93		2.80	2.91		2.58	0.33		0.17	0.45

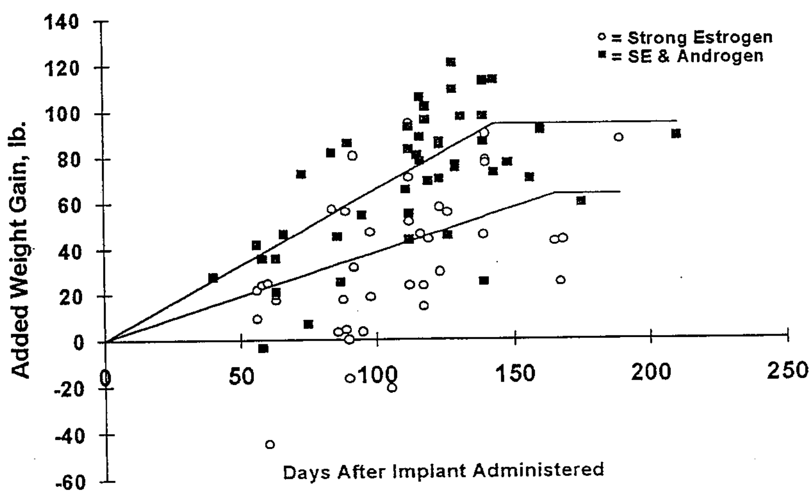

Figure 1. Added steer weight versus days from last implant.

Relationship of Gain to DMI Response.

Figure 2 illustrates the relationship between the change in gain by steers versus change in dry matter intake for steers receiving single implants of strong estrogen either alone or with added androgen. When intake was increased, gain tended to increase, too. Generally the gain response paralleled the intake response; gain increased by .18 lb for every added pound of feed dry matter. This means that rate of gain increased by approximately 1 pound for each 6 pounds of additional DMI. Considering that this increase in feed dry matter should all be above maintenance energy requirements, a higher efficiency might be expected. Regression indicates that the combination implant increased gain by over 0.4 lb./day even when feed intake was not increased; presumably this is the result of increased lean deposition or a reduced maintenance energy requirement. This response was lower from the strong estrogen alone (.14 lb/day) reflecting less impact of estrogen than of estrogen plus androgen on body composition or maintenance energy needs.

Marbling score versus ribeye area. Responses for SE and SEA implants for steers are shown in Figure 3. As ribeye area increased, marbling score tended to decline. The regressions for the estrogen and combination implants tended to be steeper than the overall regression across all steers. Subsequent laboratory data further suggests that implanting enlarges ribeye area with no concomitant increase in intramuscular lipid deposition; thereby, marbling score declines (Duckett and Wagner, 1997).

Relationship of Shear Force to Carcass Weight.

Figure 4 shows the relationship between Warner-Bratzler shear force and carcass weight for steers. The regression indicates that as carcass weight increased, shear force declined (R^2 = .73). This relationship should be interpreted cautiously due to fact that shear force data for implanted steers are limited and shear force methods vary between research institutions. Further, implants tended to increase shear force despite increasing carcass weight. In general, shear force was lower for cattle started on feed as calves than as yearlings. Stretched carcass muscles usually become more tender than contracted muscles. All measurements were on the ribeye; any increase in carcass weight may cause greater stretching of the LD, especially in calves where the LD is smaller. This might be tested by adding additional weight to the fore-quarter while cooling the carcass.

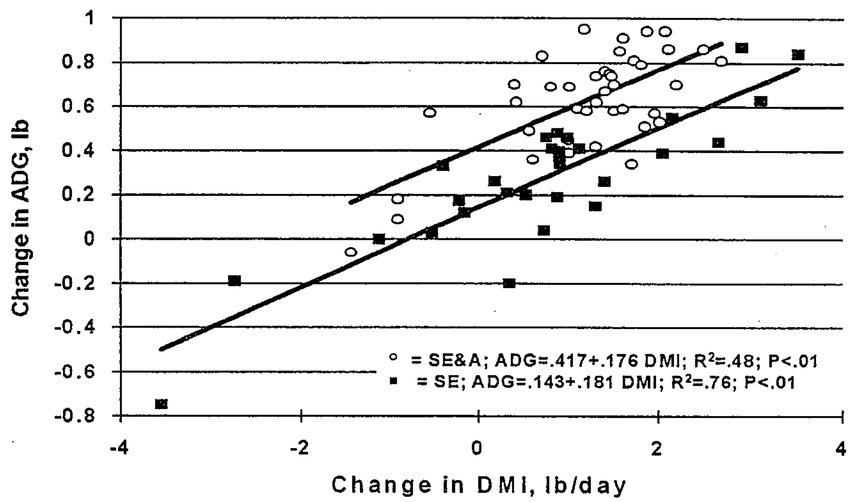

Figure 2. Change in ADG versus change in DMI associated with implants in head-on comparisons.

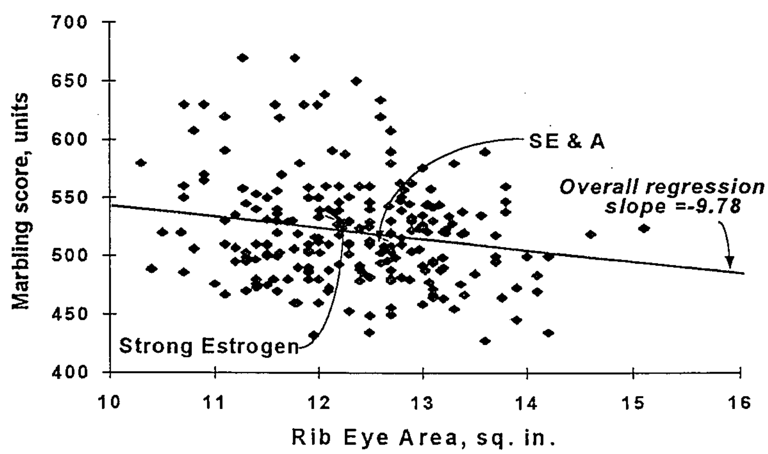

Figure 3. Relationship of marbling score to ribeye area. Regression lines are across all studies or based on changes due to implanting with a strong estrogen with or without an androgen.

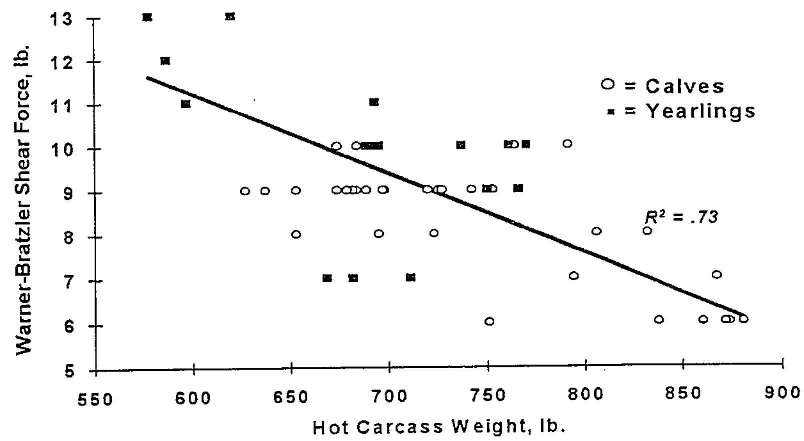

Figure 4. Relationship of shear force to carcass weight across all studies.

Impact of Implants on Carcass Quality Relationships

Two of the major items involved with carcass value are final yield grade and marbling score. Regression of marbling score against final yield grade across all trials for control steers (those never implanted) indicated that marbling score (MS) increased as final yield grade (FYG) increased (MS = 446 + 34.45 FYG). In comparison, averaged across all implant types and combinations, both the intercept and the slope tended to be lower (MS = 419 + 30.08 FYG). The plot across all trials for marbling scores and these two regression lines are shown in Figure 5. Note that there is a lot of scatter among the points for individual steer trials. Nevertheless, to achieve an equal marbling score, the two regression lines indicate that implanted animals would need to reach a final yield grade from 1 to 1.5 higher than non-implanted steers. When diethyl stilbestrol implants were first used, producers were told to feed cattle for an equal number of days so that they would be heavier but still achieve the same marbling score. These regression lines indicate that in addition to heavier weights, implanted steers would need to reach a higher yield grade. Feeding implanted animals to a heavier yield grade simply to increase the marbling score and quality grade may or may not prove economical based on the relationship between the price discount for low quality grade versus excessive yield grade (and excess carcass weight).

Because the relationship above was averaged across all trials and steer factors (weight, breed, feeding duration, implant timing), marbling scores and final yield grades of implanted cattle also were compared to those measurements for control cattle in each experiment. These are plotted as change in marbling score versus change in marbling score from control values in Figure 6. Note that final yield grade was not markedly changed by implants, being decreased or increased by a maximum of .6 to .8 units. Since implants increase rib eye area and often decrease KPH, one would expect that implants should decrease final yield grade. However, carcass weight typically is increased by effective implants, and an increase in carcass weight will increase final yield grade. Just to maintain a constant final yield grade, rib eye area would need to increase by 1.2 inches for every increase in carcass weight of 100 pounds. Of the implants, only the strong estrogen implants given twice or strong estrogen plus androgen implants (once or twice) increased this ratio by more than 1.2 (1.5, 1.3 and 1.2 inches per 100 pounds carcass weight, respectively.) Consequently, final yield grade was not consistently changed by implants. Whether the yield grade formula, which indicates that an cattle with heavier carcass weights have an increased yield grade (and decreased cutability), is equally applicable for aggressively implanted and non-implanted steers is open to question. Impact of implants on reliability of the yield grade formula, or more precisely on the weights of specific meat cuts, deserves further research attention. Perhaps the yield grade formula inadvertently discredits heavier carcasses due to the autocorrelation between carcass weight and fat thickness.

Marbling score was decreased below values for control steers in almost all studies with implants although mild estrogen implants tended to be less depressing than other implants (Figure 6). Regression across trials for non-implanted steers indicates that one would expect marbling score to increase by 34 units for every unit increase in final yield grade. No evidence of such an increase in marbling score with final yield grade is evident for implanted steers. Because in almost all of these studies, steers were fed for a constant number of days prior to marketing, the effect of time on feed on these measurements is not available. Serial slaughter studies could reveal more information about how the ratio of marbling score to yield grade is changed by implants and whether feeding aggressively implanted cattle for a longer time is beneficial economically.

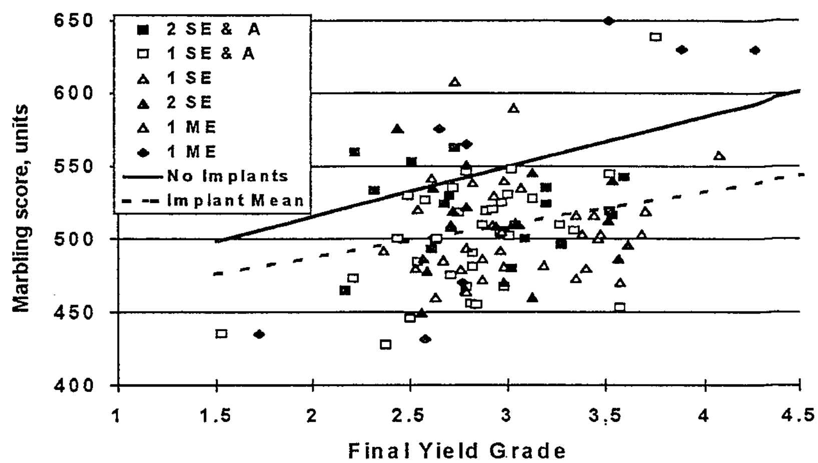

Figure 5. Marbling scores and final yield grades from trials in which steers received various implants once or twice. Solid line (no implants) is regression for non-implanted steers and dashed line (implant mean) is regression for all implanted steers weighted by the number of steers per trial.

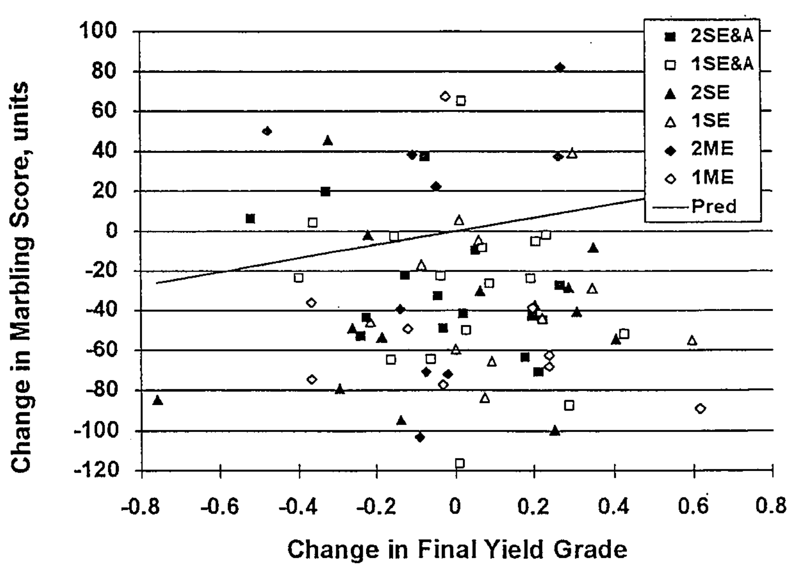

Figure 6. Effects of various implants on marbling score and final yield grade compared with non-implanted control animals from the same trial. Regression line (Pred) shows the mean slope for non-implanted cattle.

LITERATURE CITED

Belk, K. E. 1992. Low quality grades-effects of implants on maturity, marbling and incidence of dark-cutting beef. National Beef Quality Audit, Final Report, p. 173. National Cattlemen's Assoc., Englewood, CO.

Duckett, S. K. and D. G. Wagner. 1997. Effect of implanting on longissimus muscle fatty acid and cholesterol content. Proc. West. Sect., Am. Soc. Anim. Sci. 48:63.

Morgan, J. B. 1991. Tenderness problems and potential solutions. National Beef Quality Audit, Final Report, p. 180. National Cattlemen's Assoc., Englewood, CO.

Steer Database:

Ainslie, S. J., D. G. Fox, and T. C. Perry. 1992. Management systems for Holstein steers that utilize alfalfa silage and improve carcass value. J. Anim. Sci. 70:2643.

Anderson, P. T. and L. J. Johnston. 1992. Evaluation of positive and negative effects of use of different implant products within a pen of cattle. Minn. Beef Cattle Res. Rep. B-387:22.

Anderson, P. T., D. P. O'Connor, B. J. Johnson, and M. T. Lewis. 1992. Combined use of Finaplix and Synovex implants: a comparison of placement in the same ear vs. separate ears. Minn. Beef Cattle Res. Rep. B-388:27.

Anderson, P.T., L.J. Johnston and B.J. Johnson. 1992b. The effect of combined use of trenbolone acetate and estradiol implants on response of crossbred yearling steers to supplemental dietary protein. Minn. Beef Cattle Res. Rep. B-385:11.

Apple, J.K., M.E. Dikeman, D.D. Simms and D. Kuhl. 1991. Effects of synthetic hormone implants, singularly or in combinations, on performance, carcass traits, and longissmus muscle palatability of Holstein steers. J. Anim. Sci. 69:4437.

Bartle, S.J., R.L. Preston and R.C Herschler. 1992b. Production responses to reimplantation with estradiol or estradiol plus trenbolone acetate. Texas Tech Univ. Agric. Sci. Tech. Rep. No. T-5-317:138.

Bartle, S.J., R.L. Preston, R.E. Brown and R.J. Grant. 1989. Revalor (trenbolone acetate and estradiol) and Synovex reimplant study in steers. Texas Tech Univ. Agric. Sci. Tech. Rep. No. T-5-263:32.

Birkelo, C. P., T. Van Der Wal, and J. Lounsbery. 1994. Effect of Synovex, Synovex + Finaplix, and Revalor on daily gain and carcass characteristics of yearling steers. South Dakota Beef Rep. CATTLE 94-15:54.

Borger, M.L., L.L. Wilson, J.D. Sink, J.H. Ziegler and S.L. Davis. 1973. Zeranol and dietary protein level effects on live performance, carcass merit certain endocrine factors and blood metabolite levels of steers. J. Anim. Sci. 36:706.

Botts, R.L. 1992. Evaluation of various programs of Synovex-S, Finaplix-S and estradiol 17b/trenbolone acetate in feedlot steers of three distinct breed types. J. Anim. Sci. 70(Suppl. 1):280 (Abstr.).

Brandt, R.T. and M.E. Dikeman. 1993. Effect of reimplant scheme and additional time on feed on performance and carcass traits of finishing steers. J. Anim. Sci. 71(Suppl. 1):87 (Abstr.).

Busby, D. and D. Loy. 1991. Feedlot performance and carcass characteristics of steer calves implanted with combination implants. Iowa St. Beef/Sheep Rep. A.S. Leaflet R818:89.

Busby, W. D., D. Loy, and D. Strohbehn. 1991. Effect of stocker phase implant treatment on growth rate and subsequent response to finishing phase implant treatment. Iowa St. Beef/Sheep Rep., A. S. Leaflet R187:84.

Cohen, R.D.H. and J.A. Cooper. 1983. Avoparcin, monensin and zeranol for steers finishing on barley diets. Can. J. Anim. Sci. 63:361.

Combs, J. J. and D. D. Hinman. 1984. A comparison of Compudose, Ralgro, and Synovex-S implants for feedlot steers. J. Anim. Sci. 59(Suppl. 1):479.

Eck, T. P. and L. R. Corah. 1993. Implant comparisons in feedlot steers and heifers. Kansas St. Cattlemen's Day 678:131.

Faulkner, D.B., G.F. Cmarik and H.R. Spires. 1991. Evaluation of laidlomycin propionate and Synovex-S implants for finishing steers. J. Anim. Sci. 69(Suppl. 1):521.

Foutz, C.P. 1990. Effect of anabolic implants on yearling feedlot steer performance, carcass grade traits, subprimal yields and muscle properties. M.S. Thesis. Oklahoma State University, Stillwater.

Gerken, C. L., J. D. Tatum, J. B. Morgan and G. C. Smith. 1995. Use of genetically identical (clone) steers to determine the effects of estrogenic and androgenic implants on beef quality and palatability characteristics. J. Anim. Sci. 73:3317.

Goodrich, R. D., P. T. Anderson, and L. J. Johnson. 1993. Influence of Synovex-S and Finaplix-S on daily gain and carcass characteristics of steers marketed at varying weights. Minn. Beef Cattle Res. Rep. B-399:32.

Hartman, P., G. Kuhl, D. Simms, R. Ritter, and P. Houghton. 1989. Effects of Finaplix in combination with Ralgro and Synovex on performance and carcass characteristics of steers and heifers. Kansas St. Cattlemen's Day 567:100.

Hawkins, E.W., L.E. Orme, R. Dyer, L. Ogden, R.L. Park and R.A. Field. 1987. Comparisons between zeranol implanted and non-implanted bulls and steers. Proc. Annu. Meet. West. Sect. Am. Soc. Anim. Sci. 38:147.

Hicks, R.B., D.R. Gill, L.H. Carroll, J.J. Martin and C.A. Strasia. 1985. The effect of Compudose and Finaplix alone and in combination on growth of feedlot steers. Okla. Ag. Exp. Sta. Res. Rep. MP117:269.

Hinman, D.D. and J.J. Combs. 1983. Pasture and feedlot performance of steers implanted with Compudose. Proc. West. Sect. Am. Soc. Anim. Sci. 34:303.

Hoffman, D.J., C.F. Speth, T.P. Ringkob, A.L. Lesperance and J.A. McCormick. 1977. The effect of zeranol and monensin on feedlot steers. Proc. Annu. Meet. West. Sect. Am. Soc. Anim. Sci. 28:204.

Huck, G.L., R.T. Brandt, M.E. Dikeman, D.D. Simms and G.L. Kuhl. 1991. Frequency and timing of trenbolone acetate implantation on steer performance, carcass characteristics and beef quality. J. Anim. Sci. 69(Suppl. 1):560 (Abstr.).

Huffman, R.D., R.L. West, D.L. Pritchard, R.S. Sand and D.D. Johnson. 1991. Effect of Finaplix and Synovex implantation on feedlot performance and carcass traits. Fla. Beef Cattle Res. Rep.p.97.

Hunt, D.W., D.M. Henricks, G.C. Skelley and L.W. Grimes. 1991. Use of trenbolone acetate and estradiol in intact and castrate male cattle: effects on growth, serum hormones and carcass characteristics. J. Anim. Sci. 69:2452.

Hutcheson, J. P., E. M. Larson, T. L. Staton, and O. Robertson. 1995. The effects of two levels of protein and reimplanting with Revalor-S and Implus-S on finishing cattle performance. Colorado St. Beef Prog. Rep. p. 73.

Johnson, B. J., P. T. Anderson, J. C. Meiske, and W. R. Dayton. 1996. Effect of a combined trenbolone acetate and estradiol implant on feedlot performance, carcass characteristics and carcass composition of feedlot steers. J. Anim. Sci. 74:363.

Johnson, E. S., H. G. Dolezal, M. T. Al-Maamari, B. A. Gardner, D. R. Gill, R. L. Botts, and P. T. Anderson. 1995. Effects of combination androgenic and estrogenic anabolic implants on carcass traits of serially slaughtered steers. Okla. Agr. Exp. Stat. Res. Rep. P-943:35-42.

Kercher, C.J., D.C. Rule and R.R. Jones. 1990. Hormone implant combinations for growing-finishing beef steers. Proc. West. Sect. Am. Soc. Anim. Sci. 41:442.

Kuhl, G.L., D.D. Simms and D.A. Blasi. 1993. Comparison of implanting Synovex-S and two levels of Revalor-S in heavy weight Holstein steers. Kansas St. Cattlemen's Day p. 134.

Larson, E. M., N. T. Cosby, T. L. Stanton and O. Robertson. 1995. Urea levels for finishing steers fed whole-shelled vs. dry rolled corn and reimplanted with Implus-S vs. Revalor-S. Colorado St. Beef Prog. Rep. p. 43.

Laudert, S.B. and G.V. Davis. 1984. Comparison of Compudose with Ralgro or Synovex- S reimplant programs for finishing steers. Kansas St. Cattlemen's Day 448:91.

Laudert, S., G. Kuhl, and M. Walker. 1984. Implant comparisons for finishing steers. Kansas St. Cattlemen's Day 448:93.

Lee, B. and S. Laudert. 1984. Comparison of Synovex-S and Steer-oid implants for feedlot steers. Kansas St. Cattlemen's Day 448:87.

Loy, D.D., H.W. Harpster and E.H. Cash. 1988. Rate, composition and efficiency of growth in feedlot steers reimplanted with growth stimulants. J. Anim. Sci. 66:2668.

Mader, T.L. 1994. Effect of implant sequence and dose on feedlot cattle performance. J. Anim. Sci. 72:277.

Mader, T. L., D. C. Clanton, J. K. Ward, D. E. Pankaskie and G. H. Duetscher. 1985. Effect of pre- and postweaning zeranol implant on steer calf performance. J. Anim. Sci. 61:546.

Mader, T. L., J. Dahlquist, and R. Botts. 1996. Growth implants for steers. Neb. Beef Rep., p. 71.

Mader, T. L., J. M. Dahlquist, M. H. Sindt, R. A. Stock and T. J. Klopfenstein. 1994. Effect of sequential implanting with Synovex on steer and heifer performance. J. Anim. Sci. 72:1095.

Martin, T.G., T.W. Perry and L.A. Nelson. 1987. Growth, feed consumption and carcass characteristics of steers with and without implants. Purdue Beef Day Rep. p. 31.

Mathison, G.W. and L.A. Stobbs. 1983. Efficacy of Compudose as a growth promotant implant for growing-finishing steers. Can. J. Anim. Sci. 63:75.

Milton, C. T., R. T. Brandt, G. L. Kuhl, and P. T. Anderson. 1996. Implant strategies for finishing calves. Kansas St. Cattlemen's Day, p. 1.

Murray, D.A., T.D. Burgess and D.N. Mowat. 1983. Effects of feeding avoparcin in combination with progesterone-estradiol implants on growing and finishing steers. Can. J. Anim. Sci. 63:885.

Perry, T.C., D.G. Fox and D.H. Beermann. 1991. Effect of an implant of trenbolone acetate and estradiol on growth, feed efficiency and carcass composition of Holstein and beef steers. J. Anim. Sci. 69:4696.

Preston, R. L., D. U. Thompson, T. H. Montgomery and W. T. Nichols. 1995. Effect of different ratios of trenbolone acetate and estradiol on the performance and carcass characteristics of feedlot steers of different breed types. Texas Tech. Res. Rep. p. 55.

Preston, R.L., S.J. Barlte, T.R. Kasser, J.W. Day, J.J. Veenhuizen and C.A. Baile. 1992. Comparative effectiveness of somatotropin and anabolic steroids in feedlot steers. Texas Tech Univ. Agric. Sci. Tech. Rep. No. T-5-317:143.

Prior, R. L., J. D. Crouse, V. L. Harrison, and C. A. Baile. 1978. Elfazepam and Synovex-S influences on growth and carcass characteristics of steers fed two dietary energy levels. J. Anim. Sci. 47:1225.

Pritchard, R. H. 1994. Effect of implant strategies on feedlot performance and carcass traits of steers. South Dakota St. Beef Rep. p. 57.

Pritchard, R.H., D.H. Gee and M.A. Robbins. 1990. Effects of estradiol-trenbolone acetate implant combinations on feedlot performance and carcass traits of two steers types. S. Dakota Beef Rep. 11:38.

Riley, J. and R. Pope. 1984. Single vs. reimplant programs for finishing steers. Kansas St. Cattlemen's Day 448:89.

Riley, J., G. Goldy, and R. Pope. 1986. A comparison of Synovex-S and Steer-oid implants for finishing cattle. Kansas St. Cattlemen's Day 494:28.

Rouse, G., B. Reiling, D. Maxwell, and D. Loy. 1990. Performance and carcass characteristics of steers and bulls implanted with combinations of Synovex and Finaplix. Iowa St. Beef/Sheep Res. Rep., A.S. Leaflet R711:59.

Rumsey, T.S. 1982. Effect of Synovex-S implants and kiln dust on tissue gain by feedlot beef steers. J. Anim. Sci. 54:1030.

Rumsey, T.S., A.C. Hammond and J.P. McMurtry. 1992. Response to reimplanting beef steers with estradiol benzoate and progesterone: performance, implant absorption pattern, and thyroxin status. J. Anim. Sci. 70:995.

Samber, J. A., J. D. Tatum, M. I. Wray, W. T. Nichols, J. B. Morgan, and G. C. Smith. 1996. Implant program effects on performance and carcass quality of steer calves finished for 212 d. J. Anim. Sci. 74:1470.

Senn, L. A. and J. J. Wagner. 1995. Effect of anabolic agents on marbling in yearling crossbred steers. South Dakota St. Beef Rep. p. 43.

Shain, D., T. Klopfenstein, R. Stock, and M. Klemesrud. 1996. Implant and slaughter time for finishing cattle. Neb. Beef Rep., p. 72.

Simms, D. D. and G. L. Kuhl. 1993. Sequential implanting with estradiol and trenbolone acetate containing implants in calf-fed Holsteins. J. Anim. Sci. 71(Suppl. 1):86 (Abstr.).

Simms, D.D., T.B. Goehring, R.T. Brandt, G.L. Kuhl, J.J. Higgins, S.B. Laudert and R.W Lee. 1988. Effect of sequential implanting with zeranol on steers lifetime performance. J. Anim. Sci. 66:2736.

Thonney, M.L., T.C. Perry, G. Armbruster, D.H. Beerman and D.G. Fox. 1991. Comparison of steaks from Holstein and Simmental x Angus steers. J. Anim. Sci. 69:4866.

Trenkle, A.H. 1985. The effect of compudose and finaplix implants alone and in combination on growth performance and carcass characteristics of feedlot steers. Iowa St. Beef and Sheep Res. Rep. A.S. 553:123.

Trenkle, A.H. 1990. The evaluation of Synovex S, Synovex S-Finaplix S and Revalor S implant programs in feedlot steers. Iowa St. Beef and Sheep Res. Rep., A.S. Leaflet R710:56.

Trenkle, A. 1991. The evaluation of Synovex S and combinations of Synovex S with Finaplix S in feedlot steers. Iowa St. Beef and Sheep Res. Rep. A.S. Leaflet R816:81.

Trenkle, A. 1992a. Effect of delaying implanting yearling steers with a combination of Synovex S and Finaplix S on overall performance during the finishing period. Iowa St. Beef and Sheep Res. Rep. A.S. Leaflet R907:61.

Trenkle, A. 1992b. Evaluation of Synovex S and Combinations of Synovex S with Finaplix S in feedlot steers. Iowa St. Beef and Sheep Res. Rep. A.S. Leaflet R908:65.

Trenkle, A. 1993a. Effect of delaying implanting yearling steers with a combination of Synovex-S and Finaplix-S on overall performance during the finishing period. Iowa State Beef and Sheep Res. Rep. A.S. Leaflet R1052:166.

Trenkle, A. 1993b. Protein requirement of yearling steers implanted with Revalor. Iowa State Beef/Sheep Res. Rep. A.S. Leaflet R1049:154.

Trenkle, A. 1994a. Comparison of protein supplements for yearling steers implanted with estradiol and trenbolone acetate. Iowa St. Beef/Sheep Res. Rep. A. S. Leaflet R1139:33.

Trenkle, A. 1994b. Comparison of protein supplements in young continental crossed steers implanted with estradiol and trenbolone acetate. Iowa St. Beef/Sheep Res. Rep. A. S. Leaflet R1140:38.

Vanderwert, W., L.L. Berger, F.K. McKeith, A.M. Baker, H.W. Gonyou and P.J. Bechtel. 1985. Influence of zeranol implants on growth, behavior and carcass traits in Angus and Limousin bulls and steers. J. Anim. Sci. 61:310.

Wagner, J.J. and R.H. Pritchard. 1991. Synovex-S and Finaplix-S for feedlot steers. J. Anim. Sci. 69:477. 147.

Wagner, J.J., R.H. Pritchard, J.U. Thompson and M.J. Goetz. 1990. Combinations of Synovex and Finaplix for yearling steers. South Dakota Beef Rep. 10:32.

Weichenthal, B., I. Rush, and B. Van Pelt. 1990. Finaplix implants for finishing steers. Neb. Beef Rep. MP55:92.

Williams, J.E., S.J. Miller, T.A. Mollett, S.E. Grebing, D.K. Bowman and M.R. Ellersieck. 1987. Influence of frame size and zeranol on growth, compositional growth and plasma hormone characteristics. J. Anim. Sci. 65:1113.

Windels, H. F., B. W. Woodward, J. C. Meiske and R. D. Goodrich. 1994. The effect of combined use of trenbolone acetate and estradiol implants on response of large-frame crossbred steers to dietary energy sources. Minn. Cattle Feeder Rep. B410:1.

Heifer Database:

Adams, T.E., J.R. Dunbar, S.L. Berry, W.N. Garrett, T.R. Famula and Y.B. Lee. 1990. Feedlot performance of beef heifers implanted with Synovex-H: effect of melengestrol acetate, ovariectomy or active immunization against GnRH. J. Anim. Sci. 68:3079.

Bartle, S.J., R.L. Preston and J.A Rogers. 1991. Evaluation of an estradiol/testosterone implant for feedlot heifers. Texas Tech Univ. Agric. Sci. Tech. Rep. No. T-5-297:54.

Crouse, J.D., B.D. Schanbacher, H.R. Cross, S.C. Seideman and S.B. Smith. 1987. Growth and carcass traits of heifers as affected by hormonal treatment. J. Anim. Sci. 64 1434.

Eck, T. P. and L. R. Corah. 1993. Implant comparisons in feedlot steers and heifers. Kansas St. Cattlemen's Day 678:131.

Faulkner, D.B., F.K. McKeith, L.L. Berger, D.J. Kesler and D.F. Parrett. 1989. Effect of testosterone propionate on performance and carcass characteristics of heifers and cows. J. Anim. Sci. 67:1907.

Garber, M.J., R.A. Roeder, J.J. Combs, L. Eldridge, J.C. Miller, D.D. Hinman and J.J. Ney. 1990. Efficacy of vaginal spaying and anabolic implants on growth and carcass characteristics in beef heifers. J. Anim. Sci. 68:1469.

Gill, D.R., F.N. Owens, R.A. Smith and R.B. Hicks. 1987. Effects of trenbolone acetate with or without estradiol, Synovex-H and Ralgro on the rate and efficiency of gain by feedlot heifers. Okla. Ag. Exp. Sta. Res. Rep. MP-119:340.

Goodman, J.P., A.L. Slyter and L.B. Embry. 1982. Effect of intravaginal devices and Synovex-H implants on feedlot performance, cyclic activity and reproductive tract characteristics of beef heifers. J. Anim. Sci. 54:491.

Hartman, P., G. Kuhl, D. Simms, R. Ritter, and P. Houghton. 1989. Effects of Finaplix in combination with Ralgro and Synovex on performance and carcass characteristics of steers and heifers.

Hussein, H. S., L. L. Berger, and T. G. Nash. 1994. Effect of implant source and dietary crude protein level on feedlot performance and carcass characteristics of finishing beef heifers. IL Beef Res. Rep. p. 33.

Larson, E. M. and T. L. Staton. 1994. The effects of protein level and Finaplix-H on feedlot heifer performance. Colorado St. Beef Prog. Rep. p.67.

Lunt, D. K., T. H. Welsh, G. P. Rupp, R. W. Field, H. R. Cross, A. M. Miller, H. A. Recio, M. F. Miller, and G. C. Smith. 1990. Effects of autografting ovarian tissue, overiectomy and implanting on growth rate and carcass characteristics of feedlot heifers. J. Sci. Food Agric. 51:535.

Mader, T. L., J. M. Dahlquist, M. H. Sindt, R. A. Stock, and T. J. Klopfenstein. 1994. Effect of sequential implanting with Synovex on steer and heifer performance. J. Anim. Sci. 72:1095.

Mader, T., J. Dahlquist, K. Lechtenberg, and M. Thornsberry. 1995. Implant programs and melegestrol acetate (MGA) for weaned heifers placed in the feedlot. Neb. Beef Cattle Rep. p. 43.

Mader, T., K. Lechtenberg, and W. Lawrence. 1993. Growth promotants for heifers. Neb. Beef Cattle Rep. p.41.

Moran, C., J.F. Quirke, D.J. Prendiville, S. Bourke and J.F. Roche. 1991. The effect of estradiol, trenbolone acetate, or zeranol on growth rate, mammary development, carcass traits, and plasma estradiol concentrations of beef heifers. J. Anim. Sci. 69:4249.

Schutte, B. R., W. T. Nichols, J. B. Morgan, L. L. Guenther, and H. G. Dolezal. 1996. Implant program effects on feedlot performance, carcass traits, and sensory ratings of serially slaughtered heifers. Okla. St. Agric. Expt. Stat. Res. Rep. P-951:40-46.

Stanton, T.L., C.P. Birkelo and R. Hamilton. 1989. Effects of Finaplix-H and Synovex-H with MGA on finishing beef heifer performance. Colo. St. Beef Prog. Rep. 71.

Stanton, T. L., D. Lodman, and B. May. 1990. Combinations of feed additives, implants and finishing heifer performance. Colorado St. Beef Prog. Rep. p. 59.

Staton, T. L., D. Schutz, and B. Hartman. 1990. Effect of Finaplix-H reimplantation when fed with rumensin-MGA upon finishing heifer performance and carcass characteristics. Colorado St. Beef Prog. Rep. p. 73.

Stanton, T.L., W.R. Wailes and P. Redd. 1991. Effects of MGA plus Finaplix-H compared to Heiferoid on finishing heifer performance and carcass characteristics. Colo. St. Beef Prog. Rep. 75.

Stobbs, L. A., R. E. Grimson, D. N. Mowat, J. E. Richards, J. R. Nelson, H. H. Nicholson, and R. P. Stilborn. 1988. Efficacy of Compudose as an anabolic implant for growing-finishing feedlot heifers. Can. J. Anim. Sci. 68:205.

Titgemeyer, E. C., R. T. Brandt, C. T. Milton, and N. Campbell. 1996. Effect of implantation and melegestrol acetate feeding on blood serum profiles and performance of heifers. Kansas St. Cattlemen's Day 756:105.

Trenkle, A. 1992a. Evaluation of feeding MGA and implanting Finaplix H and Synovex H in feedlot heifers. Iowa St. Beef and Sheep Res. Rep. A.S. R910:73.

Trenkle, A. 1992b. Evaluation of Synovex H, Finaplix H and combinations of Synovex with Finaplix H in feedlot heifers. Iowa St. Beef and Sheep Res. Rep. A.S. R909:69.

Trenkle, A. 1993a. Feeding MGA and implanting Finaplix-S and Synovex-S in feedlot heifers. Iowa State Beef and Sheep Res. Rep. A.S. R1051:161.

Trenkle, A. 1993b. Protein requirement of finishing yearling heifers implanted with Synovex-H and Finaplix-H. Iowa State Beef and Sheep Res. Rep. A.S. R1050:158.

Trenkle, A. 1994. Response to implants by heifers fed MGA. Iowa St. Beef Res. Rep. A. S. Leaflet R1141.

Trenkle, A. and C. Iiams. 1996. Effect of frame size and hormone implant performance and carcass characteristics of finishing yearling heifers: returns to a value-based market. Iowa St. Beef Res. Rep. A.S. Leaflet R1343:81.

Utley, P. R., G. L. Newton, R. J. Ritter, and W. C. McCormick. 1976. Effects of feeding monensin in combination with zeranol and testosterone-estradiol implants for growing and finishing heifers. J. Anim. Sci. 42:754.

QUESTIONS & ANSWERS

Q: If dry matter intake is expressed as a percentage of live weight, do implants increase intake?

A: Effects are reduced but still present for estrogen but generally disappear for androgen implants.

Q: On the graphs of added gain versus time after implanting, wouldn't the first differential provide an estimate of payout time?

A: Yes, if one assumes that growth rate does not decrease as size increases.

Q: Reimplanting with a strong estrogen had limited effect in the trials you examined. Could this be due to length of time on feed? If cattle are fed for a short time period, the initial implant may still be adequate.

A: That is a possibility, yet in many of these studies, reimplants had plenty of time to work. Payout from the initial implant may be longer, especially for calves than many people believe.