CARRYOVER AND LIFETIME EFFECTS OF GROWTH PROMOTING IMPLANTS

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ABSTRACT

Numerous implant strategies can be used for cattle from suckling through finishing phases of production. Lifetime implant programs should be designed to obtain optimum growth and efficiency response with minimum expression of live animal side effects and limited adverse effects on carcass traits. Initial studies indicated that suckling implants tended to negatively affect finishing phase gains. A summary of three subsequent studies indicated that successive use of 36 mg zeranol implants, throughout life, tended to result in poorer feed conversion during the finishing phase for implanted than for non-implanted cattle. Using, in succession, low, moderate and high potency implants gave the greatest animal lifetime gain (> 50 kg) while maintaining or slightly improving post-weaning feed conversion when compared to non-implanted cattle performance. Implant strategies should match implant dose or potency to animal age, weight, and(or) production rate desired to maintain positive carryover effects from previous implants. One should begin the pre-weaning period with low potency products and end the post-weaning period with high potency androgenic implant products that complement the estrogenic response. Implant programs should be designed to maintain hormone blood levels within an optimum response range. Hormone levels below or above this range should be avoided once implant programs are initiated. Additional data are needed to determine if significant economic differences in lifetime implant response exist between steers and heifers.

INTRODUCTION

Steers and heifers destined for slaughter through a feedlot production system may receive four to six or more implants throughout their lifetime using various implant strategies. In initial implant systems research, Ward et al. (1978) compared 16 different Ralgro® implant sequences for steers and heifers through the suckling, growing, and finishing phases of production; McReynolds et al. (1979) compared 18 different implant sequences using Ralgro® and Synovex-S®. These early studies, although limited in the number of cattle involved, demonstrated that not only a large number of different implant sequences are possible, but also that carryover effects into subsequent production phases often occur from previous implants. Carryover effects in these studies were measured in subsequent production periods as the differences in gain between previously implanted and previously non-implanted cattle.

Carryover effects in gain were positive (favorable) from suckling to growing and from growing to finishing phases of production; however, implants (zeranol) during the suckling period tended to have a negative effect on subsequent finishing and overall post-weaning performance (Table 1). Positive carryover from suckling to growing phases of production were most pronounced as has been noted previously (Gill et al., 1986; Mader et al., 1985; Simms et al., 1988).

Three studies (Laudert et al., 1981; Mader et al., 1985, Simms et al., 1988) assessed effects of suckling implant on subsequent implant responses post-weaning. These studies were conducted with steers and utilized zeranol (36 mg) as the only implant. A summary of these studies (Table 2) demonstrates the magnitude of the gain response attributed to implanting and tends to show little or no improvement in finishing period feed efficiency from implanting unless the implants were administered only during the finishing period.

Table 1. Effect of previous implant treatment on average daily gain (kg) during the finishing period.

	Steers		Heifers	
	No finishing implant	Finishing implant	No finishing implant	Finishing implant
Birth implant	1.06	1.25	1.02	1.02
No birth implant	1.20	1.31	1.07	1.11
Carry-over effect	-.14	-.06	-.05	-.09
92-day implant	1.15	1.22	1.04	1.05
No 92-day implant	1.10	1.32	1.06	1.09
Carry-over effect	.05	-.10	-.02	-.04
Growing implant	1.15	1.28	1.11	1.08
No growing implant	1.10	1.28	.99	1.05
Carry-over effect	.05	.0	.12	.03

[a] Ward et. al. (1978).

Table 2. Effect of previous implant on finishing phase performance[a].

	Implant Treatment			
Suckling:	N	N	N	I
Growing:	N	N	I	I
Finishing	N	I	I	I
ADG, kg	1.18	1.32	1.31	1.27
Feed intake, kg	9.16	9.30	9.66	9.57
Feed/gain	7.58	6.98	7.31	7.47
Final wt., kg	510	530	538	534
Change in wt. gain, kg	--	20	28	24

[a]Three trial summary - CO, KS and NE.
N = no implant, I = implanted with 36 mg zeranol.

Mader et al. (1985) and Simms et al. (1988) both found that growth promoting effects of the suckling implant extended beyond weaning, although very little gain response was obtained at weaning due to implanting. The implant-mediated growth response appeared to continue 150 to 200 d following implantation (Simms et al., 1988). Very slow release of growth promoting substances in the suckling phase and subsequent continued release during the growing phase, when cattle are on a higher plane of nutrition, is one possible explanation for this carryover or delayed implant response. Alternatively, body composition and mature weight might be altered despite no change in growth rate.

No satisfactory scientific basis for the carryover effect (positive or negative) has been determined. Blood levels of growth promotant compounds would suggest that hormone activity initially peaks, post-implanting, and then declines gradually over time. However, discrepancies exist relative to time that blood levels peak and payout time for long-term growth promotants of both estrogenic and androgenic compounds (Brandt et al., 1994; Johnson et al., 1996). Carryover effects, as well as release rate, most likely depend on implanting technique, implant type and dosage, and carrier (Bartle et al., 1992). Elevating blood levels of growth promotant compounds above the lower threshold level should produce a positive performance response; the greatest response to growth promotants should occur when blood levels are near some upper threshold levels (Figure 1). Hormone activity levels above the upper thresholds level most likely produce no more positive performance response and might contribute to negative effects.

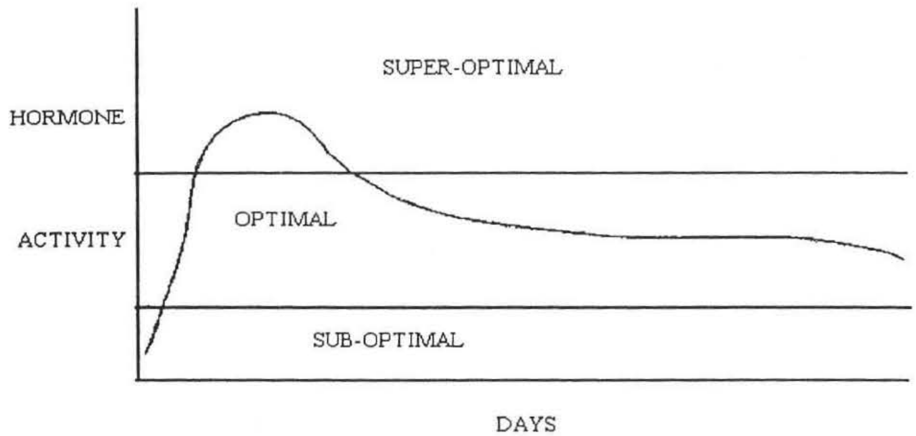

Figure 1. Growth promotant hormone activity with theoretical upper and lower threshold levels (modified from Gill, 1978).

Table 3. Growing and finishing response to zeranol implants[a].

Growing implant:	0	0	0	36 mg	36mg
Finishing implant:	0	36 mg	72 mg	36 mg	72 mg
Daily gain, kg	1.13	1.21	1.28	1.28	1.31
% change	---	7.1	13.3	13.3	15.9
Feed/gain	7.12	6.85	6.75	6.86	6.57
% change	---	-3.8	-5.2	-3.7	-7.7

[a] Mader, 1994

In an effort to maintain positive carryover effects and optimize lifetime implant responses, Mader et al. (1994) compared lifetime implant regimens based upon studies (Mader, 1994) that demonstrated that the post-weaning response to implant/reimplant programs were enhanced when lower implant doses were followed by higher implant doses at reimplanting (Table 3). Also, trenbolone acetate (TBA) as part of a terminal implant to enhance the estrogen implant response, was used as part of the lifetime implant regimen. Synovex®-C was used as the pre-weaning implant with Synovex-S and -H (S) used post-weaning in steers and heifers, respectively.

Although interactions for weights and gains between sex and implant treatment (P < .10) were detected in this study, data were pooled by sex (Table 4). Analysis by sex is shown in the original publication (Mader et al., 1994). A large portion of this weight interaction is attributed to the larger implant weaning weight response by heifers (15 kg) than steers (7.5 kg). Compared to control groups (NNNN), implants significantly increased gain and intakes in both growing and finishing periods. Over the entire post-weaning period (combined growing and finishing), implants increased intake as a percentage of body weight, in cattle implanted in post-weaning periods only (NNNN vs NSSS). Implanted cattle tended to be more efficient in feed conversion than non-implanted cattle. TBA implanted cattle had the lowest numerical feed to gain ratio (F/G). During the finishing period, F/G averaged 6.63 for control cattle vs a range of 6.42 to 6.51 for implanted cattle groups. Differences in trends in feed conversion among implant treatments between steers and heifers were apparent; however, additional studies are needed before firm conclusions can be made regarding different implant response between steers and heifers. Lifetime implant programs reduced the percentage of carcasses grading choice and prime by approximately 30% for both steers and heifers.

Table 4. Performance of cattle assigned to implant strategies using Synovex®-C (C), -S or -H (S), and trenbolone acetate (TBA)[a]

Implant treatment:	NNNN	NSSS	CSSS	CSSS-TBA
Weaning wt., kg	184[b]	184[b]	197[c]	196[c]
Feedlot daily gain, kg				
Growing (G)	1.01[b]	1.12[c]	1.12[c]	1.11[c]
Finishing (F)	1.21[b]	1.36[cd]	1.35[c]	1.41[d]
Overall G and F	1.15[b]	1.28[cd]	1.26[c]	1.31[d]
Feedlot DM intake, kg	7.43[b]	8.07[c]	8.15[cd]	8.36[d]
DM intake, % BW	2.36[b]	2.44[c]	2.38[bc]	2.41[bc]
Feedlot feed/gain	6.51	6.32	6.43	6.37
Final wt., kg	448[b]	478[c]	489[d]	498[d]
Choice and prime, %[e]	92.3	68.7	55.3	60.5

[a] Cattle were not implanted (NNNN), implanted at 0, 74, and 148 d post-weaning only (NSSS), or implanted with C preweaning and S 0, 74, and 148 d post-weaning (CSSS) plus TBA 148 d post-weaning (CSSS-TBA).
[bcd] Means within a row lacking common superscript letter differ ($P < .10$).
[e] Control vs. implant treatment groups ($P < .10$).

Table 5. Effect of Synovex-C® and S or -H (CSSS) or no implants (NNNN) on weaning and final weights in heifers and steers.

	Heifers			Steers		
	NNNN		CSSS	NNNN		CSSS
Weaning wt., kg						
Mader et al., 1994	177.0		196.0	191.0		197.0
Hardt et al., 1995	239.6		263.3	256.6		260.2
Mean	208.3		229.7	223.8		228.6
Difference		21.4			4.8	
Final wt., kg[a]						
Mader et al., 1994	423		479	473		498
Hardt et al., 1995	451		535	494		535
Mean	437		507	483.5		516.5
Difference		70			33	

[a] Adjusted to 62% dress.

A trend was observed for a greater weaning and final weight response of implanted heifers vs steers (Mader et al., 1994; Hardt et al., 1995). Data (Table 5) suggest that the gain response attributed to lifetime implant systems is considerably greater for heifers than for steers. Because lifetime implant studies in which the weaning weight response was similar between steers and heifers were not found, caution should be exercised in making conclusions from data shown in Table 5. The gain response to implants post-weaning may be more closely related to the gain response pre-weaning and not a function of gender. More data are needed to determine the nature of these interactions. In a summary of suckling implants, Selk (1996) found that weaning weight response to implants was slightly greater for heifers than for steers. However, Owens and Duckett (1996) found the gain response to feedlot implant programs was more positive and consistent for steers, than heifers. Ideally, steer and heifer comparisons should be made with herd mates from which replacement heifers have not been removed.

The aggressiveness of implant programs (number and type of implants used) also may influence the lifetime implant response. However, with aggressive implant programs, performance enhancement may not always be realized when compared to less aggressive implant programs provided that growth promotant blood levels of cattle in both program are maintained near threshold levels for optimum performance response. A large study reported by Booker (1996) demonstrated the potential for negative carryover effects when aggressive implant programs are used. In that study, 18 pens containing over 9,000 steers were initially implanted with Ralgro® and then reimplanted with Revalor-S® at day 45 or be day 70 of the feeding period.

No significant responses to implants were observed in daily gain (1.57 vs 1.56 kg) or feed/gain ratio (6.88 vs 6.83); a significant ($P < .05$) increase in daily DM intake (10.79 vs 10.63 kg) was observed in the 45 day reimplant group. In addition, the proportion of riders (4.10 vs 2.84%) was significantly ($P < .05$) greater in the 45 day vs the 70 day reimplant group (Figure 2). Reimplanting early (45 vs 70 days) did not cause rider rate to return to near zero and appeared to carryover or add to rider activity associated with the initial implant. Exceeding the upper threshold hormone levels (Figure 1) would appear to enhance the negative carryover effects from previous implants; these may manifested as side-effects rather than performance effects.

CONCLUSION

Lifetime implant programs should be designed to obtain optimum growth response with minimum expression of live animal side-effects and limited adverse effects on carcass traits. Strategically using low, moderate, and high potency implants (Table 6) in practical implant systems (Figure 3) should accomplish these objectives. Implant strategies based upon a pre-determined slaughter target date (finished endpoint), which match implant dose or potency to animal age, weight, and(or) production desired, are recommended. Beginning in the pre-weaning period with low potency products and ending in the post-weaning period with high potency androgenic containing implant products that complement the

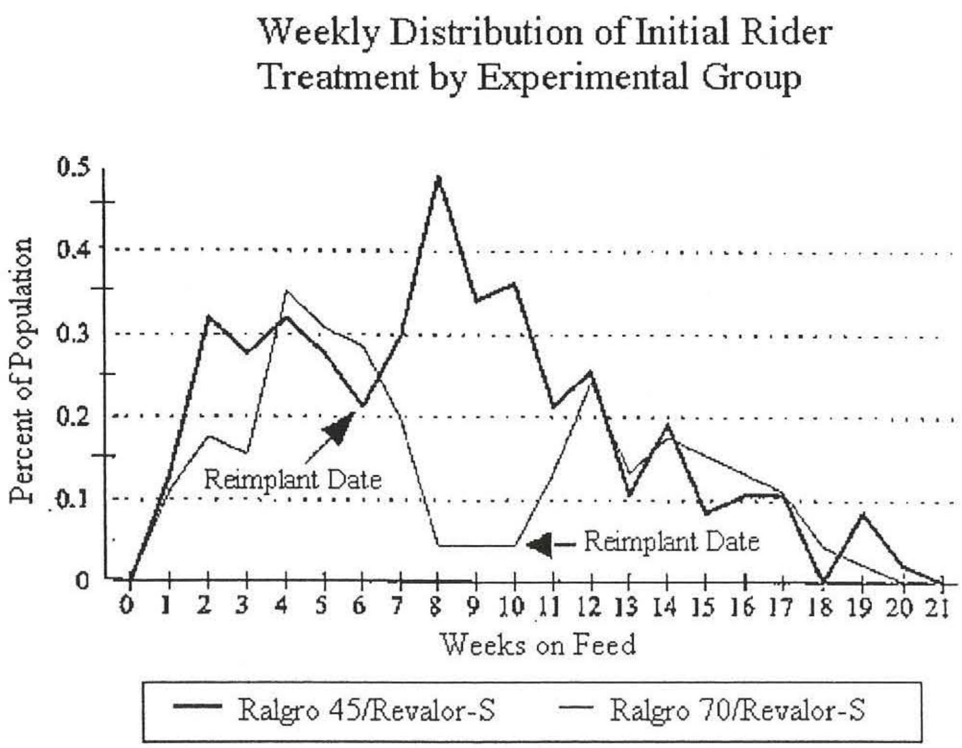

Figure 2. Effect of reimplant time (45 vs. 70 days) on initial rider percentage (Booker, 1996).

estrogenic response, should maintain positive carryover effects of previous implants. Implant programs should be designed to maintain hormone blood levels within an optimum response range. Hormone levels below or above this range should be avoided once implant programs are initiated.

Table 6. Implant potency and payout optimum based on estrogenic (E) and/or androgenic (A) activity and/or dosage.

Name	Activity	Relative potency	Approximate payout, days
Ralgro (Ral)	E	Low	60-120
Synovex-C	E	Low	60-120
Calfoid	E	Low	60-120
Compudose	E	Moderate	150-200
Magnum	E	Moderate	80-120
Synovex-S/H (Syn)	E	Moderate	80-120
Implus-S/H (Imp)	E	Moderate	80-120
Revalor G	A/E	Moderate	--
Finaplix-S/H	A	--	60-90
Finaplix-S/H+	A/E	High	90-110
Syn, Imp or Ral			
Revalor-S/H	A/E	High	90-120
Synovex Plus	A/E	High	90-120

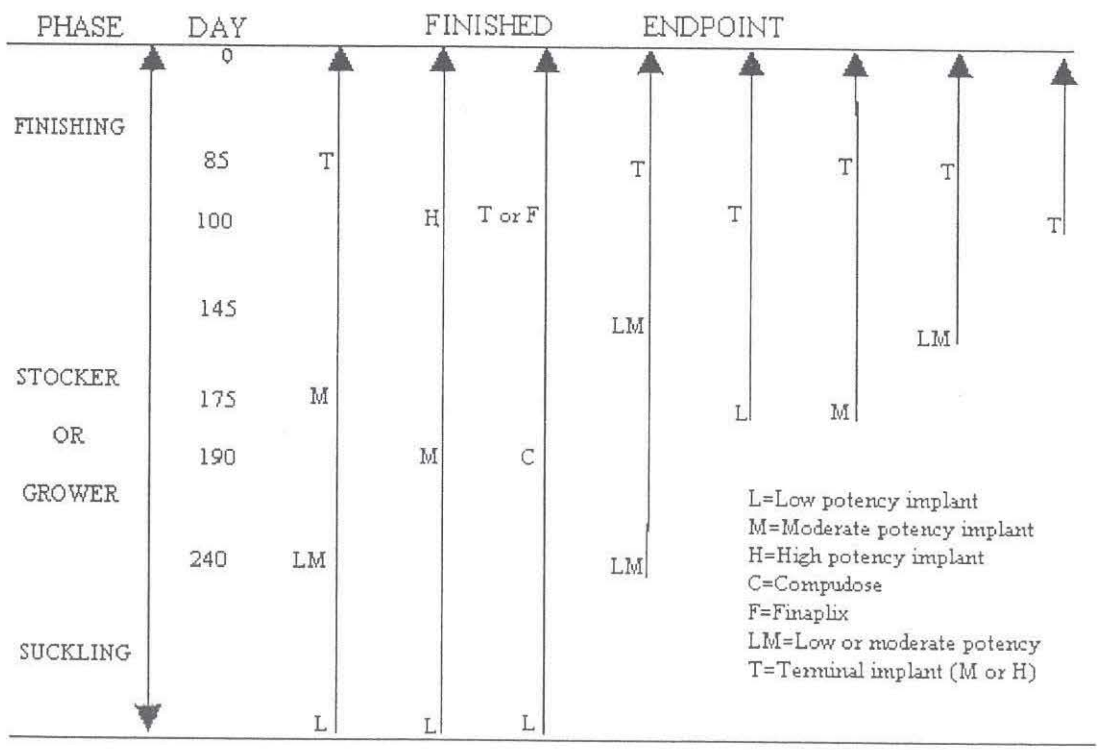

Figure 3. Possible implant programs relative to days from slaughter and initial control point of implant program.

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QUESTIONS & ANSWERS

Q: Does sequential implanting with TBA for a lifetime alter carcass confirmation?

A: The data that I incorporated into this review was on lifetime effects from suckling onward of repeated implants of one type. There may be some data on TBA implants post-weaning, but nobody has measured lifetime effects of repeated TBA implants on body composition.